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If it's your job to eat a frog, it's best to do it first thing in the morning. And If it's your job to eat two frogs, it's best to eat the biggest one first.

Mark Twain





basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS
SENIORSERTIFIKAAT-EKSAMEN/
NASIONALE SENIORSERTIFIKAAT-EKSAMEN**

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

2023

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 30 pages./
Hierdie nasienriglyne bestaan uit 30 bladsye.**

GENERAL MARKING GUIDELINES PAPER 1 ALGEMENE NASIEN RIGLYNE VRAESTEL 1

1. CALCULATIONS/BEREKENINGE

- 1.1 **Marks will be awarded for:** correct formula, correct substitution, correct answer with unit.
Punte sal toegeken word vir: korrekte formule, korrekte substitusie, korrekte antwoord met eenheid.
- 1.2 **No marks will be awarded if an incorrect or inappropriate formula is used**, even though there may be relevant symbols and applicable substitutions.
Geen punte sal toegeken word waar 'n verkeerde of ontoepaslike formule gebruik word nie, selfs al is daar relevante simbole en relevante substitusies.
- 1.3 When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.
Wanneer 'n fout gedurende substitusie in 'n korrekte formule begaan word, sal 'n punt vir die korrekte formule en vir die korrekte substitusies toegeken word, maar geen verdere punte sal toegeken word nie.
- 1.4 If **no formula** is given, but all **substitutions are correct**, a candidate will **forfeit one mark**.
Indien geen formule gegee is nie, maar al die substitusies is korrek, verloor die kandidaat een punt.
- 1.5 **No penalisation if zero substitutions are omitted** in calculations where **correct formula/principle is given correctly**.
Geen penalisering indien nulwaardes nie getoon word nie in berekeninge waar die formule/beginsel korrek gegee is nie
- 1.6 Mathematical manipulations and change of subject of appropriate formulae carry no marks, but if a candidate starts off with the correct formula and then changes the subject of the formula incorrectly, marks will be awarded for the formula and the correct substitutions. The mark for the incorrect numerical answer is forfeited.
Wiskundige manipulasies en verandering van onderwerp van toepaslike formules tel geen punte nie, maar indien 'n kandidaat met die korrekte formule begin en dan die onderwerp van die formule verkeerd verander, sal punte vir die formule en korrekte substitusies toegeken word. Die punt vir die verkeerde numeriese antwoord word verbeur

- 1.7 Marks are only awarded for a formula if a **calculation has been attempted**, i.e. substitutions have been made or a numerical answer given.
Punte word slegs vir 'n formule toegeken indien 'n poging tot 'n berekening aangewend is, d.w.s. substitusies is gedoen of 'n numeriese antwoord is gegee.
- 1.8 Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.
Punte kan slegs toegeken word vir substitusies wanneer waardes in formules ingestel is en nie vir waardes wat voor 'n berekening gelys is nie.
- 1.9 All calculations, when not specified in the question, must be rounded off to a minimum of TWO decimal places.
Alle berekenings, wanneer dit nie in die vraag gespesifiseer word nie, moet tot 'n minimum van TWEE desimale plekke afgerond word.
- 1.10 If a final answer to a calculation is correct, full marks will not automatically be awarded. Markers will always ensure that the correct/appropriate formula is used and that workings, including substitutions, are correct.
Indien 'n finale antwoord van 'n berekening korrek is, sal volpunte nie outomaties toegeken word nie. Nasieners sal altyd verseker dat die korrekte/toepaslike formule gebruik word en dat bewerkings, insluitende substitusies, korrek is
- 1.11 Questions where a series of calculations do not necessarily always have to follow the same order (as in circuit calculations), full marks will be awarded provided that it is a valid solution to the problem.
Vrae waar 'n reeks berekeninge nie noodwendig altyd in dieselfde volgorde hoef te wees nie (soos in stroombaanberekeninge) sal volpunte toegeken word op voorwaarde dat dit 'n geldige oplossing vir die probleem is.
- 1.12 Any calculation that will not bring the candidate closer to the answer than the original solution, will not count any marks.
Enige berekening wat nie die kandidaat nader aan die antwoord as die oorspronklike oplossing bring nie, sal geen punte tel nie.

2. Units/Eenhede

- 2.1 Candidates will only be penalised once for the repeated use of an incorrect unit **within a question**.
Kandidate sal slegs een keer gepeenaliseer word vir die herhaaldelike gebruik van 'n verkeerde eenheid in 'n vraag.
- 2.2 Units are only required in the final answer to a calculation.
Eenhede word slegs in die finale antwoord op 'n berekening verlang.

- 2.3 Marks are only awarded for an answer, and not for a unit per se. Candidates will therefore forfeit the mark allocated for the answer in each of the following situations:

- Correct answer + wrong unit
- Wrong answer + correct unit
- Correct answer + no unit

Punte word slegs vir 'n antwoord en nie vir 'n eenheid op sigself toegeken nie. Kandidaat sal dus die punt wat toegeken is vir die antwoord in elk van die volgende gevalle verbeur:

- Korrekte antwoord + verkeerde eenheid
- Verkeerde antwoord + korrekte eenheid
- Korrekte antwoord + geen eenheid

- 2.4 SI units must be used, except in certain cases, e.g. $V \cdot m^{-1}$ instead of $N \cdot C^{-1}$, and $cm \cdot s^{-1}$ or $km \cdot h^{-1}$ instead of $m \cdot s^{-1}$ where the question warrants this. *SI-eenhede moet gebruik word, behalwe in sekere gevalle, bv. $V \cdot m^{-1}$ in plaas van $N \cdot C^{-1}$, en $cm \cdot s^{-1}$ of $km \cdot h^{-1}$ in plaas van $m \cdot s^{-1}$ waar die vraag dit regverdig.*

3 General/Algemeen

- 3.1 If one answer or calculation is required, but two are given by the candidate, only the first one will be marked, irrespective of which one is correct. If two answers are required, only the first two will be marked, etc. *Indien een antwoord of berekening verlang word, maar twee word deur die kandidaat gegee, sal slegs die eerste een nagesien word, ongeag watter een korrek is. Indien twee antwoorde verlang word, sal slegs die eerste twee nagesien word, ens.*
- 3.2 For marking purposes, alternative symbols (s, u, t, etc.) will also be accepted. *Vir nasiendoeleindes sal alternatiewe simbole (s, u, t, ens.) ook aanvaar word.*
- 3.3 Separate compound units with a multiplication dot, not a full stop, e.g. $m \cdot s^{-1}$. For marking purposes, $m \cdot s^{-1}$ and m/s will also be accepted. *Skei saamgestelde eenhede met 'n vermenigvuldigpunt, nie met 'n punt nie, bv. $m \cdot s^{-1}$. Vir nasiendoeleindes sal $m \cdot s^{-1}$ en m/s ook aanvaar word.*

4. Positive marking/*Positiewe nasien*

Positive marking regarding calculations will be followed in the following cases:
Positiewe nasien met betrekking tot berekenings sal in die volgende gevalle geld:

- 4.1 **Subquestion to subquestion:** When a certain variable is incorrectly calculated in one subquestion (e.g. 3.1) and needs to be substituted into another subquestion (3.2 or 3.3), **full marks** are to be awarded for the subsequent subquestions.

Subvraag na subvraag: Wanneer 'n sekere veranderlike in een subvraag (bv. 3.1) bereken word en dan in 'n ander vervang moet word (3.2 of 3.3), word **volpunte** vir die daaropvolgende subvrae toegeken.

- 4.2 **A multistep question in a subquestion:** If the candidate has to calculate, for example, current in the first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer will be forfeited.
'n Vraag met veelvuldige stappe in 'n subvraag: Indien 'n kandidaat, byvoorbeeld, die stroom verkeerd bereken in die eerste stap as gevolg van 'n substitusiefout, verbeur die kandidaat die punt vir die substitusie sowel as die finale antwoord.

5. Negative marking/*Negatiewe nasien*

Normally an incorrect answer cannot be correctly motivated if based on a conceptual mistake. If the candidate is therefore required to motivate in QUESTION 3.2 the answer given to QUESTION 3.1, and QUESTION 3.1 is incorrect, no marks can be awarded for QUESTION 3.2. However, if the answer for, for example, QUESTION 3.1 is based on a calculation, the motivation for the incorrect answer in QUESTION 3.2 should be considered.
'n Verkeerde antwoord, indien dit op 'n konsepsuele fout gebaseer is, kan nie korrek gemotiveer word nie. Indien die kandidaat dus gevra word om in VRAAG 3.2 die antwoord op VRAAG 3.1 te motiveer en VRAAG 3.1 is verkeerd, kan geen punte vir VRAAG 3.2 toegeken word nie. Indien die antwoord op, byvoorbeeld, VRAAG 3.1 egter op 'n berekening gebaseer is, moet die motivering vir die verkeerde antwoord in VRAAG 3.2 oorweeg word.

QUESTION 1/VRAAG 1

- 1.1 A ✓✓ (2)
- 1.2 B ✓✓ (accept Q/aanvaar Q) (2)
- 1.3 D ✓✓ (2)
- 1.4 D ✓✓ (2)
- 1.5 D ✓✓ (2)
- 1.6 B **OR/OF** D ✓✓ (2)
- 1.7 B ✓✓ (2)
- 1.8 A ✓✓ (2)
- 1.9 A ✓✓ (2)
- 1.10 D ✓✓ (2)
- [20]**

QUESTION 2/VRAAG 2

2.1

Marking criteria/Nasienkriteria - Formula to calculate a./Formule om a te bereken. ✓ - Correct substitution to calculate a./Korrekte vervanging om a te bereken. ✓✓	
OPTION 1/OPSIE 1 DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(3,41)^2 \checkmark = (0)^2 + (2)a(1,5)$ ✓ $a = 3,88 \text{ m}\cdot\text{s}^{-2}$	UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(-3,41)^2 \checkmark = (0)^2 + (2)a(-1,5)$ ✓ $a = -3,88$ $a = 3,88 \text{ m}\cdot\text{s}^{-2}$
OPTION 2/OPSIE 2 DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$ $1,5 = \left(\frac{0 + 3,41}{2} \right) \Delta t$ $\Delta t = 0,88 \text{ s}$ UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$ $-1,5 = \left(\frac{0 - 3,41}{2} \right) \Delta t$ $\Delta t = 0,88 \text{ s}$	$v_f = v_i + a\Delta t$ ✓ $-3,41 \checkmark = (0) + a(0,88)$ ✓ $a = -3,88$ $a = 3,88 \text{ m}\cdot\text{s}^{-2}$ OR/OF $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $-1,5 \checkmark = (0)(0,88) + \frac{1}{2}a(0,88)^2$ ✓ $a = -3,88$ $a = 3,88 \text{ m}\cdot\text{s}^{-2}$ $v_f = v_i + a\Delta t$ ✓ $3,41 \checkmark = (0) + a(0,88)$ ✓ $a = 3,88 \text{ m}\cdot\text{s}^{-2}$ OR/OF $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $1,5 \checkmark = (0)(0,88) + \frac{1}{2}a(0,88)^2$ ✓ $a = 3,88 \text{ m}\cdot\text{s}^{-2}$

(3)

2.2



ACCEPT/AANVAAR



	Accepted symbols/Aanvaarde simbole
w ✓	F_g/F_w /weight/gewig/mg/gravitational force/gravitasiekrag/ $F_{\text{Earth on block}}/F_{\text{Aarde op blok}}/73,5N$
T ✓	Tension/Spinning/ $F_{\text{Tension}}/F_{\text{Spanning}}/F_{\text{rope}}/F_{\text{tou}}/F_T/F$
Notes/Aantekeninge: - Mark awarded for label <u>and</u> arrow./Punt toegeken vir byskrif <u>en</u> pyltjie. - Do not penalise for length of arrows since drawing is not to scale./Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie. - Any other additional force(s)/Enige ander addisionele krag(te): Max/Maks $\frac{1}{2}$	

(2)

2.3

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

When a resultant/net force acts on an object, the object will accelerate in the direction of the force with an acceleration that is directly proportional to the force and inversely proportional to the mass of the object. ✓✓

Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel teen 'n versnelling wat direk eweredig aan die krag en omgekeerd eweredig aan die massa van die voorwerp is.

OR/OF

The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force.

Die resulterende/netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum van die voorwerp in dieselfde rigting as die resulterende/netto krag.

(2)

2.4

Marking criteria/Nasienkriteria	
- Any correct formula./Enige korrekte formule. ✓ - Correct substitution to calculate tension./Korrekte vervanging om spanning te bereken. ✓✓ - Correct substitution to calculate mass of block A./Korrekte vervanging om massa van blok A te bereken. ✓ - Correct final answer/Korrekte finale antwoord: 3,25 kg ✓	
Calculation of tension (Block B) 3 marks: Berekening van spanning (Blok B) 3 punte:	Calculation of mass (Block A) 2 marks: Berekening van massa (Blok A) 2 punte:
DOWNWARDS POSITIVE/AFWAARTS POSITIEF $\left. \begin{array}{l} F_{\text{net}} = ma \\ F_g + T = ma \\ mg - T = ma \end{array} \right\} \begin{array}{l} \checkmark \text{Any one/} \\ \text{Enige een} \end{array}$ $\underline{7,5(9,8) - T} \checkmark = \underline{7,5(3,88)} \checkmark$ $T = 44,40 \text{ N}$ UPWARDS POSITIVE/OPWAARTS POSITIEF $\left. \begin{array}{l} F_{\text{net}} = ma \\ T - F_g = ma \\ T - mg = ma \end{array} \right\} \begin{array}{l} \checkmark \text{Any one/} \\ \text{Enige een} \end{array}$ $\underline{T - 7,5(9,8)} \checkmark = \underline{7,5(-3,88)} \checkmark$ $T = 44,40 \text{ N}$	UPWARDS POSITIVE/OPWAARTS POSITIEF $\left. \begin{array}{l} F_{\text{net}} = ma \\ T - F_g = ma \\ T - mg = ma \end{array} \right\} \begin{array}{l} \checkmark \text{Any one/} \\ \text{Enige een} \end{array}$ $\underline{44,40 - m(9,8)} = \underline{m(3,88)} \checkmark$ $m = 3,25 \text{ kg} \checkmark$ DOWN POSITIVE/AF POSITIEF $\left. \begin{array}{l} F_{\text{net}} = ma \\ F_g - T = ma \\ mg - T = ma \end{array} \right\} \begin{array}{l} \checkmark \text{Any one/} \\ \text{Enige een} \end{array}$ $\underline{m(9,8) - 44,40} = \underline{m(-3,88)} \checkmark$ $m = 3,25 \text{ kg} \checkmark$

(5)

2.5

Marking criteria/Nasienkriteria

- Any correct formula./Enige korrekte formule. ✓
- Correct substitution of v_i and v_f ./Korrekte vervanging van v_i en v_f . ✓
- Correct substitution of $9,8 \text{ m} \cdot \text{s}^{-2}$./Korrekte vervanging van $9,8 \text{ m} \cdot \text{s}^{-2}$. ✓
- Adding 1,5 m to calculated Δy ./Tel 1,5 m by berekende Δy . ✓
- Correct final answer/Korrekte finale antwoord: 2,09 m ✓

OPTION 1/OPSIE 1

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$(0^2) = (3,41)^2 \checkmark + (2)(-9,8)\Delta y \quad \checkmark$$

$$\Delta y = 0,59 \text{ m}$$

Maximum height = $0,59 + 1,5 \checkmark$
 $= 2,09 \text{ m} \checkmark$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$(0^2) = (-3,41)^2 \checkmark + (2)(9,8)\Delta y \quad \checkmark$$

$$\Delta y = -0,59$$

$$\Delta y = 0,59 \text{ m}$$

Maximum height = $0,59 + 1,5 \checkmark$
 $= 2,09 \text{ m} \checkmark$

OPTION 2/OPSIE 2

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF

$$v_f = v_i + a\Delta t$$

$$0 = 3,41 + (-9,8)\Delta t$$

$$\Delta t = 0,35 \text{ s}$$

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad \checkmark$$

$$= (3,41)(0,35) \checkmark + \frac{1}{2}(-9,8)(0,35)^2 \quad \checkmark$$

$$= 0,59 \text{ m}$$

Maximum height = $0,59 + 1,5 \checkmark$
 $= 2,09 \text{ m} \checkmark$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF

$$v_f = v_i + a\Delta t$$

$$0 = -3,41 + (9,8)\Delta t$$

$$\Delta t = 0,35 \text{ s}$$

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad \checkmark$$

$$= (-3,41)(0,35) \checkmark + \frac{1}{2}(9,8)(0,35)^2 \quad \checkmark$$

$$= -0,59$$

$$\Delta y = 0,59 \text{ m}$$

Maximum height = $0,59 + 1,5 \checkmark$
 $= 2,09 \text{ m} \checkmark$

OPTION 3/OPSIE 3 UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF $v_f = v_i + a\Delta t$ $0 = 3,41 + (-9,8)\Delta t$ $\Delta t = 0,35 \text{ s}$ $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $\Delta y = \left(\frac{3,41 + 0}{2} \right) \checkmark (0,35) \checkmark$ $= 0,59 \text{ m}$ Maximum height = $0,59 + 1,5 \checkmark$ $= 2,09 \text{ m} \checkmark$	DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF $v_f = v_i + a\Delta t$ $0 = -3,41 + (9,8)\Delta t$ $\Delta t = 0,35 \text{ s}$ $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $\Delta y = \left(\frac{-3,41 + 0}{2} \right) \checkmark (0,35) \checkmark$ $= -0,59 \text{ m}$ Maximum height = $0,59 + 1,5 \checkmark$ $= 2,09 \text{ m} \checkmark$
Note/Aantekening: OPTION 4 TO 5/OPSIE 4 TOT 5 Substitution of incorrect mass/Vervanging van verkeerde massa: $max/maks: \frac{3}{5}$	
OPTION 4/OPSIE 4 $\left. \begin{aligned} (E_{\text{mech}})_{\text{top}} &= (E_{\text{mech}})_{\text{bottom}} \\ (E_p + E_k)_{\text{top}} &= (E_p + E_k)_{\text{bottom}} \\ (mgh + \frac{1}{2}mv_i^2)_{\text{top}} &= (mgh + \frac{1}{2}mv_f^2)_{\text{bottom}} \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$ $(9,8)(h) + (0) \checkmark = (0) + \frac{1}{2}(3,41)^2 \checkmark$ $h = 0,59 \text{ m}$ Maximum height = $0,59 + 1,5 \checkmark$ $= 2,09 \text{ m} \checkmark$	
OPTION 5/OPSIE 5 $\left. \begin{aligned} W_{\text{nc}} &= \Delta K + \Delta U \\ W_{\text{nc}} &= \Delta K + mg(h_f - h_i) \\ 0 &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$ $(0) = (0) - \frac{1}{2}(3,41)^2 \checkmark + (9,8)(h) \checkmark$ $h = 0,59 \text{ m}$ Maximum height = $0,59 + 1,5 \checkmark$ $= 2,09 \text{ m} \checkmark$	
OPTION 6/OPSIE 6 $\left. \begin{aligned} W_{\text{net}} &= \Delta E_k \\ w\Delta y \cos\theta &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$ $(9,8)(\Delta y) \cos 180^\circ \checkmark = 0 - \frac{1}{2}(3,41)^2 \checkmark$ $\Delta y = 0,59 \text{ m}$ Maximum height = $0,59 + 1,5 \checkmark$ $= 2,09 \text{ m} \checkmark$	

(5)
 [17]

QUESTION 3/VRAAG 3

- 3.1 Motion under the influence of gravity/weight/gravitational force only. ✓✓
 Beweging slegs onder die invloed van gravitasie/gewig/gravitasiekrag.
 (2 or/of 0)

OR/OF

Motion in which the only force acting is the gravitational force.
 Beweging waar die enigste krag wat inwerk gravitasiekrag is.

(2)

3.2.1

Marking criteria/Nasienkriteria

- Formula to calculate Δt ./Formule om Δt te bereken. ✓
- Correct substitution to calculate Δt ./Korrekte vervanging om Δt te bereken. ✓
- Final answer/Finale antwoord: 1,76 s ✓

OPTION 1/OPSIE 1

UPWARDS AS POSITIVE/
 OPWAARTS AS POSITIEF

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$-15,2 = (0) + \frac{1}{2} (-9,8) \Delta t^2 \quad \checkmark$$

$$\Delta t = 1,76 \text{ s} \quad \checkmark$$

DOWNWARDS AS POSITIVE/
 AFWAARTS AS POSITIEF

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$15,2 = (0) + \frac{1}{2} (9,8) \Delta t^2 \quad \checkmark$$

$$\Delta t = 1,76 \text{ s} \quad \checkmark$$

OPTION 2/OPSIE 2

UPWARDS AS POSITIVE/
 OPWAARTS AS POSITIEF

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = (0)^2 + (2)(-9,8)(-15,2)$$

$$v_f = -17,26 \text{ m} \cdot \text{s}^{-1} \quad \longrightarrow$$

UPWARDS AS POSITIVE/
 OPWAARTS AS POSITIEF

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$-17,26 = (0) + (-9,8) \Delta t \quad \checkmark$$

$$\Delta t = 1,76 \text{ s} \quad \checkmark$$

DOWNWARDS AS POSITIVE/
 AFWAARTS AS POSITIEF

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = (0)^2 + (2)(9,8)(15,2)$$

$$v_f = 17,26 \text{ m} \cdot \text{s}^{-1} \quad \longrightarrow$$

OR/OF

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \quad \checkmark$$

$$-15,2 = \left(\frac{0 - 17,26}{2} \right) \Delta t \quad \checkmark$$

$$\Delta t = 1,76 \text{ s} \quad \checkmark$$

OPTION 3/OPSIE 3

$$(E_{\text{mech}})_{\text{top}} = (E_{\text{mech}})_{\text{bottom}}$$

$$(E_p + E_k)_{\text{top}} = (E_p + E_k)_{\text{bottom}}$$

$$(mgh + \frac{1}{2}mv_i^2)_{\text{top}} = (mgh + \frac{1}{2}mv_f^2)_{\text{bottom}}$$

$$(9,8)(15,2) + 0 = 0 + (\frac{1}{2})(v_f)^2$$

$$v_f = 17,26 \text{ m} \cdot \text{s}^{-1} \quad \longrightarrow$$

DOWNWARDS AS POSITIVE/
 AFWAARTS AS POSITIEF

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$17,26 = (0) + (9,8) \Delta t \quad \checkmark$$

$$\Delta t = 1,76 \text{ s} \quad \checkmark$$

OPTION 4/OPSIE 4

$$W_{\text{nc}} = \Delta K + \Delta U$$

$$W_{\text{nc}} = \Delta K + mg(h_f - h_i)$$

$$0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i$$

$$0 = \frac{1}{2}(v_f^2 - 0) + (9,8)(15,2)$$

$$v_f = 17,26 \text{ m} \cdot \text{s}^{-1} \quad \longrightarrow$$

OR/OF

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \quad \checkmark$$

$$15,2 = \left(\frac{0 + 17,26}{2} \right) \Delta t \quad \checkmark$$

$$\Delta t = 1,76 \text{ s} \quad \checkmark$$

OPTION 5/OPSIE 5

$$W_{\text{net}} = \Delta E_k$$

$$w\Delta y \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$(9,8)(15,2)\cos 180^\circ = 0 - \frac{1}{2}(v_f)^2$$

$$v_f = 17,26 \text{ m} \cdot \text{s}^{-1} \quad \longrightarrow$$

OPTION 6/OPSIE 6 UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF $F_{\text{net}}\Delta t = \Delta p = m(v_f - v_i)$ $mg\Delta t = m(v_f - v_i)$ $-9,8\Delta t = -17,26 - (0)$ ✓ $\Delta t = 1,76 \text{ s}$ ✓	DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF $F_{\text{net}}\Delta t = \Delta p = m(v_f - v_i)$ $mg\Delta t = m(v_f - v_i)$ $9,8\Delta t = 17,26 - (0)$ ✓ $\Delta t = 1,76 \text{ s}$ ✓

(3)

3.2.2 POSITIVE MARKING FROM QUESTION 3.2.1.

POSITIEWE NASIEN VANAF VRAAG 3.2.1.

Marking criteria/Nasienkriteria

- Correct substitution to calculate Δt for ball A./Korrekte vervanging om Δt te bereken vir bal A. ✓
- Subtraction $1,76 - 0,81$./Aftrekking $1,76 - 0,81$. ✓
- Correct formula to calculate v_i for ball B./Korrekte formule om v_i te bereken vir bal B. ✓
- Correct substitution to calculate v_i for ball B./Korrekte vervanging om v_i te bereken vir bal B. ✓
- Final answer/Finale antwoord: $4,66 \text{ m}\cdot\text{s}^{-1}$ ✓ (4,66 to/tot 4,7)

OPTION 1/OPSIE 1

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$-3,2 = (0) + \frac{1}{2}(-9,8)(\Delta t)^2 \checkmark$$

$$\Delta t = 0,81 \text{ s}$$

$$\Delta t(B) = 1,76 - 0,81 \checkmark$$

$$\Delta t(B) = 0,95 \text{ s}$$

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$(0) = v_i(0,95) + \frac{1}{2}(-9,8)(0,95)^2 \checkmark$$

$$v_i = 4,66 \text{ m}\cdot\text{s}^{-1} \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$3,2 = (0) + \frac{1}{2}(9,8)(\Delta t)^2 \checkmark$$

$$\Delta t = 0,81 \text{ s}$$

$$\Delta t(B) = 1,76 - 0,81 \checkmark$$

$$\Delta t(B) = 0,95 \text{ s}$$

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$0 = -v_i(0,95) + \frac{1}{2}(9,8)(0,95)^2 \checkmark$$

$$v_i = 4,66 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 2/OPSIE 2

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$-3,2 = (0) + \frac{1}{2}(-9,8)(\Delta t)^2 \checkmark$$

$$\Delta t = 0,81 \text{ s}$$

$$\Delta t(B) = 1,76 - 0,81 \checkmark$$

$$\Delta t(B) = 0,95 \text{ s}$$

$$v_f = v_i + a\Delta t$$

$$-v_i = v_i + (-9,8)(0,95) \checkmark$$

$$v_i = 4,66 \text{ m}\cdot\text{s}^{-1} \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$3,2 = (0) + \frac{1}{2}(9,8)(\Delta t)^2 \checkmark$$

$$\Delta t = 0,81 \text{ s}$$

$$\Delta t(B) = 1,76 - 0,81 \checkmark$$

$$\Delta t(B) = 0,95 \text{ s}$$

$$v_f = v_i + a\Delta t$$

$$v_i = -v_i + (9,8)(0,95) \checkmark$$

$$v_i = 4,66 \text{ m}\cdot\text{s}^{-1} \checkmark$$

Calculate/Bereken: $v_f = 7,92 \text{ m} \cdot \text{s}^{-1}$ OPTION 3/OPSIE 3 UPWARDS +/ OPWAARTS + $v_f^2 = v_i^2 + 2a\Delta y$ $v_f^2 = (0)^2 + (2)(-9,8)(-3,2)$ $v_f = -7,92 \text{ m} \cdot \text{s}^{-1}$ DOWNWARDS +/ AFWAARTS + $v_f^2 = v_i^2 + 2a\Delta y$ $v_f^2 = (0)^2 + (2)(9,8)(3,2)$ $v_f = 7,92 \text{ m} \cdot \text{s}^{-1}$	Calculate/Bereken: $\Delta t(B) = 0,95 \text{ s}$ UPWARDS +/ OPWAARTS + $v_f = v_i + a\Delta t$ $-7,92 = (0) + (-9,8)\Delta t \checkmark$ $\Delta t = 0,81 \text{ s}$ $\Delta t(B) = 1,76 - 0,81 \checkmark$ $\Delta t(B) = 0,95 \text{ s}$ OR/OF $\Delta y = \left(\frac{v_i + v_f}{2}\right) \Delta t$ $-3,2 = \left(\frac{0 - 7,92}{2}\right) \Delta t \checkmark$ $\Delta t = 0,81 \text{ s}$ $\Delta t(B) = 1,76 - 0,81 \checkmark$ $\Delta t(B) = 0,95 \text{ s}$	Calculate/Bereken: $v_i = 4,66 \text{ m} \cdot \text{s}^{-1}$ UPWARDS +/ OPWAARTS + $(\Delta t_{\text{up and down}} = 0,95 \text{ s})$ $v_f = v_i + a\Delta t \checkmark$ $-v_i = v_i + (-9,8)(0,95) \checkmark$ $v_i = 4,66 \text{ m} \cdot \text{s}^{-1} \checkmark$ OR/OF $(\Delta t_{\text{up}} = 0,475 \text{ s})$ $v_f = v_i + a\Delta t \checkmark$ $0 = v_i + (-9,8)(0,475) \checkmark$ $v_i = 4,66 \text{ m} \cdot \text{s}^{-1} \checkmark$ OR/OF $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $0 = v_i(0,95) + \frac{1}{2}(-9,8)(0,95)^2 \checkmark$ $v_i = 4,66 \text{ m} \cdot \text{s}^{-1} \checkmark$
OPTION 4/OPSIE 4 $(E_{\text{mech}})_{\text{top}} = (E_{\text{mech}})_{\text{bot}}$ $(E_p + E_k)_{\text{top}} = (E_p + E_k)_{\text{bot}}$ $(mgh + \frac{1}{2}mv_i^2)_{\text{top}} = (mgh + \frac{1}{2}mv_f^2)_{\text{bot}}$ $(9,8)(3,2) + 0 = 0 + (\frac{1}{2})(v_f)^2$ $v_f = 7,92 \text{ m} \cdot \text{s}^{-1}$	OR/OF $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ $-12 \checkmark = -7,92 \Delta t + \frac{1}{2}(-9,8) \Delta t^2 \checkmark$ $\Delta t = 0,95 \text{ s}$ DOWNWARDS +/ AFWAARTS + $v_f = v_i + a\Delta t$ $7,92 = (0) + (9,8)\Delta t \checkmark$ $\Delta t = 0,81 \text{ s}$	DOWNWARDS +/ AFWAARTS + $v_f = v_i + a\Delta t \checkmark$ $v_i = v_i + (9,8)(0,95) \checkmark$ $= -4,66$ $v_i = 4,66 \text{ m} \cdot \text{s}^{-1} \checkmark$ OR/OF $(\Delta t_{\text{up}} = 0,475 \text{ s})$ $v_f = v_i + a\Delta t \checkmark$ $0 = v_i + (9,8)(0,475) \checkmark$ $= -4,66$ $v_i = 4,66 \text{ m} \cdot \text{s}^{-1} \checkmark$ OR/OF $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $0 = -v_i(0,95) + \frac{1}{2}(9,8)(0,95)^2 \checkmark$ $v_i = 4,66 \text{ m} \cdot \text{s}^{-1} \checkmark$
OPTION 5/OPSIE 5 $W_{\text{nc}} = \Delta K + \Delta U$ $W_{\text{nc}} = \Delta K + mg(h_f - h_i)$ $0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i$ $0 = \frac{1}{2}(v_f^2 - 0) + (9,8)(3,2)$ $v_f = 7,92 \text{ m} \cdot \text{s}^{-1}$	DOWNWARDS +/ AFWAARTS + $v_f = v_i + a\Delta t$ $7,92 = (0) + (9,8)\Delta t \checkmark$ $\Delta t = 0,81 \text{ s}$ OR/OF $\Delta y = \left(\frac{v_i + v_f}{2}\right) \Delta t$ $3,2 = \left(\frac{0 + 7,92}{2}\right) \Delta t \checkmark$ $\Delta t = 0,81 \text{ s}$ $\Delta t(B) = 1,76 - 0,81 \checkmark$ $\Delta t(B) = 0,95 \text{ s}$ OR/OF $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ $12 \checkmark = 7,92 \Delta t + \frac{1}{2}(9,8) \Delta t^2 \checkmark$ $\Delta t = 0,95 \text{ s}$	OR/OF $(\Delta t_{\text{up}} = 0,475 \text{ s})$ $v_f = v_i + a\Delta t \checkmark$ $0 = v_i + (9,8)(0,475) \checkmark$ $= -4,66$ $v_i = 4,66 \text{ m} \cdot \text{s}^{-1} \checkmark$ OR/OF $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $0 = -v_i(0,95) + \frac{1}{2}(9,8)(0,95)^2 \checkmark$ $v_i = 4,66 \text{ m} \cdot \text{s}^{-1} \checkmark$
OPTION 6/OPSIE 6 $W_{\text{net}} = \Delta E_k$ $w \Delta y \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $(9,8)(3,2) \cos 0^\circ = \frac{1}{2}v_f^2 - 0$ $v_f = 7,92 \text{ m} \cdot \text{s}^{-1}$	OR/OF $\Delta y = \left(\frac{v_i + v_f}{2}\right) \Delta t$ $3,2 = \left(\frac{0 + 7,92}{2}\right) \Delta t \checkmark$ $\Delta t = 0,81 \text{ s}$ $\Delta t(B) = 1,76 - 0,81 \checkmark$ $\Delta t(B) = 0,95 \text{ s}$ OR/OF $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ $12 \checkmark = 7,92 \Delta t + \frac{1}{2}(9,8) \Delta t^2 \checkmark$ $\Delta t = 0,95 \text{ s}$	OR/OF $(\Delta t_{\text{up}} = 0,475 \text{ s})$ $v_f = v_i + a\Delta t \checkmark$ $0 = v_i + (9,8)(0,475) \checkmark$ $= -4,66$ $v_i = 4,66 \text{ m} \cdot \text{s}^{-1} \checkmark$ OR/OF $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $0 = -v_i(0,95) + \frac{1}{2}(9,8)(0,95)^2 \checkmark$ $v_i = 4,66 \text{ m} \cdot \text{s}^{-1} \checkmark$

OPTION 7/OPSIE 7 UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF $F_{\text{net}}\Delta t = \Delta p$ $= m(v_f - v_i)$ $(-9,8)(0,95) = -2v_i$ $v_i = 4,66 \text{ m}\cdot\text{s}^{-1} \quad (4,655 \text{ m}\cdot\text{s}^{-1})$	DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF $F_{\text{net}}\Delta t = \Delta p$ $= m(v_f - v_i)$ $(9,8)(0,95) = 2v_i$ $v_i = 4,66 \text{ m}\cdot\text{s}^{-1} \quad (4,655 \text{ m}\cdot\text{s}^{-1})$

(5)

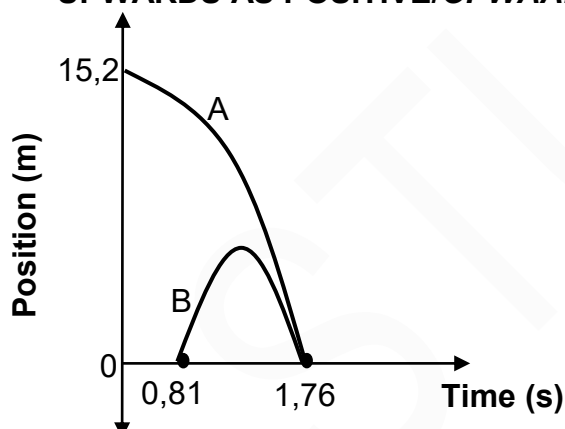
3.3

**POSITIVE MARKING FROM QUESTION 3.2.1/
 POSITIEWE NASIEN VANAF VRAAG 3.2.1**

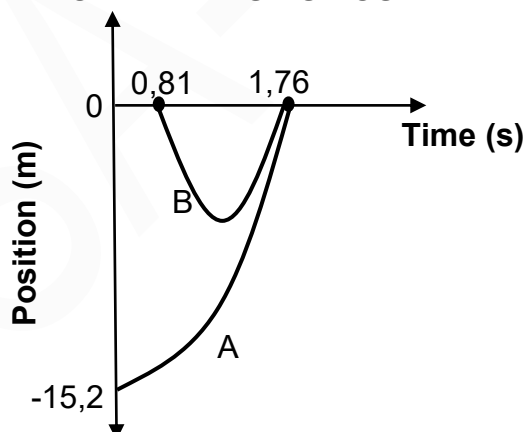
Marking criteria/Nasienkriteria:

- Initial position of ball A = 15,2 m and B = 0 m./Oorspronklike posisie van A = 15,2 m en B = 0 m. ✓
- Starting times for A = 0 s and B = 0,81 s./Begintye van A = 0 s en B = 0,81 s. ✓
- Both balls strike the ground at t = 1,76 s./Albei balle tref die grond op t = 1,76 s. ✓
- Shape of graph for ball A./Vorm van grafiek vir bal A. ✓
- Shape of graph for ball B./Vorm van grafiek vir bal B. ✓
- If graphs are drawn on separate axis/Indien grafieke op aparte asse geteken word:
 max/maks: 4/5

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF (CHANGED GRAPH)



DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:



(5)

[15]

QUESTION 4 /VRAAG 4

4.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

In an isolated system the total (linear) momentum is conserved/remains constant. ✓✓ (accept closed system)

In 'n geïsoleerde sisteem bly die totale (lineêre) momentum behoue/konstant. ✓✓ (aanvaar geslote sisteem)

ACCEPT FOR 1 MARK/AANVAAR VIR 1 PUNT

The total (linear) momentum before collision is equal to the total (linear) momentum after collision provided the system is isolated/the net external force on the system is zero.

Die totale (lineêre) momentum voor 'n botsing is gelyk aan die totale (lineêre) momentum na botsing mits die stelsel geïsoleer is/die netto eksterne krag op die stelsel is nul.

(2)

4.2.1

OPTION 1/OPSIE 1

RIGHT AS POSITIVE/REGS AS POSITIEF:

$$\begin{aligned} \Sigma p_i &= \Sigma p_f \\ m_A v_{Ai} + m_B v_{Bi} &= m_A v_{Af} + m_B v_{Bf} \\ m_A v_{Ai} + m_B v_{Bi} &= (m_A + m_B) v_f \\ (7,2)(0,4) + (0) &= (7,2 + 5,3) v_f \quad \checkmark \\ v_f &= 0,23 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \end{aligned} \quad \left. \vphantom{\begin{aligned} \Sigma p_i &= \Sigma p_f \\ m_A v_{Ai} + m_B v_{Bi} &= m_A v_{Af} + m_B v_{Bf} \\ m_A v_{Ai} + m_B v_{Bi} &= (m_A + m_B) v_f \\ (7,2)(0,4) + (0) &= (7,2 + 5,3) v_f \end{aligned}} \right\} \checkmark \text{ Any one/Enige een}$$

LEFT AS POSITIVE/LINKS AS POSITIEF:

$$\begin{aligned} \Sigma p_i &= \Sigma p_f \\ m_A v_{Ai} + m_B v_{Bi} &= m_A v_{Af} + m_B v_{Bf} \\ m_A v_{Ai} + m_B v_{Bi} &= (m_A + m_B) v_f \\ (7,2)(-0,4) + (0) &= (7,2 + 5,3) v_f \quad \checkmark \\ v_f &= -0,23 \\ \therefore v_f &= 0,23 \text{ m s}^{-1} \quad \checkmark \end{aligned} \quad \left. \vphantom{\begin{aligned} \Sigma p_i &= \Sigma p_f \\ m_A v_{Ai} + m_B v_{Bi} &= m_A v_{Af} + m_B v_{Bf} \\ m_A v_{Ai} + m_B v_{Bi} &= (m_A + m_B) v_f \\ (7,2)(-0,4) + (0) &= (7,2 + 5,3) v_f \end{aligned}} \right\} \checkmark \text{ Any one/Enige een}$$

OPTION 2/OPSIE 2

RIGHT AS POSITIVE/REGS AS POSITIEF

$$\begin{aligned} \Delta p_{\text{trolley A}} &= -\Delta p_{\text{trolley B}} \\ m_A(v_{Af} - v_{Ai}) &= -m_B(v_{Bf} - v_{Bi}) \\ (7,2)(v_f - 0,4) &= -(5,3)(v_f - 0) \quad \checkmark \\ v_f &= 0,23 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \end{aligned} \quad \left. \vphantom{\begin{aligned} \Delta p_{\text{trolley A}} &= -\Delta p_{\text{trolley B}} \\ m_A(v_{Af} - v_{Ai}) &= -m_B(v_{Bf} - v_{Bi}) \\ (7,2)(v_f - 0,4) &= -(5,3)(v_f - 0) \end{aligned}} \right\} \checkmark \text{ Any one/Enige een}$$

LEFT AS POSITIVE/LINKS AS POSITIEF

$$\begin{aligned} \Delta p_{\text{trolley A}} &= -\Delta p_{\text{trolley B}} \\ m_A(v_{Af} - v_{Ai}) &= -m_B(v_{Bf} - v_{Bi}) \\ (7,2)(v_f + 0,4) &= -(5,3)(v_f - 0) \quad \checkmark \\ v_f &= -0,23 \\ \therefore v_f &= 0,23 \text{ m s}^{-1} \quad \checkmark \end{aligned} \quad \left. \vphantom{\begin{aligned} \Delta p_{\text{trolley A}} &= -\Delta p_{\text{trolley B}} \\ m_A(v_{Af} - v_{Ai}) &= -m_B(v_{Bf} - v_{Bi}) \\ (7,2)(v_f + 0,4) &= -(5,3)(v_f - 0) \end{aligned}} \right\} \checkmark \text{ Any one/Enige een}$$

(3)

4.2.2 **POSITIVE MARKING FROM QUESTIONS 4.2.1.**
POSITIEWE NASIEN VANAF VRAAG 4.2.1.

OPTION 1/OPSIE 1 RIGHT AS POSITIVE/ REGS AS POSITIEF: Force of B on A/Krag van B op A: $F_{\text{net}}\Delta t = \Delta p$ } ✓ Any one/ $F_{\text{net}}\Delta t = m(v_f - v_i)$ } Enige een $F_{\text{net}}(0,02) = 7,2(0,23 - 0,4)$ ✓ $F_{\text{net}} = -61,2$ $\therefore F_{\text{net}} = 61,2 \text{ N}$ ✓ (60,95 N to/tot 61,2 N)	LEFT AS POSITIVE/ LINKS AS NEGATIEF: Force of B on A/Krag van B op A: $F_{\text{net}}\Delta t = \Delta p$ } ✓ Any one/ $F_{\text{net}}\Delta t = m(v_f - v_i)$ } Enige een $F_{\text{net}}(0,02) = 7,2(-0,23 + 0,4)$ ✓ $F_{\text{net}} = 61,2 \text{ N}$ ✓ (60,95 N to/tot 61,2 N)
OPTION 2/OPSIE 2 RIGHT AS POSITIVE/ REGS AS POSITIEF: Force of A on B/Krag van A op B: $F_{\text{net}}\Delta t = \Delta p$ } ✓ Any one/ $F_{\text{net}}\Delta t = m(v_f - v_i)$ } Enige een $F_{\text{net}}(0,02) = 5,3(0,23 - 0)$ ✓ $F_{\text{net}} = 60,95 \text{ N}$ ✓ (60,95 N to/tot 61,2 N)	LEFT AS POSITIVE/ LINKS AS POSITIEF: Force of A on B/Krag van A op B: $F_{\text{net}}\Delta t = \Delta p$ } ✓ Any one/ $F_{\text{net}}\Delta t = m(v_f - v_i)$ } Enige een $F_{\text{net}}(0,02) = 5,3(-0,23 - 0)$ ✓ $F_{\text{net}} = -60,95$ $\therefore F_{\text{net}} = 60,95 \text{ N}$ ✓ (60,95 N to/tot 61,2 N)
OPTION 3/OPSIE 3 RIGHT AS POSITIVE/REGS AS POSITIEF A: $v_f = v_i + a\Delta t$ $0,23 = 0,4 + a(0,02)$ $a = -8,5 \text{ m}\cdot\text{s}^{-2}$ $F_{\text{net}} = ma$ ✓ $= (7,2)(-8,5)$ ✓ $= -61,20$ $F_{\text{net}} = 61,20 \text{ N}$ ✓	LEFT AS POSITIVE/LINKS AS POSITIEF A: $v_f = v_i + a\Delta t$ $-0,23 = -0,4 + a(0,02)$ $a = 8,5 \text{ m}\cdot\text{s}^{-2}$ $F_{\text{net}} = ma$ ✓ $= (7,2)(8,5)$ ✓ $= 61,20 \text{ N}$ $F_{\text{net}} = 61,20 \text{ N}$ ✓
OPTION 4/OPSIE 4 RIGHT AS POSITIVE/REGS AS POSITIEF B: $v_f = v_i + a\Delta t$ $0,23 = 0 + a(0,02)$ $a = 11,5 \text{ m}\cdot\text{s}^{-2}$ $F_{\text{net}} = ma$ ✓ $= (5,3)(11,5)$ ✓ $= 60,95 \text{ N}$ $F_{\text{net}} = 60,95 \text{ N}$ ✓	LEFT AS POSITIVE/LINKS AS POSITIEF B: $v_f = v_i + a\Delta t$ $-0,23 = 0 + a(0,02)$ $a = -11,5 \text{ m}\cdot\text{s}^{-2}$ $F_{\text{net}} = ma$ ✓ $= (5,3)(-11,5)$ ✓ $= -60,95 \text{ N}$ $F_{\text{net}} = 60,95 \text{ N}$ ✓

(3)
 [8]

QUESTION 5/VRAAG 5

5.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

A force is non-conservative if the work it does/done on an object which is moving between two points depends on the path taken. ✓✓

'n Krag is nie-konserwatief indien die arbeid wat dit verrig/doen op 'n voorwerp wat tussen twee punte beweeg afhanklik is van die pad gevolg.

OR/OF

A force is non-conservative if the work it does/done in moving an object around a closed path is non-zero. ✓✓

'n Krag is nie-konserwatief indien die arbeid wat dit verrig/doen om 'n voorwerp op 'n geslote pad te beweeg, nie nul is nie.

Note/Aantekening:

If the word 'work' is omitted, 0/2.

Indien die woord 'arbeid' weggelaat is, 0/2.

(2)

5.2

Marking criteria/Nasienkriteria

- Any one of the correct equations./Enige een van die korrekte vergelykings. ✓
- Correct substitution for work done by gravity or ΔU . ✓
 Korrekte vervanging vir arbeid verrig deur gravitasie of ΔU .
- Correct substitution for work done by motor and friction./Korrekte vervanging aan van arbeid verrig deur motor en wrywing. ✓
- Correct substitution for ΔK ./Korrekte vervanging vir ΔK . ✓
- Correct final answer./Korrekte finale antwoord: $5,96 \text{ m} \cdot \text{s}^{-1}$ ✓

OPTION 1/OPSIE 1

$$\left. \begin{aligned} W_{\text{net}} &= \Delta K \\ W_w + W_f + W_F &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ mgsin\theta\Delta x \cos\theta + W_f + W_F &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$(20)(9,8)(\sin 18^\circ)(15,6)\cos 180^\circ + (13,5)(15,6)\cos 180^\circ + (96,8)(15,6)\cos 0^\circ = \frac{1}{2}(20)(v_f^2 - 0^2) \checkmark$$

$$v_f = 5,96 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 2/OPSIE 2

$$\left. \begin{aligned} W_{\text{nc}} &= \Delta K + \Delta U \\ W_f + W_F &= \Delta K + mg(h_f - h_i) \\ f\Delta x \cos\theta + F\Delta x \cos\theta &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$13,5(15,6)\cos 180^\circ + 96,8(15,6)\cos 0^\circ = \frac{1}{2}(20)(v_f^2 - 0^2) \checkmark + (20)(9,8)(15,6 \sin 18^\circ - 0) \checkmark$$

$$v_f = 5,96 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 3/OPSIE 3

$$\left. \begin{aligned} W_{\text{net}} &= \Delta K \\ W_w + W_f + W_F &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ -\Delta E_p + W_f + W_F &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$-(20)(9,8)(15,6 \sin 18^\circ) \checkmark + (13,5)(15,6)\cos 180^\circ + (96,8)(15,6)\cos 0^\circ = \frac{1}{2}(20)(v_f^2 - 0^2) \checkmark$$

$$v_f = 5,96 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 4/OPSIE 4

$$\begin{aligned} W_{\text{net}} &= \Delta K \\ W_w + W_f + W_F &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \quad \checkmark \text{ Any one/Enige} \\ mg\Delta x \cos\theta + W_f + W_F &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ (20)(9,8)(15,6)\cos 108^\circ + (13,5)(15,6)\cos 180^\circ + (96,8)(15,6)\cos 0^\circ &= \frac{1}{2}(20)(v_f^2 - 0^2) \quad \checkmark \\ v_f &= 5,96 \text{ m}\cdot\text{s}^{-1} \quad \checkmark \end{aligned}$$

OPTION 5/OPSIE 5

$$\begin{aligned} F_{\text{net}} &= ma \\ F_{\text{net}} &= F - F_{w//} - f \\ &= 96,8 - (20)(9,8)\sin 18^\circ \quad \checkmark - 13,5 \\ &= 22,73 \text{ N} \\ W_{\text{net}} &= \Delta K \\ F_{\text{net}}\Delta x \cos\theta &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \quad \checkmark \text{ Any one/Enige} \\ 22,73(15,6)\cos 0^\circ &= \frac{1}{2}(20)(v_f^2 - 0^2) \quad \checkmark \\ v_f &= 5,96 \text{ m}\cdot\text{s}^{-1} \quad \checkmark \end{aligned}$$

(5)

5.3

POSITIVE MARKING FROM QUESTION 5.2.

POSITIEWE NASIEN VANAF VRAAG 5.2.

Marking criteria/Nasienkriteria

- Correct equation for power/Korrekte vergelyking vir drywing. $\checkmark$
- Correct substitution into power equation./ $\checkmark$
Korrekte vervanging in drywingvergelting.
- Correct final answer/Korrekte finale antwoord: 288,46 W $\checkmark$
Range: 286,46 W to/na 288,73 W

OPTION 1/OPSIE 1

$$\begin{aligned} P_{\text{ave}} &= Fv_{\text{ave}} \quad \checkmark \\ &= 96,8 \left(\frac{(0) + 5,96}{2} \right) \quad \checkmark \\ &= 288,46 \text{ W} \quad \checkmark \end{aligned}$$

OPTION 2/OPSIE 2

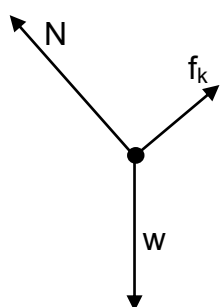
$$\begin{aligned} \Delta x &= \left(\frac{v_i + v_f}{2} \right) \Delta t \\ 15,6 &= \left(\frac{(0) + 5,96}{2} \right) \Delta t \\ \Delta t &= 5,23 \text{ s } (5,24) \\ P &= \frac{W}{\Delta t} \\ P &= \frac{F\Delta x \cos}{\Delta t} \quad \checkmark \text{ Any one/Enige een} \\ P &= \frac{96,8(15,6) \cos 0}{5,23} \quad \checkmark \\ P &= 288,73 \text{ W} \quad \checkmark \end{aligned}$$

OPTION 3/OPSIE 3

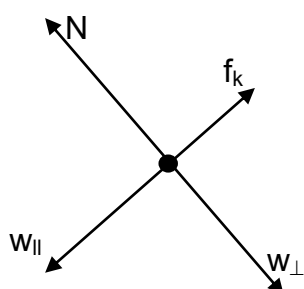
$$\begin{aligned} v_f^2 &= v_i^2 + 2a\Delta x \\ (5,96)^2 &= 0^2 + 2a(15,6) \\ a &= 1,14 \text{ m}\cdot\text{s}^{-2} \quad (1,13) \\ v_f &= v_i + a\Delta t \\ 5,96 &= 0 + (1,14)\Delta t \\ \Delta t &= 5,23 \text{ s } (5,27) \\ P_{\text{ave}} &= Fv_{\text{ave}} \quad \checkmark \\ &= 96,8(2,98) \quad \checkmark \\ &= 288,46 \text{ W} \quad \checkmark \end{aligned}$$

(3)

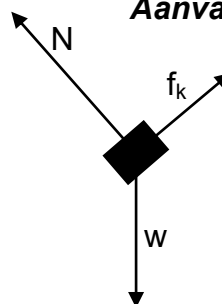
5.4



Accept/Aanvaar:



Accept force diagram/
 Aanvaar kragte-diagram:



	Accepted symbols/Aanvaarde simbole
N ✓	F_N /196N/Normal/Normaal/ F_{normal} / F_{normaal}
f ✓	(kinetic) friction/(kineties) wrywing/ F_f / F_w / f_k / f_r
w ✓	F_g / F_w /weight/gewig/mg/gravitational force/gravitasiekrag/ $F_{\text{Earth on crate}}$ / $F_{\text{Aarde op krat}}$
Notes/Aantekeninge: - Accept correct numerical values for the forces./Aanvaar korrekte numeriese waardes vir die kragte. - Mark awarded for label <u>and</u> arrow./Punt toegeken vir benoeming <u>en</u> pyltjie. - Do not penalise for length of arrows since drawing is not to scale./Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie. - Any other additional force(s)/Enige ander addisionele krag(te): Max/Maks $2/3$ - If everything correct, but no arrows/Indien alles korrek, maar geen pyltjies: Max/Maks $2/3$	

(3)

5.5

POSITIVE MARKING FROM QUESTION 5.2.
POSITIEWE NASIEN VANAF VRAAG 5.2.

Marking criteria/Nasienkriteria:

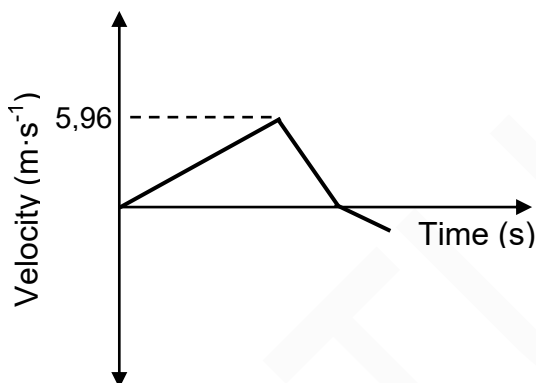
- First straight line starting at zero with positive gradient, reaching a maximum velocity./Eerste reguit lyn met 'n positiewe gradiënt begin by nul en bereik maksimum snelheid. ✓
- Second straight line with negative gradient from maximum velocity to zero./Tweede reguit lyn met negatiewe gradiënt vanaf maksimum snelheid na zero. ✓
- Third straight line continuing from second line at zero and extending below the x-axis./Derde reguit lyn wat aangaan vanaf tweede lyn vanaf nul en verleng onder die x-as. ✓
- Third line has a smaller negative gradient than the second line./Derde reguit lyn het 'n kleiner negatiewe gradiënt as die tweede lyn ✓

Note/Aantekening:

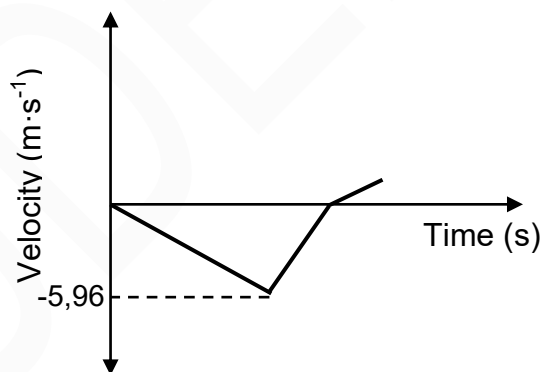
Direction of gradients opposite for graph 2./Rigting van hellings teenoorgesteld vir grafiek 2.

No marks given for values of velocities./Geen punte toegeken vir waardes van snelhede nie.

UPWARDS AS POSITIVE
OPWAARTS AS POSITIEF:



DOWNWARDS AS POSITIVE
AFWAARTS AS POSITIEF:



(4)
 [17]

QUESTION 6/VRAAG 6

6.1.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The (apparent) change in frequency (or pitch) (of the sound) detected by a listener because the source and the listener have different velocities relative to the medium of propagation. ✓✓

Die (skynbare) verandering in die frekwensie (of toonhoogte) (van die klank) waargeneem deur 'n luisteraar omdat die bron en die luisteraar verskillende snelhede relatief tot die voortplantingsmedium het.

OR/OF

An (apparent) change in observed/detected frequency/pitch as a result of the relative motion between a source and an observer/listener.

'n (Skynbare) verandering in waargenome frekwensie/toonhoogte as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/luisteraar.

(2)

6.1.2

$$f_L = \frac{v}{v} \frac{v}{v_s} f_s \quad \checkmark \quad \text{OR/OF} \quad f_L = \frac{v + v}{v} f_s$$

$$f_L = \frac{340 + 22}{340} \times 24\,000 \quad \checkmark$$

$$f_L = 25\,552,94 \text{ Hz}$$

$$f_L = \frac{v}{v} \frac{v}{v_s} f_s \quad \text{OR/OF} \quad f_L = \frac{v}{v - v_s} f_s$$

$$f_L = \frac{340}{340 - 22} \times 25\,552,94 \quad \checkmark$$

$$f_L = 27\,320,75 \text{ Hz} \quad \checkmark$$

(6)

6.2

The frequencies of the spectral lines would have decreased. / Die frekwensies van die spektrale lyne sou verminder het. ✓✓

OR/OF

The spectral lines from the distant star are shifted towards lower frequency end of the spectrum. / Die spektrale lyne van die ver af ster sou verskuif na 'n laer frekwensie op die spektrum.

(2)
[10]

QUESTION 7/VRAAG 7

7.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark. / Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

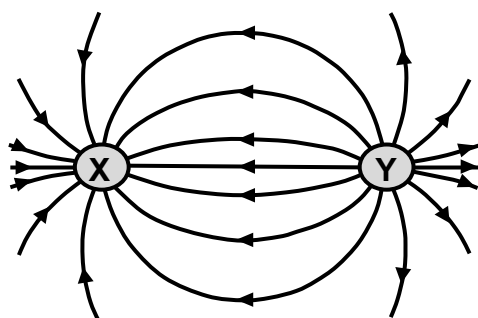
If any reference is made to mass / Indien enige verwysing gemaak is na massa: 0/2

The magnitude of the electrostatic force exerted by one (stationary) point charge (Q_1) on another (stationary) point charge (Q_2) is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance (r) between them. ✓✓

Die grootte van die elektrostatiese krag uitgeoefen deur een (stilstaande) puntlading (Q_1) op 'n ander puntlading (Q_2) is direk eweredig aan die produk van die grootte van die ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle.

(2)

7.2



Criteria for graph/Kriteria vir grafiek:	
Correct shape/ Korrekte vorm	✓
Correct direction from Y to X. /Korrekte rigting van Y na X.	✓
Lines must not cross and must touch charges./ Lyne mag nie kruis nie en moet die ladings raak.	✓

Note/Aantekening:

- If the net electric field pattern is drawn for two like charges: $0/3$
 Indien die netto elektriese veldpatroon vir twee gelyksoortige ladings geteken is: $0/3$
- Ignore labels for point charges/ Ignoreer byskrifte vir puntladings.

(3)

7.3

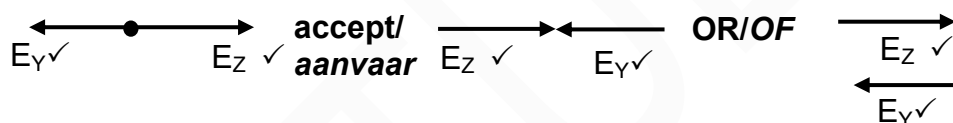
$$F = \frac{k q_Y q_X}{r^2} \checkmark$$

$$F = \frac{(9 \times 10^9)(7,2 \times 10^{-9})(7,2 \times 10^{-9})}{(0,03)^2} \checkmark$$

$$= 5,18 \times 10^{-4} \text{ N} \checkmark \quad (0,000518 \text{ N})$$

(3)

7.4



Notes/Aantekeninge:

- 1 Mark for arrows in opposite directions./1 Punt vir pyle in teenoorgestelde rigtings.
- 1 Mark for correct labels./1 Punt vir korrekte benoemings.
- Do not penalise for length of arrow since drawing is not to scale./Moenie penaliseer vir die lengte van die pyltjie nie aangesien tekening nie volgens skaal is nie.
- Accept Y and Z as labels./Aanvaar Y en Z as benoeming.

(2)

7.5

OPTION 1/OPSIE 1

Marking criteria/Nasienkriteria

- Formula for electric field./Formule vir elektriese veld. ✓
- Substitution of E_{net} ./Vervanging van E_{net} . ✓
- Correct substitution into $\frac{k}{r^2}$ equation for charge Z or charge Y ✓
 Korrekte vervanging in $\frac{k}{r^2}$.vergelyking vir lading Z of lading Y
- Subtraction of electric fields ($E_z + E_y$)/Aftrek van elektriese velde ($E_z + E_y$) ✓
- Correct final answer ✓/Korrekte finale antwoord: $6,25 \times 10^{-9} \text{ C}$
 Range/Gebied: $6,25 \times 10^{-9} \text{ C}$ to/na $6,26 \times 10^{-9} \text{ C}$

OPTION 1/OPSIE 1

$$E_{\text{net}} = E_z + E_y$$

$$= E_z - E_y$$

$$E_{\text{net}} = \frac{k}{r^2} z + \frac{k}{r^2} y$$

$$4,91 \times 10^5 \checkmark = \left(\frac{(9 \times 10^9)(z)}{0,01^2} \right) \checkmark - \left(\frac{(9 \times 10^9)(7,2 \times 10^{-9})}{0,03^2} \right) \checkmark$$

$$Q_z = 6,25 \times 10^{-9} \text{ C} \checkmark$$

OPTION 2/OPSIE 2

POSITIVE MARKING FROM QUESTION 7.3/

POSITIEWE NASIEN VANAF VRAAG 7.3

Marking criteria/Nasienkriteria

- Correct formula for electric field./Korrekte formule vir elektriese veld. ✓
- Substitution of F_{net} ./Vervanging van F_{net} . ✓
- Correct substitution into $\left(\frac{k}{r^2} \frac{z}{x} \right)$ for charge Z. ✓
 Korrekte vervanging in $\left(\frac{k}{r^2} \frac{z}{x} \right)$ vir lading Z
- Subtraction of forces ✓./Aftrek van kragte.
- Correct final answer ✓/Korrekte finale antwoord: $6,26 \times 10^{-9} \text{ C}$ ✓
 Range/Gebied: $6,25 \times 10^{-9} \text{ C}$ to/na $6,26 \times 10^{-9} \text{ C}$

$$E = \frac{F}{Q} \checkmark$$

$$4,91 \times 10^5 = \frac{F}{7,2 \times 10^{-9}}$$

$$F_{\text{net}} = 3,54 \times 10^{-3} \text{ N}$$

$$F_{\text{net}} = F_{Z \text{ on } X} + F_{Y \text{ on } X}$$

$$F_{\text{net}} = \left(\frac{k}{r^2} \frac{z}{x} \right) + \left(\frac{k}{r^2} \frac{y}{x} \right)$$

$$(3,54 \times 10^{-3}) \checkmark = \left(\frac{(9 \times 10^9)(7,2 \times 10^{-9})}{(0,01)^2} z \right) \checkmark - (5,18 \times 10^{-4})$$

$$Q_z = 6,26 \times 10^{-9} \text{ C} \checkmark$$

(5)
 [15]

QUESTION 8/VRAAG 8

8.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature (provided all other physical conditions remain constant). ✓✓

Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur (mits alle ander fisiese toestande konstant bly).

OR/OF

The ratio of potential difference to current is constant at constant temperature.

Die verhouding van potensiaalverskil tot stroom is konstant by konstante temperatuur.

OR/OF

The current in a conductor is directly proportional to the potential difference across the conductor at constant temperature (provided all other physical conditions remain constant).

Die stroom in 'n geleier is direk eweredig aan die potensiaalverskil oor 'n geleier by konstante temperatuur (mits alle fisiese toestande konstant bly).

(2)

8.2.1

OPTION 1/OPSIE 1

$$R = \frac{V}{I} \checkmark$$

$$7 = \frac{V}{1,5} \checkmark$$

$$V = 10,5 \text{ V} \checkmark$$

OPTION 2/OPSIE 2

$$R = \frac{V}{I} \checkmark$$

$$2 = \frac{V}{1,5}$$

$$V = 3 \text{ V}$$

$$5 = \frac{V}{1,5}$$

$$V = 7,5 \text{ V}$$

$$V_T = V_1 + V_2$$

$$= 3 + 7,5 \quad (\text{addition of calculated values/optel van berekende waardes})$$

$$= 10,5 \text{ V} \checkmark$$

OPTION 3/OPSIE 3

Ratio of R:

$$3 : 7$$

Ratio of I:

$$7 : 3$$

$$I = 1,5 \times \frac{7}{3} = 3,5 \text{ A}$$

$$V = IR \checkmark$$

$$= (3,5)(3) \checkmark$$

$$= 10,5 \text{ V} \checkmark$$

(3)

**8.2.2 POSITIVE MARKING FROM QUESTION 8.2.1.
 POSITIEWE NASIEN VANAF VRAAG 8.2.1.**

OPTION 1/OPSIE 1

$$R = \frac{V}{I_3} \checkmark$$

$$3 = \frac{10,5}{I_3} \checkmark$$

$$I_3 = 3,5 \text{ A}$$

$$I_T = 1,5 + 3,5 \quad (\text{addition of calculated values/optel van berekende waardes})$$

$$= 5 \text{ A} \checkmark$$

OPTION 2/OPSIE 2

$$\frac{1}{p} = \frac{1}{1} + \frac{1}{2}$$

OR/OF

$$\frac{1}{p} = \frac{1}{7} + \frac{1}{3} \checkmark$$

$$R_p = 2,1 \Omega$$

$$R = \frac{V}{I} \checkmark$$

$$2,1 = \frac{10,5}{I} \checkmark$$

$$I_T = 5 \text{ A} \checkmark$$

$$R_p = \frac{1 \cdot 2}{1 + 2}$$

$$R_p = \frac{(7)(3)}{7 + 3} \checkmark$$

$$= 2,1 \Omega$$

OPTION 3/OPSIE 3

$$I_{3\Omega} = \frac{7}{3} \times 1,5 \checkmark$$

$$= 3,5 \text{ A} \checkmark$$

$$I_{\text{total}} = 3,5 + 1,5$$

$$= 5 \text{ A} \checkmark$$

OPTION 4/OPSIE 4

$$I_s = \left(\frac{3\Omega}{3\Omega + 5} \right) \times I_{\text{total}} \checkmark$$

$$1,5 \checkmark = \frac{3}{3+7} \checkmark \times I_{\text{total}}$$

$$I_{\text{total}} = 5 \text{ A} \checkmark$$

(4)

8.2.3 **POSITIVE MARKING FROM QUESTION 8.2.1 AND/OR QUESTION 8.2.2.**
POSITIEWE NASIEN VANAF VRAAG 8.2.1 EN/OF VRAAG 8.2.2.

OPTION 1/OPSIE 1 $P = \frac{V^2}{R} \checkmark$ $= \frac{10,5^2}{3} \checkmark$ $= 36,75 \text{ W} \checkmark$	OPTION 2/OPSIE 2 $P = I^2 R \checkmark$ $= (3,5)^2 (3) \checkmark$ $= 36,75 \text{ W} \checkmark$
OPTION 3/OPSIE 3 $P = VI \checkmark$ $= (10,5)(3,5) \checkmark$ $= 36,75 \text{ W} \checkmark$	

(3)

8.3 **POSITIVE MARKING IF OPTION 2 IS USED IN QUESTION 8.2.2./**
POSITIEWE NASIEN INDIEN OPSIE 2 GEBRUIK IS IN VRAAG 8.2.2.

Marking criteria/Nasienkriteria - Correct equation for emf./Korrekte vergelyking vir emk. ✓ - Correct substitution for S_2 closed./Korrekte vervanging vir S_2 gesluit. ✓ - Correct substitution for S_2 open./Korrekte vervanging vir S_2 oop. ✓ - Equating emf or internal resistance equations. ✓ <i>Gelykstelling van emk of interne weerstand vergelykings.</i> - Correct final answer/Korrekte finale antwoord: 12,05 V ✓ <i>Range/Gebied: 12,04 V to/tot 12,05 V</i>	
$\frac{1}{p} = \frac{1}{1} + \frac{1}{2}$ $\frac{1}{p} = \frac{1}{7} + \frac{1}{3}$ $R_p = 2,1 \Omega$ For S_1 and S_2 closed: $\begin{aligned} \epsilon &= I(R + r) \\ \epsilon &= IR + Ir \\ \epsilon &= V_{\text{int}} + V_{\text{ext}} \end{aligned}$ For S_2 open: $\begin{aligned} \epsilon &= I(R + r) \\ &= 3,64(3 + r) \checkmark \dots (2) \end{aligned}$ $\left. \begin{aligned} \epsilon &= IR + Ir \\ \epsilon &= V_{\text{int}} + V_{\text{ext}} \end{aligned} \right\} \checkmark \text{ Any one/ Enige een}$ $= 5(2,1 + r) \checkmark \dots (1)$	
$\begin{aligned} (1) &= (2) \\ 5(2,1 + r) &= 3,64(3 + r) \\ r &= 0,31 \Omega \end{aligned}$ $\begin{aligned} \epsilon &= 5(2,1 + 0,31) \\ &= 12,05 \text{ V} \checkmark \quad (12,04) \end{aligned}$ OR/OF $\begin{aligned} \epsilon &= 3,64(3 + 0,31) \\ &= 12,05 \text{ V} \checkmark \quad (12,04) \end{aligned}$	$\begin{aligned} (1) &= (2): \\ \frac{\epsilon - 10,5}{5} &= \frac{\epsilon - 10,92}{3,64} \\ \epsilon &= 12,05 \text{ V} \checkmark \quad (12,04) \end{aligned}$

(5)

- 8.4 Increases/*Toeneem* ✓
(Total) resistance increases./(*Totale*) weerstand neem toe. ✓
Current decreases./*Stroom* neem af. ✓
 V_{internal} /Internal volts decreases./ V_{intern} /Interne volts neem af. ✓ (4)

Note/Aantekening:

Award marks if learner proved the statement using calculated numerical values./
Ken punte toe indien leerder die stelling bewys deur berekende waardes te gebruik.

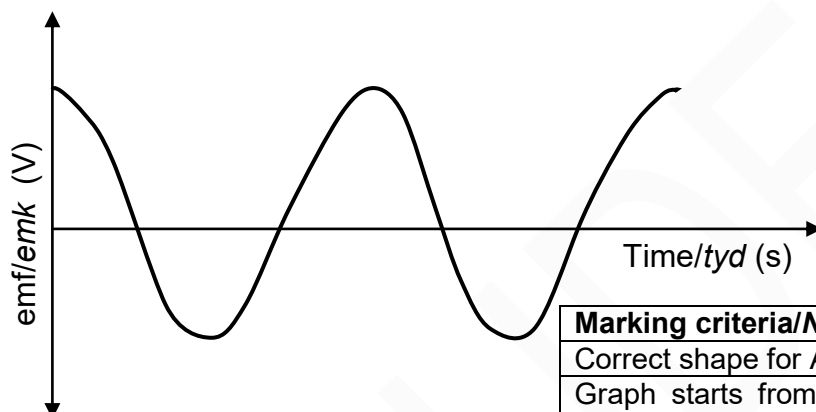
[21]

QUESTION 9/VRAAG 9

- 9.1.1 North pole/*Noord-pool* ✓ (1)

- 9.1.2 Y to X/*Y na X* ✓ (1)

- 9.1.3



Marking criteria/Nasienkriteria

Correct shape for AC./ <i>Korrekte vorm vir WS.</i>	✓
Graph starts from maximum value./ <i>Grafiek begin by maksimum waarde.</i>	✓
Two complete waves/ <i>Twee volledige golwe</i>	✓

Note/Aantekening:

Accept graph starting at negative max./*Aanvaar grafiek wat by negatiewe maks begin.*

(3)

- 9.2.1

Marking criteria/Nasienkriteria:

- Formula to calculate V_{max} or I_{rms} ./*Formule om V_{maks} of I_{wgk} te bereken.* ✓
- Correct substitution of V_{rms} or I_{max} ./*Korrekte vervanging van V_{wgk} of I_{maks} .* ✓
- Correct substitution to calculate R ./*Korrekte vervanging om R te bereken.* ✓
- Correct final answer/*Korrekte finale antwoord: 47,14 Ω to/tot 47,2 Ω* ✓

OPTION 1/OPSIE 1

$$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \quad \checkmark$$

$$200 = \frac{V_{\text{max}}}{\sqrt{2}} \quad \checkmark$$

$$V_{\text{max}} = 282,84 \text{ V}$$

$$R = \frac{V}{I} \quad \downarrow$$

$$= \frac{282,84}{6} \quad \checkmark$$

$$R = 47,14 \Omega \quad \checkmark$$

OPTION 2/OPSIE 2

$$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}} \quad \checkmark$$

$$I_{\text{rms}} = \frac{6}{\sqrt{2}} \quad \checkmark$$

$$I_{\text{rms}} = 4,24 \text{ A}$$

$$R = \frac{V}{I} \quad \downarrow$$

$$= \frac{200}{4,24} \quad \checkmark$$

$$R = 47,17 \Omega \quad \checkmark$$

OPTION 3/OPSIE 3 $I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}} \checkmark$ $I_{\text{rms}} = \frac{6}{\sqrt{2}} \checkmark$ $I_{\text{rms}} = 4,24 \text{ A}$ $P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}}$ $= (200)(4,24)$ $= 848 \text{ W (848,53)}$	$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R}$ $848 = \frac{(200)^2}{R} \checkmark$ $= 47,17 \Omega \checkmark$ OR/OF $P_{\text{ave}} = I_{\text{rms}}^2 R$ $848 = (4,24)^2 R \checkmark$ $= 47,17 \Omega \checkmark$

(4)

9.2.2 **POSITIVE MARKING FROM QUESTION 9.2.1.**
POSITIEWE NASIEN VANAF VRAAG 9.2.1.

OPTION 1/OPSIE 1 $W = I^2 R \Delta t \checkmark$ $= (4,24)^2 (47,17) \checkmark (7200) \checkmark$ $= 6,11 \times 10^6 \text{ J } \checkmark (6,10 \times 10^6)$	OPTION 2/OPSIE 2 $W = VI \Delta t \checkmark$ $= (200)(4,24) \checkmark (7200) \checkmark$ $= 6,11 \times 10^6 \text{ J } \checkmark$
OPTION 3/OPSIE 3 $W = \frac{V^2 \Delta t}{R} \checkmark$ $= \frac{(200^2) (7200) \checkmark}{47,27 \checkmark}$ $= 6,11 \times 10^6 \text{ J } \checkmark (6,10 \times 10^6)$	OPTION 4/OPSIE 4 $P = \frac{W}{\Delta t} \checkmark$ $848 = \frac{W}{7200 \checkmark}$ $= 6,11 \times 10^6 \text{ J } \checkmark$

(4)
[13]

QUESTION 10/VRAAG 10

10.1 $6,63 \times 10^{-34} \checkmark$ (1)

10.2 **Marking criteria/Nasienkriteria**
 If any of the underlined key words/phrases in the **correct context** is omitted or extra incorrect words added, deduct 1 mark./Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat of onkorrekte woorde bygevoeg is, trek 1 punt af.

The minimum energy needed to eject an electron from a (metal) surface. $\checkmark \checkmark$
 Die minimum energie benodig om 'n elektron uit 'n (metaal)oppervlak vry te stel.

(2)

10.3.1 $W_0 = hf_0 \checkmark$
 $= \frac{(6,63 \times 10^{-34})(5 \times 10^{14}) \checkmark}{\checkmark}$
 $= 3,32 \times 10^{-19} \text{ J } \checkmark$ (3)

10.3.2 **POSITIVE MARKING FROM QUESTION 10.3.1./ POSITIEWE NASIEN VANAF VRAAG 10.3.1.****OPTION 1/OPSIE 1**

$$\text{Gradient} = \frac{\Delta E_k}{\Delta f} \checkmark$$

$$6,63 \times 10^{-34} \checkmark = \frac{(X - 0)}{(12,54 \times 10^{14} - 5 \times 10^{14})} \checkmark$$

$$X = 5 \times 10^{-19} \text{ (J)} \checkmark$$

OPTION 2/OPSIE 2

$$\left. \begin{aligned} E &= W_o + E_{k(\max)} \\ hf &= hf_o + \frac{1}{2}mv_{\max}^2 \\ h\frac{c}{\lambda} &= h\frac{c}{\lambda_o} + E_{k(\max)} \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$\frac{(6,63 \times 10^{-34})(12,54 \times 10^{14})}{\lambda} \checkmark = \frac{3,32 \times 10^{-19}}{\lambda} + E_{k(\max)} \checkmark$$

$$E_{k(\max)} = 5 \times 10^{-19} \text{ J} \checkmark$$

$$X = 5 \times 10^{-19} \text{ (J)}$$

Note/Aantekening:

Do not penalise learner again in 10.3.2 if $(x \times 10^{14})$ is omitted in 10.3.1/Moenie leerder weer penaliseer in 10.3.2 indien $(x \times 10^{14})$ uitgelaat is in 10.3.1 nie.

(4)

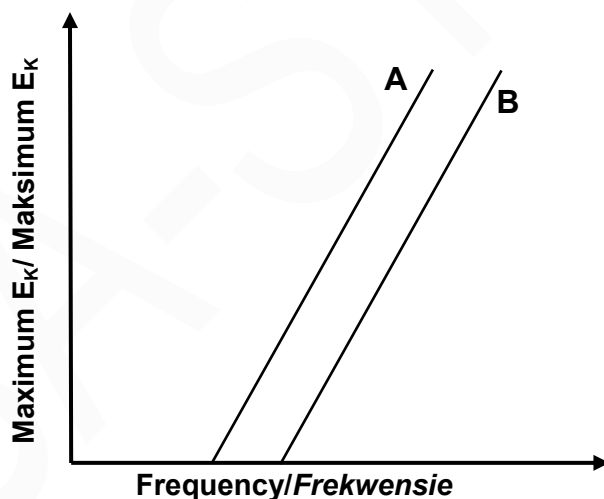
10.4.1 No effect/Geen effek $\checkmark$

(1)

10.4.2 Increases/Toeneem $\checkmark$

(1)

10.5

**Marking criteria/Nasienkriteria**

Graph B to the right of graph A./ Grafiek B aan regterkant van grafiek A.	$\checkmark$
Lines are parallel./Lyne is parallel.	$\checkmark$
If both graphs are not labelled/Indien beide grafieke nie benoem is nie: $0/2$	
If two separate graphs are drawn/Indien twee aparte grafieke geteken is: $0/2$	

(2)

[14]**TOTAL/TOTAAL: 150**



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

NOVEMBER 2022

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 32 pages.
Hierdie nasienriglyne bestaan uit 32 bladsye.**

QUESTION 1/VRAAG 1

- 1.1 B ✓✓ (2)
- 1.2 D ✓✓ (2)
- 1.3 A ✓✓ (2)
- 1.4 D ✓✓ (2)
- 1.5 B ✓✓ (2)
- 1.6 C ✓✓ (2)
- 1.7 C ✓✓ (2)
- 1.8 A ✓✓ (2)
- 1.9 C ✓✓ (2)
- 1.10 D ✓✓ (2)
- [20]**

QUESTION 2/VRAAG 2

2.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

When a resultant/net force acts on an object, the object will accelerate in the direction of the force. The acceleration is directly proportional to the resultant/net force and inversely proportional to the mass of the object. ✓✓
Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Die versnelling is direk eweredig aan die netto krag en omgekeerd eweredig aan die massa van die voorwerp.

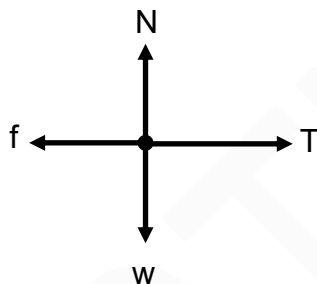
OR/OF

The resultant/net force acting on an object is equal to the rate of change of momentum of the object. **(2 or 0)**

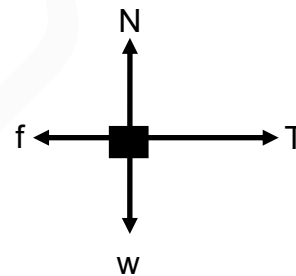
Die resulterende/netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum. **(2 of 0)**

(2)

2.2



Accept force diagram/
Aanvaar kragte-diagram:



Accepted labels/Aanvaarde benoemings	
W	F_g / F_w / $F_{\text{earth on P}}$ / weight / mg / 12,25 N / gravitational force F_g / F_w / $F_{\text{aarde op P}}$ / gewig / mg / 12,25 N / gravitasiekrag
T	F_T / F_{string} / F_{tou} / F_t / tension / spanning / F_s
f	F_f / f_k / (kinetic) friction / (kinetiese) wrywing / 1,8 N / F_w
N	F_N / Normal / F_{normal} / F_{normaal} / Normaal
Notes/Aantekeninge	
- Mark awarded for label <u>and</u> arrow./Punt toegeken vir benoeming <u>en</u> pyltjie. - Do not penalise for length of arrows since drawing is not to scale./Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie. - Any other additional force(s)/Enige ander addisionele krag(te): Max/Maks $\frac{3}{4}$ - If everything correct, but no arrows/Indien alles korrek, maar geen pyltjies: Max/Maks $\frac{3}{4}$ - If force(s) do not make contact with the dot /Indien krag(te) nie met die kolletjie kontak maak nie: Max/Maks $\frac{3}{4}$	

(4)

2.3.1

For P/Vir P RIGHT AS POSITIVE/ REGS AS POSITIEF $\left. \begin{array}{l} F_{\text{net}} = ma \\ T + f = ma \\ T - f = ma \end{array} \right\} \begin{array}{l} \text{Any one/} \\ \text{✓ Enige een} \end{array}$ $\frac{T - 1,8}{T} = \frac{(1,25)(0,1)}{1,93} \checkmark$ $T = 1,93 \text{ N } \checkmark \quad (1,925 \text{ N})$	For P/Vir P LEFT AS POSITIVE/ LINKS AS POSITIEF $\left. \begin{array}{l} F_{\text{net}} = ma \\ T + f = ma \\ -T + f = ma \end{array} \right\} \begin{array}{l} \text{Any one/} \\ \text{✓ Enige een} \end{array}$ $\frac{-T + 1,8}{T} = \frac{(1,25)(-0,1)}{1,93} \checkmark$ $T = 1,93 \text{ N } \checkmark \quad (1,925 \text{ N})$

(4)

2.3.2

POSITIVE MARKING FROM QUESTION 2.3.1/ POSITIEWE NASIEN VANAF VRAAG 2.3.1. RIGHT AS POSITIVE/REGS AS POSITIEF: For Q/Vir Q $\begin{array}{l} F_{\text{net}} = ma \\ F \cos \theta - T - f = ma \\ F \cos \theta + T + f = ma \end{array}$ $\frac{7,5 \cos \theta - 1,93 - 2,2}{\theta} = \frac{(2)(0,1)}{54,74} \checkmark$ $\theta = 54,74^\circ \checkmark \quad (\text{Range: } 54,55^\circ - 54,78^\circ)$	Accept/Aanvaar $\sin(90^\circ - \theta)$
LEFT AS POSITIVE/LINKS AS POSITIEF: For Q/Vir Q $\begin{array}{l} F_{\text{net}} = ma \\ -F \cos \theta + T + f = ma \\ F \cos \theta + T + f = ma \end{array}$ $\frac{-7,5 \cos \theta + 1,93 + 2,2}{\theta} = \frac{(2)(-0,1)}{54,74} \checkmark$ $\theta = 54,74^\circ \checkmark \quad (\text{Range: } 54,55^\circ - 54,78^\circ)$	Accept/Aanvaar $\sin(90^\circ - \theta)$

(3)
[13]**QUESTION 3/VRAAG 3**

3.1

Motion under the influence of gravity/weight/gravitational force only. ✓✓
 Beweging slegs onder die invloed van gravitasie/gewig/swaartekrag.
 (2 or/of 0)

OR/OF

Motion in which the only force acting is gravity/weight/gravitational force.
 Beweging waar die enigste krag wat inwerk, gravitasie/gewig/swaartekrag is.
 (2 or/of 0)

(2)

3.2.1

Marking criteria/Nasienkriteria

- Formula with Δt /Formule met Δt ✓
- Correct substitution into formula/Korrekte vervanging in formule ✓
- Final answer/Finale antwoord: 1,22 s ✓ (1,22 s to/tot 1,23 s)

OPTION 1/OPSIE 1**A-B:**

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$$v_f = v_i + a\Delta t \checkmark$$

$$0 = 12 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 1,22 \text{ s} \checkmark$$

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$$v_f = v_i + a\Delta t \checkmark$$

$$0 = -12 + (9,8)\Delta t \checkmark$$

$$\Delta t = 1,22 \text{ s} \checkmark$$

OPTION 2/OPSIE 2**B-C:**

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$$v_f = v_i + a\Delta t \checkmark$$

$$-12 = 0 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 1,22 \text{ s} \checkmark$$

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$$v_f = v_i + a\Delta t \checkmark$$

$$12 = 0 + (9,8)\Delta t \checkmark$$

$$\Delta t = 1,22 \text{ s} \checkmark$$

OPTION 3/OPSIE 3**A-C:**

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$$v_f = v_i + a\Delta t \checkmark$$

$$-12 = 12 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 2,45 \text{ s}$$

$$\Delta t_{\text{up}} = 1,23 \text{ s} \checkmark$$

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$$v_f = v_i + a\Delta t \checkmark$$

$$12 = -12 + (9,8)\Delta t \checkmark$$

$$\Delta t = 2,45 \text{ s}$$

$$\Delta t_{\text{up}} = 1,23 \text{ s} \checkmark$$

OPTION 4/OPSIE 4**A-C:**

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$0 = (12)\Delta t + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$$

$$\Delta t = 2,45 \text{ s}$$

$$\Delta t_{\text{up}} = 1,23 \text{ s} \checkmark$$

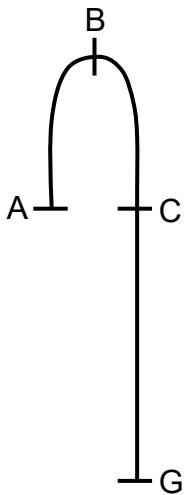
DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

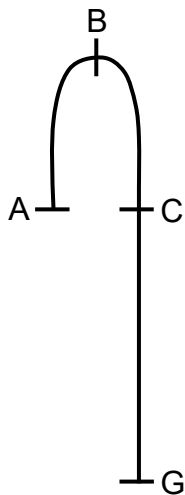
$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$0 = (-12)\Delta t + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$\Delta t = 2,45 \text{ s}$$

$$\Delta t_{\text{up}} = 1,23 \text{ s} \checkmark$$



**OPTION 5/OPSIE 5****A-B OR/OF B-C:**

$$(E_{\text{mech}})_{\text{Top/Bo}} = (E_{\text{mech}})_{25\text{ m}}$$

$$(E_P + E_K)_{\text{Top/Bo}} = (E_P + E_K)_{25\text{ m}}$$

$$(mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}} = (mgh + \frac{1}{2}mv^2)_{25\text{ m}}$$

$$(9,8)h + 0 = 0 + (\frac{1}{2})(12)^2$$

$$\Delta h = 7,35\text{ m}$$

OPTION 6/OPSIE 6**A-B OR/OF B-C**

$$W_{\text{nc}} = \Delta K + \Delta U$$

$$W_{\text{nc}} = \Delta K + mg(h_f - h_i)$$

$$0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i$$

$$0 = \frac{1}{2}(0^2 - 12^2) + (9,8)\Delta h$$

$$\Delta h = 7,35\text{ m}$$

OPTION 7/OPSIE 7**A-B OR/OF B-C**

$$W_{\text{net}} = \Delta E_K$$

$$w\Delta y \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$(9,8)\Delta y \cos 180^\circ = 0 - \frac{1}{2}(12)^2$$

$$\Delta y = 7,35\text{ m}$$

OPTION 8/OPSIE 8**A-B:****UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$0^2 = 12^2 + 2(-9,8)\Delta y$$

$$\Delta y = 7,35\text{ m}$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$0^2 = (-12)^2 + 2(9,8)\Delta y$$

$$\Delta y = -7,35\text{ m}$$

OPTION 9/OPSIE 9**B-C:****UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$(-12)^2 = 0^2 + 2(-9,8)\Delta y$$

$$\Delta y = -7,35\text{ m}$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$(12)^2 = 0^2 + 2(9,8)\Delta y$$

$$\Delta y = 7,35\text{ m}$$

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$7,35 = \left(\frac{12 + 0}{2} \right) \Delta t \checkmark$$

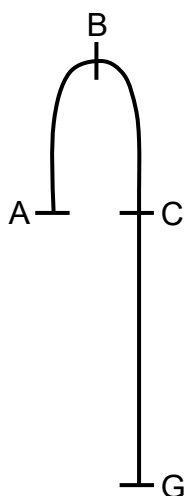
$$\Delta t = 1,23\text{ s} \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$-7,35 = \left(\frac{-12 + 0}{2} \right) \Delta t \checkmark$$

$$\Delta t = 1,23\text{ s} \checkmark$$

**OPTION 10/OPSIE 10****A-B:****UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:**

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$\Delta y = \left(\frac{12 + 0}{2} \right) \Delta t$$

$$\Delta y = 6\Delta t$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$0 = (12)^2 + 2(-9,8)(6\Delta t) \checkmark$$

$$\Delta t = 1,22 \text{ s} \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:**

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$\Delta y = \left(\frac{-12 + 0}{2} \right) \Delta t$$

$$\Delta y = -6\Delta t$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$0 = (-12)^2 + 2(9,8)(-6\Delta t) \checkmark$$

$$\Delta t = 1,22 \text{ s} \checkmark$$

OPTION 12/OPSIE 12**A-B:****UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:**

$$F_{\text{net}}\Delta t = m\Delta v$$

$$F_{\text{net}}\Delta t = m(v_f - v_i)$$

$$-(9,8)\Delta t = 0 - 12 \checkmark$$

$$\Delta t = 1,22 \text{ s} \checkmark$$

✓ Any one/
Enige een

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:**

$$F_{\text{net}}\Delta t = m\Delta v$$

$$F_{\text{net}}\Delta t = m(v_f - v_i)$$

$$(9,8)\Delta t = 12 - 0 \checkmark$$

$$\Delta t = 1,22 \text{ s} \checkmark$$

✓ Any one/
Enige een

OPTION 11/OPSIE 11**B-C:****UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:**

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$\Delta y = \left(\frac{0 - 12}{2} \right) \Delta t$$

$$\Delta y = -6\Delta t$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$-12 = (0)^2 + 2(-9,8)(-6\Delta t) \checkmark$$

$$\Delta t = 1,22 \text{ s} \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:**

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$\Delta y = \left(\frac{12 + 0}{2} \right) \Delta t$$

$$\Delta y = 6\Delta t$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$12^2 = 0^2 + 2(9,8)(6\Delta t) \checkmark$$

$$\Delta t = 1,22 \text{ s} \checkmark$$

(3)

3.2.2

Marking criteria/Nasienkriteria

- Formula with v_f . / *Formule met v_f .* ✓
- Correct substitution into formula. / *Korrekte vervanging in formule.* ✓
- Correct final answer / *Korrekte finale antwoord:*
 $25,18 \text{ m} \cdot \text{s}^{-1}$ ✓ ($25,03 \text{ m} \cdot \text{s}^{-1}$ to/tot $25,59 \text{ m} \cdot \text{s}^{-1}$)
- Correct direction (only if numerical value is given). / *Korrekte rigting (slegs indien numeriese waarde gegee is).* ✓

OPTION 1/OPSIE 1**A-G:**

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:**

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$v_f^2 = (12)^2 + 2(-9,8)(-25) \quad \checkmark$$

$$v_f = 25,18 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \text{ downwards } \checkmark$$

afwaarts

A-G:

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:**

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$v_f^2 = (-12)^2 + 2(9,8)(25) \quad \checkmark$$

$$v_f = 25,18 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \text{ downwards } \checkmark$$

afwaarts

OPTION 2/OPSIE 2**C-G:**

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$v_f^2 = (-12)^2 + 2(-9,8)(-25) \quad \checkmark$$

$$v_f = 25,18 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \text{ downwards } \checkmark$$

afwaarts

C-G:

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$v_f^2 = (12)^2 + 2(9,8)(25) \quad \checkmark$$

$$v_f = 25,18 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \text{ downwards } \checkmark$$

afwaarts

OPTION 3/OPSIE 3**B-G**

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$v_f^2 = (0)^2 + 2(-9,8)(-32,35) \quad \checkmark$$

$$v_f = 25,18 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \text{ downwards } \checkmark$$

afwaarts

B-G

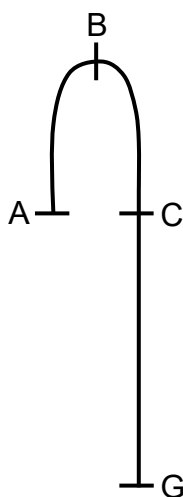
**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

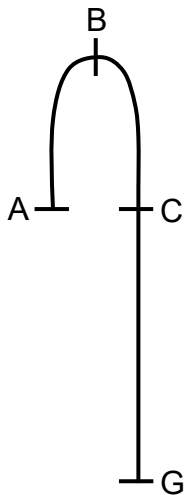
$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$v_f^2 = (0)^2 + 2(9,8)(32,35) \quad \checkmark$$

$$v_f = 25,18 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \text{ downwards } \checkmark$$

afwaarts



**OPTION 4/OPSIE 4****A-G:****UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-25 = 12\Delta t + \frac{1}{2}(-9,8)\Delta t^2$$

$$\Delta t = 3,79 \text{ s}$$

A-G

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$-25 = \left(\frac{12 + v_f}{2} \right) 3,79$$

$$v_f = -25,18 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_f = 25,18 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ downwards } \checkmark$$

afwaarts

B-G

$$v_f = v_i + a \Delta t \checkmark$$

$$v_f = 0 + (-9,8)(3,79 - 1,22) \checkmark$$

$$v_f = -25,19 \text{ m} \cdot \text{s}^{-1}$$

$$v_f = 25,19 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ downwards } \checkmark$$

afwaarts

C-G

$$v_f = v_i + a \Delta t \checkmark$$

$$v_f = -12 + (-9,8)(1,35) \checkmark$$

$$v_f = -25,19 \text{ m} \cdot \text{s}^{-1}$$

$$v_f = 25,19 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ downwards } \checkmark$$

afwaarts

A-G:**DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$25 = -12 \Delta t + \frac{1}{2} (9,8) \Delta t^2$$

$$\Delta t = 3,79 \text{ s}$$

A-G

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$25 = \left(\frac{-12 + v_f}{2} \right) 3,79 \checkmark$$

$$\therefore v_f = 25,18 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ downwards } \checkmark$$

afwaarts

B-G

$$v_f = v_i + a \Delta t \checkmark$$

$$= 0 + (9,8)(3,79 - 1,22) \checkmark$$

$$v_f = 25,19 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ downwards } \checkmark$$

afwaarts

C-G

$$v_f = v_i + a \Delta t \checkmark$$

$$v_f = 12 + (9,8)(3,79 - 2(1,22)) \checkmark$$

$$v_f = 25,19 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ downwards } \checkmark$$

afwaarts

OPTION 5/OPSIE 5**C-G:****UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-25 = -12 \Delta t + \frac{1}{2} (-9,8) \Delta t^2$$

$$\Delta t = 1,34 \text{ s}$$

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$-25 = \left(\frac{-12 + v_f}{2} \right) 1,34 \checkmark$$

$$v_f = -25,18 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_f = 25,18 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ downwards } \checkmark$$

afwaarts

C-G:**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$25 = 12 \Delta t + \frac{1}{2} (9,8) \Delta t^2$$

$$\Delta t = 1,34 \text{ s}$$

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$25 = \left(\frac{12 + v_f}{2} \right) 1,34 \checkmark$$

$$v_f = 25,18 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ downwards } \checkmark$$

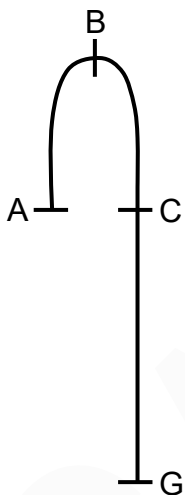
afwaarts

OPTION 6/OPSIE 6

$$\left. \begin{aligned} (E_{\text{mech/meg}})_i &= (E_{\text{mech/meg}})_f \\ (E_P + E_K)_i &= (E_P + E_K)_f \\ (mgh + \frac{1}{2}mv^2)_i &= (mgh + \frac{1}{2}mv^2)_f \end{aligned} \right\} \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array}$$

$$m(9,8)(25) + \frac{1}{2}m(12^2) = 0 + \frac{1}{2}mv_f^2 \checkmark$$

$$v_f = 25,18 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ downwards/afwaarts } \checkmark$$



OPTION 7/OPSIE 7

$$\begin{aligned}
 n_c &= \Delta E + \Delta E_p \\
 &= (E_{kf} - E_{ki}) + (E_{pf} - E_{pi}) \\
 &= \left(\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2\right) + (mgh_f - mgh_i) \quad \left. \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array} \right\} \\
 0 &= \left[\frac{1}{2}mv_f^2 - \frac{1}{2}m(12)^2\right] + [0 - m(9,8)(25)] \checkmark \\
 v_f &= 25,18 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ downwards/afwaarts } \checkmark
 \end{aligned}$$

OPTION 8/OPSIE 8

$$\begin{aligned}
 \text{net} &= \Delta E \\
 &= (E_{kf} - E_{ki}) \\
 &= \left(\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2\right) \quad \left. \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array} \right\} \\
 m(9,8)(25) &= \frac{1}{2}mv_f^2 - \frac{1}{2}m(12)^2 \checkmark \\
 v_f &= 25,18 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ downwards/afwaarts } \checkmark
 \end{aligned}$$

(4)

3.2.3

POSITIVE MARKING FROM QUESTION 3.2.2.**POSITIEWE NASIEN VANAF VRAAG 3.2.2.****Marking criteria/Nasienkriteria**

- Substitution into formula to calculate v at the top of the door ✓
Vervanging in formule om v bokant die deur te bereken.
- Formula to calculate Δt from top to bottom of door. ✓
Formule om Δt te bereken van bo tot onder van deur.
- Substitution to calculate Δt . ✓
Vervanging om Δt te bereken.
- Final answer/Finale antwoord: 0,07 to/tot 0,08 s ✓

OPTION 1/OPSIE 1**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:****A-D:**

$$\begin{aligned}
 v_f^2 &= v_i^2 + 2a\Delta y \\
 v_f^2 &= (12)^2 + 2(-9,8)(-23,1) \checkmark \\
 v_f &= 24,43 \text{ m} \cdot \text{s}^{-1}
 \end{aligned}$$

C-D:

$$\begin{aligned}
 v_f^2 &= v_i^2 + 2a\Delta y \\
 v_f^2 &= (-12)^2 + 2(-9,8)(-23,1) \checkmark \\
 v_f &= 24,43 \text{ m} \cdot \text{s}^{-1}
 \end{aligned}$$

D-G:

$$\begin{aligned}
 v_f^2 &= v_i^2 + 2a\Delta y \\
 (-25,18)^2 &= (v_i)^2 + 2(-9,8)(-1,9) \checkmark \\
 v_i &= 24,43 \text{ m} \cdot \text{s}^{-1}
 \end{aligned}$$

B-D

$$\begin{aligned}
 v_f^2 &= v_i^2 + 2a\Delta y \\
 v_f^2 &= 0 + 2(-9,8)(-30,447) \checkmark \\
 &= 24,43 \text{ m} \cdot \text{s}^{-1}
 \end{aligned}$$

D-G:

$$\begin{aligned}
 E_{(\text{mech top/meg bo})} &= E_{(\text{mech bot/meg ond})} \\
 (E_p + E_k)_{\text{top/bo}} &= (E_p + E_k)_{\text{bot/ond}} \\
 (mgh + \frac{1}{2}mv^2)_{\text{top/bo}} &= (mgh + \frac{1}{2}mv^2)_{\text{bot/ond}} \\
 m(9,8)(1,9) + \frac{1}{2}m(v_i)^2 &= 0 + \frac{1}{2}m(25,18)^2 \checkmark \\
 v_i &= 24,43 \text{ m} \cdot \text{s}^{-1}
 \end{aligned}$$

D-G:

$$\begin{aligned}
 v_f &= v_i + a\Delta t \checkmark \\
 -25,18 &= -24,43 + (-9,8)\Delta t \checkmark \\
 \Delta t &= 0,08 \text{ s } \checkmark
 \end{aligned}$$

D-G:

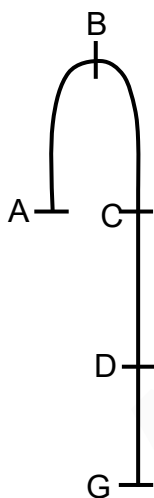
$$\begin{aligned}
 \Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark \\
 -1,9 &= -24,43\Delta t + \frac{1}{2}(-9,8)\Delta t^2 \checkmark \\
 \Delta t &= 0,08 \text{ s } \checkmark
 \end{aligned}$$

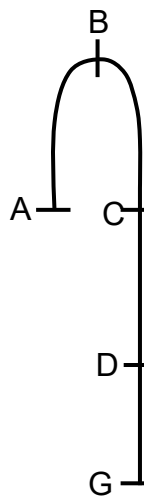
D-G:

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$-1,9 = \left(\frac{-24,43 - 25,18}{2} \right) \Delta t \checkmark$$

$$\Delta t = 0,08 \text{ s } \checkmark$$



DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:


A-D:

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = (-12)^2 + 2(9,8)(23,1) \checkmark$$

$$v_i = 24,43 \text{ m}\cdot\text{s}^{-1}$$

C-D:

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = (12)^2 + 2(9,8)(23,1) \checkmark$$

$$v_i = 24,43 \text{ m}\cdot\text{s}^{-1}$$

D-G:

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$(25,18)^2 = (v_i)^2 + 2(9,8)(1,9) \checkmark$$

$$v_i = 24,43 \text{ m}\cdot\text{s}^{-1}$$

B-D

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = 0 + 2(9,8)(30,447) \checkmark$$

$$= 24,43 \text{ m}\cdot\text{s}^{-1}$$

D-G:

$$E_{(\text{mech top/meg bo})} = E_{(\text{mech bot/meg ond})}$$

$$(E_p + E_k)_{\text{top/bo}} = (E_p + E_k)_{\text{bot/ond}}$$

$$(mgh + \frac{1}{2}mv^2)_{\text{top/bo}} = (mgh + \frac{1}{2}mv^2)_{\text{bot/ond}}$$

$$m(9,8)(1,9) + \frac{1}{2}m(v_i)^2 = 0 + \frac{1}{2}m(25,18)^2 \checkmark$$

$$v_i = 24,43 \text{ m}\cdot\text{s}^{-1}$$

D-G:

$$v_f = v_i + a\Delta t \checkmark$$

$$25,18 = 24,43 + (9,8)\Delta t \checkmark$$

$$\Delta t = 0,08 \text{ s} \checkmark$$

D-G:

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$1,9 = 24,43\Delta t + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$\Delta t = 0,08 \text{ s} \checkmark$$

D-G:

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$1,9 = \left(\frac{24,43 + 25,18}{2} \right) \Delta t \checkmark$$

$$\Delta t = 0,08 \text{ s} \checkmark$$

Marking criteria OPTION 2 and 3/Nasienkriteria OPSIE 2 en 3

- Either one of the formula to calculate Δt . / Enige een van die formules om Δt te bereken. ✓
- Substitute into formula to calculate time from A to G or C to G / Vervanging in formule om tyd te bereken tussen A tot G of C tot G ✓
- Substitute into formula to calculate time from A to D or C to D / Vervanging in formule om tyd te bereken tussen A tot D of C tot D ✓
- Final answer / Finale antwoord: 0,07 s ✓ (0,07s to/tot 0,08s)

OPTION 2/OPSIE 2**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:****A-G:**

$$v_f = v_i + a\Delta t$$

$$\underline{-25,18 = 12 + (-9,8) \Delta t} \checkmark$$

$$\Delta t = 3,79 \text{ s}$$

✓ Any one/
Enige een**A-D:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$\underline{-23,1 = (12) \Delta t + \frac{1}{2} (-9,8) \Delta t^2} \checkmark$$

$$\Delta t = 3,72 \text{ s}$$

Time from top to bottom of door / Tyd van bokant tot onderkant van deur:

D-G:

$$3,79 - 3,72 = 0,07 \text{ s} \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:****A-G:**

$$v_f = v_i + a\Delta t$$

$$\underline{25,18 = -12 + (9,8) \Delta t} \checkmark$$

$$\Delta t = 3,79 \text{ s}$$

✓ Any one/
Enige een**A-D:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$\underline{23,1 = (-12) \Delta t + \frac{1}{2} (9,8) \Delta t^2} \checkmark$$

$$\Delta t = 3,72 \text{ s}$$

Time from top to bottom of door / Tyd van bokant tot onderkant van deur:

D-G:

$$3,79 - 3,72 = 0,07 \text{ s} \checkmark$$

OPTION 3/OPSIE 3**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:****C-G:**

$$v_f = v_i + a\Delta t$$

$$\underline{-25,18 = -12 + (-9,8) \Delta t} \checkmark$$

$$\Delta t = 1,34 \text{ s}$$

✓ Any one/
Enige een**C-D:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$\underline{-23,1 = (-12) \Delta t + \frac{1}{2} (-9,8) \Delta t^2} \checkmark$$

$$\Delta t = 1,27 \text{ s}$$

Time from top to bottom of door / Tyd van bokant tot onderkant van deur:

D-G:

$$1,34 - 1,27 = 0,07 \text{ s} \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:****C-G:**

$$v_f = v_i + a\Delta t$$

$$\underline{25,18 = 12 + (9,8) \Delta t} \checkmark$$

$$\Delta t = 1,34 \text{ s}$$

✓ Any one/
Enige een**C-D:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$\underline{23,1 = (12) \Delta t + \frac{1}{2} (9,8) \Delta t^2} \checkmark$$

$$\Delta t = 1,27 \text{ s}$$

Time from top to bottom of door / Tyd van bokant tot onderkant van deur:

D-G:

$$1,34 - 1,27 = 0,07 \text{ s} \checkmark$$

OPTION 4/OPSIE 4**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF:****G-D:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$1,9 \checkmark = \frac{25,18 \Delta t}{2} + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$$

$$\Delta t = 0,08 \text{ s } \checkmark \quad (0,077 \text{ s})$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:****G-D:**

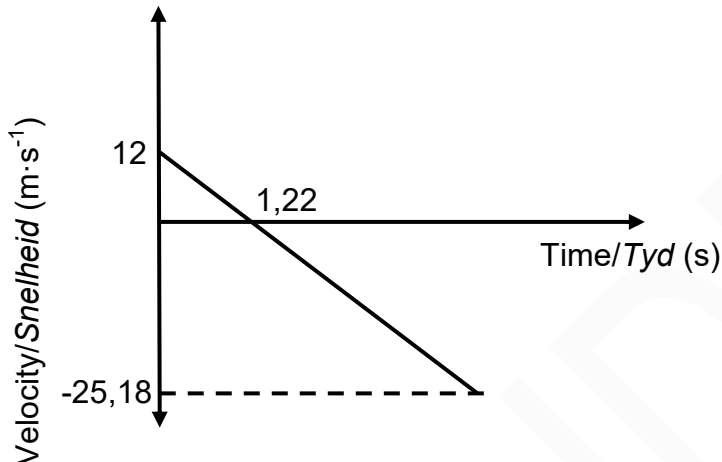
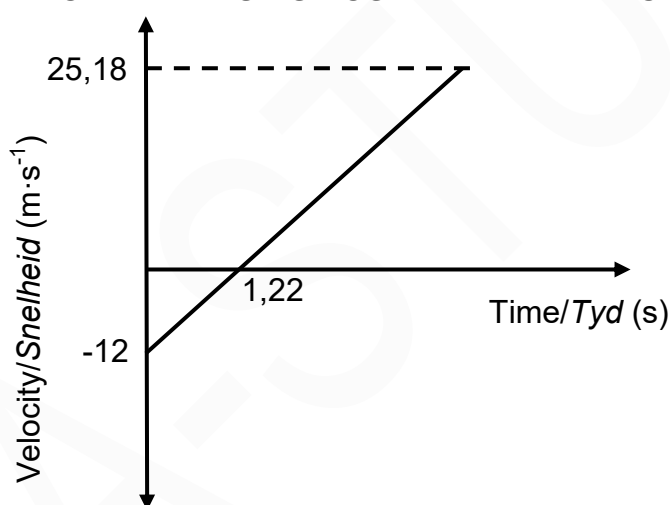
$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$-1,9 \checkmark = \frac{-25,18 \Delta t}{2} + \frac{1}{2} (9,8) \Delta t^2 \checkmark$$

$$\Delta t = 0,08 \text{ s } \checkmark \quad (0,077 \text{ s})$$

(4)

3.3

POSITIVE MARKING FROM QUESTION 3.2.1 AND QUESTION 3.2.2.**POSITIEWE NASIEN VANAF VRAAG 3.2.1 EN VRAAG 3.2.2.****UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:****DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:**

Criteria for graph/Kriteria vir grafiek	
Straight line starting at $v = 12 \text{ m} \cdot \text{s}^{-1}$ with negative final velocity or straight line starting at $v = -12 \text{ m} \cdot \text{s}^{-1}$ with positive final velocity. <i>/Reguitlyn wat begin by $v = 12 \text{ m} \cdot \text{s}^{-1}$ met negatiewe finale snelheid of reguitlyn wat begin by $v = -12 \text{ m} \cdot \text{s}^{-1}$ met positiewe finale snelheid.</i>	✓
Straight line cuts time axis at time calculated in Question 3.2.1/ <i>Reguitlyn sny tydas by die tyd bereken in Vraag 3.2.1.</i>	✓
Correct final velocity as calculated in Question 3.2.2 is indicated. <i>Korrekte finale snelheid soos uitgewerk in Vraag 3.2.2 is aangedui.</i>	✓

(3)

[16]

QUESTION 4/VRAAG 4

4.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

In an isolated/closed system the total (linear) momentum is conserved/remains constant. ✓✓

In 'n geïsoleerde/geslote sisteem bly die totale (lineêre) momentum behoue/konstant. (2)

4.2.1

OPTION 1/OPSIE 1**EAST AS POSITIVE/OOS AS POSITIEF**

$$\left. \begin{aligned} \sum p_i &= \sum p_f \\ m_x v_{ix} + m_y v_{iy} &= m_x v_{fx} + m_y v_{fy} \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$(1,2)(8) \checkmark + (0,5)(0) = (1,2)(4) + (0,5)(v_{fy}) \checkmark$$

$$\therefore v_{fy} = 9,6 \text{ m} \cdot \text{s}^{-1} \checkmark$$

WEST AS POSITIVE/WES AS POSITIEF

$$\left. \begin{aligned} \sum p_i &= \sum p_f \\ m_x v_{ix} + m_y v_{iy} &= m_x v_{fx} + m_y v_{fy} \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$(1,2)(-8) \checkmark + (0,5)(0) = (1,2)(-4) + (0,5)(v_{fy}) \checkmark$$

$$v_{fy} = -9,6 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_{fy} = 9,6 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 2 /OPSIE 2**EAST AS POSITIVE/OOS AS POSITIEF**

$$\left. \begin{aligned} \Delta p_x &= -\Delta p_y \\ m(v_{xf} - v_{xi}) &= -m(v_{yf} - v_{yi}) \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$1,2(4 - 8) \checkmark = -0,5(v_f - 0) \checkmark$$

$$\therefore v_{fy} = 9,6 \text{ m} \cdot \text{s}^{-1} \checkmark$$

WEST AS POSITIVE/WES AS POSITIEF

$$\left. \begin{aligned} \Delta p_x &= -\Delta p_y \\ m(v_{xf} - v_{xi}) &= -m(v_{yf} - v_{yi}) \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$1,2(-4 + 8) \checkmark = -0,5(v_f - 0) \checkmark$$

$$v_{fy} = -9,6 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_{fy} = 9,6 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(4)

4.2.2

OPTION 1/OPSIE 1**EAST POSITIVE/OOS POSITIEF:****For X/Vir X:**

$$\left. \begin{aligned} F_{\text{net}} \Delta t &= \Delta p \\ F_{\text{net}} \Delta t &= m(v_f - v_i) \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$F_{\text{net}}(0,1) = 1,2(4 - 8) \checkmark$$

$$F_{\text{net}} = -48 \text{ N} \checkmark$$

$$\therefore F_{\text{net}} = 48 \text{ N} \checkmark$$

WEST POSITIVE/WES POSITIEF:**For X /Vir X:**

$$\left. \begin{aligned} F_{\text{net}} \Delta t &= \Delta p \\ F_{\text{net}} \Delta t &= m(v_f - v_i) \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$F_{\text{net}}(0,1) = 1,2(-4 + 8) \checkmark$$

$$\therefore F_{\text{net}} = 48 \text{ N} \checkmark$$

OPTION 2/OPSIE 2**POSITIVE MARKING FROM QUESTION 4.2.1.****POSITIEWE NASIEN VANAF VRAAG 4.2.1.****EAST AS POSITIVE****OOS AS POSITIEF****For Y/Vir Y:**

$$\left. \begin{aligned} F_{\text{net}}\Delta t &= \Delta p \\ F_{\text{net}}\Delta t &= m(v_f - v_i) \end{aligned} \right\} \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array}$$

$$F_{\text{net}}(0,1) = 0,5(-9,6 - 0) \checkmark$$

$$F_{\text{net}} = -48 \text{ N}$$

$$\therefore F_{\text{net}} = 48 \text{ N} \checkmark$$

WEST AS POSITIVE**WES AS POSITIEF****For Y/Vir Y:**

$$\left. \begin{aligned} F_{\text{net}}\Delta t &= \Delta p \\ F_{\text{net}}\Delta t &= m(v_f - v_i) \end{aligned} \right\} \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array}$$

$$F_{\text{net}}(0,1) = 0,5(9,6 - 0) \checkmark$$

$$F_{\text{net}} = 48 \text{ N} \checkmark$$

OPTION 3/OPSIE 3**EAST AS POSITIVE for X****OOS AS POSITIEF vir X**

$$v_f = v_i + a\Delta t$$

$$-4 = -8 + a(0,1)$$

$$a = -40 \text{ m}\cdot\text{s}^{-2}$$

$$F_{\text{net}} = ma \checkmark$$

$$F_{\text{net}} = (1,2)(-40) \checkmark$$

$$F_{\text{net}} = -48 \text{ N}$$

$$\therefore F_{\text{net}} = 48 \text{ N} \checkmark$$

WEST AS POSITIVE for X**WES AS POSITIEF vir X**

$$v_f = v_i + a\Delta t$$

$$4 = 8 + a(0,1)$$

$$a = 40 \text{ m}\cdot\text{s}^{-2}$$

$$F_{\text{net}} = ma \checkmark$$

$$F_{\text{net}} = (1,2)(40) \checkmark$$

$$F_{\text{net}} = 48 \text{ N} \checkmark$$

OPTION 4/OPSIE 4**EAST AS POSITIVE for X****OOS AS POSITIEF vir X**

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$\Delta x = \left(\frac{8 + 4}{2} \right) (0,1)$$

$$\Delta x = 0,6 \text{ m}$$

$$F_{\text{net}}\Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark$$

$$F_{\text{net}}(0,6)\cos 180^\circ = \frac{1}{2}(1,2)(4)^2 - \frac{1}{2}(1,2)(8)^2 \checkmark$$

$$F_{\text{net}} = 48 \text{ N} \checkmark$$

WEST AS POSITIVE for X**WES AS POSITIEF vir X**

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$\Delta x = \left(\frac{-8 - 4}{2} \right) (0,1)$$

$$\Delta x = -0,6 \text{ m}$$

$$F_{\text{net}}\Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark$$

$$F_{\text{net}}(0,6)\cos 0^\circ = \frac{1}{2}(1,2)(-4)^2 - \frac{1}{2}(1,2)(-8)^2 \checkmark$$

$$F_{\text{net}} = -48 \text{ N} \checkmark$$

$$\therefore F_{\text{net}} = 48 \text{ N} \checkmark$$

OPTION 5/OPSIE 5

$$\begin{aligned} \text{Gradient} &= \frac{\Delta y}{\Delta x} \\ &= \frac{\Delta v}{\Delta t} \\ &= \frac{4 - 8}{0,1} \\ &= -40 \text{ m}\cdot\text{s}^{-2} \end{aligned}$$

$$F_{\text{net}} = ma \checkmark$$

$$F_{\text{net}} = (1,2)(-40) \checkmark$$

$$F_{\text{net}} = -48 \text{ N}$$

$$F_{\text{net}} = 48 \text{ N} \checkmark$$

(3)

4.3

**POSITIVE MARKING FROM QUESTION 4.2.1/
POSITIEWE NASIEN VANAF VRAAG 4.2.1.**

OPTION 1/OPSIE 1

Inelastic/onelasties ✓

$$E_k = \frac{1}{2}mv^2 \quad \checkmark$$

$$\begin{aligned}\sum E_{ki} &= \frac{1}{2}m_X v_{Xi}^2 + \frac{1}{2}m_Y v_{Yi}^2 \\ &= \frac{1}{2}(1,2)(8)^2 + 0 \quad \checkmark \\ &= 38,4 \text{ J}\end{aligned}$$

$$\begin{aligned}\sum E_{kf} &= \frac{1}{2}m_X v_{Xf}^2 + \frac{1}{2}m_Y v_{Yf}^2 \\ &= \frac{1}{2}(1,2)(4)^2 + \frac{1}{2}(0,5)(9,6)^2 \quad \checkmark \\ &= 32,64 \text{ J}\end{aligned}$$

$$\sum E_{ki} \neq \sum E_{kf} \quad \checkmark$$

OPTION 2/OPSIE 2 (Change in $E_{k\text{total}}$ total /verandering in $E_{k\text{totaal}}$)

Inelastic/onelasties ✓

$$E_k = \frac{1}{2}mv^2 \quad \checkmark$$

$$\begin{aligned}\Delta E_k(X) &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ &= \frac{1}{2}(1,2)(4)^2 - \frac{1}{2}(1,2)(8)^2 \quad \checkmark \\ &= -28,8 \text{ J}\end{aligned}$$

$$\begin{aligned}\Delta E_k(Y) &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ &= \frac{1}{2}(0,5)(9,6)^2 - \frac{1}{2}(0,5)(0)^2 \quad \checkmark \\ &= 23,04 \text{ J}\end{aligned}$$

$$\Delta E_k(X) \neq \Delta E_k(Y) \quad \checkmark$$

Note/Aantekening:

If candidate starts with conservation of kinetic energy//Indien kandidaat begin met behoud van kinetiese energie: max/maks $\frac{4}{5}$

(5)
[14]

QUESTION 5/VRAAG 5

5.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

A force is non-conservative if the work done by the force on an object (which is moving between two points) depends on the path taken. ✓✓

'n Krag waarvoor die arbeid wat verrig word deur die krag op 'n voorwerp (wat tussen twee punte beweeg,) afhanklik is van die pad wat gevolg word.

OR/OF

A force is non-conservative if the work it does in moving an object around a closed path is non-zero.

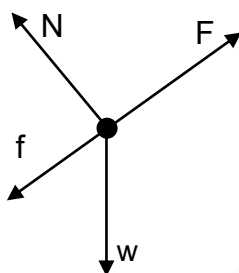
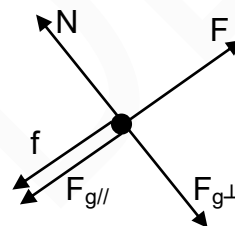
'n Krag is nie-konserwatief wanneer die arbeid wat dit verrig om 'n voorwerp in 'n geslote pad te beweeg, nie nul is nie.

(2)

Note/Aantekening:

-If work done is omitted/ Indien arbeid verrig uitgelaat word: $\frac{0}{2}$

5.2

**OR/OF****Accepted labels/Aanvaarde benoemings**

w	F_w / F_g / mg / 117,6 N / gravitational force / <i>gravitasiekrag</i> / weight / <i>gewig</i>
F	F_A / Applied force / T / <i>Toegepaste krag</i> / F_T
f	F_f / f_k / (kinetic) Friction / (<i>kinetiese</i>) <i>wrywing</i> / F_w
N	F_N / Normal / <i>Normaal</i>

Notes/Aantekeninge:

- Mark awarded for label and arrow./Punt toegeken vir benoeming en pyltjie.
- Do not penalise for length of arrows since drawing is not to scale./Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie.
- If w is not shown but $F_{||}$ and $F_{g\perp}$ are shown, give 1 mark for both./Indien w nie aangetoon is nie maar $F_{||}$ en $F_{g\perp}$ is getoon, ken 1 punt toe vir beide.
- Any other additional force(s)/Enige ander addisionele krag(te):
Max/Maks $\frac{3}{4}$
- If everything is correct, but no arrows/Indien alles korrek is, maar geen pyltjies: Max/Maks $\frac{3}{4}$ •
- If force(s) do not make contact with the dot /Indien krag(te) nie met die kolletjie kontak maak nie: Max/Maks $\frac{3}{4}$

(4)

5.3

OPTION 1/OPSIE 1

$$\begin{aligned}
 W_{nc} &= \Delta E_k + \Delta E_p \\
 W_{nc} &= \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i) \quad \checkmark \text{ Any one/Enige een} \\
 &= \frac{1}{2}(12)(2,25^2 - 0) \checkmark + (12)(9,8)(4,5 - 0) \checkmark \\
 &= 559,58 \text{ J } \checkmark
 \end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned}
 W_{Fg//} &= F_{g//}\Delta x \cos \theta \\
 &= (mg \sin \theta)\Delta x \cos \theta \\
 &= (12)(9,8)\left(\frac{4,5}{\Delta x}\right)\Delta x \cos 180^\circ \\
 &= -529,2 \text{ J}
 \end{aligned}$$

$$\begin{aligned}
 W_{Fg} &= F_g \Delta x \cos(90^\circ + \theta) \\
 &= mg \Delta x (-\sin \theta) \\
 &= (12)(9,8)\left(-\frac{4,5}{\Delta x}\right)\Delta x \\
 &= -529,2 \text{ J}
 \end{aligned}$$

$$W_{net} = \Delta E$$

$$\begin{aligned}
 &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\
 &= \frac{1}{2}(12)(2,25)^2 - 0^2 \checkmark \\
 &= 30,375 \text{ J}
 \end{aligned}$$

$$W_{net} = W_{nc} + W_c \checkmark$$

$$\begin{aligned}
 30,375 &= W_{nc} + (-529,2) \checkmark \\
 W_{nc} &= 559,575 \text{ J } \checkmark \quad (559,58 \text{ J})
 \end{aligned}$$

OPTION 3/OPSIE 3

$$\sin \theta = \frac{4,5}{\Delta x}$$

$$\Delta x = \frac{4,5}{\sin \theta}$$

$$W_{net} = \Delta E_k$$

$$W_F + W_f + W_w = \Delta E_k$$

$$W_{nc} + (mg \sin \theta)\Delta x (\cos \beta) = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

✓ Any one/
Enige een

$$W_{nc} + (12)(9,8)\left(\frac{4,5}{\sin \theta}\right)\sin \theta \cos 180^\circ \checkmark = \frac{1}{2}(12)(2,25)^2 - 0^2 \checkmark$$

$$W_{nc} = 559,58 \text{ J } \checkmark$$

(4)

5.4 **POSITIVE MARKING FROM QUESTION 5.3.**
POSITIEWE NASIEN VANAF VRAAG 5.3.**Marking criteria for OPTION 1 /Nasienkriteria vir OPSIE 1**

- Formula for W_{nc} /Formule vir W_{nc} ✓
- Correct substitution of 559,58 J in W_{nc} along inclined plane ✓
Korrekte vervanging van 559,58 J in W_{nc} langs die skuinsvlak
- Correct force equation and substitution of 0 for F_{net} **OR** $F = f_2$ on horizontal plane ✓
*Korrekte kragvergelyking en vervanging van 0 vir F_{net} **OF** $F = f_2$ op die horisontale vlak.*
- Relating the two frictional forces (substitution of $f_1 + 42$ for f_2). ✓
Bring die twee wrywingskragte in verband (vervanging van $f_1 + 42$ vir f_2).
- Correct answer/Korrekte antwoord: 13,32 m. ✓

OPTION 1/OPSIE 1**ALONG THE INCLINE/AB/TEEN DIE SKUINSVLAK**

$$\left. \begin{aligned} W_{nc} &= W_F + W_f \\ W_{nc} &= F\Delta x \cos 0^\circ + f_1 \Delta x \cos 180^\circ \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$559,58 = F\Delta x \cos 0^\circ + f_1 \Delta x \cos 180^\circ$$

$$559,58 \checkmark = (F - f_1)\Delta x \dots\dots\dots(1)$$

ALONG THE HORIZONTAL/BC/LANGS DIE HORIZONTAL

$$\begin{aligned} F - f_2 &= ma \\ F - f_2 &= 0 \checkmark \end{aligned} \quad \boxed{\text{OR/OF } F = f_2}$$

$$F - (f_1 + 42) \checkmark = 0$$

$$F - f_1 = 42 \dots\dots\dots(2)$$

Substitute/Vervang (2) into/in (1):

$$559,58 = 42\Delta x$$

$$\Delta x = 13,32 \text{ m } \checkmark$$

Marking criteria for OPTION 2 and 3 /Nasienkriteria vir OPSIE 2 en 3

- Correct force equation and substitution of 0 for F_{net} **OR** $F = f_2$ on horizontal plane ✓
*Korrekte kragvergelyking en vervanging van 0 vir F_{net} **OF** $F = f_2$ op die horisontale vlak.*
- Relating the two frictional forces (substitution of $f_1 + 42$ for f_2). ✓
Bring die twee wrywingskragte in verband (vervanging van $f_1 + 42$ vir f_2).
- Formula for W_{nc} **OR** W_{net} /Formule vir W_{nc} **OF** W_{net} ✓
- Correct substitution into equation for W_{nc} **OR** W_{net} on the horizontal plane ✓
*Korrekte vervanging in W_{nc} **OF** W_{net} vergelyking langs die skuinsvlak*
- Correct answer/Korrekte antwoord: 13,32 m. ✓

OPTION 2/OPSIE 2**ALONG THE HORIZONTAL/BC/LANGS DIE HORIZONTAL**

$$\begin{aligned} F - f_2 &= ma \\ F - f_2 &= 0 \checkmark \end{aligned} \quad \boxed{\text{OR/OF } F = f_2}$$

$$F - (f_1 + 42) \checkmark = 0$$

$$F = f_1 + 42$$

ALONG THE INCLINE/AB/TEEN DIE SKUINSVLAK

$$\left. \begin{aligned} W_{nc} &= \Delta E_K + \Delta E_P \\ (F - f_1)\Delta x \cos \theta &= \left[\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \right] + [mgh_f - mgh_i] \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$(f_1 + 42 - f_1)\Delta x \cos 0^\circ = \left[\frac{1}{2}(12)(2,25)^2 - 0^2 \right] + [(12)(9,8)(4,5) - 0] \checkmark$$

$$\Delta x = 13,32 \text{ m } \checkmark (13,32 \text{ m})$$

OPTION 3/OPSIE 3**ALONG THE HORIZONTAL/BC/LANGS DIE HORIZONTAL**

$$F - f_2 = ma$$

$$F - f_2 = 0 \checkmark$$

$$\text{OR/OF } F = f_2$$

$$F - (f_1 + 42) \checkmark = 0$$

$$F = f_1 + 42$$

ALONG THE INCLINE/AB/TEEN DIE SKUINSVLAK

$$W_{\text{net}} = \Delta E_K$$

$$(F - f_1 - F_{g//})\Delta x \cos \theta = \left[\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \right] \quad \left. \vphantom{\begin{matrix} W_{\text{net}} = \Delta E_K \\ (F - f_1 - F_{g//})\Delta x \cos \theta = \left[\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \right] \end{matrix}} \right\} \begin{matrix} \checkmark \text{ Any one/} \\ \text{Enige een} \end{matrix}$$

$$\left[(42) - (12)(9,8) \left(\frac{4,5}{\Delta x} \right) \right] \Delta x \cos 0^\circ = \frac{1}{2}(12)(2,25)^2 \checkmark - 0^2$$

$$\Delta x = 13,323214 \text{ m } \checkmark (13,32 \text{ m})$$

OPTION 4/OPSIE 4

$$W_{\text{nc}} = \Delta E_K + \Delta E_P$$

$$W_{\text{nc}} = \left[\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \right] + [mgh_f - mgh_i]$$

$$\left. \vphantom{\begin{matrix} W_{\text{nc}} = \Delta E_K + \Delta E_P \\ W_{\text{nc}} = \left[\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \right] + [mgh_f - mgh_i] \end{matrix}} \right\} \begin{matrix} \checkmark \text{ Any one/} \\ \text{Enige een} \end{matrix}$$

$$(f_1 + 42 - f_1) \checkmark \Delta x \cos 0^\circ \checkmark = 559,575 \checkmark$$

$$(42) \Delta x \cos 0^\circ = 559,575$$

$$\Delta x = 13,323214 \text{ m } \checkmark (13,32 \text{ m})$$

Marking criteria for OPTION 5/Nasienkriteria vir OPSIE 5

- Correct force equation and substitution of 0 for F_{net} **OR** $F = f_2$ on horizontal plane ✓ / *Korrekte kragvergeliking en vervanging van 0 vir F_{net} **OF** $F = f_2$ op die horisontale vlak.*
- Relating the two frictional forces (substitution of $f_1 + 42$ for f_2). ✓
Bring die twee wrywingskragte in verband (vervanging van $f_1 + 42$ vir f_2).
- Correct substitution to calculate a . / *Korrekte vervanging om a te bereken.* ✓
- Substitution to calculate F_{net} . / *Vervanging om F_{net} te bereken.* ✓
- Correct answer / *Korrekte antwoord:* 13,32 m. ✓

OPTION 5/OPSIE 5**ALONG THE HORIZONTAL/BC/LANGS DIE HORIZONTAL**

$$F - f_2 = ma$$

$$F - f_2 = 0 \checkmark$$

$$\text{OR/OF } F = f_2$$

$$F - (f_1 + 42) \checkmark = 0$$

$$F = f_1 + 42 \dots\dots(1)$$

ALONG THE INCLINE/AB/TEEN DIE SKUINSVLAK

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$2,25^2 = 0 + 2a\Delta x \checkmark$$

$$a = \frac{2,53}{\Delta x}$$

$$F_{\text{net}} = ma$$

$$F - F_{g//} - f_1 = ma$$

$$F - mgsin\theta - f_1 = 12a \dots\dots$$

$$F - (12)(9,8)\sin\theta - f_1 = 12\left(\frac{2,53}{\Delta x}\right) \checkmark \dots\dots(2)$$

Substitute/Vervang (2) into/in (1):

$$42 - (12)(9,8)\left(\frac{4,5}{\Delta x}\right) = 30,38$$

$$\Delta x = 13,32 \text{ m } \checkmark$$

(5)
[15]

QUESTION/VRAAG 6

6.1 Doppler Effect/*Doppler-effek* ✓ (1)

6.2 Measurement of foetal heartbeat./*Meting van die hartklop van 'n fetus.*✓

OR/OF

Measurement of blood flow./*Meting van bloedvloe.* ✓

OR/OF

Doppler flow meter/*Doppler vloeimeter* ✓

(1)

6.3 $f_L \propto f_s$ ✓

OR/OF

Directly (proportional)/Direk (eweredig)

(1)

6.4

Marking criteria/Nasienkriteria

- Doppler formula/Doppler formule ✓
- Correct substitution for v and v_s . /Korrekte vervanging van v en v_s . ✓
- Substitution for $\frac{f}{f_s} = 1,06$ **OR** $f_L = 1,06 f_s$ **OR** any set of values for f_L and f_s so that
 $f_L = 1,06 f_s$ / Vervanging van $\frac{f}{f_s} = 1,06$ **OF** $f_L = 1,06 f_s$ **OF** enige stel waardes vir
 f_L en f_s sodat $f_L = 1,06 f_s$ ✓✓
- Final answer/Finale antwoord: $20,4 \text{ m} \cdot \text{s}^{-1}$ ✓

OPTION 1/OPSIE 1

$$f_L = \frac{v}{v} \frac{v}{v_s} f_s \checkmark \quad \text{OR/OF} \quad f_L = \frac{v + v}{v} f_s$$

$$\frac{f}{f_s} = \frac{v}{v} \frac{v}{v_s}$$

$$1,06 = \frac{340 + v}{340} \checkmark$$

$$v_L = 20,4 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 2/OPSIE 2

$$\text{Gradient} = \frac{0-f}{0-f}$$

$$1,06 = \frac{0-f}{0-f}$$

$$f_L = 1,06 f_s$$

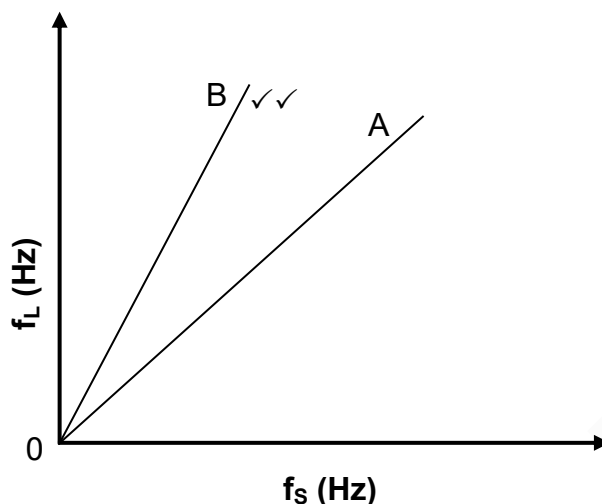
$$f_L = \frac{v}{v} \frac{v}{v_s} f_s \checkmark \quad \text{OR/OF} \quad f_L = \frac{v + v}{v} f_s$$

$$1,06 f_s = \left(\frac{340 + v}{340} \right) f_s \checkmark$$

$$v_L = 20,4 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(5)

6.5

**Marking criteria/Nasienkriteria**Graph is a straight line starting at the origin./
Grafiek is 'n reguitlyn wat by die oorsprong begin.

✓

Gradient of B is greater than gradient of A./
Gradiënt van B is groter as gradiënt van A.

✓

(2)
[10]**QUESTION 7/VRAAG 7**

7.1

Marking criteria/NasienkriteriaIf any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.The magnitude of the electrostatic force exerted by one point charge on another is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance between them. ✓✓Die grootte van die elektrostatiese krag wat een puntlading op 'n ander uitoefen, is direk eweredig aan die produk van die grootte van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.

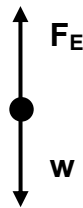
(2)

7.2

Negative/negatief ✓

(1)

7.3

**Accepted labels/Aanvaarde byskrifte**

F_E	$F_{\text{electrostatic}} / F / F_{M \text{ ON } N} / \text{electrostatic force} / F_M$ $F_{\text{elektrostaties}} / F / F_{M \text{ OP } N} / \text{elektrostatiese krag} / F_M$
w	$F_g / w / mg / \text{gravitational force} / F_w / \text{weight} / \text{gravity}$ $F_g / w / mg / \text{gravitasiekrag} / F_w / \text{gewig} / \text{swaartekrag}$

Notes/Aantekeninge:

- Do not penalise for length of arrows./Moenie vir lengte van die pyltjie penaliseer nie.
- Any other additional force(s)/Enige addisionele krag(te): Max/Maks $1/2$
- If arrows are omitted but correctly labelled/Indien pyltjies weggelaat is, maar korrek benoem: Max/Maks $1/2$
- If force(s) do not make contact with the dot /Indien krag(te) nie met die kolletjie kontak maak nie: Max/Maks $1/2$

(2)

7.4

Marking criteria/Nasienkriteria

- Correct substitution to calculate weight of M./Korrekte vervanging om gewig van M te bereken. ✓
- Coulomb's formula/Coulomb se formule ✓
- Substitute/Vervang $F_{\text{net}} = 0 / mg = \frac{\quad}{r^2}$ (equating forces)/
 $0,02 = \frac{\quad}{r^2}$ (equating forces)✓
- Correct substitution into $\frac{\quad}{r^2}$ /Korrekte vervanging in $\frac{\quad}{r}$ ✓
- Correct final answer (accept negative value)/Korrekte finale antwoord (aanvaar negatiewe waarde):
 $2,33 \times 10^{-6} \text{ C}$ to/tot $2,32 \times 10^{-6} \text{ C}$ ✓

$$F_g = mg$$

$$= (2,04 \times 10^{-3})(9,8) \checkmark$$

$$= 0,02 \text{ N}$$

$$F = \frac{\quad}{r^2} \checkmark$$

$$F_{\text{net}} = mg - \frac{\quad}{r^2}$$

$$0 = 0,02 - \frac{(9 \times 10^9)(\quad)(8,6 \times 10^{-8})}{(0,3)^2} \checkmark$$

$$Q_M = 2,33 \times 10^{-6} \text{ C} \checkmark$$

IF/INDIEN:

$$F = \frac{\quad}{r^2} \checkmark$$

$$2,04 \times 10^{-3})(9,8) \checkmark = \frac{(9 \times 10^9)(\quad)(8,6 \times 10^{-8})}{(0,3)^2} \checkmark$$

$$Q_M = 2,33 \times 10^{-6} \text{ C} \checkmark$$

(5)

7.5.1 Equal/Gelyk ✓

OR/OF

Same/Dieselfde

(1)

7.5.2 Opposite **OR** upwards/Teenoorgesteld **OF** opwaarts✓

(1)

7.6 **POSITIVE MARKING FROM QUESTION 7.4.****POSITIEWE NASIEN VANAF VRAAG 7.4.****Marking criteria/Nasienkriteria**

- Formula for E./Formule vir E. ✓
- Correct substitution for M **OR** N./Korrekte vervanging vir M **OF** N. ✓
- Subtraction of $E_M - E_N$ **OR** $E_N - E_M$ /Aftrekking van $E_M - E_N$ **OF** $E_N - E_M$. ✓
- Correct final answer/Korrekte finale antwoord:
 $5,31 \times 10^4 \text{ N}\cdot\text{C}^{-1}$ to/tot $5,37 \times 10^4 \text{ N}\cdot\text{C}^{-1}$ ✓
- Correct direction/Korrekte rigting: upwards/opwaarts ✓

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:

$$E = \frac{1}{r^2} \checkmark$$

$$E_{\text{net}} = \left(\frac{(9 \times 10^9)(2,33 \times 10^{-6})}{(0,4)^2} \right) - \left(\frac{(9 \times 10^9)(8,6 \times 10^{-8})}{(0,1)^2} \right) \checkmark$$

$$E_{\text{net}} = 131\,062,5 - 77\,400 \\ = 53\,662,5 \text{ N}\cdot\text{C}^{-1} \checkmark (5,36 \times 10^4 \text{ N}\cdot\text{C}^{-1}) \text{ upwards/towards M} \\ \text{opwaarts/na M} \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

$$E_{\text{net}} = \frac{1}{r^2} \checkmark$$

$$E_{\text{net}} = \left(\frac{(9 \times 10^9)(8,6 \times 10^{-8})}{(0,1)^2} \right) - \left(\frac{(9 \times 10^9)(2,33 \times 10^{-6})}{(0,4)^2} \right) \checkmark$$

$$E_{\text{net}} = 77\,400 - 131\,062,5 \\ = -5,37 \times 10^4 \text{ N}\cdot\text{C}^{-1} \\ \therefore E_{\text{net}} = 53\,662,5 \text{ N}\cdot\text{C}^{-1} \checkmark (5,36 \times 10^4 \text{ N}\cdot\text{C}^{-1}) \text{ upwards/towards M} \\ \text{opwaarts/na M} \checkmark$$

(5)
[17]

QUESTION 8/VRAAG 8

8.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature (provided temperature and all other physical conditions are constant). ✓✓

Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur (mits temperatuur en alle fisiese toestande konstant bly).

OR/OF

The ratio of potential difference to current is constant at constant temperature.
Die verhouding van potensiaalverskil tot stroom is konstant by konstante temperatuur.

OR/OF

The current in a conductor is directly proportional to the potential difference across the conductor at constant temperature (provided temperature and all other physical conditions are constant).

Die stroom in 'n geleier is direk eweredig aan die potensiaalverskil oor 'n geleier by konstante temperatuur (mits temperatuur en alle fisiese toestande konstant bly).

(2)

NOTE/LET WEL

Do not award the mark for addition of 4 if any other value is added to R_p / Moenie die punt vir bytel van 4 toeken indien enige ander waarde by R_p bygetel word nie.

8.2.1

OPTION 1/OPSIE 1

$$\frac{1}{p} = \frac{1}{1} + \frac{1}{2} \checkmark$$

$$\frac{1}{p} = \frac{1}{1} + \frac{1}{5} \checkmark$$

$$R_p = 0,83 \, \Omega$$

$$R_T = 0,83 + 4 \checkmark$$

$$= 4,83 \, \Omega \checkmark$$

OPTION2/OPSIE2

$$R_p = \frac{1 \cdot 2}{1 + 2} \checkmark$$

$$R_p = \frac{(1)(5)}{1 + 5} \checkmark$$

$$R_p = 0,83 \, \Omega$$

$$R_T = 0,83 + 4 \checkmark$$

$$= 4,83 \, \Omega \checkmark$$

(4)

8.2.2 **POSITIVE MARKING FROM QUESTION 8.2.1.**
POSITIEWE NASIEN VANAF VRAAG 8.2.1.**OPTION 1/OPSIE 1**

$$R = \frac{V}{I} \checkmark$$

$$4,83 = \frac{V}{3,5} \checkmark$$

$$V = 16,91 \text{ V} \checkmark \quad (16,92 \text{ V})$$

OPTION 2/OPSIE 2

$$R_p = \frac{2}{\quad} \checkmark$$

$$0,83 = \frac{V}{3,5} \checkmark$$

$$V_2 = 2,91 \text{ V}$$

$$R_{4\Omega} = \frac{4\Omega}{\quad}$$

✓ Any one/Enige een

$$4 = \frac{4\Omega}{3,5} \checkmark$$

$$V_{4\Omega} = 14 \text{ V}$$

$$V_1 = V_2 + V_{4\Omega}$$

$$V_1 = 2,91 + 14$$

$$= 16,91 \text{ V} \checkmark \quad (16,92 \text{ V})$$

(3)

8.2.3 Smaller than/Kleiner as ✓

(1)

8.3.1 **Marking criteria/Nasienkriteria**

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

Maximum work done by the battery per unit charge. ✓✓

Maksimum arbeid verrig deur die battery per eenheidslading.

OR/OF

Maximum energy supplied by the battery per unit charge.

Maksimum energie verskaf deur die battery per eenheidslading.

OR/OF

The total amount of electric energy supplied by the battery per coulomb/per unit charge.

Die totale hoeveelheid elektriese energie verskaf deur die battery per coulomb/per eenheidslading.

(2)

8.3.2 No/Nee ✓

(1)

- 8.3.3 The battery has internal resistance. ✓
Die battery het interne weerstand.

OR/OF

Some energy per coulomb of charge/volts is used to overcome internal resistance.

'n Gedeelte van die energie per coulomb lading/volts word gebruik om interne weerstand te oorkom.

OR/OF

There is a potential drop/lost volts inside the battery.

Daar is 'n potensiaalval/verlore volts binne-in die battery.

OR/OF

$$\mathcal{E} = V_{\text{ext}} + V_{\text{int}}$$

OR/OF

$$\mathcal{E} > V_{\text{ext}}$$

(1)

- 8.4.1 Decreases/*Verlaag* ✓

(1)

- 8.4.2 Increases/*Verhoog* ✓

(1)

- 8.5 When the voltmeter is connected:

- No/very little current through the 1 Ω branch **OR** Branch with 1 Ω resistor is disabled/bypassed **OR** A voltmeter has a very high resistance **OR** The resistance of the parallel branch increases. ✓
- (Total) resistance of the circuit increases. ✓
- Current in circuit decreases. ✓
- V_{internal} / Internal volts/ V_{lost} decreases. ✓

Therefore, external volts increase for a constant emf.

Wanneer die voltmeter geskakel word:

- *Geen/baie min stroom deur die 1 Ω -tak **OF** Ta m et 1 Ω -weerstand is uitgeskakel **OF** Voltmeter het baie hoë weerstand **OF** Die weerstand van die parallelle tak neem toe.*
- *(Totale) weerstand van die stroombaan neem toe.*
- *Stroom in stroombaan neem af.*
- *V_{intern} / Interne volts/ V_{verlore} neem af.*

Dus neem die eksterne volts toe vir konstante emf.

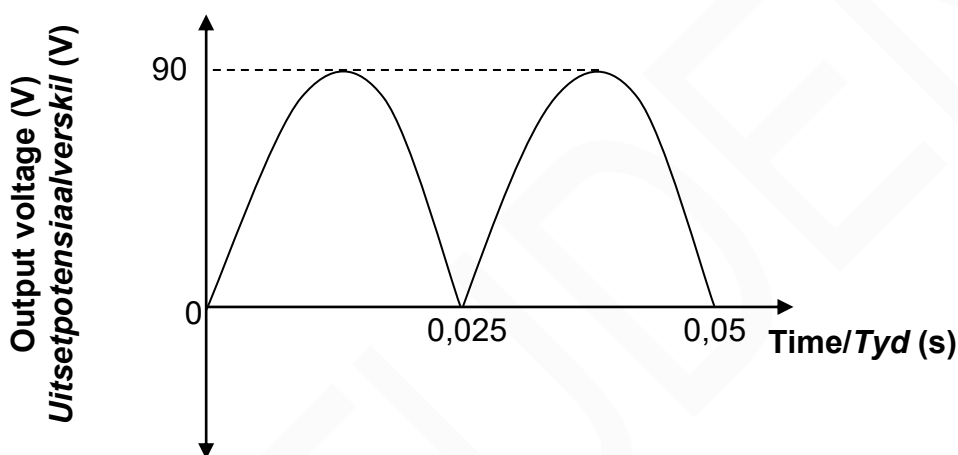
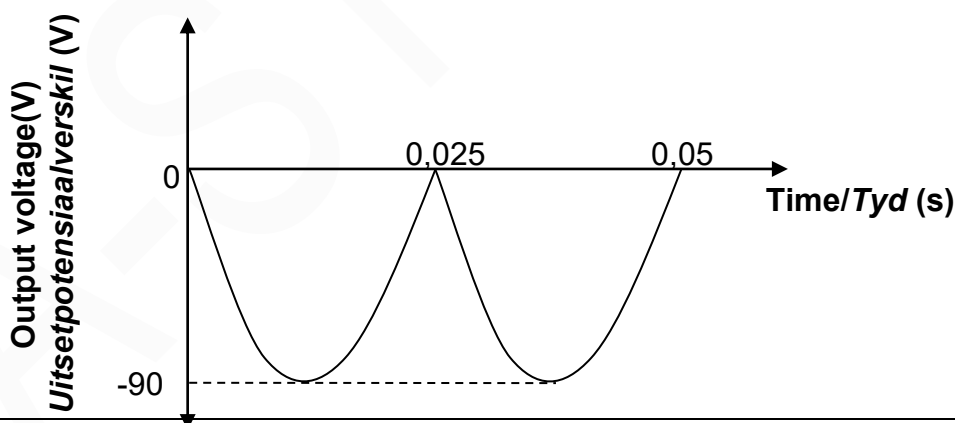
(4)

[20]

QUESTION 9/VRAAG 99.1.1 Split ring/commutator/*Splitring/kommutator* ✓ (1)9.1.2 **Y to/na X OR/OF** 0 /no current/*geen stroom nie* ✓ (1)

9.1.3 $T = \frac{1}{f}$
 $T = \frac{1}{20}$
 $T = 0,05 \text{ s}$ ✓ (1)

9.1.4 **POSITIVE MARKING FROM QUESTION 9.1.3.**
POSITIEWE NASIEN VANAF VRAAG 9.1.3.

**OR/OF**

Criteria for graph/Kriteria vir grafiek	
Correct shape with one full cycle./Korrekte vorm met 1 volledige siklus.	✓
Curve starts at zero to first peak./Kurwe begin by nulpunt tot eerste piek.	✓
Any one of the correct time values at the correct position./Enige een van die korrekte tyd waardes op die korrekte posisie.	✓
Maximum voltage of 90 V OR -90 V/ Maksimum potensiaalverskil van 90 V OF -90 V	✓
NOTE/LET WEL:	
- 1 mark for half cycle/incomplete cycle or more than one cycle - 1 punt vir halwe siklus/onvoltooide siklus of meer as een siklus	

(4)

9.2

Marking criteria/Nasienkriteria

- Formula to calculate W_{ave} (do not penalise if subscripts are omitted)./
Formule om W_{gem} te bereken (moenie penaliseer indien onderskrifte uitgelaat is nie). ✓
- Substitution of 220 and 32 in correct equation. ✓
Vervanging van 220 en 32 in die korrekte vergelyking.
- Substitution of 120 for Δt /Vervanging van 120 in Δt . ✓
- Correct answer in range: 181 500 J to 181 764 J ✓
Korrekte antwoord in gebied: 181 500 J tot 181 764 J ✓

OPTION 1/OPSIE 1

$$W_{\text{ave}} = \frac{V_{\text{rms}}^2 \Delta t}{R} \checkmark$$

$$= \frac{220^2 (120)}{32} \checkmark$$

$$= 181\,500 \text{ J} \checkmark$$

OPTION 2/OPSIE 2

$$R = \frac{V_{\text{rms}}}{I_{\text{rms}}} \checkmark$$

$$32 = \frac{220}{I_{\text{rms}}} \checkmark$$

$$I_{\text{rms}} = 6,88 \text{ A} \quad (6,875 \text{ A})$$

$$W_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \Delta t \checkmark$$

$$= (220)(6,88)(120) \checkmark$$

$$= 181\,632 \text{ J} \checkmark$$

OR/OF

$$W_{\text{ave}} = I_{\text{rms}}^2 R \Delta t \checkmark$$

$$= (6,88)^2 (32)(120) \checkmark$$

$$= 181\,764,10 \text{ J} \checkmark$$

OPTION 3/OPSIE 3

$$R = \frac{V_{\text{rms}}}{I_{\text{rms}}} \checkmark$$

$$32 = \frac{220}{I_{\text{rms}}} \checkmark$$

$$I_{\text{rms}} = 6,88 \text{ A} \quad (6,875 \text{ A})$$

$$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$$

$$= (220)(6,88) \checkmark$$

$$= 1\,513,6 \text{ W} \quad (1,51 \times 10^3 \text{ W})$$

$$P_{\text{ave}} = I_{\text{rms}}^2 R \checkmark$$

$$= (6,88)^2 (32) \checkmark$$

$$= 1\,514,7 \text{ W} \quad (1\,512,5 \text{ W})$$

$$(1,51 \times 10^3 \text{ W})$$

OPTION 4/OPSIE 4

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark$$

$$P_{\text{ave}} = \frac{220^2}{32} \checkmark$$

$$P_{\text{ave}} = 1\,512,5 \text{ W} \quad (1,51 \times 10^3 \text{ W})$$

$$P = \frac{W}{\Delta t} \checkmark$$

$$1\,513,6 = \frac{W}{120} \checkmark$$

$$W = 181\,632 \text{ J} \checkmark \quad (1,82 \times 10^5 \text{ J})$$

(4)
[11]

QUESTION 10/VRAAG 10

- 10.1 Light has a particle nature/is quantized ✓
Lig het 'n deeltjie geaardheid/is gekwantiseerd (1)

- 10.2 **Marking criteria/Nasienkriteria**
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The minimum energy (of incident photons) that can eject electrons from a metal/surface. ✓✓

Die minimum energie (van invallende fotone) wat elektrone kan vrystel vanuit 'n metaal/oppervlak. (2)

- 10.3
- $$\left. \begin{aligned} E &= W_0 + E_{k(\max)} \\ hf &= hf_0 + E_{k(\max)} \\ hf &= hf_0 + \frac{1}{2}mv_{\max}^2 \\ E &= W_0 + \frac{1}{2}mv_{\max}^2 \end{aligned} \right\} \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array}$$

$$\frac{(6,63 \times 10^{-34})(5,96 \times 10^{14})}{E_{k(\max)}} \checkmark = \frac{3,42 \times 10^{-19} + E_{k(\max)}}{E_{k(\max)}} \checkmark$$

$$E_{k(\max)} = 5,30 \times 10^{-20} \text{ J } \checkmark \quad (5,32 \times 10^{-20} \text{ J})$$
- (4)

- 10.4 $q = I\Delta t$
 $= (0,012)(10) \checkmark$
 $= 0,12 \text{ C}$
 $n = \frac{q}{e}$
 $n = \frac{0,12 \checkmark}{1,6 \times 10^{-19} \checkmark}$
 $n = 7,5 \times 10^{17} \text{ (electrons/elektrone)}$
 number of photons/aantal fotone = $n = 7,5 \times 10^{17} \checkmark$ (4)

- 10.5 Increases/Verhoog ✓
More photons strike the surface of the metal per unit time/ at a higher rate ✓ hence more (photo) electrons ejected per unit time ✓ (resulting in increased current).
Meer fotone tref die oppervlak van die metaal per eenheidstyd/ teen 'n hoër tempo, gevolglik word meer (foto) elektrone per eenheidstyd vrystel (wat tot 'n verhoogde stroom lei). (3)

[14]**TOTAL/TOTAAL: 150**



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS
SENIORSERTIFIKAAT-EKSAMEN/
NASIONALE SENIORSERTIFIKAAT-EKSAMEN**

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

2022

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 28 pages./
Hierdie nasienriglyne bestaan uit 28 bladsye.**

QUESTION 1/VRAAG 1

- 1.1 B ✓✓ (2)
- 1.2 B ✓✓ (2)
- 1.3 B ✓✓ (2)
- 1.4 A ✓✓ (2)
- 1.5 D ✓✓ (2)
- 1.6 C ✓✓ (2)
- 1.7 D ✓✓ (2)
- 1.8 D ✓✓ (2)
- 1.9 A ✓✓ (2)
- 1.10 C ✓✓ (2)
- [20]**

QUESTION 2/VRAAG 2

2.1

Marking criteria/Nasienkriteria:

If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.

Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -
1 punt per word/frase.

A body will remain in its state of rest or motion at constant velocity unless a (non-zero) resultant/net force/unbalanced force acts on it. ✓✓

'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid volhard, tensy 'n (nie-nul) resulterende/netto krag/ongebalanseerde krag daarop inwerk.

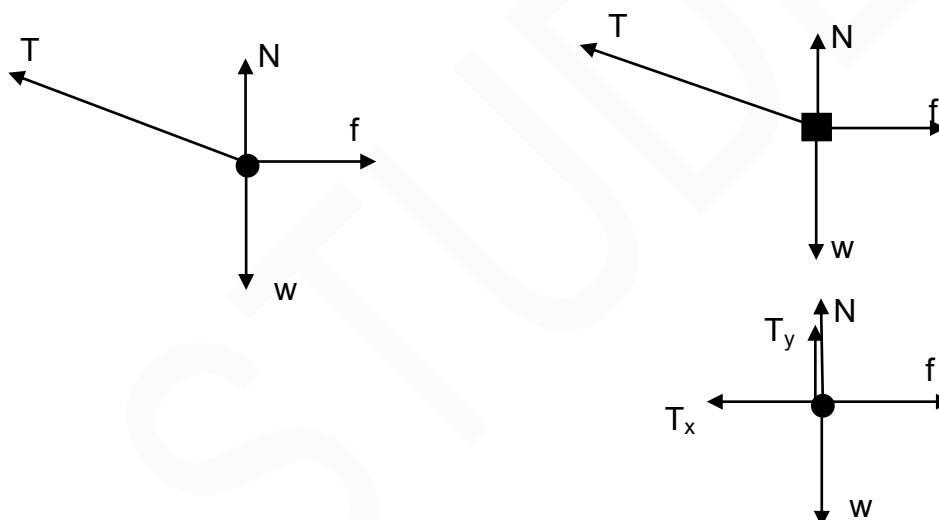
OR/OF

A body will remain in its state of rest or uniform motion in a straight line unless a (non-zero) resultant/net force acts on it. ✓✓

'n Liggaam sal in sy toestand rus of uniforme beweging in 'n reguit lyn volhard, tensy 'n (nie-nul) resulterende/netto krag daarop inwerk.

(2)

2.2

ACCEPT/AANVAAR

	Accepted symbols/Aanvaarde simbole
N ✓	F_N / Normal / Normal force / Normaal / Normaalkrag / F_{buoyant}
f ✓	F_f / f_k / frictional force / wrywingskrag / kinetic frictional force / kinetiese wrywingskrag / 300 N
w ✓	F_g / mg / Weight / Gewig / $F_{\text{Earth on man}}$ / $F_{\text{Aarde op man}}$ / F_w / Gravitational force / Gravitatiekrag / 686 N
T ✓	Tension / Spanning / F_{Tension} / F_{Spanning} / F_T / F_S / ACCEPT/ AANVAAR F / F_{applied} / F_{toegepas}
Notes/Aantekeninge - Mark is awarded for label and arrow. / Punt word toegeken vir byskrif en pyltjie. - Do not penalise for length of arrows. / Moenie vir die lengte van die pyltjies penaliseer nie. - Deduct 1 mark for any additional force / Trek 1 punt af vir enige addisionele krag - If T is not shown but T_y and T_x are shown give 1 mark for both. Indien T nie aangetoon is nie maar T_y en T_x is getoon, ken 1 punt toe vir beide.	

(4)

2.3

OPTION 1/OPSIE 1

$$F_{\text{net}} = ma$$

$$T \cos 50^\circ - F_f = ma \quad \left. \vphantom{\begin{matrix} F_{\text{net}} = ma \\ T \cos 50^\circ - F_f = ma \end{matrix}} \right\} \checkmark \text{ Any one/Enige een}$$

$$T \cos 50^\circ - 300 \checkmark = 0 \checkmark \quad \text{OR/OF} \quad T \cos 50^\circ = 300 \checkmark \checkmark$$

$$T = 466,72 \text{ N} \checkmark (468,75 \text{ N})$$

OR/OF

$$F_{\text{net}} = 0 \checkmark \checkmark$$

$$T \cos 50^\circ = F_f \checkmark \checkmark$$

OPTION 2/OPSIE 2

$$W_{\text{net}} = \Delta E_k \checkmark$$

$$T \Delta x \cos 0^\circ + f \Delta x \cos 180^\circ = 0 \checkmark$$

$$T \cos 50^\circ - 300 \checkmark = 0$$

$$T = 466,72 \text{ N} \checkmark (468,75 \text{ N})$$

OR/OF

$$W_{\text{net}} = 0 \checkmark \checkmark$$

$$T \Delta x \cos 50^\circ = -f \Delta x \cos 180^\circ \checkmark \checkmark$$

NOTE/AANTEKENINGCan use $\sin 40^\circ$ instead of $\cos 50^\circ$.Kan ook $\sin 40^\circ$ i.p.v. $\cos 50^\circ$ gebruik.

(4)

2.4

Increases/Neem toe $\checkmark$ F_{net} increases / F_{net} is not zero / $T_x > f$ / $T \cos 50^\circ > f \checkmark$ F_{net} neem toe / F_{net} is nie nul nie / $T_x > f$ / $T \cos 50^\circ > f$

(2)

2.5

Marking criteria Options 1 & 2/Nasienkriteria Opsies 1 & 2

- Substitution to calculate a/Vervanging om a te bereken $\checkmark$
- Formula to calculate $F_{\text{up/water}}$ /Formule om $F_{\text{op/water}}$ te bereken $\checkmark$
- Substitution to calculate $F_{\text{up/water}}$ /Vervanging om $F_{\text{op/water}}$ te bereken $\checkmark \checkmark$
- Final answer/Finale antwoord: 679,20 N $\checkmark$

OPTION 1/OPSIE 1**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF:**

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$0 = (16)^2 + 2a(0,8) \checkmark$$

$$a = -160 \text{ m}\cdot\text{s}^{-2}$$

$$F_{\text{net}} = ma$$

$$F_g - F_{\text{up/op}} = ma \quad \left. \vphantom{\begin{matrix} F_{\text{net}} = ma \\ F_g - F_{\text{up/op}} = ma \end{matrix}} \right\} \checkmark \text{ Any one/Enige een}$$

$$(4)(9,8) - F_{\text{up/op}} \checkmark = (4)(-160) \checkmark$$

$$F_{\text{up/op}} = -679,20 \text{ N}$$

$$F_{\text{up/op}} = 679,20 \text{ N} \checkmark$$

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$0 = (-16)^2 + 2a(-0,8) \checkmark$$

$$a = 160 \text{ m}\cdot\text{s}^{-2}$$

$$F_{\text{net}} = ma$$

$$-F_g + F_{\text{up/op}} = ma \quad \left. \vphantom{\begin{matrix} F_{\text{net}} = ma \\ -F_g + F_{\text{up/op}} = ma \end{matrix}} \right\} \checkmark \text{ Any one/Enige een}$$

$$-(4)(9,8) + F_{\text{up/op}} \checkmark = (4)(160) \checkmark$$

$$F_{\text{up/op}} = 679,20 \text{ N} \checkmark$$

OPTION 2/OPSIE 2**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$0,8 = \left(\frac{16 + 0}{2} \right) \Delta t$$

$$\Delta t = 0,1 \text{ s}$$

$$v_f = v_i + a\Delta t$$

$$0 = 16 + a(0,1) \checkmark$$

$$a = -160 \text{ m}\cdot\text{s}^{-2}$$

OR/OF

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$0,8 = (16)(0,1) + \frac{1}{2}(a)(0,1)^2 \checkmark$$

$$a = -160 \text{ m}\cdot\text{s}^{-2}$$

$$F_{\text{net}} = ma$$

$$F_g - F_{\text{up/op}} = ma \checkmark \text{ Any one/Enige een}$$

$$(4)(9,8) - F_{\text{up/op}} \checkmark = (4)(-160) \checkmark$$

$$F_{\text{up/op}} = -679,20 \text{ N}$$

$$F_{\text{up/op}} = 679,20 \text{ N} \checkmark$$

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$-0,8 = \left(\frac{-16 + 0}{2} \right) \Delta t$$

$$\Delta t = 0,1 \text{ s}$$

$$v_f = v_i + a\Delta t$$

$$0 = -16 + a(0,1) \checkmark$$

$$a = 160 \text{ m}\cdot\text{s}^{-2}$$

OR/OF

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-0,8 = (-16)(0,1) + \frac{1}{2}(a)(0,1)^2 \checkmark$$

$$a = 160 \text{ m}\cdot\text{s}^{-2}$$

$$F_{\text{net}} = ma$$

$$-F_g + F_{\text{up/op}} = ma \checkmark \text{ Any one/Enige een}$$

$$-(4)(9,8) + F_{\text{up/op}} \checkmark = (4)(160) \checkmark$$

$$F_{\text{up/op}} = 679,20 \text{ N} \checkmark$$

USING ENERGY PRINCIPLES/GEbruik VAN ENERGIE BEGINSELS**Marking criteria OPTIONS 3 to 5/Nasienkriteria OPSIES 3 to 5**

- Formula / Formule $\checkmark$
- Substitution / Vervanging $\checkmark\checkmark\checkmark$
- Final answer/Finale antwoord: 679,20 N $\checkmark$

OPTION 3/OPSIE 3

$$W_{\text{net}} = \Delta K$$

$$F_{\text{net}} \Delta x \cos \theta = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \checkmark \text{ Any one/Enige een}$$

$$(4)(9,8)(0,8) \cos 0^\circ \checkmark + F_{\text{up/op}}(0,8) \cos 180^\circ \checkmark = \frac{1}{2}(4)(0 - 16^2) \checkmark$$

$$F_{\text{up/op}} = 679,20 \text{ N} \checkmark$$

OPTION 4/OPSIE 4

$$W_{\text{nc}} = \Delta K + \Delta U$$

$$F_{\text{up/op}} \Delta x \cos \theta = \frac{1}{2} m (v_f^2 - v_i^2) + mg(h_f - h_i) \checkmark \text{ Any one/Enige een}$$

$$F_{\text{up/op}}(0,8) \cos 180^\circ \checkmark = \frac{1}{2}(4)(0 - 16^2) \checkmark + (4)(9,8)(0 - 0,8) \checkmark$$

$$F_{\text{up/op}} = 679,20 \text{ N} \checkmark$$

OPTION 5/OPSIE 5

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$0,8 = \left(\frac{16 + 0}{2} \right) \Delta t$$

$$\Delta t = 0,1 \text{ s}$$

$$F_{\text{net}} \Delta t = \Delta p$$

$$F_{\text{net}} \Delta t = (p_{\text{tube/band}})_f - (p_{\text{tube/band}})_i$$

$$(F_g - F_{\text{up/op}}) \Delta t = m(v_{\text{tube/band}(f)} - v_{\text{tube/band}(i)})$$

$$[(4)(9,8) \checkmark - F_{\text{up/op}}](0,1) \checkmark = (4)(0 - 16) \checkmark$$

$$F_{\text{up/op}} = 679,20 \text{ N} \checkmark$$

✓ Any one/Enige een

(5)
[17]

QUESTION 3/VRAAG 3

3.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.

Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -
1 punt per word/frase.

An object which has been given an initial velocity and then it moves under the influence of the gravitational force only/ is in free fall. ✓✓

'n Voorwerp waaraan 'n beginsnelheid gegee is en wat dan slegs onder die invloed van die gravitasiekrag beweeg/in vryval is.

(2)

3.2.1

OPTION 1/ OPSIE 1

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$0 = 15 + (-9,8)\Delta t \quad \checkmark$$

$$\Delta t = 1,53 \text{ s} \quad \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$0 = -15 + (9,8)\Delta t \quad \checkmark$$

$$\Delta t = 1,53 \text{ s} \quad \checkmark$$

OPTION 2/ OPSIE 2

**Motion from top/Beweging van bo
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$-15 = 0 + (-9,8)\Delta t \quad \checkmark$$

$$\Delta t = 1,53 \text{ s} \quad \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$15 = 0 + (9,8)\Delta t \quad \checkmark$$

$$\Delta t = 1,53 \text{ s} \quad \checkmark$$

OPTION 3/ OPSIE 3

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$-15 = 15 + (-9,8)\Delta t \quad \checkmark$$

$$\Delta t = 3,06 \text{ s}$$

$$\Delta t_{\text{up}} = 1,53 \text{ s} \quad \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$15 = -15 + (9,8)\Delta t \quad \checkmark$$

$$\Delta t = 3,06 \text{ s}$$

$$\Delta t_{\text{up}} = 1,53 \text{ s} \quad \checkmark$$

OPTION 4/ OPSIE 4

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad \checkmark$$

$$0 = (15)\Delta t + \frac{1}{2}(-9,8)\Delta t^2 \quad \checkmark$$

$$\Delta t = 3,06 \text{ s}$$

$$\Delta t_{\text{up}} = 1,53 \text{ s} \quad \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad \checkmark$$

$$0 = (-15)\Delta t + \frac{1}{2}(9,8)\Delta t^2 \quad \checkmark$$

$$\Delta t = 3,06 \text{ s}$$

$$\Delta t_{\text{up}} = 1,53 \text{ s} \quad \checkmark$$

(3)

Marking criteria OPTIONS 5 to 7/Nasienkriteria OPSIES 5 tot 7

- Any formula relating Δy and Δt / **OR/OF** $F_{\text{net}}\Delta t = m\Delta v$ ✓
- Substitution to calculate Δt / *Vervanging om Δt te bereken* ✓
- Final answer/*finale antwoord*: 1,53 s ✓

OPTION 5/OPSIE 5

$$\begin{aligned}(E_{\text{mech}})_{\text{Top/Bo}} &= (E_{\text{mech}})_{30\text{ m}} \\ (E_P + E_K)_{\text{Top/Bo}} &= (E_P + E_K)_{30\text{ m}} \\ (mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}} &= (mgh + \frac{1}{2}mv^2)_{30\text{ m}} \\ (9,8)h + 0 &= 0 + (\frac{1}{2})(15)^2 \\ \Delta h &= 11,48\text{ m}\end{aligned}$$

OPTION 6/OPSIE 6

$$\begin{aligned}W_{\text{nc}} &= \Delta K + \Delta U \\ W_{\text{nc}} &= \Delta K + mg(h_f - h_i) \\ 0 &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i \\ 0 &= \frac{1}{2}(0 - 15^2) + (9,8)\Delta h \\ \Delta h &= 11,48\text{ m}\end{aligned}$$

OPTION 7/OPSIE 7

$$\begin{aligned}W_{\text{net}} &= \Delta E_k \\ w\Delta y \cos\theta &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ (9,8)\Delta y \cos 180^\circ &= 0 - \frac{1}{2}(15)^2 \\ \Delta y &= 11,48\text{ m}\end{aligned}$$

OPTION A/OPSIE A**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$\begin{aligned}\Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark \\ 11,48 &= (15)\Delta t + \frac{1}{2}(-9,8)\Delta t^2 \checkmark \\ \Delta t &= 1,53\text{ s} \checkmark\end{aligned}$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$\begin{aligned}\Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark \\ 11,48 &= (-15)\Delta t + \frac{1}{2}(9,8)\Delta t^2 \checkmark \\ \Delta t &= 1,53\text{ s} \checkmark\end{aligned}$$

OPTION B/OPSIE B

$$\begin{aligned}\Delta y &= \left(\frac{v_i + v_f}{2}\right)\Delta t \checkmark \\ 11,48 &= \left(\frac{15 + 0}{2}\right)\Delta t \checkmark \\ \Delta t &= 1,53\text{ s} \checkmark\end{aligned}$$

OPTION 8/OPSIE 8**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$\begin{aligned}\Delta y &= \left(\frac{v_i + v_f}{2}\right)\Delta t \checkmark \\ \Delta y &= \left(\frac{15 + 0}{2}\right)\Delta t \\ \Delta y &= 7,5\Delta t\end{aligned}$$

$$\begin{aligned}v_f^2 &= v_i^2 + 2a\Delta y \\ 0 &= (15)^2 + 2(-9,8)(7,5\Delta t) \checkmark \\ \Delta t &= 1,53\text{ s} \checkmark\end{aligned}$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$\begin{aligned}\Delta y &= \left(\frac{v_i + v_f}{2}\right)\Delta t \\ \Delta y &= \left(\frac{-15 + 0}{2}\right)\Delta t \\ \Delta y &= -7,5\Delta t \\ v_f^2 &= v_i^2 + 2a\Delta y \checkmark \\ 0 &= (-15)^2 + 2(9,8)(-7,5\Delta t) \checkmark \\ \Delta t &= 1,53\text{ s} \checkmark\end{aligned}$$

OPTION 9/OPSIE 9**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$\begin{aligned}F_{\text{net}}\Delta t &= m\Delta v \\ F_{\text{net}}\Delta t &= m(v_f - v_i) \quad \left. \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array} \right\} \\ -(9,8)\Delta t &= 0 - 15 \checkmark \\ \Delta t &= 1,53\text{ s} \checkmark\end{aligned}$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$\begin{aligned}F_{\text{net}}\Delta t &= m\Delta v \\ F_{\text{net}}\Delta t &= m(v_f - v_i) \quad \left. \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array} \right\} \\ (9,8)\Delta t &= 15 - 0 \checkmark \\ \Delta t &= 1,53\text{ s} \checkmark\end{aligned}$$

(3)

3.2.2

POSITIVE MARKING FROM QUESTION 3.2.1/**POSITIEWE NASIEN VANAF VRAAG 3.2.1****Marking criteria/Nasienkriteria**

- Formula to calculate Δy /Formule om Δy te bereken ✓
- Substitution to calculate Δy /Vervanging om Δy te bereken ✓
- Substitution of/Vervanging van 30 m ✓
- Final answer/Finale antwoord: 41,48 m ✓

NOTE/AANTEKENING v_f and v_i can be swapped v_f en v_i kan omgeruil word**OPTION 1/OPSIE 1****UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= \frac{(15)(1,53) + \frac{1}{2}(-9,8)(1,53)^2}{\checkmark}$$

$$= 11,48 \text{ m}$$

$$\text{Height/hoogte} = 11,48 + 30 \checkmark$$

$$= 41,48 \text{ m} \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= \frac{(-15)(1,53) + \frac{1}{2}(9,8)(1,53)^2}{\checkmark}$$

$$= -11,48 \text{ m}$$

$$\text{Height/Hoogte} = 11,48 + 30 \checkmark$$

$$= 41,48 \text{ m} \checkmark$$

OPTION 2/OPSIE 2**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0 = (15)^2 + (2)(-9,8)\Delta y \checkmark$$

$$\Delta y = 11,48 \text{ m}$$

$$\text{Height/hoogte} = 11,48 + 30 \checkmark$$

$$= 41,48 \text{ m} \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0 = (-15)^2 + (2)(9,8)\Delta y \checkmark$$

$$\Delta y = -11,48 \text{ m}$$

$$\text{Height/Hoogte} = 11,48 + 30 \checkmark$$

$$= 41,48 \text{ m} \checkmark$$

OPTION 3/OPSIE 3**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$\Delta y = \left(\frac{15 + 0}{2} \right) (1,53) \checkmark$$

$$= 11,48 \text{ m}$$

$$\text{Height/Hoogte} = 11,48 + 30 \checkmark$$

$$= 41,48 \text{ m} \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$\Delta y = \left(\frac{-15 + 0}{2} \right) (1,53) \checkmark$$

$$= -11,48 \text{ m}$$

$$\text{Height/Hoogte} = 11,48 + 30 \checkmark$$

$$= 41,48 \text{ m} \checkmark$$

OPTION 4/OPSIE 4**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$v_f^2 = (-15)^2 + (2)(-9,8)(-30) \checkmark$$

$$v_f = -28,51 \text{ m} \cdot \text{s}^{-1}$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$(-28,51)^2 = (0)^2 + (2)(-9,8)\Delta y \checkmark$$

$$\Delta y = 41,48 \text{ m}$$

$$\text{Height/Hoogte} = 41,48 \text{ m} \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$v_f^2 = (15)^2 + (2)(9,8)(30) \checkmark$$

$$v_f = 28,51 \text{ m} \cdot \text{s}^{-1}$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$(28,51)^2 = (0)^2 + (2)(9,8)\Delta y \checkmark$$

$$\Delta y = 41,48 \text{ m}$$

$$\text{Height/Hoogte} = 41,48 \text{ m} \checkmark$$

OPTION 5/ OPSIE 5

$$\begin{aligned} (E_{\text{mech}})_{\text{Top/Bo}} &= (E_{\text{mech}})_{30\text{ m}} \\ (E_P + E_K)_{\text{Top/Bo}} &= (E_P + E_K)_{30\text{ m}} \\ (mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}} &= (mgh + \frac{1}{2}mv^2)_{30\text{ m}} \end{aligned} \quad \left. \vphantom{\begin{aligned} (E_{\text{mech}})_{\text{Top/Bo}} &= (E_{\text{mech}})_{30\text{ m}} \\ (E_P + E_K)_{\text{Top/Bo}} &= (E_P + E_K)_{30\text{ m}} \\ (mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}} &= (mgh + \frac{1}{2}mv^2)_{30\text{ m}} \end{aligned}} \right\} \checkmark \text{Any one/Enige een}$$

$$(9,8)h + 0 = (9,8)(30\checkmark) + (\frac{1}{2})(15)^2 \checkmark$$

$$h = 41,48\text{ m} \checkmark$$

OPTION 6/OPSIE 6

$$W_{\text{net}} = \Delta E_K \quad \left. \vphantom{W_{\text{net}} = \Delta E_K} \right\} \checkmark \text{Any one/Enige een}$$

$$w\Delta x \cos 180^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$(9,8)(\Delta x) \cos 180^\circ = \frac{1}{2}(0 - 15^2) \checkmark$$

$$\Delta x = 11,47\text{ m}$$

Height above the ground/hoogte bokant grond = $30 + \checkmark 11,47 = 41,48\text{ m} \checkmark$

OPTION 7/OPSIE 7

$$W_{\text{nc}} = \Delta E_P + \Delta E_K \quad \left. \vphantom{W_{\text{nc}} = \Delta E_P + \Delta E_K} \right\} \checkmark \text{Any one/Enige een}$$

$$0 = mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2)$$

$$0 = (9,8)(h_f - 0) + \frac{1}{2}(0 - 15^2) \checkmark$$

$$h = 11,47\text{ m}$$

Height above the ground/hoogte bokant grond = $30 + \checkmark 11,47 = 41,48\text{ m} \checkmark$

(4)

3.3

POSITIVE MARKING FROM QUESTION 3.2.2/**POSITIEWE NASIEN VANAF VRAAG 3.2.2****Marking criteria/Nasienkriteria**

- Formula/Formule $\checkmark$
- Substitute to calculate Δy_B / Vervang om Δy_B te bereken $\checkmark$
- Substitute to calculate Δy_C / Vervang om Δy_C te bereken $\checkmark$
- Substitute/Vervang $\Delta t + 0,5$ or/of $\Delta t - 0,5 \checkmark$
- Equating y_B and $y_C \checkmark$
- Final answer/Finale antwoord: $1,71\text{ s} \checkmark$

OPTION 1/OPSIE 1**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF**

Take y_C as height of disc above ground at meeting point / neem hoogte y_C as die hoogte van teiken bokant grond by ontmoetingspunt:

$$\Delta y_C = v_i \Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$y_C - 30 = \frac{15\Delta t + \frac{1}{2}(-9,8)\Delta t^2 \checkmark}{y_C = 15\Delta t - 4,9\Delta t^2 + 30 \dots (1)}$$

Take y_B as height of ball above ground at meeting point/Neem hoogte y_B as die hoogte van bal bokant grond by ontmoetingspunt:

$$\Delta y_B = v_i \Delta t + \frac{1}{2}a\Delta t^2$$

$$y_B - 0 = \frac{40(\Delta t - 0,5\checkmark) + \frac{1}{2}(-9,8)(\Delta t - 0,5\checkmark)^2 \checkmark}{y_B = 44,9t - 21,225 - 4,9t^2 \dots (2)}$$

At meeting point/By ontmoetingspunt:

$$y_C = y_B$$

$$\frac{15\Delta t - 4,9\Delta t^2 + 30 = 44,9t - 21,225 - 4,9t^2 \checkmark}{\Delta t = 1,71\text{ s} \checkmark}$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

Take y_C as height of disc above ground at meeting point/*neem hoogte y_C as die hoogte van teiken bokant grond by ontmoetingspunt:*

$$\Delta y_C = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$y_C - 30 = \frac{-15 \Delta t + \frac{1}{2}(9,8) \Delta t^2}{\Delta t} \checkmark$$

$$y_C = -15 \Delta t + 4,9 \Delta t^2 + 30 \dots (1)$$

Take y_B as height of ball above ground at meeting point/*neem hoogte y_B as die hoogte van bal bokant grond by ontmoetingspunt:*

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$y_B - 0 = \frac{-40(\Delta t - 0,5) + \frac{1}{2}(9,8)(\Delta t - 0,5)^2}{\Delta t} \checkmark$$

$$y_B = -44,9t + 21,225 + 4,9t^2 \dots (2)$$

At meeting point/*By ontmoetingspunt:*

$$y_C = y_B \therefore \frac{-15 \Delta t + 4,9 \Delta t^2 + 30}{\Delta t} = \frac{-44,9t + 21,225 + 4,9t^2}{\Delta t} \checkmark$$

$$\Delta t = 1,71 \text{ s } \checkmark$$

OPTION 2/OPSIE 2**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

$$\Delta y_C = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= \frac{15 \Delta t + \frac{1}{2}(-9,8) \Delta t^2}{\Delta t} \checkmark$$

$$= 15 \Delta t - 4,9 \Delta t^2 \dots (1)$$

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$= \frac{40(\Delta t - 0,5) + \frac{1}{2}(-9,8)(\Delta t - 0,5)^2}{\Delta t} \checkmark$$

Δy_C in terms of/in terme van Δy_B :

$$30 + \Delta y_C = 40(\Delta t - 0,5) + \frac{1}{2}(-9,8)(\Delta t - 0,5)^2$$

$$\Delta y_C = -4,9 \Delta t^2 + 44,9 \Delta t - 51,225 \dots (2)$$

Equate (1) and (2)/*Stel (1) en (2) gelyk:*

$$\frac{15 \Delta t}{\Delta t} = \frac{44,9 \Delta t - 51,225}{\Delta t} \checkmark$$

$$\Delta t = 1,71 \text{ s } \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

$$\Delta y_C = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= \frac{-15 \Delta t + \frac{1}{2}(9,8) \Delta t^2}{\Delta t} \checkmark$$

$$= 4,9 \Delta t^2 - 15 \Delta t \dots (1)$$

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$= \frac{-40(\Delta t - 0,5) + \frac{1}{2}(9,8)(\Delta t - 0,5)^2}{\Delta t} \checkmark$$

Δy_C in terms of/in terme van Δy_B :

$$30 + \Delta y_C = (-40)(t - 0,5) + \frac{1}{2}(9,8)(\Delta t - 0,5)^2$$

$$\Delta y_C = 4,9 \Delta t^2 - 44,9 \Delta t + 51,225 \dots (2)$$

Equate (1) and (2)/*Stel (1) en (2) gelyk:*

$$\frac{-15 \Delta t}{\Delta t} = \frac{-44,9 \Delta t + 51,225}{\Delta t} \checkmark$$

$$\Delta t = 1,71 \text{ s } \checkmark$$

OPTION 3/OPSIE 3**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF**

$$\begin{aligned}\Delta y_C &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark \\ &= \underline{15(\Delta t + 0,5)} + \frac{1}{2}(-9,8)(\Delta t + 0,5)^2 \checkmark \\ &= -4,9t^2 + 10,1\Delta t + 6,275 \dots (1)\end{aligned}$$

$$\begin{aligned}\Delta y_B &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ &= \underline{40\Delta t + \frac{1}{2}(-9,8)\Delta t^2} \checkmark\end{aligned}$$

 Δy_C in terms of/in terme van Δy_B :

$$\begin{aligned}30 + \Delta y &= 40\Delta t + \frac{1}{2}(-9,8)t^2 \\ \Delta y &= -4,9\Delta t^2 + 40t - 30 \dots (2)\end{aligned}$$

Equate (1) and (2)/Stel (1) en (2) gelyk:

$$\begin{aligned}\underline{10,1\Delta t + 6,275 = 40\Delta t - 30} \checkmark \\ \Delta t &= 1,21 \text{ s} \\ \Delta t_{\text{TOT}} &= 1,21 + 0,5 \\ &= 1,71 \text{ s} \checkmark\end{aligned}$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF

$$\begin{aligned}\Delta y_C &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark \\ &= \underline{-15(\Delta t + 0,5)} + \frac{1}{2}(9,8)(\Delta t + 0,5)^2 \checkmark \\ &= 4,9\Delta t^2 - 10,1\Delta t + 6,275 \dots (1)\end{aligned}$$

$$\begin{aligned}\Delta y_B &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ &= \underline{-40\Delta t + \frac{1}{2}(9,8)\Delta t^2} \checkmark\end{aligned}$$

 Δy_C in terms of/in terme van Δy_B :

$$\begin{aligned}30 + \Delta y &= -40\Delta t + \frac{1}{2}(9,8)t^2 \\ \Delta y &= -4,9\Delta t^2 - 40\Delta t - 30 \dots (2)\end{aligned}$$

Equate (1) and (2)/Stel (1) en (2) gelyk:

$$\begin{aligned}\underline{-10,1\Delta t + 6,275 = -40\Delta t - 30} \checkmark \\ \Delta t &= 1,21 \text{ s} \\ \Delta t_{\text{TOT}} &= 1,21 + 0,5 \\ &= 1,71 \text{ s} \checkmark\end{aligned}$$

OPTION 4/OPSIE 4**Marking criteria:**

- Formula: $\Delta y_C = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
- Substitute to calculate Δy_B ✓
- Substitute to calculate Δy_C ✓
- Substitute $\Delta t = 0,5$ ✓
- Adding Δy_B and Δy_C ✓
- Final answer: 1,71 s ✓

Nasienkriteria:

- Formule: $\Delta y_C = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
- Vervang om Δy_B te bereken ✓
- Vervang om Δy_C te bereken ✓
- Vervang $\Delta t = 0,5$ ✓
- Som van Δy_B en Δy_C ✓
- Finale antwoord: 1,71 s ✓

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF

Displacement of C after 0,5 s/Verplasing van C na 0,5 s

$$\Delta y_C = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$= 15(0,5) + \frac{1}{2}(-9,8)(0,5)^2 \quad \checkmark$$

$$\Delta y_C = 6,28 \text{ m}$$

Velocity of C after 0,5 s/ Snelheid van C na 0,5 s

$$v_f = v_i + a \Delta t$$

$$= 15 + (-9,8)(0,5)$$

$$= 10,10 \text{ m} \cdot \text{s}^{-1}$$

Displacement of C at meeting point/Verplasing van C by ontmoetingspunt

$$\Delta y_C = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$= \frac{10,1 \Delta t + \frac{1}{2}(-9,8) \Delta t^2}{\quad} \quad \checkmark$$

$$= 10,1 \Delta t - 4,9 \Delta t^2$$

Displacement of B at meeting point/Verplasing van B by ontmoetingspunt

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$= \frac{40 \Delta t + \frac{1}{2}(-9,8) \Delta t^2}{\quad} \quad \checkmark$$

$$= 40 \Delta t - 4,9 \Delta t^2$$

At meeting point/By ontmoetingspunt:

$$\Delta y_C + \Delta y_B = -[10,1 \Delta t - 4,9 \Delta t^2] + 40 \Delta t - 4,9 \Delta t^2 \quad \checkmark$$

$$36,28 = -10,10 \Delta t + 40 \Delta t$$

$$\Delta t = 1,21 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,21 + 0,5 = 1,71 \text{ s} \quad \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF

Displacement of C after 0,5 s/Verplasing van C na 0,5 s

$$\begin{aligned}\Delta y_C &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark \\ &= -15(0,5) + \frac{1}{2}(9,8)(\underline{0,5})^2 \checkmark \\ \Delta y_C &= -6,28 \text{ m}\end{aligned}$$

Velocity of C after 0,5 s/ Snelheid van C na 0,5 s

$$\begin{aligned}v_f &= v_i + a \Delta t \\ &= -15 + (9,8)(0,5) \\ &= -10,10 \text{ m} \cdot \text{s}^{-1}\end{aligned}$$

Displacement of C at meeting point/Verplasing van C by ontmoetingspunt

$$\begin{aligned}\Delta y_C &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ &= \underline{-10,1 \Delta t + \frac{1}{2}(9,8) \Delta t^2} \checkmark \\ &= -10,1 \Delta t + 4,9 \Delta t^2\end{aligned}$$

Displacement of B at meeting point/Verplasing van B by ontmoetingspunt

$$\begin{aligned}\Delta y_B &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ &= \underline{-40 \Delta t + \frac{1}{2}(9,8) \Delta t^2} \checkmark \\ &= -40 \Delta t + 4,9 \Delta t^2\end{aligned}$$

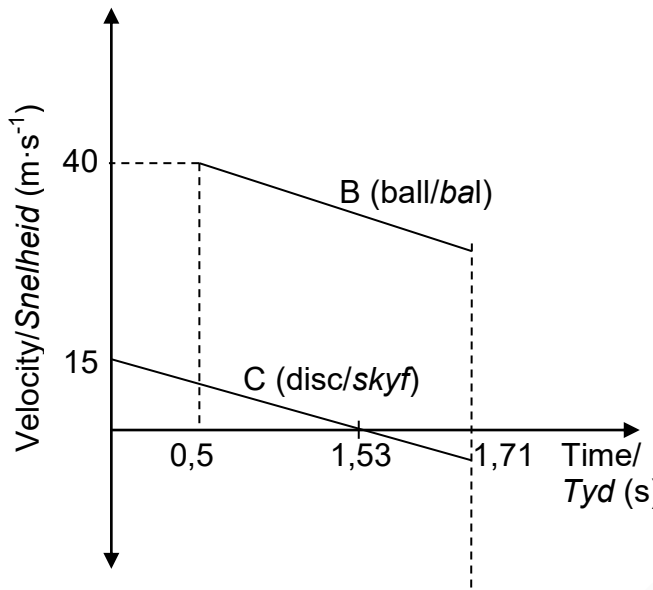
At meeting point/By ontmoetingspunt:

$$\begin{aligned}\Delta y_C + \Delta y_B &= \underline{-[-10,1 \Delta t + 4,9 \Delta t^2] - 40 \Delta t + 4,9 \Delta t^2} \checkmark \\ -36,28 &= 10,10 \Delta t - 40 \Delta t \\ \Delta t &= 1,21 \text{ s} \\ \Delta t_{\text{tot}} &= 1,21 + 0,5 = 1,71 \text{ s} \checkmark\end{aligned}$$

(6)

3.4

**POSITIVE MARKING FROM QUESTIONS 3.2.1 AND 3.3 /
POSITIEWE NASIEN VANAF VRAE 3.2.1 EN 3.3.
UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF**

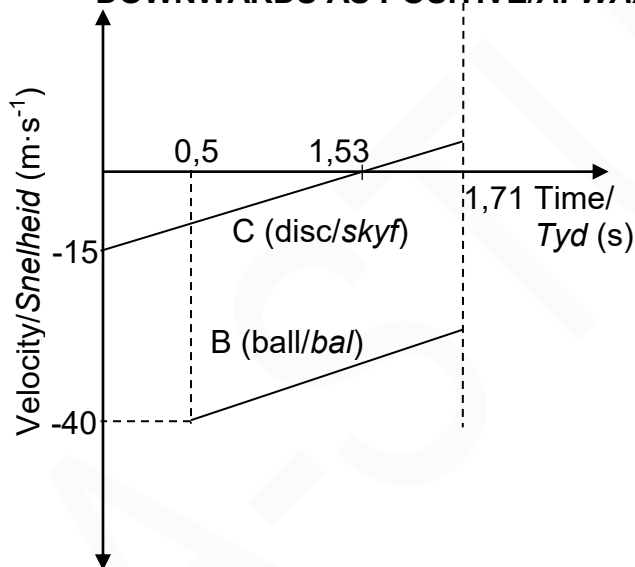
**Marking criteria:**

- Initial velocities 40 and 15 and straight lines ✓
- B starting at 0,5 s ✓
- Parallel lines with negative gradient ✓
- Time at which disc reaches maximum height (answer from 3.2.1) 1,53 s ✓
- Time at which B hits C (answer from 3.3) 1,71 s ✓

Nasienkriteria:

- Aanvanklike snelhede 40 en 15 en reguitlyne ✓
- B begin by 0,5 s ✓
- Parallele lyne met negatiewe gradiënt ✓
- Tyd wanneer skyf maks hoogte bereik (antwoord van 3.2.1) 1,53 s ✓
- Tyd wanneer B vir C tref (antwoord van 3.3) 1,71s ✓

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF

**Marking criteria:**

- Initial velocities -40 and -15 and straight lines ✓
- B starting at 0,5 s ✓
- Parallel lines with positive gradient ✓
- Time at which disc reaches maximum height (answer from 3.2.1) 1,53 s ✓
- Time at which B hits C (answer from 3.3) 1,71 s ✓

Nasienkriteria:

- Aanvanklike snelhede -40 en -15 en reguitlyne ✓
- B begin by 0,5 s ✓
- Parallele lyne met positiewe gradiënt ✓
- Tyd wanneer skyf maks hoogte bereik (antwoord van 3.2.1) 1,53 s ✓
- Tyd wanneer B vir C tref (antwoord van 3.3) 1,71s ✓

(5)
[20]

QUESTION 4 /VRAAG 4

- 4.1 A system on which the resultant/net external force is zero./'n Sisteem waarop die resultante/netto eksterne krag nul is. ✓✓ (2 or/of 0) (2)
- 4.2 1. According to Newton 3rd Law ✓ the rocket exerts a force on the toy cart to the left/opposite to direction of motion. ✓
OR
 2. The toy cart exerts a force on the rocket to the right ✓ and the rocket exerts a force on the toy cart to the left/opposite to direction of motion. ✓
OR
 3. The rocket experiences a change in momentum to the right ✓, the toy cart experiences a change in momentum to the left. ✓
OR
 4. $\Delta p_{\text{toy cart}} = -\Delta p_{\text{rocket}}$ ✓✓
OR
 5. Total momentum is conserved / remains constant. ✓
The momentum of the rocket increases. Therefore, the momentum of the toy cart must decrease. ✓
OR
 6. The rocket experiences an impulse to the right ✓ therefore, the toy cart experiences an impulse to the left. ✓
OR
 7. $\text{Impulse}_{\text{rocket}} = -\text{Impulse}_{\text{toy cart}}$ ✓✓
1. Volgens Newton se derde wet ✓ oefen die vuurpyl 'n krag op die speelgoedwaentjie na links uit/ teen die bewegingsrigting. ✓
OF
 2. Die speelgoedwaentjie oefen 'n krag op die vuurpyl na regs ✓ en die vuurpyl oefen 'n krag op die speelgoedwaentjie na links/teen die bewegingsrigting ✓.
OF
 3. Die vuurpyl ondervind 'n verandering in momentum na regs ✓, die speelgoedwaentjie ondervind 'n verandering in momentum na links. ✓
OF
 4. $\Delta p_{\text{speelgoedwaentjie}} = -\Delta p_{\text{vuurpyl}}$
OF
 5. Totale momentum bly behoue. ✓
Die momentum van die vuurpyl neem toe. Dus moet die momentum van die speelgoedwaentjie af neem. ✓
OF
 6. Die vuurpyl ondervind 'n impuls na regs ✓ dus ondervind die speelgoedwaentjie 'n impuls na links. ✓
OF
 7. $\text{Impuls}_{\text{vuurpyl}} = -\text{Impuls}_{\text{speelgoedwaentjie}}$ ✓✓ (2)

4.3

OPTION 1/OPSIE 1**RIGHT AS POSITIVE/REGS AS POSITIEF**

$$\left. \begin{aligned} \sum p_i &= \sum p_f \\ (m_1 + m_2)v_i &= m_1v_{1f} + m_2v_{2f} \\ mv_i &= m_1v_{1f} + m_2v_{2f} \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$(20 + m_2)2,5 \checkmark = 20(0,6) \checkmark + m_2(30) \checkmark$$

$$m_2 = 1,38 \text{ kg} \checkmark$$

LEFT AS POSITIVE/LINKS AS POSITIEF

$$\left. \begin{aligned} \sum p_i &= \sum p_f \\ (m_1 + m_2)v_i &= m_1v_{1f} + m_2v_{2f} \\ mv_i &= m_1v_{1f} + m_2v_{2f} \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$(20 + m_2)(-2,5) \checkmark = 20(-0,6) \checkmark + m_2(-30) \checkmark$$

$$m_2 = 1,38 \text{ kg} \checkmark$$

OPTION 2/OPSIE 2**RIGHT AS POSITIVE/REGS AS POSITIEF**

$$\left. \begin{aligned} \Delta p_{\text{toy cart/speelgoedwaentjie}} &= -\Delta p_{\text{rocket/vuurpyl}} \\ m_1(v_{1(f)} - v_{1(i)}) &= -m_2(v_{2(f)} - v_{2(i)}) \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$(20) \checkmark (0,6 - 2,5) \checkmark = - (m)(30 - 2,5) \checkmark$$

$$m_2 = 1,38 \text{ kg} \checkmark$$

LEFT AS POSITIVE/LINKS AS POSITIEF

$$\left. \begin{aligned} \Delta p_{\text{toy cart/speelgoedwaentjie}} &= -\Delta p_{\text{rocket/vuurpyl}} \\ m_1(v_{1(f)} - v_{1(i)}) &= -m_2(v_{2(f)} - v_{2(i)}) \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$(20) \checkmark [-0,6 - (-2,5)] \checkmark = - (m)[(-30) - (-2,5)] \checkmark$$

$$m_2 = 1,38 \text{ kg} \checkmark$$

(5)
[9]

QUESTION 5/VRAAG 5

5.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.

Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -1 punt per word/frase.

The net/total work done on an object is equal to the change in the object's kinetic energy. ✓✓

Die netto/totale arbeid op 'n voorwerp is gelyk aan die verandering in die voorwerp se kinetiese energie.

OR/OF

The work done on an object by a net force is equal to the change in the object's kinetic energy.

Die arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie.

(2)

5.2

F_{net} opposite to direction of displacement Δx . ✓ / Both frictional force and gravitational force are in opposite direction of displacement Δx .

F_{net} teenoorgesteld tot rigting van verplasing Δx . / Beide wrywingskrag en gravitasie krag is teenoorgesteld tot die verplasing Δx .

OR/OF

ΔK is negative. / The final K is zero. / E_k decreases.

ΔK is negatief. / Die finale K is nul. / E_k neem af.

OR/OF

$W_{\text{net}} = F_{\text{net}} \Delta x \cos \theta$ and/en $\theta = 180^\circ / \cos \theta = -1$

(1)

5.3

OPTION 1/OPSIE 1

$$\left. \begin{aligned} W_{\text{net}} &= \Delta K \\ W_w + W_f &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ mgsin\theta\Delta x \cos\theta + W_f &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$(30\,000)(9,8)\sin 28^\circ \Delta x \cos 180^\circ \checkmark + (31\,000)\Delta x \cos 180^\circ \checkmark$$

$$= \frac{1}{2}(30\,000)(0^2 - 33^2) \checkmark$$

$$\Delta x = 96,64 \text{ m } \checkmark$$

OPTION 2/OPSIE 2

$$\left. \begin{aligned} W_{\text{nc}} &= \Delta K + \Delta U \\ W_f &= \Delta K + mg(h_f - h_i) \\ f\Delta x \cos\theta &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$31\,000\Delta x \cos 180^\circ \checkmark = \frac{1}{2}(30\,000)(0^2 - 33^2) \checkmark + 30\,000(9,8)(\Delta x \sin 28^\circ - 0) \checkmark$$

$$\Delta x = 96,64 \text{ m } \checkmark$$

OPTION 3/OPSIE 3

$$\left. \begin{aligned} W_{\text{net}} &= \Delta K \\ W_w + W_f &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ -\Delta E_p + W_f &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ -mg(h_f - h_i) + W_f &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \end{aligned} \right\} \checkmark \text{ Any one/Enige}$$

$$-(30\,000)(9,8)(\Delta x \sin 28^\circ - 0) \checkmark + (31\,000)\Delta x \cos 180^\circ \checkmark = \frac{1}{2}(30\,000)(0^2 - 33^2) \checkmark$$

$$\Delta x = 96,64 \text{ m } \checkmark$$

OPTION 4/OPSIE 4

$$\begin{aligned}
 W_{\text{net}} &= \Delta K \\
 W_w + W_f &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\
 mg\Delta x \cos\theta + W_f &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2
 \end{aligned}
 \left. \vphantom{\begin{aligned} W_{\text{net}} &= \Delta K \\ W_w + W_f &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ mg\Delta x \cos\theta + W_f &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \end{aligned}} \right\} \checkmark \text{ Any one/Enige}$$

$$(30\,000)(9,8)\Delta x \cos 118^\circ \checkmark + (31\,000)\Delta x \cos 180^\circ \checkmark = \frac{1}{2}(30\,000)(0^2 - 33^2) \checkmark$$

$$\Delta x = 96,64 \text{ m} \checkmark$$

OPTION 5/OPSIE 5

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 F_{\text{net}} &= F_{w//} + f \\
 &= (30\,000)(9,8)\sin 28^\circ + 31\,000 \checkmark \\
 &= 169\,024,64 \text{ N}
 \end{aligned}$$

$$\begin{aligned}
 W_{\text{net}} &= \Delta E_k \\
 F_{\text{net}}\Delta x \cos\theta &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2
 \end{aligned}
 \left. \vphantom{\begin{aligned} W_{\text{net}} &= \Delta E_k \\ F_{\text{net}}\Delta x \cos\theta &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \end{aligned}} \right\} \checkmark \text{ Any one/Enige een}$$

$$169\,024,64\Delta x \cos 180^\circ \checkmark = \frac{1}{2}(30\,000)(0^2 - 33^2) \checkmark$$

$$\Delta x = 96,64 \text{ m} \checkmark$$

(5)

5.4 Ascending/Opgaande $\checkmark$

$$\begin{aligned}
 1. \text{ Ascending/Opgaande: } F_{\text{net(A)}} &= F_{w//} + f \\
 \text{Descending/Afgaande: } F_{\text{net(D)}} &= F_{w//} - f
 \end{aligned}
 \left. \vphantom{\begin{aligned} F_{\text{net(A)}} &= F_{w//} + f \\ F_{\text{net(D)}} &= F_{w//} - f \end{aligned}} \right\} \checkmark$$

$$F_{\text{net(A)}} > F_{\text{net(D)}} \checkmark$$

OR/OF

2. Ascending: $F_{w//}$ and f are both acting in the opposite to direction of displacement. $\checkmark$
 Descending: only f is acting in the opposite direction of displacement. $\checkmark$
 Net force for ascending greater than net force for descending. $\checkmark$

Opgaande: $F_{w//}$ en f werk beide teen die rigting van verplasing.
Afgaande: slegs f werk teen die rigting van verplasing.
Die netto krag opgaande is groter as die netto krag afgaande.

OR/OF

3. Ascending: F_{net} acts opposite to the direction of motion. $\checkmark$
 Descending: F_{net} acts downwards in the direction of motion. $\checkmark$

Opgaande: F_{net} werk teen die bewegingsrigting.
Afgaande: F_{net} werk afwaarts in die bewegingsrigting.

OR/OF

4. Ascending: $F_{w(//)}$ acts opposite to the direction of motion $\checkmark$
 Descending: $F_{w(//)}$ acts downwards in the direction of motion $\checkmark$
 Net force for ascending greater than net force for descending. $\checkmark$

Opgaande: $F_{w(//)}$ werk teen die bewegingsrigting.
Afgaande: $F_{w(//)}$ werk afwaarts in die bewegingsrigting.
Die netto krag opgaande is groter as die netto krag afgaande.

(3)

[11]

QUESTION 6/VRAAG 6

6.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.

Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -
1 punt per word/frase.

The (apparent) change in frequency (or pitch) (of the sound) detected by a listener because the source and the listener have different velocities relative to the medium of propagation. ✓✓

Die (skynbare) verandering in die frekwensie (of toonhoogte) (van die klank) waargeneem deur 'n luisteraar omdat die bron en die luisteraar verskillende snelhede relatief tot die voortplantingsmedium het.

OR/OF

An (apparent) change in observed/detected frequency/pitch as a result of the relative motion between a source and an observer/listener.

'n (Skynbare) verandering in waargenome frekwensie/toonhoogte as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/ luisteraar.

(2)

6.2

$$v = f \quad \checkmark$$

$$340 = (880) \lambda \quad \checkmark$$

$$\lambda = 0,39 \text{ m } (0,386) \quad \checkmark$$

(3)

6.3

OPTION 1/OPSIE 1

$$f_L = \frac{v}{v} \frac{v}{v_s} f_s \quad \checkmark \quad \text{OR/OF} \quad f_L = \frac{v + v}{v} f_s$$

$$f_L = \frac{340 + 10}{340} 880 \quad \checkmark$$

$$f_L = 905,88 \text{ Hz} \quad \checkmark$$

POSITIVE MARKING FROM QUESTION 6.2/**POSITIEWE NASIEN VANAF VRAAG 6.2****OPTION 2/OPSIE 2**

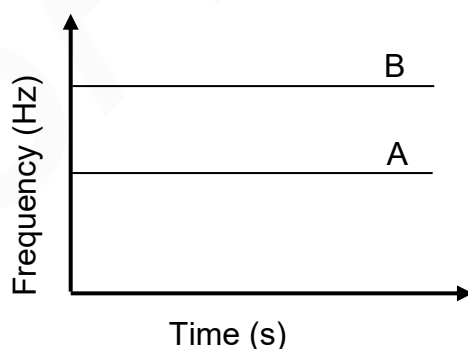
$$v = f \quad \checkmark$$

$$340 + 10 \quad \checkmark = f_L(0,39) \quad \checkmark$$

$$f_L = 897,44 \text{ Hz} \quad \checkmark$$

(4)

6.4

**Marking criteria/Nasienkriteria**

B parallel with A and above A. ✓✓

B parallel aan A en bokant A. **2 or/of 0**

(2)

[11]

QUESTION 7/VRAAG 7

7.1.1

Marking criteria/Nasienkriteria:

If any of the underlined key words/phrases in the correct context are omitted:

- 1 mark per word/phrase.

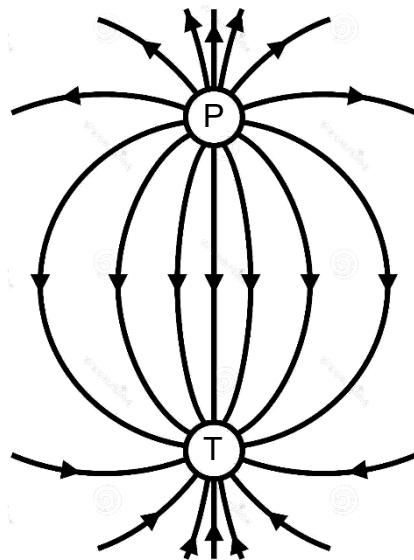
*Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: -**1 punt per word/frase.*

The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the (magnitudes) of the charges ✓ and inversely proportional to the square of the distance (r) between them. ✓

Die grootte van die elektrostatiese krag wat een puntlading (Q_1) op 'n ander puntlading (Q_2) uitoefen, is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle.

(2)

7.1.2



Criteria for graph/Kriteria vir grafiek:	
Correct shape <i>Korrekte vorm</i>	✓
Correct direction from P to T. <i>Korrekte rigting van P na T.</i>	✓
Lines must not cross and must touch spheres. <i>Lyne mag nie kruis nie en moet die sfere raak.</i>	✓
NOTE/AANTEKENING: If the net electric field pattern is drawn for two like charges: <i>Indien die netto elektriese veldpatroon vir twee gelyksoortige ladings geteken is:</i>	0/3

(3)

7.1.3 positive/ positief ✓

(1)

7.1.4

Marking criteria/Nasienkriteria

- Equation for Coulomb's law./Vergelyking vir Coulomb se wet. ✓
- Correct substitution into Coulomb's equation for for F_{TP} . ✓
Korrekte vervanging in Coulomb se vergelyking vir F_{TP} .
- Correct substitution into Coulomb's equation for F_{TS} . ✓
Korrekte vervanging in Coulomb se vergelyking vir F_{TS} .
- Correct substitution into resultant force equation (Pythagoras equation). ✓
Korrekte vervanging in resultante krag vergelyking (Pythagoras vergelyking).
- Substitute into $Q = ne$. /Vervang in $Q = ne$. ✓
- Final answer/Finale antwoord: $3,05 \times 10^{13}$ ✓

$$F_{\text{net}}^2 = F_{TP}^2 + F_{TS}^2$$

$$= \left(\frac{kQ_1 Q_2}{r^2} \right)^2 + \left(\frac{kQ_1 Q_2}{r^2} \right)^2$$

$$10^2 = \left(\frac{(9 \times 10^9)(3 \times 10^{-6})(3 \times 10^{-6})}{0,1^2} \right)^2 + \left(\frac{(9 \times 10^9)(3 \times 10^{-6})(2)}{0,15^2} \right)^2$$

$$Q_S = 4,887 \times 10^{-6} \text{ C}$$

$$\downarrow Q_S = ne$$

$$4,887 \times 10^{-6} = n(1,6 \times 10^{-19}) \checkmark$$

$$n = 3,05 \times 10^{13} \checkmark \text{ electrons/elektrone}$$

(6)

7.2.1

E is directly proportional to $\frac{1}{r^2}$. /E is direk eweredig aan $\frac{1}{r^2}$. ✓**OR/OF**

$$E \propto \frac{1}{r^2}$$

(1)

7.2.2

Gradient = $\frac{\Delta E}{\Delta \frac{1}{r^2}}$ ✓ $680 \checkmark = \frac{E - (0)}{\frac{1}{0,04^2} - (0)} \checkmark$ $E_A = 4,25 \times 10^5 \text{ N} \cdot \text{C}^{-1} \checkmark$	ACCEPT/AANVAAR $E = \frac{kQ}{r^2} \checkmark$ $E_A = \frac{680}{0,04^2} \checkmark$ $= 4,25 \times 10^5 \text{ N} \cdot \text{C}^{-1} \checkmark$ OR/OF $y = mx + c / y = mx \checkmark$ $E_A = 680 \checkmark \left(\frac{1}{0,04^2} \right) \checkmark$ $= 4,25 \times 10^5 \text{ N} \cdot \text{C}^{-1} \checkmark$

(4)

7.2.3 Greater than / Groter as ✓

The gradient is equal to kQ ./The gradient is proportional to Q . ✓
 Graph of sphere B has a steeper gradient than graph of sphere A. ✓
*Die gradiënt is gelyk aan kQ ./Die gradiënt is proporsioneel aan Q .
 Grafiek vir sfeer B het 'n steiler gradiënt as die grafiek vir sfeer A.*

OR/OF

For the same $\frac{1}{r^2}$, E is greater for sphere B. ✓✓

Vir dieselfde $\frac{1}{r^2}$, is E groter vir sfeer B.

(3)
[20]**QUESTION 8/VRAAG 8**

- 8.1 A conductor (resistor) which obeys Ohm's law./n Geleier wat Ohm se wet gehoorzaam. ✓✓ (2 or/of 0)

OR/OF

V always directly proportional to I at constant temperature. ✓✓ (2 or/of 0)
 V is altyd direk eweredig aan I by konstante temperatuur.

OR/OF

$\frac{V}{I} = \text{constant} / k / \text{constant at constant temperature}$. ✓✓ (2 or/of 0)

$\frac{V}{I} = \text{konstant} / k / \text{konstant bly by 'n konstante temperatuur}$.

OR/OF

A conductor for which the resistance remains constant at constant temperature when voltage or current change. ✓✓ (2 or/of 0)
'n Geleier waar die weerstand konstant bly by 'n konstante temperatuur wanneer die potensiaalverskil of die stroom verander.

(2)

8.2.1

$$R = - \quad \checkmark$$

$$4 = \frac{3,2}{\quad} \quad \checkmark$$

$$I = 0,8 \text{ A} \quad \checkmark$$

(3)

8.2.2

**POSITIVE MARKING FROM QUESTION 8.2.1. /
POSITIEWE NASIEN VANAF VRAAG 8.2.1.****OPTION 1/OPSIE 1**

$$\begin{aligned}\varepsilon &= (R+r) \checkmark \\ &= 0,8 (4 + 8) + 0,5 \checkmark \\ &= 10 \text{ V} \checkmark\end{aligned}$$

OR/OF

$$\begin{aligned}\varepsilon &= (R+r) \checkmark \\ &= 0,8 (4 + 8) + 0,8 \times 0,5 \checkmark \\ &= 10 \text{ V} \checkmark\end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned}V_8 &= IR \\ &= (0,8)(8) \\ &= 6,4 \text{ V}\end{aligned}$$

$$\begin{aligned}V_{\text{ext}} &= \frac{3,2 + 6,4}{} \\ &= 9,6 \text{ V}\end{aligned}$$

$$\begin{aligned}V_{\text{int}} &= Ir \\ &= (0,8)(0,5) \checkmark \\ &= 0,4 \text{ V}\end{aligned}$$

$$\begin{aligned}\varepsilon &= I(R + r) \\ &= V_{\text{ext}} + V_{\text{int}} \quad \left. \vphantom{\begin{aligned}\varepsilon &= I(R + r) \\ &= V_{\text{ext}} + V_{\text{int}}\end{aligned}} \right\} \checkmark \text{ Any one/Enige een} \\ &= \underline{9,6 + 0,4} \checkmark \\ &= 10 \text{ V} \checkmark\end{aligned}$$

(4)

8.3.1

**POSITIVE MARKING FROM QUESTION 8.2.2./
POSITIEWE NASIEN VANAF VRAAG 8.2.2.****OPTION 1/OPSIE 1**

$$\begin{aligned}V_{\text{int}} &= Ir \\ 1,2 &= I(0,5) \checkmark \\ I &= 2,4 \text{ A} \\ R_{\text{ext}} &= \frac{V}{I} \\ &= \frac{8,8 \checkmark}{2,4 \checkmark} \\ &= 3,67 \Omega \quad (3,667) \\ R_{\text{p}} &= \frac{12R}{12 + R} \\ 3,67 &= \frac{12R}{12 + R} \checkmark \\ R &= 5,29 \Omega \quad (5,28) \checkmark\end{aligned}$$

OR/OF

$$\begin{aligned}\frac{1}{R_{\text{p}}} &= \frac{1}{R_1} + \frac{1}{R_2} \\ \frac{1}{3,67} &= \frac{1}{R} + \frac{1}{12} \checkmark \\ R &= 5,29 \Omega \quad (5,28) \checkmark\end{aligned}$$

OPTION 2 /OPSIE 2

$$\begin{aligned}V_{\text{int}} &= 10 - 8,8 \\ &= 1,2 \text{ V} \\ V_{\text{int}} &= Ir \\ 1,2 &= I(0,5) \checkmark \\ I &= 2,4 \text{ A} \\ I_{\text{series branch}} &= \frac{V}{R} \\ &= \frac{8,8 \checkmark}{8+4} \\ &= 0,73 \text{ A} \quad (0,733) \\ I_{\text{R}} &= \frac{2,4 - 0,73 \checkmark}{} \\ &= 1,67 \text{ A} \quad (1,667) \\ R &= \frac{V}{I_{\text{R}}} \\ &= \frac{8,8}{1,67 \checkmark} \\ &= 5,27 \Omega \quad (5,28) \checkmark\end{aligned}$$

(5)

8.3.2 There is a short circuit /Daar is 'n kortsluiting.

- The resistance of the connected wire is very low. / The total resistance decreases. ✓

Die weerstand van die verbindingsdrade is baie klein. /Die totale weerstand neem af.

- $I \propto \frac{1}{R}$, current delivered by the battery is very high. ✓

$I \propto \frac{1}{R}$, stroom gelewer deur die battery is baie groot.

- Higher current produces more heat. ✓
Hoër stroom produseer meer hitte.

OR/OF

Any one of the following equations can be used to explain the effect of current on heat/*Enig een van die volgende vergelykings kan gebruik word om die effek van stroom op hitte te verduidelik:*

$$W = I^2 R \Delta t / W = \frac{\Delta t}{R} / W = \Delta t / P = \frac{\Delta t}{P} / P = VI$$

(3)
[17]

QUESTION 9/VRAAG 9

9.1.1 Electrical to mechanical/kinetic/rotational ✓
Elektries na meganies/kineties/rotasie (1)

9.1.2 DC/GS ✓ (1)

9.1.3 Ensures continuous rotation of the coil. ✓
Verseker aanhoudende rotasie van spoel.

OR/OF

Ensures change in direction of the current in the coil. ✓
Verseker verandering van rigting van stroom in spoel. (1)

9.2 **QUESTIONS 9.2.1 AND 9.2.2/VRAE 9.2.1 EN 9.2.2**

Only penalise once if subscripts are omitted.

Penaliseer slegs een keer indien onderskrifte uitgelaat is.

9.2.1

Marking criteria/Nasienkriteria:

- Correct formula to calculate resistance. ✓
Korrekte formule om weerstand te bereken.
- Substitute into formula to calculate resistance. ✓
Vervang in formule of weerstand te bereken.
- Final answer/*Finale antwoord*: 484 to/tot 493,83 Ω ✓

OPTION 1/OPSIE 1

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark$$

$$100 = \frac{220^2}{R} \checkmark$$

$$R = 484 \, \Omega \checkmark$$

OPTION 2/OPSIE 2

$$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}}$$

$$100 = 220 I_{\text{rms}}$$

$$I_{\text{rms}} = 0,45 \, \text{A} (0,455)$$

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \checkmark$$

$$0,45 = \frac{220}{R} \checkmark$$

$$R = 488,89 \, \Omega \checkmark$$

OPTION 3/OPSIE 3

$$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}}$$

$$100 = 220 I_{\text{rms}}$$

$$I_{\text{rms}} = 0,45 \, \text{A} (0,455)$$

$$P_{\text{ave}} = I_{\text{rms}}^2 R \checkmark$$

$$100 = (0,45)^2 R \checkmark$$

$$R = 493,83 \, \Omega \checkmark$$

(3)

9.2.2

POSITIVE MARKING FROM QUESTION 9.2.1/**POSITIEWE NASIEN VANAF VRAAG 9.2.1.****Marking criteria:**

- Uses power of Y in circuit (80 W) to calculate I_{rms} of the circuit. ✓
- Determines V_{rms} across R_Z in the circuit. ✓
- Uses I_{rms} and V_{rms} across R_Z in the circuit to calculate resistance R_Z . ✓
- Use of any one relevant power equation. ✓
- Uses R_Z and 220 V to calculate X. ✓
- Final answer for X. ✓

Accept range:

846,07 W to 856,03 W

Nasienriglyne:

- Gebruik drywing van Y in stroombaan (80 W) om I_{wgk} te bereken. ✓
- Bepaal V_{wgk} oor R_Z in die stroombaan. ✓
- Gebruik I_{wgk} en V_{wgk} oor R_Z in die stroombaan om weerstand R_Z te bereken. ✓
- Gebruik van enige drywing-formule. ✓
- Gebruik R_Z en 220 V om X te bereken. ✓
- Finale antwoord vir X. ✓

Aanvaar gebied:

846,07 W tot 856,03 W

For resistor Y/Vir resistor Y

$$P_{\text{ave}} = I_{\text{rms}}^2 R$$

$$80 = \frac{I_{\text{rms}}^2 (484)}{1}$$

$$I_{\text{rms}} = 0,407 \text{ A}$$

OR/OF

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R}$$

$$80 = \frac{V_{\text{rms}}^2}{484}$$

$$V_{\text{rms}} = 196,77 \text{ V}$$

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{R}$$

$$= \frac{196,77}{484} \checkmark$$

$$= 0,407 \text{ A}$$

For/Vir Z

$$V_{\text{rms}} = 220 - 196,77 \checkmark$$

$$= 23,23 \text{ V}$$

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{R}$$

$$[0,407 = \frac{23,23}{R}] \checkmark$$

$$R = 57,08 \Omega$$

Range/Gebied:56,66 Ω to/tot 57,13 Ω **X for Z/X vir Z:**

$$X = P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark$$

$$= \frac{220^2}{57,08} \checkmark$$

$$= 847,93 \text{ W} \checkmark$$

OR/OF

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{R}$$

$$= \frac{220}{57,08}$$

$$= 3,85 \text{ A}$$

$$X = P_{\text{ave}} = I_{\text{rms}}^2 R \checkmark$$

$$= (3,85)^2 (57,08) \checkmark$$

$$= 846,07 \text{ W} \checkmark$$

OR/OF

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{R}$$

$$= \frac{220}{57,08}$$

$$= 3,85 \text{ A}$$

$$X = P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$$

$$= (220)(3,85) \checkmark$$

$$= 847 \text{ W} \checkmark$$

(6)

[12]

QUESTION 10/VRAAG 10

10.1.1

Marking criteria/Nasienkriteria:

If any of the underlined key words/phrases in the correct context are omitted:

- 1 mark per word/phrase.

*Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per word/frase.*The process whereby electrons are ejected from a (metal) surface when light of suitable frequency is incident on that surface. ✓✓*Die proses waartydens elektrone vrygestel word vanaf 'n (metaal) oppervlak wanneer lig van geskikte frekwensie invallend is op die oppervlak.* (2)

10.1.2 For one photon/Vir een foton:

$$E = hf \checkmark$$

$$= (6,63 \times 10^{-34})(1,2 \times 10^{15}) \checkmark$$

$$= 7,96 \times 10^{-19} \text{ J}$$

NOTE/LET WEL

$$W_0 = hf_0 \text{ } ^0/2$$

No of e = No of photons/Hoeveelheid fotone

$$= \frac{\text{Total energy of photons}}{\text{Energy of one photon}} / \frac{\text{Totale energie van fotone}}{\text{Energie van een foton}}$$

$$= \frac{1,75 \times 10^{-9}}{7,96 \times 10^{-19}} \checkmark$$

$$= 2,2 \times 10^9 \checkmark (2,198 \times 10^9)$$
 (4)

10.1.3

**POSITIVE MARKING FOR E ONLY FROM QUESTION 10.1.2/
POSITIEWE NASIEN VIR SLEGS E VANAF VRAAG 10.1.2**

$$\left. \begin{aligned} E &= W_0 + K_{\max} \\ hf &= hf_0 + \frac{1}{2}mv_{\max}^2 \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$7,96 \times 10^{-19} \checkmark = (6,63 \times 10^{-34})(9,09 \times 10^{14}) \checkmark + \frac{1}{2}(9,11 \times 10^{-31})v_{\max}^2 \checkmark$$

$$v_{\max} = 6,51 \times 10^5 \text{ m}\cdot\text{s}^{-1} \checkmark$$
 (5)

10.2

An atom (electron) in higher (excited) energy state/level returns to a lower energy state/level. ✓

Energy is released as light (photons/frequencies of light are released). ✓

*'n Atoom (elektron) in 'n hoër (opgewekte) energie toestand/vlak keer terug na 'n laer energievlak (grondvlak).**Energie word vrygestel as lig (fotone/frekwensies van lig word vrygestel).* (2)**[13]****TOTAL/TOTAAL:****150**



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

NOVEMBER 2021

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**This marking guidelines consists of 26 pages.
Hierdie nasienriglyne bestaan uit 26 bladsye.**

QUESTION 1/VRAAG 1

- 1.1 A ✓✓ (2)
- 1.2 B ✓✓ (2)
- 1.3 D ✓✓ (2)
- 1.4 B ✓✓ (2)
- 1.5 C ✓✓ (2)
- 1.6 D ✓✓ (2)
- 1.7 B or/of F ✓✓ (2)
- 1.8 A or/of V_1 ✓✓ (2)
- 1.9 D ✓✓ (2)
- 1.10 D ✓✓ (2)
- [20]**

QUESTION 2/VRAAG 2

2.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark. /Indien enige van die onderstreepte sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.

A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force/unbalanced force acts on it. ✓✓

'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid volhard, tensy 'n (nie-nul) resulterende/netto krag/ongebalanseerde krag daarop inwerk.

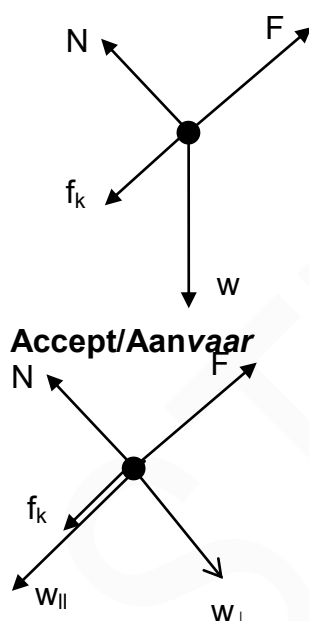
OR/OF

A body will remain in its state of rest or uniform motion in a straight line unless a (non-zero) resultant/net /unbalanced force acts on it. ✓✓

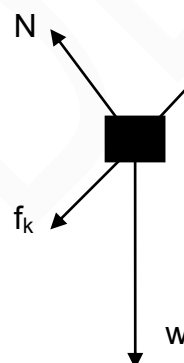
'n Liggaam sal in sy toestand rus of uniforme beweging in 'n reguit lyn volhard, tensy 'n (nie-nul) resulterende/netto/ongebalanseerde krag daarop inwerk.

(2)

2.2



**Accept force diagram/
Aanvaar kragtediagram**



Accepted labels/Aanvaarde benoemings	
w	F_g / F_w / weight / mg / 196 N / gravitational force F_g / F_w / gewig / mg / 196 N / gravitasiekrag
F	F_A / Applied force F_T / Toegepaste krag
f_k	(kinetic) Friction / (kineties) wrywing / F_f / f / 18 N / F_w / f_w
N	F_N / Normal / Normaal / 169,74 N

Notes/Aantekeninge:

- Mark awarded for label and arrow, but penalise only once if arrows are omitted / Punt toegeken vir benoeming en pyltjie, maar penaliseer slegs een keer indien pyle uitgelaat is.
- Do not penalise for length of arrows, drawing is not to scale. / Moenie vir die lengte van die pyltjies penaliseer nie, die tekening is nie volgens skaal nie.
- Any other additional force(s) deduct 1 mark. / Enige ander addisionele krag(te) trek 1 punt af.
- If force(s) do not make contact with body deduct 1 mark. / Indien krag(te) nie met die voorwerp kontak maak nie, trek 1 punt af.

(4)

2.3

OPTION 1/OPSIE 1**Positive up the incline/Positief opwaarts teen skuinsvlak**

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 F + f_k + w_{\parallel} &= ma \\
 F + (-f_k) + (-w_{\parallel}) &= ma \\
 F - (f_k + w_{\parallel}) &= ma \\
 F - [18 + (20)(9,8)(\sin 30^\circ)] &= 0 \checkmark \\
 F &= 116 \text{ N} \checkmark
 \end{aligned}
 \quad \left. \begin{array}{l} \\ \\ \\ \end{array} \right\} \checkmark \text{ Any one/Enige een}$$

NOTE/LET WEL

$$\begin{aligned}
 F_{\text{net}} &= 0 \checkmark \checkmark \\
 F &= f_k + w_{\parallel} \checkmark \checkmark
 \end{aligned}$$

OPTION 2/OPSIE 2**Positive up the incline/Positief opwaarts teen skuinsvlak**

$$\begin{aligned}
 W_{\text{net}} &= \Delta E_k \checkmark \\
 F\Delta x \cos 0^\circ + f\Delta x \cos 180^\circ + w\Delta x \cos 120^\circ &= 0 \checkmark \\
 F\Delta x &= 18\Delta x + (20)(9,8)\Delta x(0,5) \\
 F &= 116 \text{ N} \checkmark
 \end{aligned}$$

NOTE/LET WEL

$$\begin{aligned}
 W_{\text{net}} &= 0 \checkmark \checkmark \\
 F\Delta x &= f\Delta x + w\Delta x(0,5) \checkmark \checkmark
 \end{aligned}$$

(4)

2.4

POSITIVE MARKING FROM QUESTION 2.3 /**POSITIEWE NASIEN VANAF VRAAG 2.3**

116 N / $f + w_{\parallel} \checkmark$ Down the incline/opposite to direction of motion / Teen die helling af / in teenoorgestelde rigting van beweging $\checkmark$

ACCEPT/AANVAAR:

Downwards/down/Afwaarts/af

(2)

2.5

POSITIVE MARKING FROM QUESTION 2.4 /**POSITIEWE NASIEN VANAF VRAAG 2.4****OPTION 1/OPSIE 1****Up the incline positive/Teen skuinsvlak op positief**

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 -116 &= 20a \checkmark \\
 a &= -5,80 \text{ m}\cdot\text{s}^{-2}
 \end{aligned}$$

$$\begin{aligned}
 v_f^2 &= v_i^2 + 2a\Delta x \checkmark \\
 0 &= (2)^2 + (2)(-5,8)\Delta x \checkmark \\
 \Delta x &= 0,34 \text{ m} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 v_f &= v_i + \Delta t \\
 0 &= 2 + (-5,8)\Delta t \\
 \Delta t &= 0,34 \text{ s}
 \end{aligned}$$

OR/OF

$$\begin{aligned}
 F_{\text{net}}\Delta t &= m(v_f - v_i) \\
 (-116)\Delta t &= (20)(0 - 2) \\
 \Delta t &= 0,34 \text{ s}
 \end{aligned}$$

$$\begin{aligned}
 \Delta x &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark \\
 &= (2)(0,34) + \frac{1}{2}(-5,8)(0,34)^2 \checkmark \\
 &= 0,34 \text{ m} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 v_f &= v_i + \Delta t \\
 0 &= 2 + (-5,8)\Delta t \\
 \Delta t &= 0,34 \text{ s}
 \end{aligned}$$

OR/OF

$$\begin{aligned}
 F_{\text{net}}\Delta t &= m(v_f - v_i) \\
 (-116)\Delta t &= (20)(0 - 2) \\
 \Delta t &= 0,34 \text{ s}
 \end{aligned}$$

$$\begin{aligned}
 \Delta x &= \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark \\
 &= \left(\frac{2 + 0}{2} \right) 0,34 \checkmark \\
 &= 0,34 \text{ m} \checkmark
 \end{aligned}$$

OPTION 1/OPSIE 1**Down the incline positive /Teen skuinsvlak af positief**

$$F_{\text{net}} = ma$$

$$116 = 20a \checkmark$$

$$a = 5,80 \text{ m} \cdot \text{s}^{-2}$$

$$v_f^2 = v_i^2 + 2a\Delta x \checkmark$$

$$0 = (-2)^2 + (2)(5,8)\Delta x \checkmark$$

$$\Delta x = -0,34 \text{ m}$$

Distance = 0,34 m $\checkmark$
Afstand

$$v_f = v_i + a\Delta t$$

$$0 = -2 + (5,8)\Delta t$$

$$\Delta t = 0,34 \text{ s}$$

OR/OF

$$F_{\text{net}}\Delta t = m(v_f - v_i)$$

$$(116)\Delta t = (20)(0 - (-2))$$

$$\Delta t = 0,34 \text{ s}$$

$$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$= (-2)(0,34) + \frac{1}{2}(5,8)(0,34)^2 \checkmark$$

$$= -0,34 \text{ m} \checkmark$$

Distance/*Afstand* = 0,34 m $\checkmark$

$$v_f = v_i + a\Delta t$$

$$0 = -2 + (5,8)\Delta t$$

$$\Delta t = 0,34 \text{ s}$$

OR/OF

$$F_{\text{net}}\Delta t = m(v_f - v_i)$$

$$(116)\Delta t = (20)(0 - (-2))$$

$$\Delta t = 0,34 \text{ s}$$

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{-2 + 0}{2} \right) 0,34 \checkmark$$

$$= -0,34 \text{ m} \checkmark$$

Distance/*Afstand* = 0,34 m $\checkmark$

OPTION 2/OPSIE 2

$$W_{\text{net}} = \Delta E_K$$

$$F_{\text{net}}\Delta x \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2) \checkmark \text{ Any one/Enige een}$$

$$(116)\Delta x \cos 180^\circ \checkmark = \frac{1}{2}(20)(0^2 - 2^2) \checkmark$$

$$\Delta x = 0,34 \text{ m} \checkmark$$

OPTION 3/OPSIE 3

$$W_{\text{net}} = \Delta E_K$$

$$W_f + W_{\text{wll}} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$f\Delta x \cos \theta + (mg \sin 30^\circ)\Delta x \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2) \checkmark \text{ Any one/Enige een}$$

$$(18)\Delta x \cos 180^\circ + (20)(9,8)\sin 30^\circ \Delta x \cos 180^\circ \checkmark = \frac{1}{2}(20)(0^2 - 2^2) \checkmark$$

$$\Delta x = 0,34 \text{ m} \checkmark$$

OPTION 4/OPSIE 4

$$W_{\text{net}} = \Delta E_K$$

$$W_f + W_w = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$f\Delta x \cos \theta + mg\Delta x \cos 120^\circ = \frac{1}{2}m(v_f^2 - v_i^2) \checkmark \text{ Any one/Enige een}$$

$$(18)\Delta x \cos 180^\circ + (20)(9,8)\Delta x \cos 120^\circ \checkmark = \frac{1}{2}(20)(0^2 - 2^2) \checkmark$$

$$\Delta x = 0,34 \text{ m} \checkmark$$

OPTION 5/OPSIE 5

$$W_{\text{nc}} = \Delta E_p + \Delta E_k$$

$$f\Delta x \cos \theta = mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2) \checkmark \text{ Any one/Enige een}$$

$$18\Delta x \cos 180^\circ \checkmark = 20(9,8)\Delta x + \frac{1}{2}(20)(0^2 - 2^2) \checkmark$$

$$-18\Delta x = 196\Delta x \sin 30^\circ - 40$$

$$\Delta x = 0,34 \text{ m} \checkmark$$

(4)
[16]

QUESTION 3/VRAAG 3

3.1 No/Nee ✓

ANY ONE/ENIGE EEN:

- Gravitational force is not the only force acting on the balloon. /There are other forces acting on the balloon. ✓
Gravitasiekrag is nie die enigste krag wat op die ballon inwerk nie./Daar is ander kragte wat op die ballon inwerk.
- Its acceleration is not $9,8 \text{ m}\cdot\text{s}^{-2}$ /is zero.
Sy versnelling is nie $9,8 \text{ m}\cdot\text{s}^{-2}$ /is nul.
- It has constant velocity/no acceleration.
Dit het 'n konstante snelheid/geen versnelling nie.

(2)

3.2.1

OPTION 1/OPSIE 1 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(-62,68)^2 = v_i^2 + 2(-9,8)(-200)$ ✓ $v_i = 2,96 \text{ m}\cdot\text{s}^{-1}$ ✓	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(62,68)^2 = v_i^2 + 2(9,8)(200)$ ✓ $v_i = -2,96 \text{ m}\cdot\text{s}^{-1}$ $= 2,96 \text{ m}\cdot\text{s}^{-1}$ ✓
OPTION 2/OPSIE 2 $(E_{\text{mech/meg}})_{200 \text{ m}} = (E_{\text{mech/meg}})_{\text{bottom/onder}}$ $(E_P + E_K)_{200 \text{ m}} = (E_P + E_K)_{\text{bottom/onder}}$ $(mgh + \frac{1}{2}mv^2)_{200 \text{ m}} = (mgh + \frac{1}{2}mv^2)_{\text{bottom/onder}}$ $m(9,8)(200) + \frac{1}{2}m(v^2) = 0 + \frac{1}{2}m(62,68)^2$ ✓ $v_i = 2,96 \text{ m}\cdot\text{s}^{-1}$ ✓	
NOTE/LET WEL Mass may be omitted during substitution. <i>Massa mag uitgelaat word tydens vervanging.</i>	
OPTION 3/OPSIE 3 $W_{\text{nc}} = \Delta E_p + \Delta E_k$ $0 = mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓ Any one/Enige een $0 = m(9,8)(0 - 200) + \frac{1}{2}m(62,68^2 - v_i^2)$ ✓ $v_i = 2,96 \text{ m}\cdot\text{s}^{-1}$ ✓	
NOTE/LET WEL Mass may be omitted during substitution. <i>Massa mag uitgelaat word tydens vervanging.</i>	
OPTION 4/OPSIE 4 $W_{\text{net}} = \Delta E_k$ $F_{\text{net}}\Delta x \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓ Any one/Enige een $mg\Delta x \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2)$ } $m(9,8)(200) = + \frac{1}{2}m(62,68^2 - v_i^2)$ ✓ $v_i = 2,96 \text{ m}\cdot\text{s}^{-1}$ ✓	
NOTE/LET WEL Mass may be omitted during substitution. <i>Massa mag uitgelaat word tydens vervanging.</i>	

(3)

3.2.2 POSITIVE MARKING FROM QUESTION 3.2.1/ POSITIEWE NASIEN VANAF VRAAG 3.2.1

Marking criteria/Nasienkriteria	
- Formula to calculate Δt of stone A ✓ <i>Formule om Δt van klip A te bereken</i> - Substitution to calculate Δt of stone A ✓ <i>Vervanging om Δt van klip A te bereken</i> - Final answer/<i>Finale antwoord</i>: 6,70 s ✓ Accept/Aanvaar: (6,69 to/tot 6,7)	
NOTE: The calculation of Δt for A might be split up into two parts. LET WEL: Die berekening van Δt vir A kan in twee dele opgedeel word.	
OPTION 1/OPSIE 1 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $v_f = v_i + a\Delta t$ ✓ $-62,68 = 2,96 + (-9,8)\Delta t$ ✓ $\Delta t = 6,70 \text{ s}$ ✓ (6,698)	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $v_f = v_i + a\Delta t$ ✓ $62,68 = -2,96 + 9,8\Delta t$ ✓ $\Delta t = 6,70 \text{ s}$ ✓ (6,698)
OPTION 2/OPSIE 2 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $-200 = (2,96)\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓ $\Delta t = 6,70 \text{ s}$ ✓ (6,697)	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $200 = (-2,96)\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓ $\Delta t = 6,70 \text{ s}$ ✓ (6,697)
OPTION 3/OPSIE 3 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $-200 = \left(\frac{+2,96 + (-62,68)}{2}\right)\Delta t$ ✓ $\Delta t = 6,70 \text{ s}$ ✓ (6,698)	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $200 = \left(\frac{-2,96 + 62,68}{2}\right)\Delta t$ ✓ $\Delta t = 6,70 \text{ s}$ ✓ (6,698)
OPTION 4/OPSIE 4 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF From 200 m upwards: <i>Vanaf 200 m opwaarts:</i> $v_f = v_i + a\Delta t$ ✓ $0 = 2,96 + (-9,8)\Delta t$ ✓ $\Delta t = 0,3 \text{ s}$ (0,302) From max h downwards: <i>Vanaf maks h afwaarts:</i> $v_f = v_i + a\Delta t$ $-62,68 = 0 + (-9,8)\Delta t$ $\Delta t = 6,40 \text{ s}$ (6,369) $t_A = 0,3 + 6,40 = 6,7 \text{ s}$ ✓	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF From 200 m upwards: <i>Vanaf 200 m opwaarts:</i> $v = v_i + a\Delta t$ ✓ $0 = -2,96 + (9,8)\Delta t$ ✓ $\Delta t = 0,3 \text{ s}$ (0,302) From max h downwards: <i>Vanaf maks h afwaarts:</i> $v_f = v_i + a\Delta t$ $62,68 = 0 + (9,8)\Delta t$ $\Delta t = 6,40 \text{ s}$ (6,369) $t_A = 0,3 + 6,40 = 6,7 \text{ s}$ ✓

OPTION 5/OPSIE 5 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF From 200 m upwards: <i>Vanaf 200 m opwaarts:</i> $v_f = v_i + a\Delta t$ ✓ $0 = 2,96 + (-9,8)\Delta t$ ✓ $\Delta t = 0,3 \text{ s } (0,302)$ From 200 m downwards: <i>Vanaf 200 m afwaarts:</i> $v_f = v_i + a\Delta t$ $-62,68 = -2,96 + (-9,8)\Delta t$ $\Delta t = 6,09 \text{ s } (6,094)$ $t_A = 2(0,3) + 6,09 = 6,69 \text{ s } ✓$	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF From 200 m upwards: <i>Vanaf 200 m opwaarts:</i> $v_f = v_i + a\Delta t$ ✓ $0 = -2,96 + (9,8)\Delta t$ ✓ $\Delta t = 0,3 \text{ s } (0,302)$ From 200 m downwards: <i>Vanaf 200 m afwaarts:</i> $v_f = v_i + a\Delta t$ $62,68 = 2,96 + (9,8)\Delta t$ $\Delta t = 6,09 \text{ s } (6,094)$ $t_A = 2(0,3) + 6,09 = 6,69 \text{ s } ✓$
OPTION 6/OPSIE 6 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $F_{\text{net}}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $g\Delta t = v_f - v_i$ $(-9,8)\Delta t = (-62,68) - (2,96)$ ✓ $\Delta t = 6,69 \text{ s } ✓$	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $F_{\text{net}}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $g\Delta t = v_f - v_i$ $(9,8)\Delta t = 62,68 - (-2,96)$ ✓ $\Delta t = 6,69 \text{ s } ✓$

(3)

3.2.3 **POSITIVE MARKING FROM QUESTION 3.2.1 and QUESTION 3.2.2/**
POSITIEWE NASIEN VANAF VRAAG 3.2.1 en VRAAG 3.2.2

Marking criteria/Nasienkriteria

- Formula to calculate Δy of stone **B** ✓
*Formule om Δy van klip **B** te bereken*
- Substitution of $t = 1,7 \text{ s}$ ✓ ($t_A - 5$)
Vervanging van $t = 1,7 \text{ s}$ ($t_A - 5$)
- Substitution to calculate Δy of stone **B** ✓
*Vervanging om Δy van klip **B** te bereken*
- Substitution to calculate Δy of balloon ✓
Vervanging om Δy van ballon te bereken
- Calculating distance between balloon and stone **B** ✓
*Berekening van afstand tussen ballon en klip **B***
- Final answer/*Finale antwoord*: 14,16 m ✓ (14,11 to/tot 14,16)

OPTION 1/OPSIE 1

**UPWARDS AS POSITIVE/
 OPWAARTS AS POSITIEF**

Stone B/Klip B:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= \underline{2,96(6,7 - 5) + \frac{1}{2}(-9,8)(6,7 - 5)^2} \checkmark$$

$$= -9,13 \text{ m } (-9,09 \text{ to/tot } -9,13)$$

Distance travelled by stone **B**: 9,13 m

*Afstand afgelê deur klip **B**: 9,13 m*

Hot-air balloon/Lugballon

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$= \underline{2,96(6,7 - 5)} \checkmark + 0$$

$$= 5,03 \text{ m}$$

Distance travelled by hot-air balloon/

Afstand afgelê deur lugballon: 5,03 m

Distance between hot-air balloon and stone **B**/

*Afstand tussen lugballon en klip **B** = $\underline{9,13 + 5,03}$ ✓*

$$= 14,16 \text{ m } \checkmark (14,11 - 14,16)$$

**DOWNWARDS AS POSITIVE/
 AFWAARTS AS POSITIEF**

Stone B/Klip B:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= \underline{-2,96(6,7 - 5) + \frac{1}{2}(9,8)(6,7 - 5)^2} \checkmark$$

$$= 9,13 \text{ m } (9,09 \text{ to/tot } 9,13)$$

Distance travelled by stone **B**: 9,13 m

*Afstand afgelê deur klip **B**: 9,13 m*

Hot-air balloon/Lugballon

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$= \underline{-2,96(6,7 - 5)} \checkmark + 0$$

$$= -5,03 \text{ m}$$

Distance travelled by hot-air balloon/

Afstand afgelê deur lugballon: 5,03 m

Distance between hot-air balloon and stone **B**/

*Afstand tussen lugballon en klip **B** = $\underline{9,13 + 5,03}$ ✓*

$$= 14,16 \text{ m } \checkmark (14,11 - 14,16)$$

OPTION 2/OPSIE 2 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF Stone B/Klip B: $v_f = v_i + a\Delta t$ $= 2,96 + (-9,8)(6,70 - 5)$ $= -13,7 \text{ m}\cdot\text{s}^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(-13,7)^2 = (2,96)^2 + 2(-9,8)\Delta y$ ✓ $\Delta y = -9,13 \text{ m}$ Distance travelled by stone B: 9,13 m <i>Afstand afgelê deur klip B</i>: 9,13 m Hot-air balloon/Lugballon $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= -2,96(6,70 - 5) + 0$ ✓ $= -5,03 \text{ m}$ Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon</i>: 5,03 m Distance between hot-air balloon and stone B/<i>Afstand afgelê deur lugballon en klip B</i> = 9,13 + 5,03 ✓ $= 14,16 \text{ m}$ ✓ (14,11 - 14,16)	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF Stone B/Klip B: $v_f = v_i + a\Delta t$ $= -2,96 + (9,8)(6,70 - 5)$ $= 13,7 \text{ m}\cdot\text{s}^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(13,7)^2 = (-2,96)^2 + 2(9,8)\Delta y$ ✓ $\Delta y = 9,13 \text{ m}$ Distance travelled by stone B: 9,13 m <i>Afstand afgelê deur klip B</i>: 9,13 m Hot-air balloon/Lugballon $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= -2,96(6,70 - 5) + 0$ ✓ $= -5,03 \text{ m}$ Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon</i>: 5,03 m Distance between hot-air balloon and stone B/<i>Afstand afgelê deur lugballon en klip B</i> = 9,13 + 5,03 ✓ $= 14,16 \text{ m}$ ✓ (14,11 - 14,16)
OPTION 3/OPSIE 3 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF Stone B/Klip B: $v_f = v_i + a\Delta t$ $= 2,96 + (-9,8)(6,70 - 5)$ $= -13,7 \text{ m}\cdot\text{s}^{-1}$ $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\frac{+2,96 + (-13,7)}{2}\right)(6,70 - 5)$ ✓ $= -9,13 \text{ m}$ Distance travelled by stone B: 9,13 m <i>Afstand afgelê deur klip B</i>: 9,13 m Hot-air balloon/Lugballon $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= 2,96(6,70 - 5) + 0$ ✓ $= 5,03 \text{ m}$ Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon</i>: 5,03 m Distance between hot-air balloon and stone B/<i>Afstand afgelê deur lugballon en klip B</i> = 9,13 + 5,03 ✓ $= 14,16 \text{ m}$ ✓ (14,11 - 14,16)	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF Stone B/Klip B: $v_f = v_i + a\Delta t$ $= -2,96 + (9,8)(6,70 - 5)$ $= 13,7 \text{ m}\cdot\text{s}^{-1}$ $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\frac{-2,96 + (13,7)}{2}\right)(6,70 - 5)$ ✓ $= 9,13 \text{ m}$ Distance travelled by stone B: 9,13 m <i>Afstand afgelê deur klip B</i>: 9,13 m Hot-air balloon/Lugballon $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= -2,96(6,70 - 5) + 0$ ✓ $= -5,03 \text{ m}$ Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon</i>: 5,03 m Distance between hot-air balloon and stone B/<i>Afstand afgelê deur lugballon en klip B</i> = 9,13 + 5,03 ✓ $= 14,16 \text{ m}$ ✓ (14,11 - 14,16)

OPTION 4/OPSIE 4 UPWARDS POSITIVE/ OPWAARTS POSITIEF: Stone B/Klip B: $v_f = v_i + a\Delta t$ $= 2,96 + (-9,8)(6,70 - 5) \checkmark$ $= -13,7 \text{ m}\cdot\text{s}^{-1}$ Balloon's height after 5 s: 214,8 m <i>Ballon se hoogte na 5 s: 214,8 m</i> $E_{\text{mech/meg}})_{214,8 \text{ m}} = (E_{\text{mech/meg}})_{1,7 \text{ s}}$ $(E_P + E_K)_{214,8 \text{ m}} = (E_P + E_K)_{1,7 \text{ s}} \checkmark$ $(mgh + \frac{1}{2}mv^2) = (mgh + \frac{1}{2}mv^2)_{1,7 \text{ s}}$ $(9,8)(214,8) + \frac{1}{2}(2,96)^2 =$ $(9,8)h + \frac{1}{2}(13,7)^2 \checkmark$ $\therefore h = 205,67 \text{ m}$ Distance travelled by stone B/ <i>Afstand afgelê deur klip B:</i> $214,8 - 205,67 = 9,13 \text{ m}$ Hot-air balloon/Lugballon $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= \underline{2,96(6,70 - 5)} \checkmark + 0$ $= 5,03 \text{ m}$ Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon: 5,03 m</i> Distance between hot-air balloon and stone B/<i>Afstand tussen lugballon en</i> <i>klip B: 9,13 + 5,03</i> $\checkmark = 14,16 \text{ m} \checkmark$ <i>(14,11 to/tot 14,16)</i>	DOWNWARDS POSITIVE/ AFWAARTS POSITIEF: Stone B/Klip B: $v_f = v_i + a\Delta t$ $= -2,96 + (9,8)(6,70 - 5) \checkmark$ $= 13,7 \text{ m}\cdot\text{s}^{-1}$ Balloon's height after 5 s: 214,8 m <i>Ballon se hoogte na 5 s: 214,8 m</i> $(E_{\text{mech/meg}})_{214,8 \text{ m}} = (E_{\text{mech/meg}})_{1,7 \text{ s}}$ $(E_P + E_K)_{214,8 \text{ m}} = (E_P + E_K)_{1,7 \text{ s}} \checkmark$ $(mgh + \frac{1}{2}mv^2) = (mgh + \frac{1}{2}mv^2)_{1,7 \text{ s}}$ $(9,8)(214,8) + \frac{1}{2}(2,96)^2 =$ $(9,8)h + \frac{1}{2}(13,7)^2 \checkmark$ $\therefore h = 205,67 \text{ m}$ Distance travelled by stone B/ <i>Afstand afgelê deur klip B:</i> $214,8 - 205,67 = 9,13 \text{ m}$ Hot-air balloon/Lugballon $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= \underline{-2,96(6,70 - 5)} \checkmark + 0$ $= -5,03 \text{ m}$ Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon: 5,03 m</i> Distance between hot-air balloon and stone B/<i>Afstand tussen lugballon en</i> <i>klip B: 9,13 + 5,03</i> $\checkmark = 14,16 \text{ m} \checkmark$ <i>(14,11 to/tot 14,16)</i>

OPTION 5/OPSIE 5 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF Stone B/Klip B: $v_f = v_i + a\Delta t$ $= 2,96 + (-9,8)(6,70 - 5)$ $= -13,7 \text{ m}\cdot\text{s}^{-1}$ $W_{\text{net}} = \Delta E_K$ ✓ $F_{\text{net}}\Delta x \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $= \frac{1}{2}m(v_f^2 - v_i^2)$ $(9,8)\Delta h \cos 0^\circ = \frac{1}{2}(13,7^2 - 2,96^2)$ ✓ $\Delta h = 9,13 \text{ m}$ Distance travelled by stone B/ <i>Afstand afgelê deur klip B:</i> 9,13 m Hot-air balloon/Lugballon $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= 2,96(6,70 - 5)$ ✓ + 0 $= 5,03 \text{ m}$ Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon:</i> 5,03 m Distance between hot-air balloon and stone B/Afstand tussen lugballon en <i>klip B:</i> $9,13 + 5,03$ ✓ = 14,16 m ✓ (14,11 to/tot 14,16)	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF Stone B/Klip B: $v_f = v_i + a\Delta t$ $= -2,96 + (9,8)(6,70 - 5)$ $= 13,7 \text{ m}\cdot\text{s}^{-1}$ $W_{\text{net}} = \Delta E_K$ ✓ $F_{\text{net}}\Delta x \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $= \frac{1}{2}m(v_f^2 - v_i^2)$ $(9,8)\Delta h \cos 0^\circ = \frac{1}{2}(13,7^2 - 2,96^2)$ ✓ $\Delta h = 9,13 \text{ m}$ Distance travelled by stone B/ <i>Afstand afgelê deur klip B:</i> 9,13 m Hot-air balloon/Lugballon $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= -2,96(6,70 - 5)$ ✓ + 0 $= -5,03 \text{ m}$ Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon:</i> 5,03 m Distance between hot-air balloon and stone B/Afstand tussen lugballon en <i>klip B:</i> $9,13 + 5,03$ ✓ = 14,16 m ✓ (14,11 to/tot 14,16)
OPTION 6/OPSIE 6 Using relative velocities/Deur relatiewe snelhede te gebruik: UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= (2,96 - 2,96)(1,7) + \frac{1}{2}(-9,8)(1,7)^2$ $= -14,16 \text{ m}$ Distance between hot-air balloon and stone B/Afstand tussen lugballon en <i>klip B:</i> 14,16 m ✓	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= (2,96 - 2,96)(1,7) + \frac{1}{2}(9,8)(1,7)^2$ $= 14,16 \text{ m}$ ✓

OPTION 7/OPSIE 7**UPWARDS AS POSITIVE/****OPWAARTS AS POSITIEF**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= \underline{(2,96)(1,7) + \frac{1}{2} (-9,8)(1,7)^2} \checkmark$$

$$= -9,13 \text{ m}$$

Distance travelled by stone **B**: 9,13 mAfstand afgelê deur klip **B**: 9,13 m**DOWNWARDS AS POSITIVE/****AFWAARTS AS POSITIEF**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= \underline{(-2,96)(1,7) + \frac{1}{2} (9,8)(1,7)^2} \checkmark$$

$$= 9,13 \text{ m}$$

Height of stone B from the ground = $200 + 14,8 - 9,13 = 205,63 \text{ m}$

Hoogte van klip B vanaf die grond:

Height of balloon from the ground = $200 + (6,7)(2,96) \checkmark = 219,83 \text{ m}$

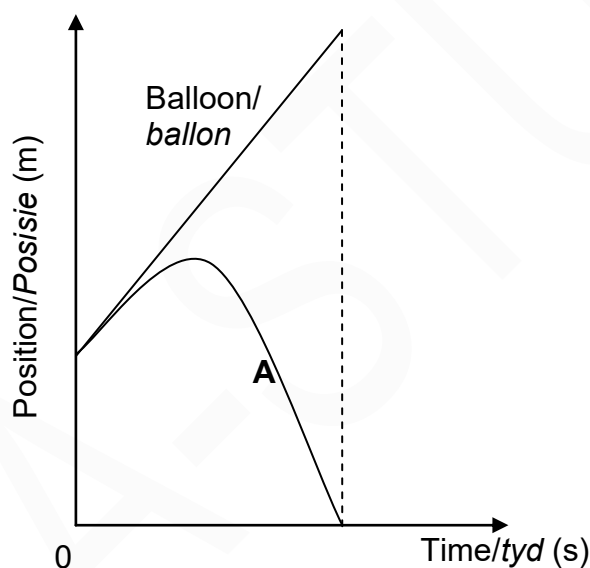
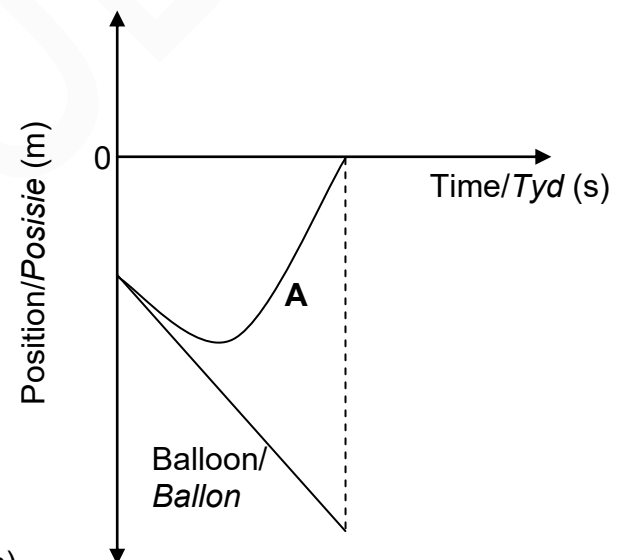
Hoogte van ballon vanaf die grond:

Distance between B and the balloon = $219,83 - 205,63 \checkmark = 14,16 \text{ m} \checkmark$

Afstand tussen B en die ballon:

(6)

3.3

**UPWARDS POSITIVE
OPWAARTS POSITIEF****DOWNWARDS POSITIVE
AFWAARTS POSITIEF**

Criteria for graph/Kriteria vir grafiek	
Correct shape for stone A not starting from 0 m./Korrekte vorm vir klip A wat nie by 0 m begin nie.	✓
Correct shape and initial position for hot-air balloon. /Korrekte vorm en aanvanklike posisie vir lugballon.	✓
Gradient for hot-air balloon is higher than that of stone A until stone A reaches the maximum height./Gradiënt vir lugballon is groter as dié vir klip A totdat klip A sy maksimum hoogte bereik.	✓
Both graphs starting at the same position and ending at the same time. / Beide grafieke begin by dieselfde posisie en eindig by dieselfde tyd.	✓

(4)
[18]

QUESTION 4/VRAAG 4

4.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark. /Indien enige van die onderstreepte sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.

NOTE/LET WEL

If "total" is omitted: minus 1 mark / Indien "totaal" uitgelaat is: minus 1 punt

A collision in which both the total momentum and total kinetic energy are conserved. ✓✓

'n Botsing waar die totale momentum en die totale kinetiese energie behoue bly.

(2)

4.2

OPTION 1/OPSIE 1

$$\sum E_{Ki} = \sum E_{Kf}$$

$$\frac{1}{2}m_1v_{i1}^2 + \frac{1}{2}m_2v_{i2}^2 = \frac{1}{2}m_1v_{f1}^2 + \frac{1}{2}m_2v_{f2}^2 \quad \left. \begin{array}{l} \text{✓ Any one/Enige een} \\ \frac{1}{2}m_xv_{ix}^2 + \frac{1}{2}m_yv_{iy}^2 = \frac{1}{2}m_xv_{fx}^2 + \frac{1}{2}m_yv_{fy}^2 \end{array} \right\}$$

$$\frac{1}{2}(10)(2)^2 + \frac{1}{2}(2)v_{iy}^2 \quad \checkmark = 0 + 36 \quad \checkmark$$

$$v_y = \pm 4 \text{ m} \cdot \text{s}^{-1}$$

$$v_y = 4 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \quad \text{west/wes} \quad \checkmark$$

ACCEPT/AANVAAR: left/links**OPTION 2/OPSIE 2**

$$E_{Ki} = \frac{1}{2} m_Y v_f^2$$

$$36 = \frac{1}{2} (2) v_f^2$$

$$v_f = 6 \text{ m} \cdot \text{s}^{-1}$$

$$\sum p_i = \sum p_f$$

$$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f} \quad \left. \begin{array}{l} \text{✓ Any one/Enige een} \\ m_xv_{xi} + m_yv_{yi} = m_xv_{xf} + m_yv_{yf} \end{array} \right\}$$

$$m_xv_{xi} + m_yv_{yi} = m_xv_{xf} + m_yv_{yf}$$

$$(10)(2) + (2)v_y \quad \checkmark = 0 + (2)(6) \quad \checkmark$$

$$v_y = -4 \text{ m} \cdot \text{s}^{-1}$$

$$v_y = 4 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \quad \text{west/wes} \quad \checkmark$$

ACCEPT/AANVAAR: left/links**OPTION 3/OPSIE 3**

$$E_{Ki} = \frac{1}{2} m_Y v_f^2$$

$$36 = \frac{1}{2} (2) v_f^2$$

$$v_f = 6 \text{ m} \cdot \text{s}^{-1}$$

$$\Delta p_x = -\Delta p_y$$

$$m_x(v_{xf} - v_{xi}) = -m_y(v_{yf} - v_{yi}) \quad \left. \begin{array}{l} \text{✓ Any one/Enige een} \\ m_x(v_{xf} - v_{xi}) = -m_y(v_{yf} - v_{yi}) \end{array} \right\}$$

$$(10)(0 - 2) \quad \checkmark = -(2)(6 - v_y) \quad \checkmark$$

$$v_{yf} = -4 \text{ m} \cdot \text{s}^{-1}$$

$$v_y = 4 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \quad \text{west/wes} \quad \checkmark$$

ACCEPT/AANVAAR: left/links

(5)

4.3

POSITIVE MARKING FROM QUESTION 4.2 FOR Y; OPTIONS 1, 3 and 6
POSITIEWE NASIEN VANAF VRAAG 4.2 VIR Y; OPSIES 1, 3 en 6

OPTION 1/OPSIE 1 EAST POSITIVE/OOS POSITIEF: For Y/Vir Y: $F_{\text{net}}\Delta t = \Delta p$ $F_{\text{net}}\Delta t = m(v_f - v_i)$ } ✓ Any one/ Enige een $F_{\text{net}}(0,1) = 2\{6 - (-4)\}$ ✓ $F_{\text{net}} = 200 \text{ N}$ ✓	WEST POSITIVE/WES POSITIEF: For Y/Vir Y: $F_{\text{net}}\Delta t = \Delta p$ $F_{\text{net}}\Delta t = m(v_f - v_i)$ } ✓ Any one/ Enige een $F_{\text{net}}(0,1) = 2\{-6 - 4\}$ ✓ $F_{\text{net}} = -200 \text{ N}$ $F_{\text{net}} = 200 \text{ N}$ ✓
OPTION 2/OPSIE 2 EAST POSITIVE/OOS POSITIEF: For X/Vir X: $F_{\text{net}}\Delta t = \Delta p$ $F_{\text{net}}\Delta t = m(v_f - v_i)$ } ✓ Any one/ Enige een $F_{\text{net}}(0,1) = 10(0 - 2)$ ✓ $F_{\text{net}} = -200 \text{ N}$ $F_{\text{net}} = 200 \text{ N}$ ✓	WEST POSITIVE/WES POSITIEF For X/Vir X: $F_{\text{net}}\Delta t = \Delta p$ $F_{\text{net}}\Delta t = m(v_f - v_i)$ } ✓ Any one/ Enige een $F_{\text{net}}(0,1) = 10\{0 - (-2)\}$ ✓ $F_{\text{net}} = 200 \text{ N}$ ✓
OPTION 3/OPSIE 3 EAST POSITIVE/OOS POSITIEF: For Y/Vir Y: $v_f = v_i + a\Delta t$ $6 = -4 + a(0,1)$ $a = 100 \text{ m}\cdot\text{s}^{-2}$ $F_{\text{net}} = ma$ ✓ $= \underline{2(100)}$ ✓ $= 200 \text{ N}$ ✓	WEST POSITIVE/WES POSITIEF For Y/Vir Y: $v_f = v_i + a\Delta t$ $-6 = 4 + a(0,1)$ $a = -100 \text{ m}\cdot\text{s}^{-2}$ $F_{\text{net}} = ma$ ✓ $= \underline{2(-100)}$ ✓ $= -200 \text{ N}$ $F_{\text{net}} = 200 \text{ N}$ ✓
OPTION 4/OPSIE 4 EAST POSITIVE/OOS POSITIEF: For X/Vir X: $v_f = v_i + a\Delta t$ $0 = 2 + a(0,1)$ $a = -20 \text{ m}\cdot\text{s}^{-2}$ $F_{\text{net}} = ma$ ✓ $= \underline{10(-20)}$ ✓ $= -200 \text{ N}$ $F_{\text{net}} = 200 \text{ N}$ ✓	WEST POSITIVE/WES POSITIEF For X/Vir X: $v_f = v_i + a\Delta t$ $0 = -2 + a(0,1)$ $a = 20 \text{ m}\cdot\text{s}^{-2}$ $F_{\text{net}} = ma$ ✓ $= \underline{10(20)}$ ✓ $F_{\text{net}} = 200 \text{ N}$ ✓
OPTION 5/OPSIE 5 EAST POSITIVE/OOS POSITIEF: For X/Vir X: $v_f = v_i + a\Delta t \qquad v_f^2 = v_i^2 + 2a\Delta x \qquad \Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$ $0 = 2 + a(0,1) \qquad 0 = (2)^2 + 2(-20)\Delta x \qquad = \left(\frac{0+2}{2}\right)(0,1)$ $a = -20 \text{ m}\cdot\text{s}^{-2} \qquad \Delta x = 0,10 \text{ m} \qquad = 0,10 \text{ m}$ $W_{\text{net}} = \Delta E_k \checkmark$ $F_{\text{net}}\Delta x \cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$ $F_{\text{net}}(0,1)\cos 180^\circ = \frac{1}{2} (10)(0^2 - 2^2) \checkmark$ $F_{\text{net}} = 200 \text{ N} \checkmark$	

OPTION 5/OPSIE 5**WEST POSITIVE/WES POSITIEF:**

For X/Vir X:

$$v_f = v_i + a\Delta t$$

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$\Delta x = \left(\frac{v_f + v_i}{2} \right) \Delta t$$

$$0 = -2 + a(0,1)$$

$$0 = (-2)^2 + 2(20)\Delta x$$

$$= \left(\frac{0 + (-2)}{2} \right) (0,1)$$

$$a = 20 \text{ m}\cdot\text{s}^{-2}$$

$$\Delta x = -0,10 \text{ m}$$

$$= -0,10 \text{ m}$$

$$W_{\text{net}} = \Delta E_k \checkmark$$

$$F_{\text{net}}\Delta x \cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$F_{\text{net}}(0,1)\cos 180^\circ = \frac{1}{2} (10)(0^2 - 2^2) \checkmark$$

$$F_{\text{net}} = 200 \text{ N} \checkmark$$

OPTION 6/OPSIE 6**EAST POSITIVE/OOS POSITIEF:**

For Y/Vir Y:

$$v_f = v_i + a\Delta t$$

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$\Delta x = \left(\frac{v_f + v_i}{2} \right) \Delta t$$

$$6 = -4 + a(0,1)$$

$$(6)^2 = (-4)^2 + 2(100)\Delta x$$

$$= \left(\frac{6 - 4}{2} \right) (0,1)$$

$$a = 100 \text{ m}\cdot\text{s}^{-2}$$

$$\Delta x = 0,10 \text{ m}$$

$$= 0,10 \text{ m}$$

$$W_{\text{net}} = \Delta E_k \checkmark$$

$$F_{\text{net}}\Delta x \cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$F_{\text{net}}(0,1)\cos 0^\circ = \frac{1}{2} (2)(6^2 - (-4)^2) \checkmark$$

$$F_{\text{net}} = 200 \text{ N} \checkmark$$

OPTION 6/OPSIE 6**WEST POSITIVE/WES POSITIEF:**

For Y/Vir Y:

$$v_f = v_i + a\Delta t$$

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$\Delta x = \left(\frac{v_f + v_i}{2} \right) \Delta t$$

$$-6 = 4 + a(0,1)$$

$$(-6)^2 = (4)^2 + 2(-100)\Delta x$$

$$= \left(\frac{-6 + 4}{2} \right) (0,1)$$

$$a = -100 \text{ m}\cdot\text{s}^{-2}$$

$$\Delta x = -0,10 \text{ m}$$

$$= -0,10 \text{ m}$$

$$W_{\text{net}} = \Delta E_k \checkmark$$

$$F_{\text{net}}\Delta x \cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$F_{\text{net}}(0,1)\cos 0^\circ = \frac{1}{2} (2)((-6)^2 - (4)^2) \checkmark$$

$$F_{\text{net}} = 200 \text{ N} \checkmark$$

(3)
[10]

QUESTION 5/VRAAG 5

5.1

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark. /Indien enige van die onderstreepte sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.

ACCEPT/AANVAAR

For isolated system:

- Closed system/Geslote sisteem.
- Only conservative forces act on the system/Slegs konserwatiewe kragte werk in op die sisteem.
- No external forces act on system/Geen eksterne kragte werk in op die sisteem.

The total mechanical energy in an isolated system remains constant / the same. ✓✓

Die totale meganiese energie in 'n geïsoleerde sisteem bly konstant / dieselfde.

OR/OF

The sum of the kinetic and gravitational potential energies in an isolated system remains constant/the same.

Die som van die kinetiese en gravitasie potensiële energie in 'n geïsoleerde/geslote sisteem bly konstant/dieselfde.

(2)

5.2

NOTE/LET WEL

- Mass may be omitted during substitution. /Massa mag uitgelaat word tydens vervanging.
- If equations of motion are used. Max 1/3 for correct answer. / Indien bewegingsvergelykings gebruik word. Maks 1/3 vir korrekte antwoord.

OPTION 1/OPSIE 1

$$E_{P/mech\ top/meg\ bo} = E_{Q/mech\ ground\ /meg\ grond}$$

$$(E_p + E_k)_{P/top/bo} = (E_p + E_k)_{Q/bottom/onder}$$

$$(mgh + \frac{1}{2}mv^2)_{P/top/bo} = (mgh + \frac{1}{2}mv^2)_{Q/bottom/onder}$$

$$(2)(9,8)(5) + 0 = 0 + \frac{1}{2}(2)v_f^2 \quad \checkmark$$

$$v_f = 9,90\ m \cdot s^{-1} \quad \checkmark \quad (9,899)$$

} ✓ Any one/Enige een

OPTION 2/OPSIE 2

$$\Delta E_p + \Delta E_k = 0$$

$$(mgh_f - mgh_i) + \frac{1}{2}m(v_f^2 - v_i^2) = 0$$

$$0 - (2)(9,8)(5) + \frac{1}{2}(2)(v_f^2 - 0) \quad \checkmark = 0$$

$$v_f = 9,90\ m \cdot s^{-1} \quad \checkmark \quad (9,899)$$

} ✓ Any one/Enige een

(3)

5.3

POSITIVE MARKING FROM QUESTION 5.2.**POSITIEWE NASIEN VANAF VRAAG 5.2.****OPTION 1/OPSIE 1**

$$W_{net} = \Delta E_k$$

$$W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$W_N + W_f + W_w = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$f\Delta x \cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$f(10)\cos 180^\circ \quad \checkmark = \frac{1}{2}(2)(4^2 - 9,90^2) \quad \checkmark$$

$$f = 8,2\ N \quad \checkmark$$

} ✓ Any one/Enige een

OPTION 2/OPSIE 2

$$W_{nc} = \Delta E_K + \Delta E_p$$

$$W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$W_N + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$f\Delta x \cos\theta = \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i)$$

$$\underline{f(10)\cos 180^\circ} \checkmark = \underline{\frac{1}{2}(2)(4^2 - 9,90^2)} + 0 \checkmark$$

$$f = 8,2 \text{ N} \checkmark$$

✓ Any one/Enige een

(4)

5.4

LEFT NEGATIVE/LINKS NEGATIEF

$$F_{net}\Delta t = \Delta p$$

$$F_{net}\Delta t = mv_f - mv_i$$

$$F_{net}\Delta t = m(v_f - v_i)$$

$$\underline{-14 = 2(v_f - 4)} \checkmark$$

$$v_f = -3 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta E_K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark$$

$$= \underline{\frac{1}{2}(2)[(-3)^2 - 4^2]} \checkmark$$

$$= -7 \text{ J} \checkmark$$

ACCEPT/AANVAARImpulse/Impuls = $m\Delta v$ Do not penalise if +3 is substituted.
Moenie penaliseer indien +3 vervang is.**ACCEPT/AANVAAR**

$$\Delta E_K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark$$

$$= \underline{\frac{1}{2}(2)[(0)^2 - (-3)^2]} \checkmark$$

$$= -9 \text{ J} \checkmark$$

Do not penalise if +3 is substituted.
Moenie penaliseer indien +3 vervang is.**RIGHT NEGATIVE/REGS NEGATIEF**

$$F_{net}\Delta t = \Delta p$$

$$F_{net}\Delta t = mv_f - mv_i$$

$$F_{net}\Delta t = m(v_f - v_i)$$

$$\underline{14 = 2(v_f - (-4))} \checkmark$$

$$v_f = 3 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta E_K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark$$

$$= \underline{\frac{1}{2}(2)[(3)^2 - (-4)^2]} \checkmark$$

$$= -7 \text{ J} \checkmark$$

ACCEPT/AANVAARImpulse/Impuls = $m\Delta v$ Do not penalise if +4 is substituted.
Moenie penaliseer indien +4 vervang is.**ACCEPT/AANVAAR**

$$\Delta E_K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark$$

$$= \underline{\frac{1}{2}(2)[(0)^2 - (-3)^2]} \checkmark$$

$$= -9 \text{ J} \checkmark$$

Do not penalise if +3 is substituted.
Moenie penaliseer indien +3 vervang is.

(5)

[14]

QUESTION 6/VRAAG 6

6.1 $v = f\lambda$ ✓
 $340 = 680\lambda$ ✓
 $\lambda = 0,5 \text{ m}$ ✓

(3)

6.2

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark. *Indien enige van die onderstreepte sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.*

The change in frequency/pitch/wavelength of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓

Die verandering in frekwensie/toonhoogte/golflengte van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klank voortplanting het.

OR/OF

An (apparent) change in observed/detected frequency/pitch/wavelength, as a result of the relative motion between a source and an observer (listener). ✓✓

'n (Skynbare) verandering in waargenome frekwensie/toonhoogte/golflengte as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/luisteraar.

(2)

6.3.1 Decreased/Afgeneem ✓

(1)

6.3.2 Increased/Toegeneem ✓

(1)

6.4 **POSITIVE MARKING FROM QUESTION 6.1 /**
POSITIEWE NASIEN VANAF VRAAG 6.1

OPTION 1/OPSIE 1

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR } f_L = \frac{v}{v - v_s} f_s \checkmark$$

$$f_L = \frac{v}{\lambda_L} \checkmark$$

$$= \frac{340}{0,5 - 0,05} \checkmark$$

$$= \frac{340}{0,45}$$

$$= 755,56 \text{ Hz}$$

$$755,56 = \left(\frac{340 + 0}{340 - v_s} \right) 680 \checkmark$$

$$v_s = 34 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (33,67 - 34,04)$$

OPTION 2/OPSIE 2

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR } f_L = \frac{v}{v - v_s} f_s \checkmark$$

$$\frac{v}{\lambda_L} = \left(\frac{v + 0}{v - v_s} \right) f_s$$

$$\frac{340}{0,5 - 0,05} = \left(\frac{340 + 0}{340 - v_s} \right) 680 \checkmark$$

$$\frac{340}{0,45} = \left(\frac{340 + 0}{340 - v_s} \right) 680$$

$$v_s = 34 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (33,67 - 34,04)$$

OPTION 3/OPSIE 3	OPTION 4/OPSIE 4
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR } f_L = \frac{v}{v - v_s} f_s \checkmark$ $\frac{v}{\lambda_L} = \left(\frac{v+0}{v-v_s} \right) \frac{v}{\lambda_s}$ $\therefore \frac{1}{\lambda_L} = \left(\frac{v+0}{v-v_s} \right) \frac{1}{\lambda_s}$ $\left(\frac{1}{0,5 - 0,05} \right) \checkmark = \left(\frac{340+0}{340-v_s} \right) \frac{1}{0,5} \checkmark$ $\frac{1}{0,45} = \left(\frac{340+0}{340-v_s} \right) \frac{1}{0,5}$ $v_s = 34 \text{ m}\cdot\text{s}^{-1} \checkmark \quad (33,67 - 34,04)$	$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR } f_L = \frac{v}{v - v_s} f_s \checkmark$ $v_1 = v_2$ $f_s \lambda_1 = f_L \lambda_2$ $(600)(0,5) = f_L(0,45) \checkmark$ $f_L = 755,56 \text{ Hz}$ $755,56 = \left(\frac{340+0}{340-v_s} \right) 680 \checkmark$ $v_s = 34 \text{ m}\cdot\text{s}^{-1} \checkmark \quad (33,67 - 34,04)$

(5)
[12]

QUESTION 7/VRAAG 7

7.1.1 Added/Toegevoeg $\checkmark$

(1)

7.1.2

NOTE/LET WEL

Ignore signs of the charges./ Ignoreer tekens van die ladings.

$$n = \frac{Q}{q_e} \checkmark$$

$$= \frac{-1,95 \times 10^{-6}}{-1,6 \times 10^{-19}} \checkmark$$

$$= 1,22 \times 10^{13} \checkmark \quad (1,21875 \times 10^{13})$$

(3)

7.1.3

Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.

The (electrostatic) force experienced per unit positive charge placed at that point.

Die (elektrostatiese) krag per eenheid positiewe lading wat by die punt geplaas is.

NOTE/LET WEL (1 mark for:/1 punt vir:)

An electric field is a region of space in which an electric charge experiences a force.

'n Gebied in die ruimte waarin 'n elektriese lading 'n krag ondervind.

(2)

7.1.4

$$E = \frac{kQ}{r^2} \checkmark$$

$$= \frac{(9 \times 10^9)(1,95 \times 10^{-6})}{(0,5)^2} \checkmark$$

$$= 7,02 \times 10^4 \text{ N}\cdot\text{C}^{-1} \checkmark$$

(3)

7.2

OPTION 1/OPSIE 1**Marking criteria/Nasienkriteria:**

- Coulomb's Law formula/Coulomb se formule ✓
- Correct substitution for F_{q1} **OR** F_{q2} into $\frac{kQ_1Q_2}{r^2}$ ✓
*Korrekte substitusie van F_{q1} **OF** F_{q2} in $\frac{kQ_1Q_2}{r^2}$*
- Correct substitution of 1,38 N for $F_{(net)}$ /*Korrekte substitusie van 1,38 N vir $F_{(net)}$* ✓
- Subtracting (vector addition) electrostatic forces /*Aftrek (vektoraddisie) van elektrostatiese kragte* ✓
- Final answer/*Finale antwoord*: $1,11 \times 10^{-7} \text{ C}$ ✓ ($1,106 \times 10^{-7} \text{ C}$)

$$F_{E(net)} = F_{q2} + F_{q1}$$

$$1,38 \checkmark = \left(+ \frac{kQ_1Q_2}{r^2} \right) + \left(- \frac{kQ_1Q_2}{r^2} \right) \checkmark$$

$$1,38 = \left(+ \frac{(9 \times 10^9)(1,95 \times 10^{-6})q_2}{(0,03)^2} \right) + \left(- \frac{(9 \times 10^9)(1,95 \times 10^{-6})q_2}{(0,05)^2} \right) \checkmark$$

$$q_2 = 1,11 \times 10^{-7} \text{ C} \checkmark (1,106 \times 10^{-7} \text{ C})$$

OPTION 2/OPSIE 2**Marking criteria/Nasienkriteria:**

- $E = \frac{kQ}{r^2}$ ✓
- Correct substitution of $7,08 \times 10^5 \text{ N} \cdot \text{C}^{-1}$ /*Korrekte substitusie van $7,08 \times 10^5 \text{ N} \cdot \text{C}^{-1}$* ✓
- Correct substitution for E_{q1} **OR** E_{q2} into $\frac{kQ_2}{r^2}$ ✓
*Korrekte substitusie van E_{q1} **OF** E_{q2} in $\frac{kQ_2}{r^2}$*
- Subtracting electric fields/*Aftrek van elektriese velde* ✓
- Final answer/*Finale antwoord*: $1,11 \times 10^{-7} \text{ C}$ ✓ ($1,106 \times 10^{-7} \text{ C}$)

$$E = \frac{F}{q} = \frac{1,38}{1,95 \times 10^{-6}}$$

$$= 7,08 \times 10^5 \text{ N} \cdot \text{C}^{-1} (707692,30)$$

$$E_{net} = E_{q2} + E_{q1}$$

$$7,08 \times 10^5 \checkmark = \left(+ \frac{kQ_2}{r^2} \right) + \left(- \frac{kQ_1}{r^2} \right) \checkmark$$

$$= \left(+ \frac{(9 \times 10^9)q_2}{(0,03)^2} \right) + \left(- \frac{(9 \times 10^9)q_1}{(0,05)^2} \right) \checkmark$$

$$q_2 = 1,11 \times 10^{-7} \text{ C} \checkmark (1,106 \times 10^{-7} \text{ C})$$

(5)
[14]

QUESTION 8/VRAAG 8

8.1.1 12 V ✓ (1)

8.1.2 0 (V) ✓ (1)

8.2 **Marking criteria/Nasienkriteria**

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.

The rate at which work is done or energy is expended/transferred.
Die tempo waarteen arbeid verrig word of energie oorgedra word.

(2)

8.3 **OPTION 1/OPSIE 1**

$$P = I^2 R \checkmark$$

$$5,76 = (1,2^2) R \checkmark$$

$$R = 4 \Omega \checkmark$$

OPTION 2/OPSIE 2

$$P = VI$$

$$5,76 = V(1,2)$$

$$V = 4,8 \text{ V}$$

$$P = \frac{V^2}{R} \checkmark$$

$$5,76 = \frac{(4,8)^2}{R} \checkmark$$

$$R = 4 \Omega \checkmark$$

$$V = IR \checkmark$$

$$4,8 = (1,2)R \checkmark$$

$$R = 4 \Omega \checkmark$$

(3)

8.4 **POSITIVE MARKING FROM QUESTION 8.3**
POSITIEWE NASIEN VANAF VRAAG 8.3**OPTION 1/OPSIE 1**

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{8,4} \checkmark$$

$$R_p = 3,5 \Omega$$

$$R_T = 3,5 + 4 \checkmark$$

$$= 7,5 \Omega \checkmark$$

OPTION 2/OPSIE 2

$$R_p = \frac{R_1 R_2}{R_1 + R_2}$$

$$R_p = \frac{(6)(8,4)}{6 + 8,4} \checkmark$$

$$R_p = 3,5 \Omega$$

$$R_T = 3,5 + 4 \checkmark$$

$$= 7,5 \Omega \checkmark$$

(3)

8.5 **POSITIVE MARKING FROM QUESTION 8.3**
POSITIEWE NASIEN VANAF VRAAG 8.3

CALCULATE V_p/BEREKEN V_p Marking criteria/Nasienkriteria - Formula/Formule: $V = IR$ ✓ - Substitution to calculate V_p / Vervanging om V_p te bereken. ✓	CALCULATE V_2/BEREKEN V_2 Marking criteria/Nasienkriteria - Substitution to calculate I_{branch} or ratio of R_{branch}/Vervanging om I_{tak} of verhouding van R_{tak} te bereken. ✓ - Substitution to calculate V_2 / Vervanging om V_2 te bereken. ✓ - Final Answer/Finale antwoord: 3 V ✓
OPTION 1/OPSIE 1 $V_p = IR$ $= (1,2)(3,5)$ ✓ $= 4,2 \text{ V}$	$I = \frac{V}{R}$ $= \frac{4,2}{8,4}$ ✓ $= 0,5 \text{ A}$
OPTION 2/OPSIE 2 $P_x = VI$ $5,76 = V(1,2)$ $V_x = 4,8 \text{ V}$ $I_{6\Omega} = \frac{8,4}{14,4} \times 1,2$ $= 0,7 \text{ A}$ $V_{6\Omega} = IR$ ✓ $= (0,7)(6)$ ✓ $= 4,2 \text{ V}$	$V_2 = IR$ ✓ $= (0,5)(6)$ ✓ $= 3 \text{ V}$ ✓ OR/OF
OPTION 3/OPSIE 3 $\varepsilon = I(R + r)$ $12 = 1,2(7,5 + r)$ $r = 2,5 \Omega$ $V_p = 12 - 1,2(2,5 + 4)$ ✓ = 4,2 V	$R_{2,4} : R_6 = 2,4 : 6$ ✓ $= 2 : 5$ $V_{2,4} : V_6 = 1,2 : 3$ ✓ ✓ $V_2 = 3 \text{ V}$ ✓
CALCULATION OF $I_{8,4\Omega}$ AND V_2/BEREKENING VAN $I_{8,4\Omega}$ EN V_2 OPTION 4/OPSIE 4 $I_{8,4\Omega} = \left(\frac{6}{14,4}\right)(1,2)$ OR/OF $\left(\frac{3,5}{8,4}\right)(1,2)$ $= 0,5 \text{ A}$ ✓ ✓ $V_2 = IR$ ✓ $= (0,5)(6)$ ✓ $= 3 \text{ V}$ ✓	
OPTION 5/OPSIE 5 $V_x = IR$ $= (1,2)(4)$ $= 4,8 \text{ V}$ $V_{\text{ext}} = IR_{\text{ext}}$ $= (1,2)(7,5)$ $= 9 \text{ V}$ $V_p = 9 - 4,8$ ✓ = 4,2 V $V_{8,4\Omega} = IR$ $4,2 = I(8,4)$ ✓ $I = 0,5 \text{ A}$ $V_2 = IR$ ✓ $= (0,5)(6)$ ✓ $= 3 \text{ V}$ ✓	

(5)

8.6 Decreases/Neem af ✓

Total resistance decreases. / Totale weerstand neem af. ✓

Current increases. / Stroom neem toe. ✓

V_{internal} / Internal voltage (“lost volts”) increases. / Interne potensiaalverskil neem toe. ✓

V_{external} / external voltage decreases. / Eksterne potensiaalverskil neem af.

NOTE/LET WEL

Do not penalise if “total” is omitted. / Moenie penaliseer indien “totaal” uitgelaat is nie.

(4)
[19]

QUESTION 9/VRAAG 9

9.1 Slip rings/Sleepringe ✓

ACCEPT/AANVAAR

Split ring/slip ring commutator / splitring/sleepring kommutator

(1)

9.2 Y to/na X ✓✓

(2)

9.3 **Marking criteria/Nasienkriteria**

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.

The AC potential difference which dissipates the same amount of energy as an equivalent DC potential difference.

Die WS-potensiaalverskil wat dieselfde hoeveelheid energie verbruik as die ekwivalente/soortgelyke GS-potensiaalverskil.

ACCEPT/AANVAAR

The DC potential difference which dissipates the same amount of energy as an equivalent AC potential difference.

Die GS-potensiaalverskil wat dieselfde hoeveelheid energie verbruik as die ekwivalente/soortgelyke WS-potensiaalverskil.

(2)

9.4

OPTION 1/OPSIE 1

$$V_{\text{rms/wgk}} = \frac{V_{\text{max/maks}}}{\sqrt{2}}$$

$$= \frac{100}{\sqrt{2}} \checkmark$$

$$= 70,71 \text{ V}$$

$$I_{\text{rms/wgk}} = \frac{V_{\text{rms/wgk}}}{R} \checkmark$$

$$= \frac{70,71}{25} \checkmark$$

$$= 2,83 \text{ A} \checkmark$$

ACCEPT/AANVAAR

If subscripts omitted in

$V = IR$

Indien onderskrifte

uitgelaat is in $V = IR$

OPTION 2/OPSIE 2

$$I_{\text{max/maks}} = \frac{V_{\text{max/maks}}}{R}$$

$$= \frac{100}{25} \checkmark$$

$$= 4 \text{ A}$$

$$I_{\text{rms/wgk}} = \frac{I_{\text{max/maks}}}{\sqrt{2}} \checkmark$$

$$= \frac{4}{\sqrt{2}} \checkmark$$

$$= 2,83 \text{ A} \checkmark$$

OPTION 3/OPSIE 3

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R}$$

$$= \frac{100^2}{25}$$

$$= \frac{\sqrt{2}}{25} \checkmark = 200 \text{ W}$$

$$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$$

$$200 = \left(\frac{100}{\sqrt{2}} \right) I_{\text{rms}} \checkmark$$

$$I_{\text{rms}} = 2,83 \text{ A} \checkmark$$

(4)

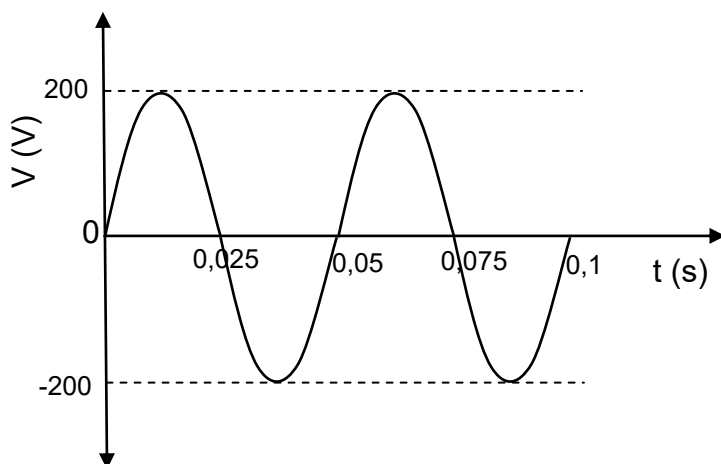
9.5

**POSITIVE MARKING FROM QUESTION 9.4 /
POSITIEWE NASIEN VANAF VRAAG 9.4**

OPTION 1/OPSIE 1 $P_{ave/gem} = \frac{V_{rms/wgk}^2}{R} \checkmark$ $= \frac{70,71^2}{25} \checkmark$ $= 200,00 \text{ W } \checkmark (200 \text{ W})$	OPTION 2/OPSIE 2 $P_{ave} = V_{rms} I_{rms} \checkmark$ $= (70,71)(2,83) \checkmark$ $= 200,11 \text{ W } \checkmark$	OPTION 3/OPSIE 3 $P_{ave/gem} = I_{rms/wgk}^2 R \checkmark$ $= (2,83)^2 (25) \checkmark$ $= 200,22 \text{ W } \checkmark$
OPTION 4/OPSIE 4 $I_{rms/wgk} = \frac{I_{max/maks}}{\sqrt{2}}$ $2,83 = \frac{I_{max}}{\sqrt{2}}$ $I_{max/maks} = 4 \text{ A}$ $P_{ave/gem} = \frac{V_{max/maks} I_{max/maks}}{2} \checkmark$ $= \frac{(100)(4)}{2} \checkmark$ $= 200 \text{ W } \checkmark$		

(3)

9.6



Marking criteria/Nasienkriteria

- 2 waves $\checkmark$
2 golwe
- Period of wave is 0,05 s $\checkmark$
Periode van golf is 0,05 s
- Amplitude = 200 V $\checkmark$

(3)
[15]

QUESTION 10/VRAAG 10

- 10.1 **Marking criteria/Nasienkriteria**
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.
The minimum frequency of light needed to eject electrons from a metal / surface. ✓✓
Minimum frekwensie van lig benodig om elektrone vanaf 'n metaal / oppervlak vry te stel. (2)
- 10.2 Greater than/Groter as ✓✓ (2)
- 10.3 **OPTION 1/OPSIE 1**
 $E = W_o + E_{k(max)}$ ✓
 $f_x = \left(\frac{1}{6,63 \times 10^{-34}} \right) \checkmark (23,01 \times 10^{-19}) \checkmark + 10,40 \times 10^{14} \checkmark$
 $= 4,51 \times 10^{15} \text{ (Hz)} \checkmark (45,1 \times 10^{14} \text{ Hz})$
- OPTION 2/OPSIE 2**
 $m = \frac{1}{h} \checkmark$
 $\frac{f_x - 10,4 \times 10^{14} \checkmark}{23,01 \times 10^{-19} - 0 \checkmark} = \frac{1}{6,63 \times 10^{-34} \checkmark}$
 $f_x = 4,51 \times 10^{15} \text{ (Hz)} \checkmark (45,1 \times 10^{14} \text{ Hz})$
- OPTION 3/OPSIE 3**
 $E = W_o + E_{k(max)} \checkmark$
 $hf = hf_0 + E_{k(max)}$
 $6,63 \times 10^{-34} f_x \checkmark = (6,63 \times 10^{-34})(10,40 \times 10^{14}) \checkmark + 23,01 \times 10^{-19} \checkmark$
 $f_x = 4,51 \times 10^{15} \text{ (Hz)} \checkmark (45,1 \times 10^{14} \text{ Hz})$ (5)
- 10.4
- 10.4.1 No effect/Geen effek nie ✓ (1)
- 10.4.2 Increases/Verhoog ✓ (1)
- 10.4.3 No effect/Geen effek nie ✓ (1)

[12]

TOTAL/TOTAAL: 150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS
SENIORSERTIFIKAAT-EKSAMEN/
NASIONALE SENIORSERTIFIKAAT-EKSAMEN**

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

2021

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 24 pages./
Hierdie nasienriglyne bestaan uit 24 bladsye.**

QUESTION 1/VRAAG 1

1.1	C ✓✓	(2)
1.2	A ✓✓	(2)
1.3	D ✓✓	(2)
1.4	D ✓✓	(2)
1.5	B ✓✓	(2)
1.6	B ✓✓	(2)
1.7	A ✓✓	(2)
1.8	C ✓✓	(2)
1.9	C ✓✓	(2)
1.10	C ✓✓	(2)
		[20]

QUESTION 2/VRAAG 2

2.1

NOTE/LET WEL

-1 mark for each key word/phrase omitted in the correct context.
-1 punt vir elke sleutel woord/frase in die korrekte konteks weggelaat.
The word “resultant/net force” has to be mentioned at least once
Die woord “resultante/netto krag” moet ten minste een keer genoem word

When a (non-zero) resultant/net force acts on an object, the object will accelerate in the direction of the force with an acceleration that is directly proportional to the force ✓ and inversely proportional to the mass of the object. ✓

Wanneer 'n (nie-nul) resultante/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel teen 'n versnelling wat direk eweredig is aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

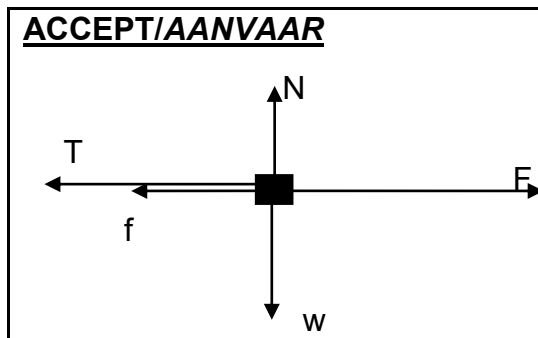
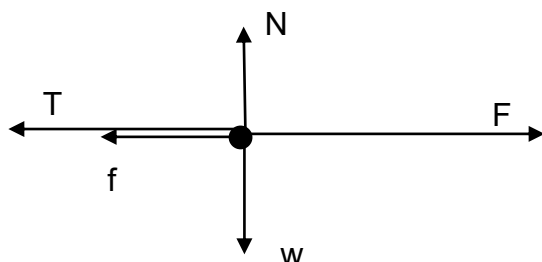
OR/OF

The (non-zero) resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force. ✓✓

Die (nie-nul) resultante/netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum van die voorwerp in die rigting van die resultante/netto krag.

(2)

2.2



Accept the following symbols./Aanvaar die volgende simbole:

N ✓	F_N / Normal / Normaal / Normal force / Normaalkrag / 78,4 N
f ✓	F_f / f_k / f_r / F_w / frictional force/wrywingskrag/kinetic frictional force / kinetiese wrywingskrag
w ✓	F_g , mg / weight / $F_{\text{Earth on block}}$ / 78,4 N / gravitational force / gewig / $F_{\text{aarde op blok}}$ / gravitasiekrag/ gravity / gravitasie
T ✓	Tension / Spanning / F_T / F_s
$F_{\text{applied/toegepas}}$ ✓	F / F_A / F_{app} / F_{toeg} / 29,6 N / Applied force / Toegepaste krag

Notes/Aantekeninge

- Mark is awarded for label and arrow. /Punt word toegeken vir byskrif en pyltjie
- Do not penalise for length of arrows.
Moenie vir die lengte van die pyltjies penaliseer nie.
- Deduct 1 mark for any additional force. /Trek 1 punt af vir enige addisionele krag.
- If force(s) do not make contact with body/dot //Indien krag(te) nie met die voorwerp / kolletjie kontak maak nie: Max./Maks: $\frac{4}{5}$
- If arrows missing//Indien pyltjies uitgelaat is: Max./Maks: $\frac{4}{5}$

(5)

2.3

OPTION 1/OPSIE 1 8 kg block/blok: $F_{\text{net}} = ma$ $F_{\text{net}} = 0$ $F - (f + T) = ma$ $29,6 - 10 - T = 0$ ✓ $T = 19,6 \text{ N}$ ✓	OPTION 2/OPSIE 2 2 kg block/blok: $F_{\text{net}} = ma$ $F_{\text{net}} = 0$ $T - w = 0$ $T = w = mg = (2)(9,8)$ ✓ $T = 19,6 \text{ N}$ ✓
OPTION 3/OPSIE 3 $W_{\text{net}} = \Delta E_k$ ✓ $W_w + W_N + W_F + W_f + W_T = 0$ $0 + 0 + F\Delta x \cos \theta + f\Delta x \cos \theta + T\Delta x \cos \theta = 0$ $(29,6)\cos 0^\circ + (10)\cos 180^\circ + T\cos 180^\circ = 0$ ✓ $29,6 - 10 - T = 0$ $T = 19,6 \text{ N}$ ✓	
OPTION 4/OPSIE 4 $W_{\text{nc}} = \Delta E_p + \Delta E_k$ ✓ $W_F + W_f + W_T = 0 + 0$ $F\Delta x \cos \theta + f\Delta x \cos \theta + T\Delta x \cos \theta = 0$ $(29,6)\cos 0^\circ + (10)\cos 180^\circ + T\cos 180^\circ = 0$ ✓ $29,6 - 10 - T = 0$ $T = 19,6 \text{ N}$ ✓	

(3)

2.4.1

8 kg block/blok

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 F - (f + T) &= ma \quad \left. \begin{array}{l} F_{\text{net}} = ma \\ F_{\text{net}} = 0 \end{array} \right\} \checkmark \text{Any one/Enige een} \\
 50 - 10 - T &= 8a \quad \checkmark \\
 40 - T &= 8a
 \end{aligned}$$

2 kg block/blok

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 T - mg &= ma \\
 T - 2(9,8) &= 2a
 \end{aligned}$$

$$40 - 19,6 = 10a$$

$$20,4 = 10a$$

$$a = 2,04 \text{ m} \cdot \text{s}^{-2} \quad \checkmark$$

Marking criteria/Nasienkriteria

- Appropriate formula / Geskikte formule ✓
- Substitution for forces on 8 kg / Vervanging van kragte op die 8 kg ✓
- 2a **OR/OF** 8a ✓
- Substitution of forces on 2 kg / Vervanging van kragte op die 2 kg ✓
- Final answer/Finale antwoord
2,04 m·s⁻² ✓

(5)

2.4.2

POSITIVE MARKING FROM QUESTION 2.4.1**POSITIEWE NASIEN VANAF VRAAG 2.4.1**

Substitute/Vervang a

$$T - 2(9,8) = 2a$$

$$T - 19,6 = 2(2,04) \quad \checkmark$$

$$T = 23,68 \text{ N} \quad \checkmark$$

OR/OF

$$40 - T = 8a$$

$$T = 40 - 8(2,04) \quad \checkmark$$

$$T = 23,68 \text{ N} \quad \checkmark$$

Marking criteria/Nasienkriteria

- Substitution of a/Vervanging van a ✓
- Final answer/Finale antwoord:
23,68 N ✓

Notes/Aantekeninge

If substitution into incorrect equation for T / Indien vervanging in verkeerde vergelyking vir T: Max/Maks $\frac{1}{2}$

(2)

[17]

QUESTION 3/VRAAG 3

3.1 Weight / gravitational force / *Gewig / Gravitatie* ✓

Accept/Aanvaar:
Gravity / *Gravitasie*

(1)

3.2 $9,8 \text{ m} \cdot \text{s}^{-2}$ ✓ downwards / *afwaarts* ✓

(2)

3.3 3 (m) ✓

(1)

3.4.1

OPTION 1/OPSIE 1

$$\begin{aligned} \text{Gradient/Gradiënt} &= \frac{y_2 - y_1}{x_2 - x_1} \\ -9,8 \checkmark &= \left(\frac{0 - v_i}{1,02 - 0} \right) \checkmark \\ v_i &= 10 \text{ m} \cdot \text{s}^{-1} \checkmark (9,996) \end{aligned}$$

OPTION 2/OPSIE 2

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$\begin{aligned} v_f &= v_i + a\Delta t \checkmark \\ 0 &= v_i + (-9,8)(1,02) \checkmark \\ v_i &= 10 \text{ m} \cdot \text{s}^{-1} \checkmark (9,996) \end{aligned}$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$\begin{aligned} v_f &= v_i + a\Delta t \checkmark \\ 0 &= v_i + (9,8)(1,02) \checkmark \\ v_i &= -10 \\ v_i &= 10 \text{ m} \cdot \text{s}^{-1} \checkmark (9,996) \end{aligned}$$

OPTION 3/OPSIE 3

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$\begin{aligned} v_f &= v_i + a\Delta t \checkmark \\ -v &= v + (-9,8)(2,04) \checkmark \\ v &= 10 \text{ m} \cdot \text{s}^{-1} \checkmark (9,996) \end{aligned}$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$\begin{aligned} v_f &= v_i + a\Delta t \checkmark \\ v &= -v + (9,8)(2,04) \checkmark \\ v &= -10 \\ v &= 10 \text{ m} \cdot \text{s}^{-1} \checkmark (9,996) \end{aligned}$$

OPTION 4/ OPSIE 4

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$\begin{aligned} \Delta y &= v_i\Delta t + \frac{1}{2} a\Delta t^2 \checkmark \\ 0 &= v_i(2,04) + \frac{1}{2}(-9,8)(2,04)^2 \checkmark \\ v_i &= 10 \text{ m} \cdot \text{s}^{-1} \checkmark (9,996) \end{aligned}$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$\begin{aligned} \Delta y &= v_i\Delta t + \frac{1}{2} a\Delta t^2 \checkmark \\ 0 &= v_i(2,04) + \frac{1}{2}(9,8)(2,04)^2 \checkmark \\ v_i &= -10 \\ v_i &= 10 \text{ m} \cdot \text{s}^{-1} \checkmark (9,996) \end{aligned}$$

OPTION 5/OPSIE 5 UPWARDS POSITIVE/ OPWAARTS POSITIEF: $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$ $= \left(\frac{v_i + 0}{2} \right) (1,02)$ $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $0^2 = v_i^2 + 2(-9,8) \left(\frac{v_i + 0}{2} \right) (1,02) \checkmark$ $v_i = 10 \text{ m}\cdot\text{s}^{-1} \checkmark (9,996)$	DOWNWARDS POSITIVE/ AFWAARTS POSITIEF: $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$ $= \left(\frac{v_i + 0}{2} \right) (1,02)$ $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $0^2 = v_i^2 + 2(9,8) \left(\frac{v_i + 0}{2} \right) (1,02) \checkmark$ $v_i = -10 \text{ m}\cdot\text{s}^{-1}$ $v_i = 10 \text{ m}\cdot\text{s}^{-1} \checkmark (9,996)$

From maximum height to projection point/

Vanaf maksimum hoogte tot punt van projeksie:

OPTION 6/OPSIE 6 UPWARDS POSITIVE/ OPWAARTS POSITIEF $v_f = v_i + a\Delta t \checkmark$ $v_f = 0 + (-9,8)(1,02)$ $v_f = 10 \text{ m}\cdot\text{s}^{-1}$ $v_i = 10 \text{ m}\cdot\text{s}^{-1} \checkmark$	DOWNWARDS AS POSITIVE/ AFWAARTS POSITIEF $v_f = v_i + a\Delta t \checkmark$ $v_f = 0 + (9,8)(1,02) \checkmark$ $v_f = 10 \text{ m}\cdot\text{s}^{-1}$ $v_i = 10 \text{ m}\cdot\text{s}^{-1} \checkmark$
OPTION 7/OPSIE 7 $(E_p + E_k)_{\text{top/bo}} = (E_p + E_k)_{\text{bottom/onder}} \checkmark$ $mgh + 0 = 0 + \frac{1}{2}mv^2$ $(9,8)(5,09796) = \frac{1}{2}v^2 \checkmark$ $(2)(9,8)(5,09796) = v^2$ $v_i = 10 \text{ m}\cdot\text{s}^{-1} \checkmark (9,996)$	OPTION 8/OPSIE 8 $W_{\text{net}} = \Delta E_k \checkmark$ $F_{\text{net}}\Delta y \cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$ $ma\Delta y \cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$ $(0,06)(9,8)(5,09796) = \frac{1}{2}(0,06)(v_f^2 - 0^2) \checkmark$ $v_i = 10 \text{ m}\cdot\text{s}^{-1} \checkmark (9,996)$
OPTION 9/OPSIE 9 $W_{\text{nc}} = \Delta E_p + \Delta E_k \checkmark$ $0 = mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2)$ $0 = (0,06)(9,8)(h_f - 0) + \frac{1}{2}(0,06)(0^2 - v_i^2) \checkmark$ $v_i = 10 \text{ m}\cdot\text{s}^{-1} \checkmark (9,996)$	
OPTION 10/OPSIE 10 $F_{\text{net}}\Delta t = m\Delta v \checkmark$ $(0,06)(-9,8)(1,02) = (0,06)(0 - v_i) \checkmark$ $v_i = 10 \text{ m}\cdot\text{s}^{-1} \checkmark (9,996)$	

(3)

3.4.2 **POSITIVE MARKING FROM QUESTION 3.4.1 /
POSITIEWE NASIEN VANAF VRAAG 3.4.1**

Marking criteria OPTIONS 1-5/Nasienkriteria OPSIES 1-5	
- Appropriate formula / Geskikte formule ✓ - Substitution / Vervanging ✓ - Adding answer to 3/Tel 3 by antwoord ✓ - Final answer/ Finale antwoord 8,1 m ✓ (8,098 – 8,102)	
OPTION 1/ OPSIE 1 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0^2 = (10)^2 + 2(-9,8)\Delta y$ ✓ $\Delta y = -5,1 \text{ m } (-5,102)$  $h = 5,1 \text{ m } + 3$ ✓ $= 8,1 \text{ m } (8,102)$	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0^2 = (-10)^2 + 2(9,8)\Delta y$ ✓ $\Delta y = 5,1 \text{ m } (5,102)$  $h = 5,1 \text{ m } + 3$ ✓ $= 8,1 \text{ m } (8,102)$
OPTION 2/ OPSIE 2 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= (10)(1,02) + \frac{1}{2}(-9,8)(1,02)^2$ ✓ $\Delta y = 5,1 \text{ m } (5,102)$  $h = 5,1 \text{ m } + 3$ ✓ $= 8,1 \text{ m } (8,102)$	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= (-10)(1,02) + \frac{1}{2}(9,8)(1,02)^2$ ✓ $\Delta y = -5,1 \text{ m } (-5,102)$  $h = 5,1 \text{ m } + 3$ ✓ $= 8,1 \text{ m } (8,102)$
OPTION 3/ OPSIE 3 UPWARDS POSITIVE/ OPWAARTS POSITIEF: $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\frac{0 - 10}{2}\right)(1,02)$ ✓ $\Delta y = -5,1 \text{ m}$  $h = 5,1 \text{ m } + 3$ ✓ $= 8,1 \text{ m } (8,102)$	DOWNWARDS POSITIVE/ AFWAARTS POSITIEF: $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\frac{0 + 10}{2}\right)(1,02)$ ✓ $\Delta y = 5,1 \text{ m}$  $h = 5,1 \text{ m } + 3$ ✓ $= 8,1 \text{ m } (8,102)$
OPTION 4/ OPSIE 4 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= 0 + \frac{1}{2}(-9,8)(1,02)^2$ ✓ $\Delta y = -5,1 \text{ m } (-5,098)$  $h = 5,1 \text{ m } + 3$ ✓ $= 8,1 \text{ m } (8,098)$	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= 0 + \frac{1}{2}(9,8)(1,02)^2$ ✓ $\Delta y = 5,1 \text{ m } (5,098)$  $h = 5,1 \text{ m } + 3$ ✓ $= 8,1 \text{ m } (8,098)$

OPTION 5/OPSIE 5

$$W_{\text{net}} = \Delta E_k \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} \checkmark \text{Any one/Enige een}$$

$$w\Delta y \cos 180^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$(0,06)(9,8)(\Delta y) \cos 180^\circ = \frac{1}{2}(0,06)(0 - 10^2) \checkmark$$

$$\Delta y = 5,1 \text{ m}$$



$$h = 5,1 + 3 \checkmark$$

$$= 8,1 \text{ m} \checkmark$$

OPTION 6/ OPSIE 6

$$(E_{\text{mech}})_{3 \text{ m (ref/verw)}} = (E_{\text{mech}})_{\text{Top/Bo}}$$

$$(E_P + E_K)_{3 \text{ m (ref/verw)}} = (E_P + E_K)_{\text{Top/Bo}}$$

$$(mgh + \frac{1}{2}mv^2)_{3 \text{ m (ref/verw)}} = (mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}}$$

$$(0) + \frac{1}{2}(0,06)(10)^2 = (0,06)(9,8)(h) + 0 \checkmark$$

$$h = 5,1 \text{ m}$$

$$h = 5,1 \text{ m}$$



$$h = 5,1 + 3 \checkmark$$

$$= 8,1 \text{ m} \checkmark$$

Marking criteria OPTIONS 7 to 9/Nasienkriteria OPSIES 7 tot 9

- Appropriate formula / Geskikte formule ✓
- Substitution / Vervanging ✓✓
- Final answer/ Finale antwoord: 8,1 m ✓

OPTION 7/ OPSIE 7

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

$$\Delta y = v_i \Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$-3 = 10 \Delta t + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$$

$$\Delta t = 2,31 \text{ s (2,306)}$$

$$\Delta y = v_i \Delta t + \frac{1}{2}a\Delta t^2$$

$$= 0 + \frac{1}{2}(-9,8)(2,31 - 1,02)^2 \checkmark$$

$$\Delta y = -8,15 \text{ m (8,1)}$$

$$h = 8,15 \text{ m (8,1)} \checkmark$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

$$\Delta y = v_i \Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$+3 = -10 \Delta t + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$\Delta t = 2,31 \text{ s (2,306)}$$

$$\Delta y = v_i \Delta t + \frac{1}{2}a\Delta t^2$$

$$= 0 + \frac{1}{2}(9,8)(2,31 - 1,02)^2 \checkmark$$

$$\Delta y = 8,15 \text{ m (8,1)}$$

$$h = 8,15 \text{ m (8,1)} \checkmark$$

OPTION 8/ OPSIE 8

$$(E_{\text{mech}})_{3 \text{ m (ref/verw)}} = (E_{\text{mech}})_{\text{Top/Bo}}$$

$$(E_P + E_K)_{3 \text{ m (ref/verw)}} = (E_P + E_K)_{\text{Top/Bo}}$$

$$(mgh + \frac{1}{2}mv^2)_{3 \text{ m (ref/verw)}} = (mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}}$$

$$(0,06)(9,8)(3) + \frac{1}{2}(0,06)(10)^2 \checkmark = (0,06)(9,8)(h) + 0 \checkmark$$

$$h = 8,1 \text{ m} \checkmark$$

OPTION 9/OPSIE 9

$$W_{\text{nc}} = \Delta E_p + \Delta E_k \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} \checkmark \text{Any one/Enige een}$$

$$0 = mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2)$$

$$0 = (0,06)(9,8)(h_f - 3) \checkmark + \frac{1}{2}(0,06)(0 - 10^2) \checkmark$$

$$h = 8,1 \text{ m} \checkmark$$

Marking criteria Options 10 to 11/Nasienkriteria Opsies 10 tot 11	
- Formula / Formule ✓ - Substitution to calculate v_f/ Vervanging om v_f te bereken ✓ - Substitution to calculate Δy/ Vervanging om Δy te bereken ✓ - Final answer / Finale antwoord: 8,1 m ✓	
OPTION 10/OPSIE 10 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF MAXIMUM HEIGHT TO GROUND/ MAKSIMUM HOOGTE TOT GROND $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= (10)^2 + 2(-9,8)(-3)$ ✓ $v_f = -12,60$ $v_f = 12,6 \text{ m} \cdot \text{s}^{-1} (12,62)$ $v_f^2 = v_i^2 + 2a\Delta y$ $(-12,60)^2 = (0)^2 + 2(-9,8)\Delta y$ ✓ $\Delta y = -8,1 \text{ m}$ $\Delta y = 8,1 \text{ m} \checkmark (8,102 - 8,103)$	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF MAXIMUM HEIGHT TO GROUND/ MAKSIMUM HOOGTE TOT GROND $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= (-10)^2 + 2(9,8)(3)$ ✓ $v_f = 12,60 \text{ m} \cdot \text{s}^{-1} (12,62)$ $v_f^2 = v_i^2 + 2a\Delta y$ $(12,60)^2 = (0)^2 + 2(9,8)\Delta y$ ✓ $\Delta y = 8,1 \text{ m} \checkmark (8,102 - 8,103)$
OPTION 11/OPSIE 11 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF FROM BALCONY TO GROUND/ VANAF BALKON TOT GROND $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= (-10)^2 + 2(-9,8)(-3)$ ✓ $v_f = -12,60$ $v_f = 12,6 \text{ m} \cdot \text{s}^{-1}$ $v_f = v_i + a\Delta t$ $-12,60 = 0 + (-9,8)\Delta t$ $\Delta t = 1,29 \text{ s} (1,286)$ $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= 0 + \frac{1}{2}(-9,8)(1,29)^2$ ✓ $\Delta y = -8,1 \text{ m} (-8,098)$ $h_1 = 8,1 \text{ m} \checkmark (8,098 - 8,102)$	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF FROM BALCONY TO GROUND/ VANAF BALKON TOT GROND $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= (10)^2 + 2(9,8)(3)$ ✓ $v_f = 12,6 \text{ m} \cdot \text{s}^{-1}$ $v_f = v_i + a\Delta t$ $12,60 = 0 + (9,8)\Delta t$ $\Delta t = 1,29 \text{ s} (1,286)$ $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= 0 + \frac{1}{2}(9,8)(1,29)^2$ ✓ $\Delta y = 8,1 \text{ m} (8,098)$ $h_1 = 8,1 \text{ m} \checkmark (8,098 - 8,102)$
OPTION 12/OPSIE 12 Displacement = Area between the graph and the t-axis Verplasing = Area tussen die grafiek en die t-as = Area of a triangle/Area van „n driehoek } ✓ = $\frac{1}{2}bh$ = $\frac{1}{2}(1,02)(9,996)$ ✓ = 5,09796 m Height h/Hoogte $h = 3 + 5,09796$ ✓ = 8,09796 m ✓ (8,09796 – 8,102)	

(4)

3.5 **POSITIVE MARKING FROM QUESTIONS 3.4.1 and 3.4.2**
POSITIEWE NASIEN VANAF VRAE 3.4.1 en 3.4.2

Marking criteria/Nasienkriteria

Calculation of / Berekening van $10,78 \text{ m}\cdot\text{s}^{-1}$ or/of $12,60 \text{ m}\cdot\text{s}^{-1}$ or/of $5,93 \text{ m}$:

- Any suitable formula/*Enige geskikte formule* ✓
- Any correct substitution/*Enige korrekte vervanging* ✓

W calculation/berekening:

- Formula/*Formule* ✓
- Difference in calculated velocities/height/*Verskil in berekende snelhede/hoogtes* ✓
- Correct substitution/*Korrekte vervanging* ✓
- Final answer/*Finale antwoord*: $-1,28 \text{ J}$ ✓

OPTION 1/OPSIE 1

When ball is on ground/*Wanneer bal op grond is*:

Work done by the floor = change in E_k ($\Delta E_p = 0$)

Arbeid verrig deur vloer = verandering in E_k ($\Delta E_p = 0$)

UPWARDS AS POSITIVE/

OPWAARTS AS POSITIEF

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$0 = v_i + (-9,8)(1,1) \quad \checkmark$$

$$v_i = 10,78 \text{ m}\cdot\text{s}^{-1}$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= (10)^2 + 2(-9,8)(-3)$$

$$v_f = -12,60$$

$$v_f = 12,6 \text{ m}\cdot\text{s}^{-1} \quad (12,62)$$

OR

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= (0)^2 + 2(-9,8)(-8,1)$$

$$v_f = -12,60$$

$$v_f = 12,6 \text{ m}\cdot\text{s}^{-1} \quad (12,62)$$

DOWNWARDS AS POSITIVE/

AFWAARTS AS POSITIEF →

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$0 = v_i + (9,8)(1,1) \quad \checkmark$$

$$v_i = -10,78$$

$$v_i = 10,78 \text{ m}\cdot\text{s}^{-1}$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= (-10)^2 + 2(9,8)(3)$$

$$v_f = 12,60 \text{ m}\cdot\text{s}^{-1} \quad (12,62)$$

$$\left. \begin{aligned} W_{\text{net}} &= \Delta E_k \\ W_{\text{nc}} &= \Delta E_p + \Delta E_k \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$= 0 + \frac{1}{2}(0,06)(10,78^2 - 12,60^2) \quad \checkmark$$

$$= -1,28 \text{ J} \quad \checkmark \quad (-1,2785)$$

OPTION 2/OPSIE 2

Comparing differences in heights/vergelyk verskil in hoogtes:

Work done by the floor = change in E_k ($\Delta E_p = 0$)Arbeid verrig deur vloer = verandering in E_k ($\Delta E_p = 0$)**UPWARDS AS POSITIVE****OPWAARTS AS POSITIEF**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= 0 + \frac{1}{2}(-9,8)(1,1)^2 \checkmark$$

$$= -5,93 \text{ m}$$

$$\Delta y = 5,93 \text{ m (5,929)}$$

DOWNWARDS AS POSITIVE**AFWAARTS AS POSITIEF**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= 0 + \frac{1}{2}(9,8)(1,1)^2 \checkmark$$

$$= -5,93 \text{ m}$$

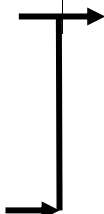
$$\Delta y = 5,93 \text{ m}$$

$$W_{nc} = \Delta E_p + \Delta E_k \checkmark$$

$$= mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2)$$

$$= (0,06)(9,8)(5,93 - 8,10) + 0 \checkmark$$

$$= -1,28 \text{ J} \checkmark$$

**OPTION 3/OPSIE 3**

Comparing differences in heights/vergelyk verskil in hoogtes:

Work done by floor/arbeid verrig deur vloer = Change/Verandering in E_p **UPWARDS AS POSITIVE****OPWAARTS AS POSITIEF**

$$v_f = v_i + a \Delta t$$

$$0 = v_i + (-9,8)(1,1)$$

$$v_i = 10,78 \text{ m} \cdot \text{s}^{-1}$$

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{10,78 + 0}{2} \right) (1,1) \checkmark$$

$$\Delta y = 5,93 \text{ m}$$

OR/OF

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0 = (10,78)^2 + 2(-9,8) \Delta y \checkmark$$

$$\Delta y = 5,93 \text{ m}$$

DOWNWARDS AS POSITIVE**AFWAARTS AS POSITIEF**

$$v_f = v_i + a \Delta t$$

$$0 = v_i + (9,8)(1,1)$$

$$v_i = -10,78$$

$$v_i = 10,78 \text{ m} \cdot \text{s}^{-1}$$

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{-10,78 - 0}{2} \right) (1,1) \checkmark$$

$$\Delta y = -5,93 \text{ m}$$

OR/OF

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0 = (-10,78)^2 + 2(9,8) \Delta y \checkmark$$

$$\Delta y = -5,93 \text{ m}$$

$$\Delta y = 5,93 \text{ m}$$

$$W_{nc} = \Delta E_p + \Delta E_k \checkmark$$

$$= mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2)$$

$$= (0,06)(9,8)(5,93 - 8,10) + 0 \checkmark$$

$$= -1,28 \text{ J} \checkmark$$



QUESTION 4/VRAAG 4

4.1

NOTE: -1 mark for each key word/phrase omitted in the correct context.

LET WEL: -1 punt vir elke sleutelwoord/frase weggelaat in die korrekte konteks.

The total (linear) momentum of an isolated/closed system remains constant (is conserved). ✓✓

Die totale (liniêre) momentum in „n geïsoleerde/ geslote sisteem bly konstant (behoue).

Accept/Aanvaar

The total (linear) momentum before a collision is equal to the total linear momentum after collision in an isolated/closed system.

Die totale (lineêre) momentum voor botsing is gelyk aan die totale lineêre momentum na botsing in „n geïsoleerde/geslote sisteem.

(2)

4.2

OPTION 1/OPSIE 1 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $\sum p_i = \sum p_f$ $(m_1 + m_2)v_i = m_1v_{2f} + m_2v_{Bf}$ $(2m + 3m)v \checkmark = (3m)(-\frac{1}{3}v) + 2mv_{Bf} \checkmark$ $v_{Bf} = 3v \checkmark \text{ upwards/opwaarts } \checkmark$	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $\sum p_i = \sum p_f$ $(m_1 + m_2)v_i = m_1v_{2f} + m_2v_{Bf}$ $(2m + 3m)(-v) \checkmark = (3m)(\frac{1}{3}v) + 2mv_{Bf} \checkmark$ $v_{Bf} = -3v$ $v_{Bf} = 3v \checkmark \text{ upwards/opwaarts } \checkmark$
OPTION 2/OPSIE 2 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $\Delta p_{iA} = -\Delta p_{iB}$ $m_A(v_{Af} - v_{Aif}) = -m_A(v_{Bf} - v_{Bi})$ $3m(-\frac{1}{3}v - v) \checkmark = -(2m)(v_{Bf} - v) \checkmark$ $v_{Bf} = 3v \checkmark \text{ upwards/opwaarts } \checkmark$	DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $\Delta p_{iA} = -\Delta p_{iB}$ $m_A(v_{Af} - v_{Aif}) = -m_A(v_{Bf} - v_{Bi})$ $3m[\frac{1}{3}v - (-v)] \checkmark = (2m)[v_{Bf} - (-v)] \checkmark$ $v_{Bf} = -3v$ $v_{Bf} = 3v \checkmark \text{ upwards/opwaarts } \checkmark$

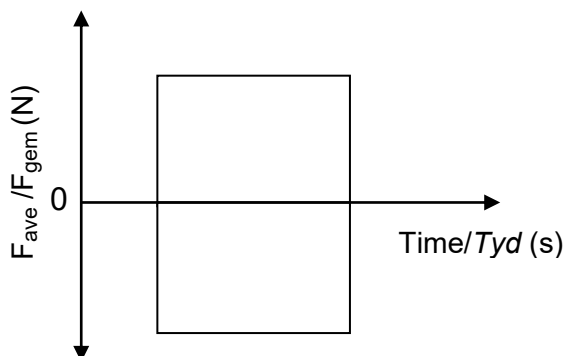
(5)

4.3

Impulse/Impuls ✓

(1)

4.4



Marking criteria/Nasienkriteria

Exact mirror image
Presiese spieëlbeeld ✓✓

IF/INDIEN

Mirror image at different times /
Spieëlbeeld by verskillende tye

Max/maks $\frac{1}{2}$

Note/Let wel:

If graph is drawn as given in question paper – no mirror image/Indien grafiek geteken word soos in vraestel

– geen spieëlbeeld: Max/Maks: $\frac{1}{2}$

(2)

[10]

QUESTION 5/VRAAG 5

- 5.1 The rate at which work is done/energy is expended. ✓✓ (2 or 0)
Die tempo waarteen arbeid/werk verrig word/energie verkwis word. (2 of 0)

Accept/Aanvaar

Work done per unit time / energy expended per unit time.

Arbeid verrig per eenheidstyd / energie verkwis per eenheidstyd.

(2)

5.2

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$P = \frac{W}{\Delta t}$ $= \frac{\Delta mgh}{\Delta t}$ $= \frac{(1\,250)(9,8)(5,8)}{60} \checkmark$ $= 1\,184,17\,W \checkmark (1\,184,167)$	$P = \frac{W}{\Delta t}$ $= \frac{F\Delta x \cos \theta}{\Delta t} \text{ or/of } \frac{F\Delta y \cos \theta}{\Delta t}$ $= \frac{mg\Delta x \cos 0^\circ}{\Delta t}$ $= \frac{(1250)(9,8)(5,8) \cos 0^\circ}{60} \checkmark$ $= 1\,184,17\,W \checkmark (1\,184,167)$
OPTION 3/OPSIE 3 $P = \frac{W}{\Delta t}$ $= \frac{F\Delta x \cos \theta}{\Delta t} \text{ or/of } \frac{F\Delta y \cos \theta}{\Delta t}$ $= \frac{mg\Delta x \cos 180^\circ}{\Delta t} \checkmark$ $= \frac{(1250)(9,8)(5,8) \cos 180^\circ}{60}$ $= -1\,184,17\,W \quad (-1\,184,167)$ Power dissipated by the crane/Drywing verkwis deur hyskraan = 1 184,17 W ✓	
OPTION 4/OPSIE 4 $P_{\text{ave}} = Fv_{\text{ave}} \checkmark$ $= 1\,250(9,8) \frac{5,8}{60} \checkmark$ $= 1\,184,17\,W \checkmark$	

(3)

5.3

Note: -1 mark for each key word/phrase omitted in the correct context.
Let Wel: -1 punt vir elke sleutelwoord/frase weggelaat in die korrekte konteks.
IF: The word 'work' is omitted - 0 marks.
INDIEN: Die woord 'arbeid' uitgelaat is - 0 punte.

A conservative force is a force for which the work done (in moving an object between two points) is independent of the path taken. ✓✓

'n Konserwatiewe krag is 'n krag waarvoor die arbeid wat verrig is (om 'n voorwerp tussen twee punte te beweeg) onafhanklik is van die pad wat gevat word.

OR/OF

A conservative force is a force for which the work done in moving an object in a closed path is zero.

„n Konserwatiewe krag is „n krag waarvoor die arbeid verrig om „n voorwerp in „n geslote pad te beweeg, nul is.

(2)

5.4 Non-conservative/ Nie-konserwatief ✓ (1)

5.5 (Gravitational) potential to kinetic (energy)
(Gravitasie)potensiële na kinetiese (energie) ✓ (1)

5.6 **Marking criteria/ Nasienkriteria**

- Any one of the following formulae/ Enigeen van die volgende formules:
 $W_{\text{net}} = \Delta E_k$ / $W_{\text{nc}} = \Delta E_k + \Delta E_p$ ✓
- Substitution to calculate the ΔE_k or initial velocity. ✓
Vervanging om ΔE_k of begin snelheid te bereken.
- Correct substitution of ΔE_k in: / Korrekte vervangings van ΔE_k in:
 $W_{\text{net}} = \Delta E_k$ / $W_{\text{nc}} = \Delta E_k + \Delta E_p$ ✓
- Correct substitution into / Korrekte vervangings in $F\Delta x \cos\theta$. ✓
- Final answer / Finale antwoord: 284 089 N ✓ (283 510,63 N to/tot 284 200 N)

OPTION 1/OPSIE 1
From R to the wall / Vanaf R na die muur:
 $\Delta U = mg(h_f - h_i)$
 $= 1\,250(9,8)(0 - 5,8)$ ✓
 $= -71\,050 \text{ J}$
 $\Delta K = -\Delta U = 71\,050 \text{ J}$
Into the wall: / In die muur in
 $W_{\text{net}} = \Delta K$
 $W_{\text{wall/muur}} = K_f - K_i$
 $F_{\text{wall/muur}} \Delta x \cos\theta = K_f - K_i$
 $F_{\text{wall/muur}}(0,25)\cos 180^\circ = 0 - 71\,050$ ✓
 $F_{\text{wall/muur}} = 284\,089 \text{ N}$ ✓

OPTION 2/OPSIE 2
From R to the wall / Vanaf R na die muur
 $W_{\text{nc}} = \Delta K + \Delta U$
 $W_{\text{nc}} = (mgh_f - mgh_i) + \frac{1}{2}m(v_f^2 - v_i^2)$
 $0 = 0 - (1\,250)(9,8)(5,8) + \frac{1}{2}(1\,250)(v_f^2 - 0)$ ✓
 $v_i = 10,66 \text{ m}\cdot\text{s}^{-1} (10,662)$
Into the wall / In die muur in:
 $W_{\text{net}} = \Delta K$
 $W_{\text{wall/muur}} = K_f - K_i$
 $F_{\text{wall/muur}} \Delta x \cos\theta = K_f - K_i$
 $F_{\text{wall/muur}}(0,25)\cos 180^\circ = 0 - \frac{1}{2}(1\,250)(10,66)^2$ ✓
 $F_{\text{wall/muur}} = 284\,089 \text{ N}$ ✓ (284 195,61 N)

OPTION 3/OPSIE 3
With ground as reference/ Met grond as verwysing
From R to the wall / Vanaf R na die muur:
 $W_{\text{nc}} = \Delta K + \Delta U$
 $W_{\text{nc}} = (mgh_f - mgh_i) + \frac{1}{2}m(v_f^2 - v_i^2)$
 $0 = (1\,250)(9,8)[h - (5,8+h)] + \frac{1}{2}(1\,250)(v_f^2 - 0)$ ✓
 $v_i = 10,66 \text{ m}\cdot\text{s}^{-1} (10,662)$
Into the wall / In die muur in:
 $W_{\text{net}} = \Delta K$
 $W_{\text{wall/muur}} = K_f - K_i$
 $F_{\text{wall/muur}} \Delta x \cos\theta = K_f - K_i$
 $F_{\text{wall/muur}}(0,25)\cos 180^\circ = 0 - \frac{1}{2}(1\,250)(10,66)^2$ ✓
 $F_{\text{wall/muur}} = 284\,089 \text{ N}$ ✓ (284 195,61 N)

OPTION 4/OPSIE 4From R to the wall / *Vanaf R na die muur:*

$$W_{nc} = \Delta K + \Delta U$$

$$W_{nc} = (mgh_f - mgh_i) + \frac{1}{2}m(v_f^2 - v_i^2)$$

$$0 = 0 - (1\,250)(9,8)(5,8) + \frac{1}{2}(1\,250)(v_f^2 - 0) \checkmark$$

$$v_i = 10,66 \text{ m}\cdot\text{s}^{-1} \quad (10,662)$$

Into the wall / *In die muur in:*

$$W_{nc} = \Delta K + \Delta U$$

$$W_{\text{wall/muur}} = \frac{1}{2}m(v_f^2 - v_i^2) + (mgh_f - mgh_i)$$

$$F_{\text{wall/muur}} \Delta x \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2) + mgh_f - mgh_i$$

$$F_{\text{wall/muur}} (0,25) \cos 180^\circ \checkmark = \frac{1}{2}(1\,250)(0 - 10,66^2) \checkmark + 0$$

$$F_{\text{wall/muur}} = 284\,089 \text{ N} \checkmark \quad (284\,195,61)$$

✓ Any one/Enige een

OPTION 5/OPSIE 5From R to the wall / *Vanaf R na die muur:*

$$(E_{\text{mech}})_{\text{Top/Bo}} = (E_{\text{mech}})_{\text{Ground/Grond}}$$

$$(E_p + E_k)_{\text{Top}} = (E_p + E_k)_{\text{Bottom/Onder}}$$

$$(mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}} = (mgh + \frac{1}{2}mv^2)_{\text{Bottom/Onder}}$$

$$(9,8)(5,8) + 0 = 0 + (\frac{1}{2})v^2$$

$$v = 10,662 \text{ m}\cdot\text{s}^{-1}$$

Into the wall / *In die muur in:*

$$W_{nc} = \Delta K + \Delta U$$

$$W_{\text{wall/muur}} = \frac{1}{2}m(v_f^2 - v_i^2) + (mgh_f - mgh_i)$$

$$F_{\text{wall/muur}} \Delta x \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2) + mgh_f - mgh_i$$

$$F_{\text{wall/muur}} (0,25) \cos 180^\circ \checkmark = \frac{1}{2}(1\,250)(0 - 10,66^2) \checkmark + 0$$

$$F_{\text{wall/muur}} = 284\,089 \text{ N} \checkmark$$

✓ Any one/Enige een

OPTION 6/OPSIE 6For the total motion / *Vir die totale beweging:*

$$W_{nc} = \Delta K + \Delta U$$

$$W_{\text{wall/muur}} = \Delta K + mg(h_f - h_i)$$

$$F_{\text{wall/muur}} \Delta x \cos \theta = \Delta K + mgh_f - mgh_i$$

$$F_{\text{wall/muur}} (0,25) \cos 180^\circ \checkmark = 0 + [0 - 1\,250(9,8)(5,8)] \checkmark \checkmark$$

$$F_{\text{wall/muur}} = 284\,200 \text{ N} \checkmark$$

✓ Any one/Enige een

OPTION 7/OPSIE 7From R to the wall / *Vanaf R na die muur:*

$$(E_{\text{mech}})_{\text{Top/Bo}} = (E_{\text{mech}})_{\text{Ground/Grond}}$$

$$(E_p + E_k)_{\text{Top}} = (E_p + E_k)_{\text{Bottom/Onder}}$$

$$(mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}} = (mgh + \frac{1}{2}mv^2)_{\text{Bottom/Onder}}$$

$$(9,8)(5,8) + 0 = 0 + (\frac{1}{2})v^2 \checkmark$$

$$v = 10,662 \text{ m}\cdot\text{s}^{-1}$$

Into the wall / *In die muur in:*

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$0,25 = \left(\frac{10,66 + 0}{2} \right) \Delta t$$

$$\Delta t = 0,0469 \text{ s}$$

$$F_{\text{net}} \Delta t = m \Delta v$$

$$F_{\text{wall/muur}} (0,047) \checkmark = 1250(0 - 10,66) \checkmark$$

$$F_{\text{wall/muur}} = 283\,510,63 \text{ N} \checkmark$$

✓ Any one/Enige een

OPTION 8/OPSIE 8

From R to the wall/Vanaf R na die muur:

$$\begin{aligned}(E_{\text{mech}})_{\text{Top/Bo}} &= (E_{\text{mech}})_{\text{Ground/Grond}} \\ (E_P + E_K)_{\text{Top}} &= (E_P + E_K)_{\text{Bottom/Onder}} \\ (mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}} &= (mgh + \frac{1}{2}mv^2)_{\text{Bottom/Onder}}\end{aligned} \quad \left. \vphantom{\begin{aligned}(E_{\text{mech}})_{\text{Top/Bo}} &= (E_{\text{mech}})_{\text{Ground/Grond}} \\ (E_P + E_K)_{\text{Top}} &= (E_P + E_K)_{\text{Bottom/Onder}} \\ (mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}} &= (mgh + \frac{1}{2}mv^2)_{\text{Bottom/Onder}}\end{aligned}} \right\} \checkmark \text{ Any one/Enige een}$$

$$(9,8)(5,8) + 0 = 0 + \frac{1}{2}v^2 \checkmark$$

$$v = 10,66 \text{ m}\cdot\text{s}^{-1}$$

Into the wall / In die muur in:

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$0 = (10,66)^2 + (2)a(0,25) \checkmark$$

$$a = -227,36 \text{ m}\cdot\text{s}^{-1} \quad (-227,356)$$

$$F_{\text{wall/muur}} = ma$$

$$F_{\text{wall/muur}} = (1\,250)(-227,356) \checkmark$$

$$F_{\text{wall/muur}} = -284\,200 \quad (-284\,195)$$

$$F_{\text{wall/muur}} = 284\,200 \text{ N} \checkmark \quad (284\,195)$$

(5)
[14]

QUESTION 6/VRAAG 6

6.1

NOTE: -1 mark for each key word/phrase omitted in the correct context.

LET WEL: -1 punt vir elke sleutelwoord/frase weggelaat in die korrekte konteks.

The change in frequency (or pitch) of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓

Die verandering in frekwensie (of toonhoogte) van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium waarin die klank voortgeplant word, het.

OR

An (apparent) change in observed/detected frequency (pitch), as a result of the relative motion between a source and an observer (listener).

'n Skynbare verandering in waargenome frekwensie (toonhoogte), as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/luisteraar.

(2)

6.2.1



700 Hz ✓

Learner/observer/listener velocity/speed = zero.

Luisteraar/waarnemer/leerder se spoed/snelheid = nul

OR/OF

No relative motion between source and listener. ✓

Geen relatiewe beweging tussen bron en luisteraar nie.

OR/OF

Listener and source both stationary.

Luisteraar en bron altwee in rus.

(2)

6.2.2 Away ✓/ Weg

Observed frequency smaller (than actual frequency / frequency of source.) ✓
Waargenome frekwensie is kleiner as die werklike frekwensie/ frekwensie van die bron.

OR/OF

$$f_L < f_s$$

OR/OF

The (observed) frequency decreases / Die (waargenome) frekwensie neem af (2)

6.2.3

OPTION 1/OPSIE 1

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \text{OR/OF} \quad f_L = \frac{v - v_L}{v} f_s$$

$$679,1 = \frac{v - 10}{v} (700) \quad \checkmark$$

$$\therefore v = 334,93 \text{ m} \cdot \text{s}^{-1} \quad \checkmark (333,33 \text{ m} \cdot \text{s}^{-1})$$

OPTION 2/OPSIE 2

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \text{OR/OF} \quad f_L = \frac{v - v_L}{v} f_s$$

$$658,2 = \frac{v - 20}{v} (700) \quad \checkmark$$

$$\therefore v = 334,93 \text{ m} \cdot \text{s}^{-1} \quad \checkmark (333,33 \text{ m} \cdot \text{s}^{-1})$$

OPTION 3/OPSIE 3

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \checkmark \quad \text{OR/OF} \quad f_L = \frac{v - v_L}{v} f_s$$

$$\frac{679,1}{658,2} = \frac{v - 10}{v - 20} \quad \checkmark$$

$$1,032 = \frac{v - 10}{v - 20}$$

$$v = 332,50 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

Note/Aantekening:

If ratio is used/Indien verhoudings gebruik:

- Any correct formula/Enige korrekte formule ✓
- Any correct f value/Enige korrekte f waarde ✓
- Any correct substitution/Enige korrekte vervanging - v_L ✓
- Correct ratio/Regte verhouding ✓
- Final answer/Finale antwoord: $332,50 \text{ m} \cdot \text{s}^{-1}$ ✓

OPTION 4/OPSIE 4

$$f_L = \frac{v - v_L}{v} f_s \quad \checkmark$$

$$f_L = -\frac{f_s}{v} v_L + f_s$$

$$\text{Gradient} = -\frac{f_s}{v} \quad \checkmark$$

$$\frac{658,2 - 679,1}{20 - 10} \quad \checkmark = -\frac{700}{v} \quad \checkmark$$

$$v = 334,93 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

(5)
[11]

QUESTION 7/VRAAG 7

7.1

NOTE: -1 mark for each key word/phrase omitted in the correct context. If the word "force" is omitted 0 marks

LET WEL: -1 punt vir elke sleutel woord/frase in die korrekte konteks weggelaat. Indien die woord "krag" uitgelaat word 0 punte.

The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the (magnitudes) of the charges ✓ and inversely proportional to the square of the distance (r) between them ✓

Die grootte van die elektrostatische krag wat een puntlading (Q_1) op 'n ander puntlading (Q_2) uitoefen, is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle. (2)

7.2

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$1,2 \times 10^{-3} = \frac{(9 \times 10^9)(6 \times 10^{-9})(5 \times 10^{-9})}{r^2} \checkmark$$

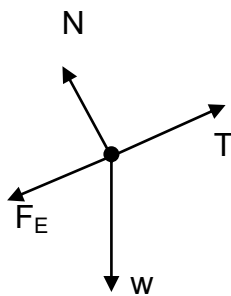
$$r = 0,015 \text{ m} \checkmark (0,02 \text{ m})$$

Note /Aantekening:

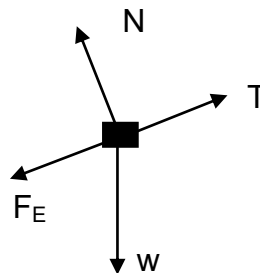
- 1 mark for all substitutions/
1 punt vir alle vervangings
- If negative charge substituted /
Indien negatiewe lading
vervang is Max / Maks 2/3

(3)

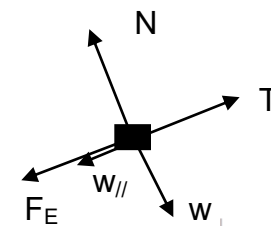
7.3



ACCEPT/AANVAAR



ACCEPT/AANVAAR



Accept the following symbols:/Aanvaar die volgende simbole:

N ✓	F_N / Normal / <i>Normaal</i> / Normal force / <i>Normaalkrag</i>
w ✓	F_g , mg / weight / $F_{\text{Earth on sphere}}$ / 0,098 N / gravitational force / <i>gewig</i> / $F_{\text{aarde op sfeer}}$ / <i>gravitasiekrag</i>
T ✓	Tension / <i>Spanning</i> / F_T / F_A / F_s / F_p
F_E ✓	F_R / F / Coulombic Force / Electrostatic force / <i>Coulombkrag</i> / <i>elektrostatische krag</i>

Notes/Aantekeninge

- Mark awarded for label and arrow / Punt toegeken vir benoeming en pyltjie
- Do not penalise for length of arrows since drawing is not to scale. / Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie
- Any other additional force(s) / Enige ander addisionele krag(te) Max/Maks $\frac{3}{4}$
If force(s) do not make contact with body / Indien krag(te) nie met die voorwerp kontak maak nie: Max/Maks: $\frac{3}{4}$
- If w is not shown but $w_{||}$ and $w_{\perp}$ are shown give 1 mark for both.
Indien w nie aangetoon is nie maar $w_{||}$ and $w_{\perp}$ is getoon, ken 1 punt toe vir beide.

(4)

7.4.1

$$\left. \begin{array}{l} F_{\text{net}} = ma \\ T - F_E - w_{||} = ma \\ T - F_E - w_{||} = 0 \end{array} \right\} \checkmark \text{Any one/Enige een}$$

$$T - \underline{1,2 \times 10^{-3}} \checkmark - \underline{(0,01)(9,8)\sin 25^\circ} \checkmark = 0$$

$$T = 0,04 \text{ N} \checkmark (0,0426 \text{ N})$$

OR/OF

$$\left. \begin{array}{l} F_{\text{net}} = ma \checkmark \\ T - F_E - w_{||} = ma \\ T - F_E - w_{||} = 0 \end{array} \right\} \checkmark \text{Any one/Enige een}$$

$$T - \underline{1,2 \times 10^{-3}} \checkmark - \underline{(0,01)(9,8)\cos 65^\circ} \checkmark = 0$$

$$T = 0,04 \text{ N} \checkmark (0,0426 \text{ N})$$

(4)

7.4.2

POSITIVE MARKING FROM QUESTION 7.2
POSITIEWE NASIEN VANAF VRAAG 7.2

$$\left. \begin{array}{l} E = k \frac{Q}{r^2} \\ E_{\text{net}} = E_R + E_S \\ E_{\text{net}} = E_R + (-E_S) \\ E_{\text{net}} = k \frac{Q_R}{r^2} - k \frac{Q_S}{r^2} \\ E_{\text{net}} = k \frac{Q_R}{r^2} + k \frac{Q_S}{r^2} \end{array} \right\} \checkmark \text{Any one/Enige een}$$

$$E_{\text{net}} = \frac{(9 \times 10^9)(5 \times 10^{-9})}{(0,015 + 0,03)^2} \checkmark - \frac{(9 \times 10^9)(6 \times 10^{-9})}{(0,03)^2} \checkmark$$

$$= -37\,777,78$$

$$= 37\,777,78 \text{ N} \cdot \text{C}^{-1} \checkmark (3,78 \times 10^4) \text{ down (the incline) / towards the charges}$$

afwaarts (teen skuinsvlak) / na die ladings $\checkmark$

(5)

[18]

QUESTION 8/VRAAG 8

- 8.1 (a) (Electrical) energy/work (Elektriese) energie/arbeid ✓
(b) Unit charge/eenheidslading ✓ (Accept/ Aanvaar coulomb) (2)

8.2	OPTION 1/OPSIE 1 $R_s = R_1 + R_2$ $= 4 + 3$ ✓ $= 7 \Omega$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ $\frac{1}{R_p} = \frac{1}{7} + \frac{1}{7}$ ✓ $R_p = 3,5 \Omega$ ✓	OPTION 2/OPSIE 2 $R_s = R_1 + R_2$ $= 4 + 3$ ✓ $= 7 \Omega$ $R_p = \frac{R_1 R_2}{R_1 + R_2}$ ✓ $R_p = \frac{(7)(7)}{7 + 7}$ ✓ $= 3,5 \Omega$ ✓	(4)

8.3.1 POSITIVE MARKING FROM QUESTION 8.2/POSITIEWE NASIEN VANAF VRAAG 8.2

Marking criteria/Nasienkriteria Calculation of current when switch is open and when closed/ Berekening van stroom wanneer skakelaar S oop is en gesluit is: - Suitable formula for open or closed switch /Geskikte formule vir geslote of oop skakelaar ✓ - Correct substitution when switch is open /Korrekte vervanging wanneer skakelaar oop is ✓ - Correct substitution when switch is closed /Korrekte vervanging wanneer skakelaar gesluit is ✓ Substitution into formula $\varepsilon = I(R + r)$ or $\varepsilon = V_{\text{ext}} + Ir$: Vervanging in formule $\varepsilon = I(R + r)$ of $\varepsilon = V_{\text{eks}} + Ir$: - Formula/Formule ✓ - Substitution in formula for open switch/ Vervanging in formule vir oop skakelaar ✓ - Substitution in formula for closed switch/ Vervanging in formule vir geslote skakelaar ✓ Calculating r / Berekening van r - Equating the equations / Stel twee vergelykings gelyk aan mekaar ✓ - Final answer/Finale antwoord: $0,49 \Omega$ ✓	
When the switch is OPEN/Wanneer die skakelaar OOP is $I = \frac{V}{R}$ ✓ ← (Any one / Enige een) → $I = \frac{2,8}{7}$ ✓ $= 0,4 \text{ A}$ $\varepsilon = I(R + r)$ ✓ $= 0,4(7 + r)$ ✓ OR $\varepsilon = V_{\text{ext}} + Ir$ $\varepsilon = 2,8 + (0,4)r$ ✓	When the switch is CLOSED/Wanneer die skakelaar GESLUIT is $I = \frac{V}{R}$ $I = \frac{2,63}{3,5}$ ✓ $= 0,75 \text{ A}$ $\varepsilon = I(R + r)$ $= 0,75(3,5 + r)$ ✓ OR $\varepsilon = V_{\text{ext}} + Ir$ $\varepsilon = 2,63 + (0,75)r$ ✓
$0,4(7 + r) = 0,75(3,5 + r)$ $r = 0,49 \Omega$ ✓	OR/OF $2,8 + (0,4)r = 2,63 + (0,75)r$ $r = 0,49 \Omega$ ✓

(8)

8.3.2 **POSITIVE MARKING FROM QUESTION 8.3.1/**

POSITIEWE NASIEN VANAF VRAAG 8.3.1

Option depends on the equation in which r is substituted/

Opsie hang af van die vergelyking waarin r vervang is

<u>OPTION 1/OPSIE 1</u> $\varepsilon = V_{\text{ext}} + Ir$ $\varepsilon = 2,8 + (0,4)r$ $= 2,8 + (0,4)(0,49) \checkmark$ $= 3 \text{ V } \checkmark$	<u>OPTION 2/OPSIE 2</u> $\varepsilon = V_{\text{ext}} + Ir$ $\varepsilon = 2,63 + (0,75)r$ $= 2,63 + (0,75)(0,49) \checkmark$ $= 3 \text{ V } \checkmark$
<u>OPTION 3/OPSIE 3</u> $\varepsilon = I(R + r)$ $= 0,4(7 + 0,49) \checkmark$ $= 3 \text{ V } \checkmark$	<u>OPTION 4/OPSIE 4</u> $\varepsilon = I(R + r)$ $= 0,75(3,5 + 0,49) \checkmark$ $= 2,99 \text{ V } \checkmark$

(2)
[16]

QUESTION 9/VRAAG 9

9.1 Slip rings/sleepringe $\checkmark$ (1)

9.2 Allows the slips rings to rotate while maintaining contact with the external circuit.

Laat die sleepringe toe om te roteer terwyl dit kontak met die eksterne stroombaan behou.

OR/OF

Transfer/conduct current to the external circuit. $\checkmark$

Dra stroom oor/Gelei stroom na eksterne stroombaan.

OR/OF

Connection between external circuit and coil/slip rings/internal circuit.

Verbinding tussen eksterne stroombaan en spoel/sleepringe/interne stroombaan.

(1)

9.3 According to the principle of electromagnetic induction, an emf/current is induced as a result of the change in the magnetic flux linkage $\checkmark\checkmark$ with the coil. **(2 or 0)**

*Volgens die beginsel van elektromagnetiese induksie word 'n emk/stroom geïnduseer as gevolg van die verandering in magnetiese-vloedkoppeling met die spoel. **(2 of 0)***

Accept/Aanvaar

When the coil rotates there is a change of magnetic flux linked/associated with the coil and according to the principle of electromagnetic induction, an emf/current is induced in the coil. **(2 or 0)**

*Wanneer die spoel roteer is daar 'n verandering in magnetiese-vloedkoppeling met die spoel en volgens die beginsel van elektromagnetiese induksie word 'n stroom/emk in die spoel geïnduseer. **(2 of 0)***

Accept/Aanvaar

There is relative motion between the conductor and the magnetic field. **(2 or 0)**

*Daar is relatiewe beweging tussen die geleier en die magneetveld . **(2 of 0)***

(2)

9.4 **P to/na Q** $\checkmark\checkmark$

(2)

9.5

OPTION 1/OPSIE 1 $T = \frac{1}{f} = \frac{1}{50} \checkmark$ $= 0,02 \text{ s}$ $t = (1,5)(0,02) \checkmark$ $= 0,03 \text{ s} \checkmark$ OR/OF $t = (0,02) + \frac{1}{2}(0,02) \checkmark$ $= 0,03 \text{ s} \checkmark$	OPTION 2/OPSIE 2 50 waves/golwe = 1 s ✓ 1,5 waves/golwe ✓ = 0,03 s ✓ OPTION 3/OPSIE 3 $t = \frac{1,5}{50} \checkmark \checkmark = 0,03 \text{ s} \checkmark$ OPTION 4/OPSIE 4 $t = \frac{3}{4}(0,04) \checkmark \checkmark = 0,03 \text{ s} \checkmark$

(3)

9.6

$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$ $= \frac{311}{\sqrt{2}} \checkmark$ $= 219,91 \text{ V}$		$I_{\text{rms}} = \frac{V_{\text{rms}}}{R}$ $= \frac{219,91}{100} \checkmark$ $= 2,2 \text{ A (2,199)}$	
<u>OPTION 1/OPSIE 1</u> $W = \frac{V^2 \Delta t}{R} \checkmark$ $= \frac{(219,11)^2}{100} (60) \checkmark$ $= 29\,016,24 \text{ J} \checkmark$		<u>OPTION 2/OPSIE 2</u> $W = VI\Delta t \checkmark$ $= (219,91)(2,2)(60) \checkmark$ $= 29\,028,12 \text{ J} \checkmark$ $(29\,013,61 - 29\,028,12)$	
		<u>OPTION 3/OPSIE 3</u> $W = I^2 R \Delta t \checkmark$ $= (2,2^2)(100)(60) \checkmark$ $= 29\,040 \text{ J} \checkmark$ $(29\,013,61 - 29\,040)$	
<u>OPTION 4/OPSIE 4</u> $P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$ $= (219,11)(2,2) \checkmark$ $= 483,605 \text{ W}$ $P = \frac{W}{\Delta t} \checkmark$ $483,605 = \frac{W}{60} \checkmark$ $W = 29\,016,30 \text{ J} \checkmark$		<u>OPTION 5/OPSIE 5</u> $P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark$ $= \frac{(219,11)^2}{100} \checkmark$ $= 483,605 \text{ W}$ $P = \frac{W}{\Delta t} \checkmark$ $483,605 = \frac{W}{60} \checkmark$ $W = 29\,016,30 \text{ J} \checkmark$	
		<u>OPTION 6/OPSIE 6</u> $P_{\text{ave}} = I_{\text{rms}}^2 R \checkmark$ $= (2,2)^2 (100) \checkmark$ $= 483,605 \text{ W}$ $P = \frac{W}{\Delta t} \checkmark$ $483,605 = \frac{W}{60} \checkmark$ $W = 29\,016,30 \text{ J} \checkmark$	

(5)
[14]

QUESTION 10/VRAAG 10

10.1 $11,6 \times 10^{-19} \text{ J}$ ✓

ACCEPT/AANVAAR

$11,6 \times 10^{-19}$ to/tot $11,8 \times 10^{-19} \text{ J}$ ✓

(1)

10.2 As the wavelength of the incident radiation/light increases the maximum kinetic energy of the emitted electrons decreases. ✓✓/
Soos die golflengte van die invallende straling/lig toeneem verminder die maksimum kinetiese energie van die vrygestelde elektrone.

OR/OF

As the wavelength of the incident radiation/light decreases the maximum kinetic energy of the emitted electrons increases. /
Soos die golflengte van die invallende straling/lig afneem vermeerder die maksimum kinetiese energie van die vrygestelde elektrone.

OR/OF

The maximum kinetic energy is inversely proportional to the wavelength./
Die maksimum kinetiese energie is omgekeerd eweredig aan die golflengte.

OR/OF

$$E_{k(\max)} \propto \frac{1}{\lambda}$$

(2)

10.3 **NOTE:** -1 mark for each key word/phrase omitted in the correct context.

LET WEL: -1 punt vir elke sleutelwoord/frase weggelaat in die korrekte konteks.

The work function of a metal/surface is the minimum energy needed to remove/release an electron from a (metal) surface. ✓✓
Die werksfunksie van „n metaal/oppervlak is die minimum energie wat benodig word om „n elektron vanaf die (metaal) oppervlak vry te stel.

(2)

10.4

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2																												
$\left. \begin{aligned} W_o &= hf_o \\ E &= \frac{hc}{\lambda_o} \\ E &= \frac{hc}{\lambda} \end{aligned} \right\} \checkmark \text{Any one/Enige een}$ $W_o = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{4,9 \times 10^{-7}} \checkmark$ $= 4,06 \times 10^{-19} \text{ J } \checkmark (4,059 \times 10^{-19})$	$\left. \begin{aligned} E &= W_o + E_{k(\max)} \\ W_o &= \frac{hc}{\lambda_o} + 0 \end{aligned} \right\} \checkmark \text{Any one/Enige een}$ $E = \frac{hc}{\lambda_o} + 0$ $W_o = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{4,9 \times 10^{-7}} \checkmark$ $= 4,06 \times 10^{-19} \text{ J } \checkmark (4,059 \times 10^{-19})$																												
Accept any set of co-ordinates for calculation of W_o see table below <u>Aanvaar enige stel ko-ordinate vir die berekening van W_o sien tabel hieronder</u> $\left. \begin{aligned} E &= W_o + E_{k(\max)} \\ \frac{hc}{\lambda} &= W_o + E_{k(\max)} \end{aligned} \right\} \checkmark \text{Any one/Enige een}$ $\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{1,5 \times 10^{-7}} \checkmark = W_o + 8 \times 10^{-19} \checkmark$ $W_o = 5,26 \times 10^{-19} \text{ J } \checkmark$																													
Table of values for W_o /Tabel van waardes vir W_o																													
<table border="1"> <thead> <tr> <th>λ</th> <th>$E_{K(\max)}$</th> </tr> </thead> <tbody> <tr><td>$4,9 \times 10^{-7}$</td><td>0</td></tr> <tr><td>$0,75 \times 10^{-7} - 0,8 \times 10^{-7}$</td><td>$14,0 \times 10^{-19}$</td></tr> <tr><td>$1,5 \times 10^{-7}$</td><td>$8 \times 10^{-19}$</td></tr> <tr><td>$2 \times 10^{-7}$</td><td>$6,0 \times 10^{-19} - 6,2 \times 10^{-19}$</td></tr> <tr><td>$3 \times 10^{-7}$</td><td>$3,6 \times 10^{-19}$</td></tr> <tr><td>$4 \times 10^{-7}$</td><td>$1,6 \times 10^{-19}$</td></tr> </tbody> </table>	λ	$E_{K(\max)}$	$4,9 \times 10^{-7}$	0	$0,75 \times 10^{-7} - 0,8 \times 10^{-7}$	$14,0 \times 10^{-19}$	$1,5 \times 10^{-7}$	8×10^{-19}	2×10^{-7}	$6,0 \times 10^{-19} - 6,2 \times 10^{-19}$	3×10^{-7}	$3,6 \times 10^{-19}$	4×10^{-7}	$1,6 \times 10^{-19}$	<table border="1"> <thead> <tr> <th>Q 10.4 W_o</th> <th>Q 10.5 $E_{K(\max)}$</th> </tr> </thead> <tbody> <tr><td>$4,06 \times 10^{-19}$</td><td>$3,572 \times 10^{-18}$</td></tr> <tr><td>$1,252 \times 10^{-18} - 1,08625 \times 10^{-18}$</td><td>$2,726 \times 10^{-18}$</td></tr> <tr><td>$5,26 \times 10^{-19}$</td><td>$3,452 \times 10^{-18}$</td></tr> <tr><td>$3,745 \times 10^{-19} - 3,95 \times 10^{-19}$</td><td>$3,6035 \times 10^{-18} - 3,945 \times 10^{-18}$</td></tr> <tr><td>$3,03 \times 10^{-19}$</td><td>$3,675 \times 10^{-18}$</td></tr> <tr><td>$3,3725 \times 10^{-19}$</td><td>$3,64075 \times 10^{-18}$</td></tr> </tbody> </table>	Q 10.4 W_o	Q 10.5 $E_{K(\max)}$	$4,06 \times 10^{-19}$	$3,572 \times 10^{-18}$	$1,252 \times 10^{-18} - 1,08625 \times 10^{-18}$	$2,726 \times 10^{-18}$	$5,26 \times 10^{-19}$	$3,452 \times 10^{-18}$	$3,745 \times 10^{-19} - 3,95 \times 10^{-19}$	$3,6035 \times 10^{-18} - 3,945 \times 10^{-18}$	$3,03 \times 10^{-19}$	$3,675 \times 10^{-18}$	$3,3725 \times 10^{-19}$	$3,64075 \times 10^{-18}$
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10.5

POSITIVE MARKING FROM QUESTION 10.4

POSITIEWE NASIEN VANAF VRAAG 10.4

$$\left. \begin{aligned} E &= W_o + E_{k(\max)} \\ \frac{hc}{\lambda} &= W_o + E_{k(\max)} \end{aligned} \right\} \checkmark \text{Any one/Enige een}$$

$$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{0,5 \times 10^{-7}} \checkmark = 4,06 \times 10^{-19} \checkmark + E_{k(\max)}$$

$$E_{k(\max)} = 3,57 \times 10^{-18} \text{ J } \checkmark (3,572 \times 10^{-18} \text{ or/of } 35,72 \times 10^{-19})$$

(4)
[13]
150

TOTAL/TOTAAL:



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**SENIOR CERTIFICATE/SENIOR SERTIFIKAAT
NATIONAL SENIOR CERTIFICATE/
NASIONALE SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

NOVEMBER 2020

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 19 pages./
*Hierdie nasienriglyne bestaan uit 19 bladsye.***

QUESTION 1/VRAAG 1

1.1	B ✓✓	(2)
1.2	D ✓✓	(2)
1.3	C ✓✓	(2)
1.4	C ✓✓	(2)
1.5	C ✓✓	(2)
1.6	A ✓✓	(2)
1.7	A ✓✓	(2)
1.8	D ✓✓	(2)
1.9	A ✓✓	(2)
1.10	B ✓✓	(2)
		[20]

QUESTION 2/VRAAG 2

2.1

Marking criteria/Nasienriglyne

If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.

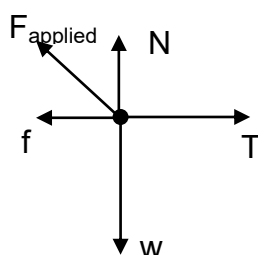
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word:
- 1 punt per woord/frase

The perpendicular force exerted by a surface on an object in contact with the surface. ✓✓

Die loodregte krag deur 'n oppervlak uitgeoefen op 'n voorwerp wat daarmee in kontak is.

(2)

2.2



	Accepted symbols/Aanvaarde simbole
N ✓	F_N /Normal/Normal force/173,5N /Normaal/Normaalkrag
f ✓	F_f / f_k /frictional force/wrywingskrag/kinetic frictional force/kinetiese wrywingskrag/5 N
w ✓	F_g /mg/Weight/ $F_{\text{Earth on block}}$ /Fw/Gewig/Gravitational force/Gravitasiekrag/196 N
T ✓	Tension/Spinning/ F_T
F_{applied} ✓ F_{toegepas}	F/Applied force/35 N/Toegepaste krag/ F_A

Notes/Aantekeninge

- Mark is awarded for label and arrow./Punt word toegeken vir byskrif en pyltjie.
- Do not penalise for length of arrows./Moenie vir die lengte van die pyltjies penaliseer nie.
- Deduct 1 mark for any additional force./Trek 1 punt af vir enige addisionele krag.
- If all forces are correctly drawn and labelled, but no arrows, deduct 1 mark. / Indien all kragte korrek geteken en benoem is, maar geen lyne nie, trek 1punt af.

(5)

2.3

For the/Vir die 20 kg:

$$\left. \begin{aligned} F_{\text{net}} &= ma \\ T - f - F_{Ax} &= ma \end{aligned} \right\} \checkmark$$

$$T - 5 - 35 \cos 40^\circ \checkmark = 0 \checkmark$$

$$T = 31,81 \text{ N}$$

For/vir m:

$$\left. \begin{aligned} F_{\text{net}} &= ma \\ mg - T &= ma \end{aligned} \right\} \checkmark$$

$$m(9,8) - 31,81 \checkmark = 0$$

$$m = 3,25 \text{ kg} \checkmark$$

Marking criteria/Nasienriglyne

- Formula for 20 kg or m kg/Formule vir 20 kg of m kg / $F_{\text{net}} = ma$ ✓
- Substitution of zero into either formula ✓
Vervanging van nul in een van die formules
- All substitutions into F_{net} for 20 kg as shown ✓
Alle vervanging in F_{net} for 20 kg soos getoon
- Substitution of value of T in eqn for m
/Substitusie van waarde vir T in vgl vir m ✓
- Final answer/finale antwoord: 3,25 kg ✓

(5)

2.4.1 Decreases/Neem af ✓

(1)

2.4.2 **POSITIVE MARKING FROM QUESTION 2.3**

POSITIEWE NASIEN VANAF VRAAG 2.3

Moving to the right/Beweeg na regs

Velocity decreases/*snelheid neem af* ✓

Accelerates/Net force to left /*Versnelling/netto krag na links* ✓✓

OR/OF

As the tension force decreases, the net force/acceleration acts in the opposite direction of motion /to the left. ✓✓

Soos die spanning afneem, is daar 'n netto krag/versnelling in die teenoorgestelde rigting / na links

Moving to the left/Beweeg na links

Velocity increases/*snelheid neem toe* ✓

Accelerates/Net force to left /*Versnelling/netto krag na links* ✓✓

(3)
[16]

QUESTION 3/VRAAG 3

- 3.1 (Motion of an object) under the influence of gravity (weight) only. ✓✓ (2 or 0)
(*Beweging van 'n voorwerp*) slegs onder die invloed van gravitasie (gewig).

OR/OF

(Motion in which) the only force acting on the object is gravity (weight).
(*Beweging waar*) die enigste krag wat op die voorwerp inwerk, gravitasie (gewig) is.

(2)

- 3.2.1 $\Delta t = 0,67 - 0,64 = 0,03 \text{ s}$ ✓✓

(2)

3.2.2	<u>OPTION 1/OPSIE 1</u> $\Delta t = \frac{(1,90 - 0,67)}{2}$ ✓ $= 0,62 \text{ s}$ ✓ (0,615 s)	<u>OPTION 2/OPSIE 2</u> $\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ $(-1,85) = 0 + \frac{1}{2} (-9,8) \Delta t^2$ ✓ $\Delta t = 0,61 \text{ s}$ ✓ (0,6145 s)
	<u>OPTION 3/OPSIE 3</u> $\Delta t = \frac{(1,90 + 0,67)}{2} = 1,285 \text{ s}$ $\Delta t = 1,285 - 0,67$ ✓ $= 0,62 \text{ s}$ ✓ (0,615 s)	<u>OPTION 4/OPSIE 4</u> $v_f^2 = v_i^2 + 2a\Delta x$ $0 = v_i^2 + 2(-9,8)(1,85)$ $v_i = 6,02 \text{ m} \cdot \text{s}^{-1}$ $v_f = v_i + a\Delta t$ $0 = 6,02 + (-9,8)\Delta t$ ✓ $\Delta t = 0,61 \text{ s}$ ✓

(2)

3.2.3

POSITIVE MARKING FROM QUESTION 3.2.2**POSITIEWE NASIEN VANAF VRAAG 3.2.2****Marking Criteria/Nasienriglyne**

- Any appropriate formula/*Enige geskikte formule* ✓
- Correct substitution/*Korrekte vervanging* ✓
- Final answer/*Finale antwoord*: 5,94 to 6,08 m·s⁻¹ ✓

OPTION 1/OPSIE 1Upwards positive/*Opwaarts positief*

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$0 = v_i + (-9,8)(0,62) \quad \checkmark$$

$$v_i = 6,08 \text{ m}\cdot\text{s}^{-1} \text{ (6,076 m}\cdot\text{s}^{-1}) \quad \checkmark$$

Downwards positive/*Afwaarts positief*

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$0 = v_i + (9,8)(0,62) \quad \checkmark$$

$$v_i = -6,08$$

$$\therefore 6,08 \text{ m}\cdot\text{s}^{-1} \text{ (6,076 m}\cdot\text{s}^{-1}) \quad \checkmark$$

OPTION 3/OPSIE 3**Motion from top to bottom /****Beweging vanaf bo na onder**Downwards positive/*Afwaarts positief*

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$v_f^2 = 0 + 2(9,8)(1,85) \quad \checkmark$$

$$v_f = 6,02 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

$$\text{initial velocity/beginsnelheid} = 6,02 \text{ m}\cdot\text{s}^{-1}$$

Upwards positive/*Opwaarts positief*

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$v_f^2 = 0 + 2(-9,8)(-1,85) \quad \checkmark$$

$$v_f = 6,02 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

$$\text{initial velocity/beginsnelheid} = 6,02 \text{ m}\cdot\text{s}^{-1}$$

Motion from bottom to top**Beweging vanaf onder na bo**Downwards positive/*Afwaarts positief*

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$0^2 = v_i^2 + 2(9,8)(-1,85) \quad \checkmark$$

$$v_i = 6,02 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

Upwards positive/*Opwaarts positief*

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$0 = v_i^2 + 2(-9,8)(1,85) \quad \checkmark$$

$$v_i = 6,02 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

OPTION 7/OPSIE 7

$$(E_p + E_k)_{\text{floor/vloer}} = (E_p + E_k)_{\text{top/bo}} \quad \checkmark$$

$$(mgh + \frac{1}{2}mv^2)_{\text{floor/vloer}} = (mgh + \frac{1}{2}mv^2)_{\text{top/bo}}$$

$$0 + \frac{1}{2}v^2 = (9,8)(1,85) + 0 \quad \checkmark$$

$$v = 6,02 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

OPTION 2/OPSIE 2Upwards positive/*Opwaarts positief*

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad \checkmark$$

$$1,85 = v_i(0,62) + \frac{1}{2}(-9,8)(0,62)^2 \quad \checkmark$$

$$v_i = 6,02 \text{ m}\cdot\text{s}^{-1} \text{ (6,022 m}\cdot\text{s}^{-1}) \quad \checkmark$$

Downwards positive/*Afwaarts positief*

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad \checkmark$$

$$1,85 = v_i(0,62) + \frac{1}{2}(9,8)(0,62)^2 \quad \checkmark$$

$$v_i = -6,02$$

$$\therefore v_i = 6,02 \text{ m}\cdot\text{s}^{-1} \text{ (6,022 m}\cdot\text{s}^{-1}) \quad \checkmark$$

OPTION 4/OPSIE 4Upwards positive/*Opwaarts positief*

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad \checkmark$$

$$0 = v_i(1,23) + \frac{1}{2}(-9,8)(1,23)^2 \quad \checkmark$$

$$v_i = 6,03 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

Downwards positive/*Afwaarts positief*

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad \checkmark$$

$$0 = v_i(1,23) + \frac{1}{2}(9,8)(1,23)^2 \quad \checkmark$$

$$v_i = -6,03 \text{ m}\cdot\text{s}^{-1}$$

$$\text{speed/speed} = 6,03 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

OPTION 5/OPSIE 5

$$\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t \quad \checkmark$$

$$1,85 = \left(\frac{0 + v_i}{2} \right) (0,62) \quad \checkmark$$

$$v_i = 5,97 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

OPTION 6/OPSIE 6

$$F_{\text{net}}\Delta t = m\Delta v$$

$$F_{\text{net}}\Delta t = m(v_f - v_i) \quad \checkmark$$

$$m(9,8)(0,62) = m(0 - v_i) \quad \checkmark$$

$$v_i = 6,08 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

(3)

3.2.4

OPTION/OPSIE 1, 2, 3, 4: Marking criteria/Nasienriglyne	
Calculate initial velocity: Bereken aanvanklike snelheid: - Appropriate formula/Gesikhte formule ✓ - Substitution/Vervanging ✓	Calculate/Bereken Δt: - Appropriate formula/Gesikhte formule ✓ - Substitution/Vervanging ✓ $1,97 \text{ s} + \Delta t$ ✓ - Fin answer/Fin antwoord: $2,95 - 2,97 \text{ s}$ ✓
Calculate initial velocity: Bereken beginsnelheid	Calculate time Δt Bereken tyd Δt
OPTION 1/OPSIE 1 Downwards positive/Afwaarts positief $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0 = v_i^2 + 2(9,8)(-1,2)$ ✓ $v_i = -4,85 \text{ m}\cdot\text{s}^{-1}$ Upwards positive/Opwaarts positief $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0 = v_i^2 + 2(-9,8)(1,2)$ ✓ $v_i = 4,85 \text{ m}\cdot\text{s}^{-1}$	Upwards positive <u>Opwaarts positief</u> $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $1,2 = (4,85)\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓ $\Delta t = 0,4898 \text{ s} / 0,5 \text{ s}$ $t = \underline{1,97 + 2(0,4898)}$ ✓ $= 2,95 \text{ s} / 2,97 \text{ s}$ ✓ OR/OF $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $0 = (4,85)\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓ $\Delta t = 0,9898 \text{ s} \text{ (or } \Delta t = 0)$ $t = \underline{1,97 + 0,9898}$ ✓ = $2,96 \text{ s}$ ✓ Downwards positive <u>Afwaarts positief</u> $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $1,2 = (-4,85)\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓ $\Delta t = 0,4898 \text{ s} / 0,5 \text{ s}$ $t = \underline{1,97 + 2(0,4898)}$ ✓ $= 2,95 \text{ s} / 2,97 \text{ s}$ ✓ OR/OF $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $0 = (4,85)\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓ $\Delta t = 0,9898 \text{ s} \text{ (or } \Delta t = 0)$ $t = \underline{1,97 + 0,9898}$ ✓ = $2,96 \text{ s}$ ✓ OR/OF $v_f = v_i + a\Delta t$ ✓ $-4,85 = 4,85 + (-9,8)\Delta t$ ✓ $\Delta t = 0,9898 \text{ s}$ $\Delta t = \underline{1,97 + 0,9898}$ ✓ = $2,96 \text{ s}$ ✓ OR/OF <u>Upwards positive</u> <u>Opwaarts positief</u> $v_f = v_i + a\Delta t$ ✓ $0 = 4,85 + (-9,8)\Delta t$ ✓ $\Delta t = 0,4949 \text{ s}$ $\Delta t = \underline{1,97 + (2)(0,4949)}$ ✓ $= 2,96 \text{ s}$ ✓ OR/OF $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$ ✓ $1,2 = \left(\frac{0 + 4,85}{2} \right) \Delta t$ ✓ $\Delta t = 0,4948 \text{ s}$ $\Delta t_{\text{total}} = 2(0,4948) = 0,99 \text{ s}$ $\Delta t = \underline{1,97 + 0,99}$ ✓ = $2,96 \text{ s}$ ✓
OPTION 2/OPSIE 2 $(E_{\text{mech}})_{\text{top}} = (E_{\text{mech}})_{\text{bot/ond}}$ } ✓ Any one/ $(E_p + E_k)_{\text{top}} = (E_p + E_k)_{\text{Bot/Ond}}$ } Enige een $(mgh + \frac{1}{2}mv^2)_{\text{top}} = (mgh + \frac{1}{2}mv^2)_{\text{Bot/Ond}}$ $(9,8)(1,2) + 0 = 0 + \frac{1}{2}v^2$ ✓ $v_i = 4,85 \text{ m}\cdot\text{s}^{-1}$ upwards /opwaarts	
OPTION 3/OPSIE 3 $W_{\text{nc}} = \Delta E_p + \Delta E_k$ $0 = (0 - mgh) + \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓ Any one/ $0 = -(9,8)(1,2) + \frac{1}{2}v_i^2$ } Enige een $v_i = 4,85 \text{ m}\cdot\text{s}^{-1}$ upwards /opwaarts	
OPTION 4/OPSIE 4 $W_{\text{net}} = \Delta E_k$ $w\Delta x \cos 180^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓ Any one/ $(9,8)(1,2) \cos 180^\circ = \frac{1}{2}v_i^2$ } Enige een $v_i = -4,85 \text{ m}\cdot\text{s}^{-1}$	

OPTION 5/OPSIE 5 Downwards positive/Afwaarts positief $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $1,2 \checkmark = 0 + \frac{1}{2}(9,8) \Delta t^2 \checkmark$ $\Delta t = 0,49 \text{ s}$ $t = 1,97 + \checkmark 2(0,49) \checkmark$ $= 2,96 \text{ s} \checkmark$ Upwards positive/Opwaarts positief $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $-1,2 \checkmark = 0 + \frac{1}{2}(-9,8) \Delta t^2 \checkmark$ $\Delta t = 0,49 \text{ s}$ $t = 1,97 + \checkmark 2(0,49) \checkmark$ $= 2,96 \text{ s} \checkmark$	OPTION 5: Marking criteria/OPSIE 5: Nasienriglyne • Formula $\checkmark$/Formule • Substitution/Vervanging $\Delta y = 1,2 \checkmark$ • Substitution/Vervanging $0 + \frac{1}{2}(9,8) \Delta t^2$ • $1,97 \text{ s} + \checkmark$ • $2 \Delta t \checkmark$ • Final answer/Finale antwoord: $2,95 - 2,97 \text{ s} \checkmark$

(6)
[15]

QUESTION 4/VRAAG 4

- 4.1 (Linear) momentum (of an object) is the product of mass and velocity. $\checkmark \checkmark$
(Liniêre) momentum (van 'n voorwerp) is die produk van massa en snelheid.
(2 or/of 0)

(2)

4.2.1

OPTION 1/OPSIE 1 East as positive/Oos as positief $\sum p_i = \sum p_f$ $m_p v_{pi} + m_Q v_{Qi} = m_p v_{pf} + m_Q v_{Qf} \checkmark$ Any one/Enige een $(0,16)(10) + (0,2)(-15) \checkmark = (0,16)(-5) + (0,2)v_{Qf} \checkmark$ $v_{Qf} = -3 \text{ m} \cdot \text{s}^{-1}$ $v_{Qf} = 3 \text{ m} \cdot \text{s}^{-1} \checkmark$ west/wes $\checkmark$
OPTION 2/OPSIE 2 West as positive/Wes as positief $\sum p_i = \sum p_f$ $m_p v_{pi} + m_Q v_{Qi} = m_p v_{pf} + m_Q v_{Qf} \checkmark$ Any one/Enige een $(0,16)(-10) + (0,2)(15) \checkmark = (0,16)(5) + (0,2)v_{Qf} \checkmark$ $v_{Qf} = 3 \text{ m} \cdot \text{s}^{-1} \checkmark$ west/wes $\checkmark$
OPTION 3/OPSIE 3 $\Delta p_p = -\Delta p_Q \checkmark$ $(0,16)(-5 - 10) \checkmark = -(0,2)(v - (-15)) \checkmark$ $v = -3 \text{ m} \cdot \text{s}^{-1}$ $= 3 \text{ m} \cdot \text{s}^{-1} \checkmark$ west/wes $\checkmark$

(5)

4.2.2

For ball/Vir bal P: West as negative/Wes as negatief Impulse = Δp $F_{\text{net}}\Delta t = \Delta p$ $\Delta p = m(v_{\text{Pf}} - v_{\text{Pi}})$ $= 0,16(-5 - 10) \checkmark$ $= -2,4$ $\therefore 2,4 \text{ N}\cdot\text{s} \checkmark \quad (2,4 \text{ kg}\cdot\text{m}\cdot\text{s}^{-1})$ OR/OF West as positive /Wes as positief Impulse = Δp $F_{\text{net}}\Delta t = \Delta p$ $= m(v_{\text{Pf}} - v_{\text{Pi}})$ $= 0,16(5 - (-10)) \checkmark$ $= 2,4 \text{ N}\cdot\text{s} \checkmark$	POSITIVE MARKING FROM QUESTION 4.2.1 /POSITIEWE NASIEN VANAF VRAAG 4.2.1 For ball/Vir bal Q: West as negative/Wes as negatief Impulse = Δp $F_{\text{net}}\Delta t = \Delta p$ $= m(v_{\text{Qf}} - v_{\text{Qi}})$ $= 0,2[-3 - (-15)] \checkmark$ $= 2,4 \text{ N}\cdot\text{s} \checkmark \quad (2,4 \text{ kg}\cdot\text{m}\cdot\text{s}^{-1})$ OR/OF West as positive /Wes as positief Impulse = Δp $F_{\text{net}}\Delta t = \Delta p$ $= m(v_{\text{Qf}} - v_{\text{Qi}})$ $= 0,16(3 - (15)) \checkmark$ $= -2,4 \text{ N}\cdot\text{s}$ $\therefore 2,4 \text{ N}\cdot\text{s} \checkmark \quad (2,4 \text{ kg}\cdot\text{m}\cdot\text{s}^{-1})$

(3)
[10]**QUESTION 5/VRAAG 5**

5.1

Marking criteria/Nasienriglyne

If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase. However, **IF**: The word “work” is omitted 0 marks
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word:
- 1 punt per woord/frase. Maar, **INDIEN**: Die woord “arbeid” uitgelaat is, 0 punte

A force is non-conservative if the work it does on an object (which is moving between two points) depends on the path taken. $\checkmark\checkmark$

'n Krag is nie-konserwatief indien die arbeid wat dit verrig (op 'n voorwerp wat tussen twee punte beweeg) afhanklik is van die pad.

OR/OF

A force is non-conservative if the work it does on an object depends on the path taken. $\checkmark\checkmark$

'n Krag is nie-konserwatief indien die arbeid wat dit verrig afhanklik is van die pad.

OR/OF

A force is non-conservative if the work it does in moving an object around a closed path is non-zero. $\checkmark\checkmark$

'n Krag is nie-konserwatief indien die arbeid wat dit verrig om 'n voorwerp op 'n geslote pad te beweeg, nie-nul is nie.

(2)

5.2

$$\begin{aligned}
 K &= \frac{1}{2}mv^2 / E_k = \frac{1}{2}mv^2 \\
 \Delta K &= K_f - K_i \\
 \Delta K &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\
 &= \frac{1}{2}m(v_f^2 - v_i^2) \\
 &= \frac{1}{2}(200)(2^2 - 4^2) \checkmark \\
 \Delta K &= -1\,200 \text{ J} \checkmark
 \end{aligned}
 \quad \left. \vphantom{\begin{aligned} K &= \frac{1}{2}mv^2 \\ \Delta K &= K_f - K_i \\ \Delta K &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ &= \frac{1}{2}m(v_f^2 - v_i^2) \\ &= \frac{1}{2}(200)(2^2 - 4^2) \checkmark \\ \Delta K &= -1\,200 \text{ J} \checkmark \end{aligned}} \right\} \checkmark \text{ Any one / Enige een}$$

(3)

5.3

POSITIVE MARKING FROM QUESTION 5.2.**POSITIEWE NASIEN VANAF VRAAG 5.2.****Marking criteria/Nasienriglyne**

- Appropriate formula/Geskikte formule ✓
- Substitution into appropriate formula together with/Vervanging in geskikte formule saam met $-3,40 \times 10^3$ ✓✓
- Final answer/Finale antwoord: 8,88 m ✓

OPTION 1/OPSIE 1

$$\begin{aligned}
 W_{nc} &= \Delta K + \Delta U \\
 W_{nc} &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i \quad \left. \vphantom{\begin{aligned} W_{nc} &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i \\ &= \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i) \end{aligned}} \right\} \checkmark \text{Any one/Enige een} \\
 &= \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i) \\
 -3,40 \times 10^3 \checkmark &= \frac{-1\,200 + 200(9,8)(h_f - 10)}{\quad} \checkmark \\
 h &= 8,88 \text{ m } \checkmark \quad (8,87765 \text{ m})
 \end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned}
 E_{(\text{mech/meg})A} + W_f &= E_{(\text{mech})B} \\
 (E_p + E_k)_A + W_f &= (E_p + E_k)_B \quad \left. \vphantom{\begin{aligned} E_{(\text{mech/meg})A} + W_f &= E_{(\text{mech})B} \\ (E_p + E_k)_A + W_f &= (E_p + E_k)_B \end{aligned}} \right\} \checkmark \text{Any one/Enige een} \\
 (mgh + \frac{1}{2}mv^2)_A + W_f &= (mgh + \frac{1}{2}mv^2)_B \\
 \frac{200(9,8)(10) + \frac{1}{2}(200)(4^2) - 3,40 \times 10^3}{\quad} \checkmark &= \frac{200(9,8)(h) + \frac{1}{2}(200)(2)^2}{\quad} \checkmark \\
 h &= 8,88 \text{ m } \checkmark \quad (8,87755)
 \end{aligned}$$

OPTION 3/OPSIE 3

$$\begin{aligned}
 W_{net} &= \Delta K \\
 W_f + W_w &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\
 W_f - \Delta E_p &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \quad \left. \vphantom{\begin{aligned} W_f + W_w &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ W_f - \Delta E_p &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \end{aligned}} \right\} \checkmark \text{Any one/Enige een} \\
 W_f - mg(h_f - h_i) &= \frac{1}{2}m(v_f^2 - v_i^2) \\
 \frac{-3,40 \times 10^3 - 200(9,8)(h-10)}{\quad} \checkmark &= \frac{-1\,200}{\quad} \checkmark \\
 h &= 8,88 \text{ m } \checkmark \quad (8,87755 \text{ m})
 \end{aligned}$$

(4)

5.4

OPTION 1 AND 2/OPSIE 1 EN 2: Marking criteria /Nasienriglyne

- Appropriate formula/Geskikte formule ✓✓
- Work done by friction/Arbeid verrig deur wrywing ✓✓
- Substitution of/Vervanging van $(200)(9,8)(13,12)$ ✓
- Appropriate formula/Geskikte formule
- Substitution into power formula/Vervanging in drywingformule
- Final answer /Finale antwoord: 1 814,35 W

OPTION 1/OPSIE 1

$$\begin{aligned}
 W_{nc} &= \Delta K + \Delta U \\
 W_{engine} + W_f &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i \quad \left. \vphantom{\begin{aligned} W_{engine} + W_f &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i \\ &= \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i) \end{aligned}} \right\} \checkmark \checkmark \text{Any one/Enige een} \\
 &= \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i) \\
 W_{engine} + \frac{(50)(15)(2)\cos 180^\circ}{\quad} \checkmark \checkmark &= 0 + \frac{200(9,8)}{\quad} \checkmark (22 - 8,88) \\
 W_{engine} &= 27\,215,20 \text{ J} \\
 P_{engine} &= \frac{W_{engine}}{\Delta t} \\
 &= \frac{27\,215,20}{15} \\
 &= 1\,814,35 \text{ W}
 \end{aligned}$$

OPTION 2/OPSIE 2

$$\left. \begin{aligned} W_{\text{net}} &= \Delta K \\ W_N + W_{\text{engine}} + W_w + W_f &= 0 \\ W_N + W_{\text{engine}} - \Delta E_p + W_f &= 0 \end{aligned} \right\} \checkmark\checkmark \text{ Any one/Enige een}$$

$$0 + W_{\text{engine}} - (200)(9,8)\checkmark(13,12) + (50)(2)(15)\cos 180^\circ \checkmark\checkmark = 0$$

$$W_{\text{engine}} = 27\,215,20 \text{ J}$$

OR/OF

$$W_{\text{net}} = \Delta K \checkmark\checkmark$$

$$W_N + W_{\text{engine}} + W_{w\parallel} + W_f = 0$$

$$W_N + W_{\text{engine}} + mg\sin\theta\Delta x\cos 180^\circ + W_f = 0$$

$$0 + W_{\text{engine}} - (200)(9,8)\checkmark\left(\frac{13,12}{\Delta x}\right)\Delta x(-1) + (50)(2)(15)\cos 180^\circ \checkmark\checkmark = 0$$

$$W_{\text{engine}} = 27\,215,20 \text{ J}$$

$$P_{\text{engine}} = \frac{W_{\text{engine}}}{\Delta t}$$

$$= \frac{27\,215,20}{15}$$

$$= 1\,814,35 \text{ W}$$

OPTION/OPSIE 3: Marking criteria/Nasienriglyne Opsie 3

- Appropriate formula/Geskikte formule $\checkmark\checkmark$
- Substitution of/Vervanging van - 50 $\checkmark\checkmark$
- Substitution of/Vervanging van $(-200)(9,8)(0,4373)$ or/of $(-200)(9,8)(0,44)\checkmark$
- Appropriate formula/Geskikte formule
- Substitution into/Vervanging in $P_{\text{ave}} = Fv_{\text{ave}}$
- Final answer/Finale antwoord: 1 814,35 W - 1 824,8 W

OPTION 3/OPSIE 3

$$\left. \begin{aligned} F_{\text{net}} &= ma \\ F_{\text{engine}} + F_{\text{friction}} + F_{g\parallel} &= 0 \end{aligned} \right\} \checkmark\checkmark \text{ Any one/Enige een}$$

$$F_{\text{engine}} + (-50)\checkmark\checkmark + (-200)(9,8)\checkmark(0,4373) = 0$$

$$F_{\text{engine}} = 906,52 \text{ N } (906,52 - 912,4)$$

$$P_{\text{ave}} = Fv_{\text{ave}}$$

$$P_{\text{ave}} = (908,52)(2)$$

$$= 1\,813,04 \text{ W } (1\,824,8 \text{ W})$$

OR/OF

$$W = F_{\text{engine}}\Delta x\cos\theta$$

$$= (906,52)(30)\cos 0^\circ$$

$$= 27\,195,6 \text{ J } (27\,372 \text{ W})$$

$$P = \frac{W}{\Delta t} = \frac{27\,195,6}{15} = 1\,813,04 \text{ W } \checkmark \quad (1\,824,8 \text{ W})$$

$$\sin\theta = \frac{h}{\Delta x}$$

$$= \frac{13,12}{2(15)}$$

$$= 0,4373$$

(5)
[14]

QUESTION 6/VRAAG 6

6.1

Marking criteria/Nasienriglyne

If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.

Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word:
- 1 punt per woord/frase

The change in frequency✓ (or pitch) (of the sound) detected by a listener because the source and the listener have different velocities relative to the medium of propagation. ✓

Die verandering in die frekwensie (of toonhoogte) (van die klank) waargeneem deur 'n luisteraar omdat die bron en die luisteraar verskillende snelhede relatief tot die voortplantingsmedium het.

OR/OF

An (apparent) change in (observed/detected) frequency (pitch), as a result of the relative motion between a source and an observer (listener).

'n (Skynbare) verandering in (waargenome) frekwensie (toonhoogte), as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/luisteraar.

(2)

6.2

Towards/Nader ✓

(1)

6.3

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \text{OR/OF} \quad f_L = \frac{v}{v - v_s} f_s \quad \text{OR/OF} \quad f_L = \frac{v}{v + v_s} f_s$$

$$3148 = \frac{340 + 0}{340 - v_s} f_s \quad \text{OR/OF} \quad 2073 = \frac{340 - 0}{340 + v_s} f_s$$

$$\frac{3148(340 - v_s)}{340 + 0} = \frac{2073(340 + v_s)}{340 - 0}$$

$$v_s = 70 \text{ m} \cdot \text{s}^{-1} \quad (69,95 - 70,16 \text{ m} \cdot \text{s}^{-1})$$

(6)

6.4

POSITIVE MARKING FROM QUESTION 6.3 **POSITIEWE NASIEN VANAF VRAAG 6.3**

OPTION 1/OPSIE 1

$$\Delta t = \frac{\Delta x}{v}$$

$$\Delta t = \frac{350}{70} \quad \checkmark$$

$$\Delta t = 5 \text{ s} \quad \checkmark$$

OPTION 2/OPSIE 2

$$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$350 = 70 \Delta t + 0 \quad \checkmark$$

$$\Delta t = 5 \text{ s} \quad \checkmark$$

OPTION 3/OPSIE 3

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$350 = \left(\frac{70 + 70}{2} \right) \Delta t \quad \checkmark$$

$$\Delta t = 5 \text{ s} \quad \checkmark$$

(2)

[11]

QUESTION 7/VRAAG 7

7.1

$$n = \frac{Q}{e} \checkmark$$
$$= \frac{(-)4 \times 10^{-6}}{(-)1,6 \times 10^{-19}} \checkmark$$
$$= 2,5 \times 10^{13} \checkmark \quad (3)$$

7.2 **Electrostatic force on B due to A:/Elektrostatiese krag op B a.g.v. A:**

$$F_{AB} = \frac{kQ_1Q_2}{r^2} \checkmark$$
$$= \left[\frac{9 \times 10^9 (4 \times 10^{-6})(3 \times 10^{-6})}{0,2^2} \right] \checkmark$$
$$= 2,7 \text{ N} \checkmark \quad (3)$$

Ignore negative signs
Ignoreer negatiewe tekens

7.3 **Marking criteria/Nasienriglyne**

If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word:
- 1 punt per woord/frase

Electric field is a region (in space) where (in which) an (electric) charge experiences a (electric) force. ✓✓
Elektriese veld is 'n gebied (in die ruimte) waarin 'n (elektriese) lading 'n (elektriese) krag ondervind. (2)

7.4

Marking criteria/Nasienriglyne

- Appropriate formula/Geskikte formule ✓
- Correct substitution for A and B/Korrekte vervanging van A en B ✓✓
- Subtraction of electric fields/Aftrek van elektriese velde ✓
- Final answer/Finale antwoord: $2,3 \times 10^6 \text{ N} \cdot \text{C}^{-1}$ ✓

OPTION 1/OPSIE 1

Electric field at M due to / Elektriese veld by M as gevolg van: $-4 \times 10^{-6} \text{ C}$

$$E_{AM} = k \frac{Q}{r^2} \checkmark$$

$$= 9 \times 10^9 \frac{(4 \times 10^{-6})}{(0,3)^2} \checkmark$$

$$= 4,0 \times 10^5 \text{ N} \cdot \text{C}^{-1} \text{ (to left /links)}$$

Electric field at M due to / Elektriese veld by M as gevolg van: $+3 \times 10^{-6} \text{ C}$,

$$E_{BM} = k \frac{Q}{r^2}$$

$$= 9 \times 10^9 \frac{(3 \times 10^{-6})}{(0,1)^2} \checkmark$$

$$= 2,7 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ (to right /regs)}$$

Net electric field at M /Netto elektrieseveld by M

$$E_{\text{net}} = E_{BM} + E_{AM}$$

$$= 4,0 \times 10^5 - 2,7 \times 10^6 \checkmark$$

$$= 2,3 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark \text{ (right/regs)}$$

OR/OF

Net electric field at M /Netto elektrieseveld by M

$$E_{\text{net}} = E_{BM} + E_{AM}$$

$$= -4,0 \times 10^5 + 2,7 \times 10^6 \checkmark$$

$$= -2,3 \times 10^6 \text{ N} \cdot \text{C}^{-1}$$

$$= 2,3 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark \text{ (right)}$$

OPTION 2/OPSIE 2

$$F_{AM} = \frac{kQ_1Q_2}{r^2} = \frac{(9 \times 10^9)(4 \times 10^{-6})Q}{(0,3)^2} \checkmark = 4 \times 10^5 Q \text{ N}$$

$$F_{BM} = \frac{kQ_1Q_2}{r^2} = \frac{(9 \times 10^9)(3 \times 10^{-6})Q}{(0,1)^2} \checkmark = 2,7 \times 10^6 Q \text{ N}$$

$$F_{\text{net}} = 2,7 \times 10^6 Q + (-4 \times 10^5 Q) \checkmark = 2,3 \times 10^6 Q$$

$$E = \frac{F}{q} \checkmark = \frac{2,3 \times 10^6 Q}{Q} = 2,3 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark \text{ (right/regs)}$$

(5)

7.5 Positive/Positief ✓

(1)

7.6

POSITIVE MARKING FROM 7.2/POSITIEWE NASIEN VANAF 7.2

Marking criteria/Nasienriglyne

- Correct substitution into Pythagoras's equation/Korrekte vervanging in Pythagoras se vergelyking ✓
- Correct substitution into Coulomb's Law/Korrekte vervanging in Coulomb se wet ✓
- Correct answer/Korrekte antwoord ✓

$$(F_{\text{net}})^2 = (F_{\text{AD}})^2 + (F_{\text{AB}})^2$$

$$(7,69)^2 = (F_{\text{AD}})^2 + (2,7)^2 \checkmark$$

$$F_{\text{AD}} = 7,2 \text{ N}$$

$$F_{\text{AD}} = \frac{kQ_1Q_2}{r^2}$$

$$7,2 = \frac{(9 \times 10^9)(4 \times 10^{-6})Q}{(0,15)^2} \checkmark$$

$$Q_D = 4,5 \times 10^{-6} \text{ C} \checkmark$$

OR/OF

$$F_{\text{AD}} = k \frac{Q_1Q_2}{r^2}$$

$$= 9 \times 10^9 \frac{(4 \times 10^{-6})Q}{0,15^2} \checkmark$$

$$= 1,6 \times 10^6 Q$$

$$F_{\text{net}} = \sqrt{F_{\text{AB}}^2 + F_{\text{AD}}^2} \quad \text{OR/OF} \quad F_{\text{net}}^2 = F_{\text{AB}}^2 + F_{\text{AD}}^2$$

$$7,69 = \sqrt{2,7^2 + (1,6 \times 10^6 Q)^2} \checkmark$$

$$Q = 4,50 \times 10^{-6} \text{ C} \checkmark$$

(3)
[17]

QUESTION 8/VRAAG 8

8.1

Marking criteria/Nasienriglyne

If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.

Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word:
- 1 punt per woord/frase

(Maximum) energy provided (work done) by a battery per coulomb/unit charge passing through it. ✓✓

(Maksimum) energie verskaf (arbeid verrig) deur 'n battery per coulomb/eenheidslading wat daardeur beweeg.

Work done by the battery to move a unit coulomb of charge across the circuit./Arbeid verrig deur die battery om 'n eenheidslading oor die stroombaan te beweeg.

(2)

8.2

Energy (per coulomb of charge) is converted to heat in the battery due to the internal resistance. ✓✓

Energie (per coulomb lading) word na hitte omskep binne-in die battery a.g.v. interne weerstand.

(2)

8.3.1

$$I = \frac{V}{R} \checkmark$$

$$I = \frac{1,5}{0,5} \checkmark$$

$$= 3 \text{ A} \checkmark$$

(3)

8.3.2

OPTION 1/OPSIE 1

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$$

$$\frac{1}{R_p} = \frac{1}{25} + \frac{1}{15} \checkmark$$

$$R_p = 9,375 \Omega$$

$$R_{\text{ext}} = 9,375 + 4 \checkmark = 13,38 \Omega \checkmark$$

(13,375 Ω)

OPTION 2/OPSIE 2

$$R_p = \frac{R_1 R_2}{R_1 + R_2} \checkmark$$

$$R_p = \frac{(25)(15)}{25+15} \checkmark$$

$$R_p = 9,375 \Omega$$

$$R_{\text{ext}} = 9,375 + 4 \checkmark = 13,38 \Omega \checkmark$$

(13,375 Ω)

(4)

8.3.3

POSITIVE MARKING FROM QUESTIONS 8.3.1 AND 8.3.2.
POSITIEWE NASIEN VANAF VRAAG 8.3.1 EN 8.3.2.

OPTION 1/OPSIE 1

$$\begin{aligned}\mathcal{E} &= I(R + r) \checkmark \\ &= 3(13,38 + 0,5) \checkmark \\ &= 41,64 \text{ V} \checkmark \quad (\text{Range/Gebied: } 41,625 - 41,64)\end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned}\mathcal{E} &= V_{\text{ext/eks}} + V_{\text{int}} \checkmark \\ &= (3)(13,38) + 1,5 \checkmark \\ &= 41,64 \text{ V} \checkmark \quad (\text{Range/Gebied: } 41,625 - 41,64)\end{aligned}$$

(3)

8.4 Yes. $\checkmark$ /Ja

For the same voltage/potential difference, $\checkmark$

a larger current will flow through a smaller resistor ($I = \frac{V}{R}$) $\checkmark$

Vir dieselfde spanning/ potensiaalverskil

sal 'n groter stroom deur die kleiner weerstand vloei ($I = \frac{V}{R}$).

OR/OF

$$I \propto \frac{1}{R} \checkmark, V = \text{constant /konstant} \checkmark$$

I is inversely proportional to R and V is constant.

I is omgekeerd eweredig aan R en V is konstant.

OR/OF

$$\begin{aligned}V_{\parallel} &= IR \\ &= (3)(9,38) \\ &= 28,14 \text{ V}\end{aligned}$$

$$I_{R2} = \frac{V}{R} = \frac{28,14}{25} = 1,13 \text{ A} \checkmark$$

$$I_{R3} = \frac{V}{R} = \frac{28,14}{15} = 1,88 \text{ A} \checkmark$$

OR/OF

V is the same / V is dieselfde $\checkmark$

$$\left. \begin{aligned}I_{15\Omega} &= \frac{25}{40} I \\ I_{25\Omega} &= \frac{15}{40} I\end{aligned} \right\} \checkmark$$

(3)

8.5 Remains the same/Bly dieselfde $\checkmark$

(1)

[18]

QUESTION 9/VRAAG 9

9.1.1 (DC) motor/(GS-)motor ✓ (1)

9.1.2 **POSITIVE MARKING FROM QUESTION 9.1.1**

POSITIEWE NASIEN VANAF VRAAG 9.1.1

Electrical to mechanical /kinetic (energy) ✓✓ (2 or 0)

Elektriese na meganiese/kinetiese (energie) (2 of 0) (2)

9.1.3 Split ring/commutator/Splitring/kommutator ✓ (1)

9.1.4 Anticlockwise/antikloksgewys ✓✓ (2)

9.2.1 (The rms voltage/value of AC is) the AC voltage/potential difference which dissipates the same amount of energy/heat/power as an equivalent DC voltage/potential difference. ✓✓ (2 or 0)

(Die wgk-waarde van WS is) die WS-potensiaalverskil/spanning wat dieselfde hoeveelheid energie/hitte/drywing verbruik as 'n ekwivalente GS-spanning/potensiaalverskil. (2 of 0)

ACCEPT/AANVAAR

The rms voltage/value of AC is the DC potential difference which dissipates the same amount of energy/heat/power as AC.

Die wgk-waarde van WS is die GS-potensiaalverskil wat dieselfde hoeveelheid energie/hitte/drywing verbruik as die WS. (2)

9.2.2 **Marking criteria/Nasienriglyne**

- Appropriate formula for P_{ave} /Gesikte formule vir P_{ave} ✓
- Substitution to calculate/Vervanging vir berekening van R ✓
- Final answer/Finale antwoord: 242Ω ✓

OPTION 1/OPSIE 1

$$P_{ave} = \frac{V_{rms}^2}{R} \checkmark$$

$$200 = \frac{220^2}{R} \checkmark$$

$$R = 242 \Omega \checkmark$$

OPTION 2/OPSIE 2

$$P_{ave} = V_{rms} I_{rms} \checkmark$$

$$200 = I_{rms} (220)$$

$$I_{rms} = 0,909 \text{ A (0,91)}$$

$$R = \frac{V_{rms}}{I_{rms}} \text{ or/of } R = \frac{V}{I}$$

$$R = \frac{220}{0,909} \checkmark$$

$$R = 242 \Omega \checkmark (241,76 \Omega)$$

OPTION 3/OPSIE 3

$$P_{ave} = V_{rms} I_{rms} \checkmark$$

$$200 = I_{rms} (220)$$

$$I_{rms} = 0,909 \text{ A (0,91)}$$

$$P_{ave} = I_{rms}^2 R$$

$$200 = (0,909)^2 R \checkmark$$

$$R = 242 \Omega \checkmark$$

$$(241,52 \Omega)$$

(3)

9.2.3

Marking criteria for options 1,2 and 3 /Nasienriglyne vir opsies 1,2 en 3

- Appropriate formula to calculate P or I_{rms} /Geskikte formule om P of I_{rms} te bereken ✓
- Substitution/Vervanging ✓
- Formula for P or W containing Δt /Formule vir P of W wat Δt bevat ✓
- Substitution/Vervanging ✓
- Final answer/Finale antwoord: 55 785,12 J ✓

POSITIVE MARKING FROM QUESTION 9.2.2.**POSITIEWE NASIEN VANAF VRAAG 9.2.2.****OPTION 1/OPSIE 1****Marking criteria / Nasienriglyne**

- Appropriate formula for W containing V /Geskikte formule vir W wat V bevat ✓✓
- Substitution/Vervanging ✓✓
- Final answer/Finale antwoord: 55 785,12 J ✓

$$W = \frac{V^2 \Delta t}{R} \checkmark \checkmark$$

$$= \frac{(150^2)(10 \times 60)}{242} \checkmark$$

$$= 55\,785,12 \text{ J} \checkmark$$

OPTION 2/OPSIE 2

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark$$

$$= \frac{150^2}{242} \checkmark$$

$$P_{\text{av}} = 92,975 \text{ W}$$

$$P = \frac{W}{\Delta t} \checkmark$$

$$92,975 = \frac{W}{(10)(60)} \checkmark$$

$$W = 55\,785,12 \text{ J} \checkmark$$

$$(55\,785,12 - 55\,896 \text{ J})$$

OPTION 3/OPSIE 3

$$R = \frac{V_{\text{rms}}}{I_{\text{rms}}} \checkmark / R = \frac{V}{I}$$

$$242 = \frac{150}{I_{\text{rms}}} \checkmark$$

$$I_{\text{rms}} = 0,620 \text{ A}$$

$$P_{\text{ave}} = I_{\text{rms}} V_{\text{rms}}$$

$$= (0,62)(150) \checkmark$$

$$= 92,97 \text{ W} (93 \text{ W})$$

$$P = \frac{W}{\Delta t} \checkmark$$

$$92,975 = \frac{W}{(10)(60)} \checkmark$$

$$W = 55\,785,12 \text{ J} \checkmark$$

$$(55\,785,12 - 55\,896 \text{ J})$$

OPTION 4/OPSIE 4

$$R = \frac{V_{\text{rms}}}{I_{\text{rms}}} \checkmark / R = \frac{V}{I}$$

$$242 = \frac{150}{I_{\text{rms}}} \checkmark$$

$$I_{\text{rms}} = 0,620 \text{ A}$$

$$W = I^2 R \Delta t \checkmark$$

$$= (0,62)^2 (242)(10)(60) \checkmark$$

$$= 55\,814,88 \text{ J} \checkmark$$

$$(55\,785,12 - 55\,896 \text{ J})$$

OR/OF

$$W = VI \Delta t$$

$$= (150)(0,62)(600)$$

$$= 55\,800 \text{ J}$$

OPTION 5/OPSIE 5

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark = \frac{150^2}{242} \checkmark = 92,975 \text{ W}$$

$$P_{\text{ave}} = I_{\text{rms}}^2 R$$

$$92,975 = I_{\text{rms}}^2 (242)$$

$$I_{\text{rms}} = 0,6198 \text{ A}$$

$$W = I^2 R \Delta t \checkmark$$

$$= (0,6198)^2 (242)(10)(60) \checkmark$$

$$= 55\,778,88 \text{ J} \checkmark$$

(5)
[16]

QUESTION 10/VRAAG 10

10.1 Photoelectric effect/Fotoëlektriese effek ✓ (1)

10.2 Work function (of potassium)/Werksfunksie/Arbeidsfunksie (van kalium) ✓ (1)

10.3 Potassium/Kalium ✓
It has the lowest work function / threshold frequency / highest threshold wavelength. ✓
Dit het die laagste arbeidsfunksie / drumpelfrekwensie / hoogste drumpel golflengte. (2)

10.4 **Marking criteria/Nasienriglyne**
If any of the underlined key words/phrases in the correct context are omitted:
- 1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per woord/frase

The work function of a metal is the minimum energy that an electron (in the metal) needs to be emitted/ejected from the metal / surface. ✓
Die werksfunksie/arbeidsfunksie van 'n metaal is die minimum energie benodig om 'n elektron vanaf 'n oppervlak / metaal vry te stel. (2)

10.5.1 $W_o = hf_o$ ✓
 $= (6,63 \times 10^{-34})(1,75 \times 10^{15})$ ✓
 $= 1,160 \times 10^{-18} \text{ J}$ ✓

OR/OF

$$\left. \begin{aligned} E &= W_o + E_{k(\max)} \\ hf &= W_o + E_{k(\max)} \end{aligned} \right\} \text{✓ Any one / Enigeen}$$

$$(6,63 \times 10^{-34})(1,75 \times 10^{15}) = W_o + 0 \text{ ✓}$$

$$W_o = 1,160 \times 10^{-18} \text{ J} \text{ ✓} \quad (3)$$

10.5.2 **POSITIVE MARKING FROM QUESTION 10.5.1.**
POSITIEWE NASIEN VANAF VRAAG 10.5.1.

$$\left. \begin{aligned} E &= W_o + E_{k(\max)} \\ hf &= hf_o + \frac{1}{2}mv_{\max}^2 \end{aligned} \right\} \text{✓ Any one/Enige een}$$

$$(6,63 \times 10^{-34})f \text{ ✓} = \frac{1,160 \times 10^{-18}}{2} + \frac{1}{2} (9,11 \times 10^{-31}) (5,60 \times 10^5)^2 \text{ ✓}$$

$$\therefore f = 1,97 \times 10^{15} \text{ Hz} \text{ ✓} \quad (4)$$

[13]

TOTAL/TOTAAL: 150

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**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

NOVEMBER 2019

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 24 pages. /
*Hierdie nasienriglyne bestaan uit 24 bladsye.***

QUESTION 1/VRAAG 1

1.1	C ✓✓	(2)
1.2	A ✓✓	(2)
1.3	A ✓✓	(2)
1.4	D ✓✓	(2)
1.5	B ✓✓	(2)
1.6	D ✓✓	(2)
1.7	A ✓✓	(2)
1.8	B ✓✓	(2)
1.9	D ✓✓	(2)
1.10	C ✓✓	(2)
		[20]

QUESTION 2/VRAAG 2

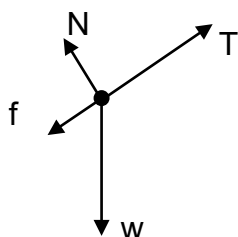
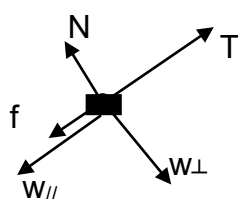
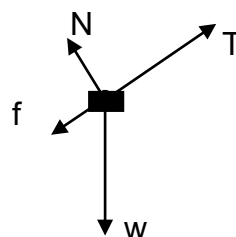
NOTE: -1 mark for each key word/phrase omitted in the correct context
LET WEL: -1 punt vir elke sleutel woord/frase in die korrekte konteks weggelaat

- 2.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force with an acceleration that is directly proportional to the force and inversely proportional to the mass of the object. ✓ ✓
 Wanneer 'n resultante/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel teen 'n versnelling wat direk eweredig is aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

OR/OF

The resultant/net force acting on an object is equal to the rate of change of momentum of the object (in the direction of the resultant/net force.) ✓ ✓
 Die netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum van die voorwerp (in die rigting van die resulterende/netto krag.)

2.2

**ACCEPT/AANVAAR****OR/OF**

	Accept the following symbols/Aanvaar die volgende simbole.
N ✓	F_N /Normal/Normaal/Normal force/Normaalkrag /16,97 N
f ✓	F_f / f_k / f_r / frictional force/wrywingskrag/kinetic frictional force/kinetiese wrywingskrag
W ✓	F_g / mg / weight / $F_{\text{Earth on block}}$ / 19,6 N / gravitational force/gewig / $F_{\text{aarde op blok}}$ / gravitasiekrag
T ✓	Tension/Spanning / F_T / F_A / F / F_s

Notes/Aantekeninge

- Mark is awarded for label and arrow. /Punt word toegeken vir byskrif en pyltjie
- Do not penalise for length of arrows.
Moenie vir die lengte van die pyltjies penaliseer nie.
- Deduct 1 mark for any additional force. /Trek 1 punt af vir enige addisionele krag.
- If force(s) do not make contact with body/dot /Indien krag(te) nie met die voorwerp / kolletjie kontak maak nie: Max./Maks: $\frac{3}{4}$
- If arrows missing/Indien pyltjies uitgelaat is: Max./Maks: $\frac{3}{4}$

2.3

For the 2 kg (P) block/Vir die 2 kg (P) blok: $\left. \begin{aligned} F_{\text{net}} &= ma \\ T + (-w_{\parallel}) + (-f_k) &= ma \\ T - (w_{\parallel} + f_k) &= ma \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$ $T - (2)(9,8)\sin 30^\circ \checkmark - 2,5 \checkmark = 2a \checkmark$ $T - 9,8 - 2,5 = 2a$ $T - 12,3 = 2a \dots\dots\dots(1)$ For the 3 kg (Q) block/Vir die 3 kg (Q) blok: $\left. \begin{aligned} F_x + (-T) + (-w_{\parallel}) &= ma \\ F_x - (T + w_{\parallel}) &= ma \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$ $[40 \cos 25^\circ \checkmark - T - (3)(9,8)\sin 30^\circ \checkmark] \checkmark = 3a$ $36,25 - T - 14,7 = 3a$ $21,55 - T = 3a \dots\dots\dots(2)$ $9,25 = 5a$ $a = 1,85 \text{ m}\cdot\text{s}^{-2} \checkmark$	Marking criteria/Nasienriglyne • Formula/Formule $\checkmark$ • Substitution of /vervanging van $w_{\parallel}$ for/vir 2 kg: $(2)(9,8)\sin 30^\circ \checkmark$ • Substitution of -2,5 N /Vervanging van -2,5 N $\checkmark$ • 2a OR/OF 3a $\checkmark$ • Calculate/Bereken F_x: $40 \cos 25^\circ \checkmark$ ($40 \sin 65^\circ$) • Substitution of /vervanging van $w_{\parallel}$ for/vir for 3 kg: $(3)(9,8)\sin 30^\circ \checkmark$ • Left hand side substitution for 3 kg/Linkerkant vervanging vir 3 kg $\checkmark$ • Final answer/Finale antwoord: $1,85 \text{ m}\cdot\text{s}^{-2} \checkmark$
Systems Approach (Massless String Approximation / Sisteembenadering (Massalose Tou Benadering)) (Max 5/8 marks / Maks 5/8 punte) $\left. \begin{aligned} F_{\text{net}} &= ma \\ F_x + (-w_{\parallel}) + (-f_k) &= ma \\ F_x - (w_{\parallel} + f_k) &= ma \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$ $40 \cos 25^\circ \checkmark - (5)(9,8)\sin 30^\circ \checkmark - 2,5 \checkmark = 5a$ $a = 1,85 \text{ m}\cdot\text{s}^{-2} \checkmark$	

(8)

2.4

Greater than/groter as $\checkmark$ F_{net} increases. / F_{net} neem toe. $\checkmark$ **ACCEPT/AANVAAR**

There is no friction. /Daar is geen wrywing nie.

OR/OF

The surface is smooth / Die oppervlak is glad

(2)

[16]

QUESTION 3/VRAAG 3

- 3.1 (Motion during which) the only force acting is the force of gravity. ✓✓
(Beweging waartydens) die enigste krag wat inwerk gravitasiekrag is.

(2 or/of 0)**(2)**

3.2

Marking criteria/Nasienriglyne:

- Any appropriate formula for Δy /Enige toepaslike formule vir Δy ✓
- Whole substitution to calculate 5,1 m /Hele vervanging om 5,1 m te bereken ✓
- 40 + answer from calculation/antwoord van berekening ✓
- Final answer/Finale antwoord: 45,10 m ✓ (Accept/aanvaar 45,1 m)

OPTION 1/OPSIE 1**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$0 = (10)^2 + (2)(-9,8)\Delta y \quad \checkmark$$

$$\Delta y = 5,10 \text{ m } (5,102 \text{ m})$$

$$\begin{aligned} \text{Height} &= 40 + 5,10 \quad \checkmark \\ &= 45,10 \text{ m } \quad \checkmark \end{aligned}$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$0 = (-10)^2 + (2)(9,8)\Delta y \quad \checkmark$$

$$\Delta y = -5,10 \text{ m } (5,102)$$

$$\begin{aligned} \text{Height} &= 40 + 5,10 \quad \checkmark \\ &= 45,10 \text{ m } \quad \checkmark \end{aligned}$$

OPTION 2/OPSIE 2**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

$$v_f = v_i + a\Delta t$$

$$0 = (10) + (-9,8)\Delta t$$

$$\Delta t = 1,02 \text{ s}$$

$$\begin{aligned} \Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad \checkmark \\ &= (10)(1,02) + \frac{1}{2}(-9,8)(1,02)^2 \quad \checkmark \\ &= 5,10 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{Height} &= 40 + 5,10 \quad \checkmark \\ &= 45,10 \text{ m } \quad \checkmark \end{aligned}$$

Accept swapping of v_i and v_f
Aanvaar die omruiling van v_i en v_f

OR/OF

$$\begin{aligned} \Delta y &= \left(\frac{v_i + v_f}{2} \right) \Delta t \quad \checkmark \\ &= \left(\frac{10 + 0}{2} \right) (1,02) \quad \checkmark \\ &= 5,10 \text{ m} \end{aligned}$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

$$v_f = v_i + a\Delta t$$

$$0 = (-10) + (9,8)\Delta t$$

$$\Delta t = 1,02 \text{ s}$$

$$\begin{aligned} \Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad \checkmark \\ &= (-10)(1,02) + \frac{1}{2}(9,8)(1,02)^2 \quad \checkmark \\ &= 5,10 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{Height} &= 40 + 5,10 \quad \checkmark \\ &= 45,10 \text{ m } \quad \checkmark \end{aligned}$$

Accept swapping of v_i and v_f
Aanvaar die omruiling van v_i en v_f

OPTION 3/OPSIE 3**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$0 = (10) \Delta t + \frac{1}{2}(-9,8) \Delta t^2$$

$$\Delta t = 2,04 \text{ s} \quad \swarrow \frac{1}{2} \Delta t$$

$$\begin{aligned} \Delta y &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark \\ &= (10)(1,02) + \frac{1}{2}(-9,8)(1,02)^2 \checkmark \\ &= 5,10 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{Height} &= 40 + 5,10 \\ &= 45,10 \text{ m} \checkmark \end{aligned}$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$0 = (-10) \Delta t + \frac{1}{2}(9,8) \Delta t^2$$

$$\Delta t = 2,04 \text{ s} \quad \swarrow \frac{1}{2} \Delta t$$

$$\begin{aligned} \Delta y &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark \\ &= (-10)(1,02) + \frac{1}{2}(9,8)(1,02)^2 \checkmark \\ &= -5,10 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{Height} &= 40 + 5,10 \checkmark \\ &= 45,10 \text{ m} \checkmark \end{aligned}$$

OPTION 4/OPSIE 4**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$0 = (10) \Delta t + \frac{1}{2}(-9,8) \Delta t^2$$

$$\Delta t = 2,04 \text{ s} \quad \swarrow \frac{1}{2} \Delta t$$

$$\begin{aligned} \Delta y &= \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark \\ &= \left(\frac{10 + 0}{2} \right) (1,02) \checkmark \\ &= 5,10 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{Height} &= 40 + 5,10 \checkmark \\ &= 45,10 \text{ m} \checkmark \end{aligned}$$

Accept swapping of v_i and v_f
Aanvaar die omruiling van v_i en v_f

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$0 = (-10) \Delta t + \frac{1}{2}(9,8) \Delta t^2$$

$$\Delta t = 2,04 \text{ s} \quad \swarrow \frac{1}{2} \Delta t$$

$$\begin{aligned} \Delta y &= \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark \\ &= \left(\frac{-10 + 0}{2} \right) (1,02) \checkmark \\ &= -5,10 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{Height} &= 40 + 5,10 \checkmark \\ &= 45,10 \text{ m} \checkmark \end{aligned}$$

Accept swapping of v_i and v_f
Aanvaar die omruiling van v_i en v_f

OPTION 5/OPSIE 5

$$E_{(\text{mech/meg})\text{roof/dak}} = E_{(\text{mech/meg})\text{top/bo}}$$

$$(E_p + E_k)_{\text{roof/dak}} = (E_p + E_k)_{\text{top/bo}}$$

$$(mgh + \frac{1}{2}mv^2)_{\text{roof/dak}} = (mgh + \frac{1}{2}mv^2)_{\text{top/bo}}$$

$$[m(9,8)(0) + \frac{1}{2}m(10)^2] = m(9,8)(h) + 0 \quad \checkmark$$

$$h = 5,10 \text{ m}$$

$$\text{Height} = 40 + 5,10 \quad \checkmark$$

$$= 45,10 \text{ m} \quad \checkmark$$

} ✓ Any one/Enige een

OPTION 6/OPSIE 6

$$W_{\text{net}} = \Delta E_k \quad \checkmark$$

$$W\Delta x \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$(m)(9,8)\Delta x \cos 180^\circ = 0 - \frac{1}{2}m(10)^2 \quad \checkmark$$

$$\Delta x = 5,10 \text{ m}$$

$$\text{Height} = 40 + 5,10 \quad \checkmark$$

$$= 45,10 \text{ m} \quad \checkmark$$

OPTION 7/OPSIE 7

$$W_{\text{nc}} = \Delta E_p + \Delta E_k \quad \checkmark$$

$$0 = m(9,8)(h_f - 0) + \frac{1}{2}m(0 - 10^2) \quad \checkmark$$

$$h_f = 5,10 \text{ m}$$

$$\text{Height} = 40 + 5,10 \quad \checkmark$$

$$= 45,10 \text{ m} \quad \checkmark$$

OPTION 8/OPSIE 8**Marking criteria/Nasienriglyne:**

- Appropriate formula/Toegepaste formule ✓
- Substitution left/Vervanging links ✓
- Substitution right/Vervanging regs ✓
- Final answer/Finale antwoord: 45,10 m ✓

$$E_{(\text{mech/meg})\text{roof/dak}} = E_{(\text{mech/meg})\text{top/bo}}$$

$$(E_p + E_k)_{\text{roof/dak}} = (E_p + E_k)_{\text{top/bo}}$$

$$(mgh + \frac{1}{2}mv^2)_{\text{roof/dak}} = (mgh + \frac{1}{2}mv^2)_{\text{top/bo}}$$

$$m(9,8)(40) + \frac{1}{2}m(10)^2 = m(9,8)(h) + 0 \quad \checkmark$$

$$h = 45,10 \text{ m} \quad \checkmark$$

} ✓ Any one/Enige een

(4)

3.3 $9,8 \text{ m} \cdot \text{s}^{-2} \quad \checkmark$ downwards/afwaarts ✓

(2)

3.4

Marking criteria/Nasienriglyne

- Calculation/use of 10,26 m./Berekening/gebruik van 10,26 m. ✓
- Appropriate formula to calculate Δt /Toepaslike formule om Δt te bereken ✓
- Substitution for stone A/Vervanging vir klip A ✓
- Substitution for stone B/Vervanging vir klip B ✓
- Calculating time difference between two stones. /Berekening van tydverskil tussen klippe. ✓
- Final answer/Finale antwoord: 1,34 (s) ✓

OPTION 1/OPSIE 1**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

Displacement from roof to meeting point /Verplasing vanaf dak tot ontmoetingspunt = $-40 + 29,74 = -10,26$ m

Stone/Klip A

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$-10,26 \checkmark = \frac{10 \Delta t}{2} + \frac{1}{2} (-9,8) \Delta t^2 \quad \checkmark$$

$$\Delta t = 2,79 \text{ s}$$

Stone/Klip B

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-10,26 = 0 + \frac{1}{2} (-9,8) \Delta t^2 \quad \checkmark$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \quad \checkmark$$

OR/OF

$$[-10,26 = 0(2,79 - x) + \frac{1}{2} (-9,8)(2,79 - x)^2] \checkmark \checkmark$$

$$x = 1,34 \text{ (s)} \quad \checkmark$$

$$\begin{aligned} v_f^2 &= v_i^2 + 2a\Delta y \\ &= 0^2 + 2(-9,8)(-10,26) \\ v_f &= -14,18 \text{ m} \cdot \text{s}^{-1} \end{aligned}$$

$$\begin{aligned} v_f &= v_i + a\Delta t \\ -14,18 &= 0 + (-9,8)\Delta t \quad \checkmark \\ \Delta t &= 1,45 \text{ s} \end{aligned}$$

$$\begin{aligned} x &= 2,79 - 1,45 \quad \checkmark \\ &= 1,34 \text{ (s)} \quad \checkmark \end{aligned}$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

Displacement from roof to meeting point /Verplasing vanaf dak tot ontmoetingspunt = $40 - 29,74 = 10,26$ m

Stone/Klip A

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$10,26 \checkmark = \frac{-10 \Delta t}{2} + \frac{1}{2} (9,8) \Delta t^2 \quad \checkmark$$

$$\Delta t = 2,79 \text{ s}$$

Stone/Klip B

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$10,26 = 0 + \frac{1}{2} (9,8) \Delta t^2 \quad \checkmark$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \quad \checkmark$$

OR/OF

$$[-10,26 = 0(2,79 - x) + \frac{1}{2} (-9,8)(2,79 - x)^2] \checkmark \checkmark$$

$$x = 1,34 \text{ (s)} \quad \checkmark$$

$$\begin{aligned} v_f^2 &= v_i^2 + 2a\Delta y \\ &= 0^2 + 2(9,8)(10,26) \\ v_f &= 14,18 \text{ m} \cdot \text{s}^{-1} \end{aligned}$$

$$\begin{aligned} v_f &= v_i + a\Delta t \\ 14,18 &= 0 + (9,8)\Delta t \quad \checkmark \\ \Delta t &= 1,45 \text{ s} \end{aligned}$$

$$\begin{aligned} x &= 2,79 - 1,45 \quad \checkmark \\ &= 1,34 \text{ (s)} \quad \checkmark \end{aligned}$$

OPTION 2/OPSIE 2**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

Displacement from roof to meeting point /Verplasing vanaf dak tot ontmoetingspunt = $-40 + 29,74 = -10,26$ m

Displacement of stone A from max height to meeting point/ Verplasing van klip A vanaf maksimum hoogte tot ontmoetingspunt = $-15,36$ m

Stone/Klip A

$$v_f = v_i + a\Delta t$$

$$0 = 10 + (-9,8)\Delta t$$

$$\Delta t = 1,02 \text{ s}$$

$$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$-15,36 = 0 + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$$

$$\Delta t = 1,77 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,77 + 1,02 = 2,79 \text{ s}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$-10,26 \checkmark = 0 + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \checkmark$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(-9,8)(-10,26)$$

$$v_f = -14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$-14,18 = 0 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45 \checkmark$$

$$= 1,34 \text{ (s)} \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

Displacement from roof to meeting point /Verplasing vanaf dak tot ontmoetingspunt = $40 - 29,74 = 10,26$ m $\checkmark$

Displacement of ball A from max height to meeting point/ Verplasing van bal A vanaf maksimum hoogte tot ontmoetingspunt = $15,36$ m

Stone/Klip A

$$v_f = v_i + a\Delta t$$

$$0 = -10 + (9,8)\Delta t$$

$$\Delta t = 1,02 \text{ s}$$

$$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$15,36 = 0 + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$\Delta t = 1,77 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,77 + 1,02 = 2,79 \text{ s}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$10,26 = 0 + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \checkmark$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(9,8)(10,26)$$

$$v_f = 14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$14,18 = 0 + (9,8)\Delta t \checkmark$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45 \checkmark$$

$$= 1,34 \text{ (s)} \checkmark$$

OPTION 3/OPSIE 3**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

Displacement of stones A and B from roof to meeting point/Verplasing van klippe A en B vanaf dak tot by ontmoetingspunt = $-40 + 29,74$
 $= -10,26 \text{ m}$

Stone/Klip A

$$v_f = v_i + a\Delta t$$

$$0 = 10 + (-9,8)\Delta t$$

$$\Delta t = 1,02 \text{ s}$$

$$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$-10,26 \checkmark = \underline{-10 + \frac{1}{2}(-9,8)\Delta t^2} \checkmark$$

$$\Delta t = 0,75 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,02 + 1,02 + 0,75 = 2,79 \text{ s}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$\underline{-10,26 = 0 + \frac{1}{2}(-9,8)\Delta t^2} \checkmark$$

$$\Delta t = 1,45 \text{ s } (1,447 \text{ s})$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \checkmark$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(-9,8)(-10,26)$$

$$v_f = -14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$\underline{-14,18 = 0 + (-9,8)\Delta t} \checkmark$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45 \checkmark$$

$$= 1,34 \text{ (s)} \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

Displacement of stones A and B from roof to meeting point/Verplasing van klippe A en B vanaf dak tot by ontmoetingspunt = $40 - 29,74 = 10,26 \text{ m}$

Stone/Klip A

$$v_f = v_i + a\Delta t$$

$$0 = -10 + (9,8)\Delta t$$

$$\Delta t = 1,02 \text{ s}$$

$$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$10,26 \checkmark = \underline{10 + \frac{1}{2}(9,8)\Delta t^2} \checkmark$$

$$\Delta t = 0,75 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,02 + 1,02 + 0,75 = 2,79 \text{ s}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$\underline{10,26 = 0 + \frac{1}{2}(9,8)\Delta t^2} \checkmark$$

$$\Delta t = 1,45 \text{ s } (1,447 \text{ s})$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \checkmark$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(9,8)(10,26)$$

$$v_f = 14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$\underline{14,18 = 0 + (9,8)\Delta t} \checkmark$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45 \checkmark$$

$$= 1,34 \text{ (s)} \checkmark$$

OPTION 4/OPSIE 4**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

Displacement from roof to meeting point /Verplasing vanaf dak tot ontmoetingspunt = $-40 + 29,74 = -10,26$ m

Stone/Klip A

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-5,10 = 0 + \frac{1}{2}(-9,8)\Delta t^2$$

$$\Delta t = 1,02 \text{ s}$$

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$-10,26 \checkmark = -10 + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$$

$$\Delta t = 0,75 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,02 + 1,02 + 0,75 = 2,79 \text{ s}$$

Stone/Klip B

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-10,26 = 0 + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \checkmark$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(-9,8)(-10,26)$$

$$v_f = -14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$-14,18 = 0 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45 \checkmark$$

$$= 1,34 \text{ (s)} \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

Displacement from roof to meeting point /verplasing vanaf dak tot by ontmoetingspunt = $40 - 29,74 = 10,26$ m

Stone/Klip A

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$5,10 = 0 + \frac{1}{2}(9,8)\Delta t^2$$

$$\Delta t = 1,02 \text{ s}$$

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$10,26 \checkmark = 10 + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$\Delta t = 0,75 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,02 + 1,02 + 0,75 = 2,79 \text{ s}$$

Stone/Klip B

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$10,26 = 0 + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \checkmark$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(9,8)(10,26)$$

$$v_f = 14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$14,18 = 0 + (9,8)\Delta t \checkmark$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45 \checkmark$$

$$= 1,34 \text{ (s)} \checkmark$$

OPTION 5/OPSIE 5**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

Displacement from roof to meeting point /Verplasing vanaf dak tot ontmoetingspunt = $-40 + 29,74 = -10,26$ m

Displacement of stone A from max height to meeting point/ Verplasing van klip A vanaf maksimum hoogte tot ontmoetingspunt = $-15,36$ m

Stone/Klip A

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = (0)^2 + (2)(-9,8)(-15,36)$$

$$v_f = -17,35 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$-17,35 = 0 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 1,77 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,02 + 1,77 = 2,79 \text{ (s)}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$-10,26 \checkmark = 0 + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \checkmark$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(-9,8)(-10,26)$$

$$v_f = -14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$-14,18 = 0 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45 \checkmark$$

$$= 1,34 \text{ (s)} \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

Displacement from roof to meeting point /Verplasing vanaf dak tot ontmoetingspunt = $40 - 29,74 = 10,26$ m

Displacement of stone A from max height to meeting point/ Verplasing van klip A vanaf maksimum hoogte tot ontmoetingspunt = $15,36$ m

Stone/Klip A

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = (0)^2 + (2)(9,8)(15,36)$$

$$v_f = 17,35 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$17,35 = 0 + (9,8)\Delta t \checkmark$$

$$\Delta t = 1,77 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,02 + 1,77 = 2,79 \text{ (s)}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$10,26 \checkmark = 0 + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \checkmark$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(9,8)(10,26)$$

$$v_f = 14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$14,18 = 0 + (9,8)\Delta t \checkmark$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45 \checkmark$$

$$= 1,34 \text{ (s)} \checkmark$$

OPTION 6/OPSIE 6**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

Displacement from roof to meeting point/Verplasing vanaf dak tot by ontmoetingspunt = $-40 + 29,74 = -10,26$ m

Stone/Klip A

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = (-10)^2 + (2)(-9,8)(-10,26)$$

$$v_f = -17,35 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$-17,35 = -10 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 0,75 \text{ s}$$

$$\text{Ball A: } \Delta t = 1,02 + 1,02 + 0,75 = 2,79 \text{ (s)}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$-10,26 \checkmark = 0 + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \checkmark$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(-9,8)(-10,26)$$

$$v_f = -14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$-14,18 = 0 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45 \checkmark$$

$$= 1,34 \text{ (s)} \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

Displacement from roof to meeting point/Verplasing vanaf dak tot by ontmoetingspunt = $40 - 29,74 = 10,26$ m

Stone/Klip A

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = [(10)^2 + (2)(9,8)(10,26)$$

$$v_f = 17,35 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$17,35 = 10 + (9,8)\Delta t \checkmark$$

$$\Delta t = 0,75 \text{ s}$$

$$\text{Ball A: } \Delta t = 1,02 + 1,02 + 0,75 = 2,79 \text{ (s)}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$10,26 \checkmark = 0 + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \checkmark$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(9,8)(10,26)$$

$$v_f = 14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$14,18 = 0 + (9,8)\Delta t \checkmark$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45 \checkmark$$

$$= 1,34 \text{ (s)} \checkmark$$

(6)

3.5.1 d ✓ **Accept / Aanvaar** (0 – e; 0 – d; d – e)

(1)

3.5.2 a ✓

(1)

3.5.3 f ✓

(1)

3.5.4 c ✓

(1)

[18]

QUESTION 4/VRAAG 4

4.1

NOTE: -1 mark for each key word/phrase omitted in the correct context.**LET WEL:** -1 punt vir elke sleutelwoord/frase weggelaat in die korrekte konteks.

Isolated system is a system on which the resultant/net external force is zero. ✓✓

Geïsoleerde sisteem is 'n sisteem waarop die resultante / netto eksterne krag nul is.

OR/OF

Isolated system is one that has no net / external force acting on it.

'n Geïsoleerde stelsel is een wat geen netto eksterne krag het wat daarop inwerk nie.

(2)

4.2.1

$$p = mv \checkmark$$

$$24 = m (480) \checkmark$$

$$m = 0,05 \text{ kg} \checkmark$$

Note: p and v must have the same sign

Let wel: p en v moet dieselfde tekens hê

(3)

4.2.2

Marking criteria/Nasienriglyne

- Appropriate formula including F_{net} or W_{net} . /Toepaslike formule wat F_{net} of W_{net} insluit. ✓
- Substitutions/Vervangings ✓✓
- Final answer/Finale antwoord: 2 000 N ✓
- Correct direction/Korrekte rigting: west or left/Wes of links ✓

POSITIVE MARKING FROM QUESTION 4.2.1**POSITIEWE NASIEN VANAF VRAAG 4.2.1****OPTION 1/OPSIE 1**

$$F_{\text{net}}\Delta t = \Delta p$$

$$F_{\text{net}}\Delta t = (p_{\text{bullet}})_f - (p_{\text{bullet}})_i$$

$$F_{\text{net}}\Delta t = (mv_{\text{bullet}})_f - (mv_{\text{bullet}})_i$$

$$F_{\text{net}}(0,01) \checkmark = (0,05)(80) - 24 \checkmark \text{ or/of } (0,05)(80) - (0,05)(480)$$

$$F_{\text{net}} = -2\,000 \text{ N}$$

$$F_{\text{net}} = 2\,000 \text{ N} \checkmark \text{ west/wes} \checkmark$$

OPTION 2/OPSIE 2

$$v_f = v_i + a\Delta t$$

$$80 = 480 + a(0,01) \checkmark$$

$$a = -40\,000 \text{ m}\cdot\text{s}^{-2}$$

$$F_{\text{net}} = ma \checkmark$$

$$= (0,05)(-40\,000) \checkmark$$

$$= -2\,000 \text{ N}$$

$$F_{\text{net}} = 2\,000 \text{ N} \checkmark \text{ west/wes} \checkmark$$

OPTION 3/OPSIE 3

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$= \frac{480 + 80}{2} (0,01)$$

$$= 2,80 \text{ m}$$

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$(80)^2 = (480)^2 + 2a(2,80) \checkmark$$

$$a = -40\,000 \text{ m}\cdot\text{s}^{-2}$$

$$F_{\text{net}} = ma \checkmark$$

$$= (0,05)(-40\,000) \checkmark$$

$$= -2\,000 \text{ N}$$

$$F_{\text{net}} = 2\,000 \text{ N} \checkmark \text{ west/wes} \checkmark$$

$$W_{\text{net}} = \Delta K \checkmark$$

$$F_{\text{net}} \Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$F_{\text{net}}(2,80)\cos 0^\circ \checkmark = \frac{1}{2}(0,05)(80^2 - 480^2) \checkmark$$

$$F_{\text{net}} = -2\,000 \text{ N}$$

$$F_{\text{net}} = 2\,000 \text{ N} \checkmark \text{ west/wes} \checkmark$$

OR/OF

$$F_{\text{net}}(2,80)\cos 180^\circ \checkmark = \frac{1}{2}(0,05)(80^2 - 480^2) \checkmark$$

$$F_{\text{net}} = 2\,000 \text{ N} \checkmark \text{ west/wes} \checkmark$$

(5)

[10]

QUESTION 5

5.1

Note: -1 mark for each key word/phrase omitted in the correct context.**Let Wel:** -1 punt vir elke sleutelwoord/frase weggelaat in die korrekte konteks.**IF:** The word "work" is omitted - 0 marks.**INDIEN:** Die woord "arbeid" uitgelaat is - 0 punte.

A conservative force is a force for which the work done (in moving an object between two points) is independent of the path taken. ✓✓

'n Konserwatiewe krag is 'n krag waarvoor die arbeid wat verrig is (om 'n voorwerp tussen twee punte te beweeg) onafhanklik is van die pad wat gevat word.

OR/OF

A conservative force is a force for which the work done in moving an object in a closed path is zero.

'n Konserwatiewe krag is 'n krag waarvoor die arbeid verrig om 'n voorwerp in 'n geslote pad te beweeg, nul is.

(2)

5.2

Gravitational (force)/Gravitasiekrag ✓

ACCEPT/AANVAAR: Gravitation /Gravity /Gravitasie /Weight /Gewig

(1)

5.3

No/Nee ✓

There is friction/non-conservative force (doing work)/It is not isolated system. ✓

Daar is wrywing/nie konserwatiewe krag (wat arbeid verrig)./Dit is nie 'n geïsoleerde sisteem nie.

OR/OF

The net work done by the non-conservative forces is not zero/Die netto arbeid deur die nie-konserwatiewe kragte is nie nul nie. ✓

(2)

5.4

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$E_p = mgh \checkmark$ $= (1,8)(9,8)(1,5) \checkmark$ $= 26,46 \text{ J} \checkmark$	$W_w = -\Delta E_p \checkmark$ $(1,8)(9,8)(h - 0)\cos 180^\circ = -(E_{pA} - E_{p(\text{ground})})$ $(1,8)(9,8)(1,5)(-1) = -E_{pA} \checkmark$ $E_p = 26,46 \text{ J} \checkmark$ OR/OF $W = F\Delta x \cos \theta$ $= mg\Delta h \cos \theta$ $= (1,8)(9,8)(1,5)\cos 0^\circ \checkmark$ $= 26,46 \text{ J} \checkmark$

(3)

5.5

POSITIVE MARKING FROM QUESTION 5.4 /**POSITIEWE NASIEN VANAF VRAAG 5.4****OPTION 1/OPSIE 1**

$$W_{nc} = \Delta K + \Delta U$$

$$W_f = \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i) \checkmark \text{ Any one/Enige een}$$

$$= \frac{1}{2}(1,8)(4^2 - 0,95^2) \checkmark + (0 - 26,46) \checkmark$$

$$= -12,87 \text{ J} \checkmark$$

OPTION 2/OPSIE 2

$$W_{net} = \Delta K$$

$$W_f + W_g = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark \text{ Any one/Enige een}$$

$$W_f + mgh = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$W_f + mgh = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$\frac{W_f + 26,46}{W_f} \checkmark = \frac{\frac{1}{2}(1,8)[(4)^2 - (0,95)^2]}{(-12,872 \text{ J})} \checkmark$$

OPTION 3/OPSIE 3

$$E_{(\text{mech/meg})A} = E_{(\text{mech})B} - W_f$$

$$(E_p + E_k)_A = (E_p + E_k)_B - W_f \checkmark \text{ Any one/Enige een}$$

$$(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_B - W_f$$

$$\frac{26,46 + \frac{1}{2}(1,8)(0,95^2)}{W_f} \checkmark = 0 + \frac{1}{2}(1,8)(4^2) - W_f \checkmark$$

$$W_f = -12,87 \text{ J} \checkmark$$

(4)

5.6

$$W_{net} = 0 \text{ (J) / zero} \checkmark$$

(1)

[13]**QUESTION 6/VRAAG 6**

6.1

Doppler effect/Doppler-effek $\checkmark$

(1)

6.2

(Q): (records sounds with) longer period/ longer time per wave / lower frequency.

(Q): (teken klank aan met) langer periode / langer tyd per golf / laer frekwensie.

OR/OFP: (records sounds with) shorter period/ shorter time per wave / higher frequency. $\checkmark$

P: (teken klank aan met) korter periode/ korter tyd per golf / hoër frekwensie.

ACCEPT/AANVAAR

(Q): longer wavelength. /P: shorter wavelength.

(Q): langer golflengte./P: korter golflengte het.

(1)

6.3 **OPTION 1/OPSIE 1**

$$f = \frac{1}{T} \checkmark = \frac{1}{17 \times 10^{-4}} \checkmark = 5,88 \times 10^2 = 588,24 \text{ Hz} \checkmark$$

OPTION 2/OPSIE 2

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$340 = \frac{\text{distance}}{25,5 \times 10^{-4}}$$

$$\text{Distance} = 0,867 \text{ m}$$

$$\text{Distance} = 1 \frac{1}{2} \lambda$$

$$\therefore \lambda = 0,578 \text{ m}$$

$$v = f\lambda \checkmark$$

$$340 = f(0,578) \checkmark$$

$$f = 588,24 \text{ Hz} \checkmark$$

OPTION 3/OPSIE 3

$$v = \frac{\lambda}{T}$$

$$340 = \frac{\lambda}{17 \times 10^{-4}}$$

$$\therefore \lambda = 0,578 \text{ m}$$

$$v = f\lambda \checkmark$$

$$340 = f(0,578) \checkmark$$

$$f = 588,24 \text{ Hz} \checkmark$$

(3)

6.4 **POSITIVE MARKING FROM QUESTIONS 6.2 AND 6.3.****POSITIEWE NASIEN VANAF VRAE 6.2 EN 6.3**

Do not penalise if 10^{-4} is again omitted. *!Moenie penaliseer indien 10^{-4} weer uitgelaat is nie.*

OPTION 1/OPSIE 1

$$f = \frac{1}{18 \times 10^{-4}} \checkmark = 5,56 \times 10^2 = 555,56 \text{ Hz}$$

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \checkmark \quad \text{OR/OF} \quad f_L = \frac{v}{v + v_s} f_s$$

$$555,56 \checkmark = \left(\frac{340}{340 + v} \right) 588,24 \checkmark$$

$$v = 20 \text{ m} \cdot \text{s}^{-1} \checkmark$$

$$\text{Range/Gebied } 19,57 - 20,09 \text{ m} \cdot \text{s}^{-1}$$

OPTION 2/OPSIE 2

$$f_L = \frac{1}{18 \times 10^{-4}} \checkmark$$

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \checkmark \quad \text{OR/OF} \quad f_L = \frac{v}{v + v_s} f_s$$

$$\frac{1}{18 \times 10^{-4}} \checkmark = \left(\frac{340}{340 + v} \right) \frac{1}{17 \times 10^{-4}} \checkmark$$

$$v = 20 \text{ m} \cdot \text{s}^{-1} \checkmark$$

$$\text{Range/Gebied } 19,57 - 20,09 \text{ m} \cdot \text{s}^{-1}$$

(6)

[11]

QUESTION 7/VRAAG 7

7.1.1 Positive/Positief ✓

(1)

7.1.2

Marking criteria/Nasienriglyne:

- Appropriate formula /Toepaslike formule ✓
- Whole substitution *Hele vervanging* ✓
- Final answer/finale antwoord: $2,26 \times 10^{-6} \text{ C}$ ✓

OPTION 1/OPSIE 1

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$3,05 = \frac{(9 \times 10^9)(6 \times 10^{-6})Q}{0,2^2} \checkmark$$

$$Q = 2,26 \times 10^{-6} \text{ C} \checkmark$$

$$(2,259 \times 10^{-6} \text{ C})$$

OPTION 2/OPSIE 2

$$E = \frac{kQ}{r^2}$$

$$= \frac{(9 \times 10^9)(6 \times 10^{-6})}{0,2^2}$$

$$= 1,35 \times 10^6 \text{ N} \cdot \text{C}^{-1}$$

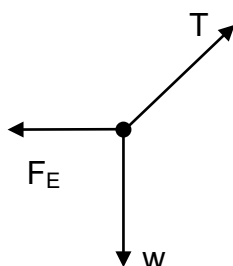
$$F = Eq \checkmark$$

$$3,05 = (1,35 \times 10^6)q \checkmark$$

$$q = 2,26 \times 10^{-6} \text{ N} \checkmark$$

(3)

7.1.3



Accepted labels/Aanvaarde benoemings	
$w \checkmark$	F_g / F_w / weight / mg / gravitational force F_g / F_w / gewig / mg / gravitasiekrag
$T \checkmark$	F_T / tension / spanning
$F_E / F \checkmark$	Electrostatic force/ Coulomb force/ $F_{E \text{ Field}} / F_{x \text{ on } Y}$ / 3,05 N Elektrostatiese krag/ Coulombkrag

Notes/Aantekeninge

- Mark is awarded for label and arrow. /Punt word toegeken vir byskrif en pyltjie.
- Do not penalise for length of arrows.
Moenie vir die lengte van die pyltjies penaliseer nie.
- Deduct 1 mark for any additional force /Trek 1 punt af vir enige addisionele krag
- If force(s) do not make contact with dot /Indien krag(te) nie met die kolletjie kontak maak nie: Max/Maks $\frac{2}{3}$
- If arrows missing/Indien pyltjies uitgelaat word: Max/Maks $\frac{2}{3}$

(3)

7.1.4

$$F_{\text{net}} = 0$$

$$F_E = T \sin 10^\circ$$

$$F_E = T \cos 80^\circ$$

$$[3,05 = T \sin 10^\circ \checkmark] \checkmark$$

$$[\text{IF /INDIEN } T \cos 10^\circ = 3,05 \left(\frac{1}{3} \right)]$$

OR/OF

$$[3,05 = T \cos 80^\circ \checkmark] \checkmark$$

$$[\text{IF /INDIEN } T \sin 80^\circ = 3,05 \left(\frac{1}{3} \right)]$$

$$T = 17,56 \text{ N} \checkmark (17,564 \text{ N})$$

(3)

7.2.1

Marking criteria/Nasienriglyne

-1 mark for each key word/phrase omitted in the correct context.

-1 punt vir elke sleutelwoord/frase weggelaat in die korrekte konteks.

The electric field at a point is the (electrostatic) force experienced per unit positive charge placed at that point. ✓✓

Die elektriese veld by 'n punt is die (elektrostatiese) krag wat per positiewe eenheidslading wat by die punt geplaas is, ondervind word.

[If the word “unit” or phrase “positive charge” is omitted in this definition: -1 for each
INDIEN die woord “eenheid” of frase “positiewe lading” uitgelaat is in hierdie definisie: -1 vir elk]

OR/OF

The electric field at a point is the (electrostatic) force experienced by a UNIT positive charge placed at that point. ✓✓

Die elektriese veld by 'n punt is die (elektrostatiese) krag wat deur 'n positiewe EENHEIDSlading wat by die punt geplaas is, ondervind word.

[If “UNIT” is omitted in this definition, then 0 marks.

Indien “EENHEIDS” uitgelaat word in hierdie definisie, dan 0 punte.]

(2)

7.2.2

OPTION 1/OPSIE 1

Electric field at **M** due to **A** ($+2 \times 10^{-5}$ C):

$$E_A = \frac{kQ}{r^2} \checkmark$$

$$= 9 \times 10^9 \frac{(2 \times 10^{-5})}{(0,2)^2} \checkmark$$

$$= 4,5 \times 10^6 \text{ N} \cdot \text{C}^{-1}$$

Electric field at **M** due to **B** (-4×10^{-5} C):

$$E_B = \frac{kQ}{r^2}$$

OR/OF

$$q_B = 2q_A$$

$$= 9 \times 10^9 \frac{(4 \times 10^{-5})}{(0,2)^2} \checkmark$$

$$E_B = 2E_A \checkmark$$

$$= 9 \times 10^6 \text{ N} \cdot \text{C}^{-1}$$

$$= 9 \times 10^6 \text{ N} \cdot \text{C}^{-1}$$

$$E_{\text{net}} \text{ at } \mathbf{M} = E_A + E_B$$

$$= (4,5 \times 10^6 + 9 \times 10^6) \checkmark$$

$$= 1,35 \times 10^7 \text{ N} \cdot \text{C}^{-1} \checkmark \text{ to the right/na regs/towards B/na B}$$

away from A / weg vanaf A ✓

OPTION 2/OPSIE 2

Net electrostatic force at **M** / Netto elektrostatische krag by **M**

$$F_{\text{net}} = \frac{kQ_1Q_2}{r^2} + \frac{kQ_1Q_2}{r^2}$$

$$\text{If/Indien } F = \frac{kQ}{r^2} \text{ Max/Maks } \frac{2}{6}$$

$$= \frac{(9 \times 10^9)(2 \times 10^{-5})q}{(0,2)^2} + \frac{(9 \times 10^9)(4 \times 10^{-5})q}{(0,2)^2} \checkmark \text{ (any one/ enige een)}$$

$$= 4,5 \times 10^6 q + 9 \times 10^6 q$$

$$= 1,35 \times 10^7 q \text{ N}$$

$$F_{\text{net}} = E_{\text{net}}q \checkmark$$

$$1,35 \times 10^7 q \checkmark = E_{\text{net}}q$$

$$E_{\text{net}} = 1,35 \times 10^7 \text{ N} \cdot \text{C}^{-1} \checkmark \text{ to the right/na regs } \checkmark \text{ /towards B / na B}$$

(6)

[18]

QUESTION 8/VRAAG 8

- 8.1 (Maximum) energy provided (work done) ✓ by a battery per coulomb / unit charge passing through it. ✓
 (Maksimum) energie verskaf (arbeid verrig) deur 'n battery per coulomb/eenheidlading wat daardeur beweeg.

ACCEPT/AANVAAR:

The reading on a voltmeter connected across a battery when there is no current/ in an open circuit. ✓✓

Lesing op 'n voltmeter oor 'n battery as daar geen stroom is nie

(2)

- 8.2 13 V ✓

(1)

- 8.3.1

$R = \frac{V}{I} \checkmark$ $5,6 = \frac{10,5}{I} \checkmark$ $I = 1,88 \text{ A} \checkmark (1,875 \text{ A})$	Marking criteria/Nasienriglyne: • Appropriate formula/Toepaslike formule ✓ • Whole substitution/Hele vervanging ✓ • Final answer/Finale antwoord: 1,88 A ✓

(3)

- 8.3.2

POSITIVE MARKING FROM QUESTION 8.3.1. POSITIEWE NASIEN VANAF VRAAG 8.3.1	
OPTION 1 $P = VI \checkmark$ $= (10,5)(1,88) \checkmark$ $= 19,74 \text{ W} \checkmark (19,688 \text{ W})$	OPTION 2 $P = I^2 R \checkmark$ $= (1,88)^2 (5,6) \checkmark$ $= 19,79 \text{ W} \checkmark (19,688 \text{ W})$
OPTION 3 $P = \frac{V^2}{R} \checkmark$ $= \frac{10,5^2}{5,6} \checkmark$ $= 19,69 \text{ W} \checkmark (19,688 \text{ W})$	

(3)

- 8.3.3

POSITIVE MARKING FROM QUESTIONS 8.2 AND 8.3.1. POSITIEWE NASIEN VANAF VRAAG 8.2 EN 8.3.1	
OPTION 1/OPSIE 1 $\mathcal{E} = I(R + r) \checkmark$ $13 = 1,88 (5,6 + r) \checkmark$ $r = 1,31 \Omega \checkmark (1,31 - 1,33 \Omega)$	OPTION 2/OPSIE 2 $r = \frac{V_{\text{internal}}}{I} \checkmark$ $= \frac{2,5}{1,88} \checkmark$ $= 1,33 \Omega \checkmark (1,31 - 1,33 \Omega)$
OPTION 3/OPSIE 3 $\mathcal{E} = V_{\text{ext}} + V_{\text{int}}$ $13 = 10,5 + V_{\text{int}}$ $V_{\text{int}} = 2,5 \text{ V}$ $V_{\text{int}} = Ir \checkmark$ $2,5 = (1,88)r \checkmark$ $r = 1,31 \Omega \checkmark (1,31 - 1,33 \Omega)$	

(3)

8.4.1 Decreases/Neem af ✓

 $V_{\text{internal resistance}}$ /Internal volts increase ✓ $V_{\text{interne weerstand}}$ /Interne volts neem toe

(2)

8.4.2

Marking criteria/Nasienriglyne

- Formula/Formule $\mathcal{E} = I(R + r)$ ✓
- Correct substitution into/ Korrekte vervanging in $\mathcal{E} = I(R + r)$ ✓
- Substitution of values into R_p formula/Vervanging van waarde van R_p in formule ✓
- Halving value of R_{2X} /Halvering van waarde van R_{2X} ✓
- Final answer/Finale antwoord: $1,49 \Omega$ ✓ Range/Gebied: $1,46 \Omega - 1,49 \Omega$

POSITIVE MARKING FROM QUESTIONS 8.2 AND 8.3.3**POSITIEWE NASIEN VANAF VRAE 8.2 EN 8.3.3****OPTION 1/OPSIE 1**

$$\mathcal{E} = I(R + r) \checkmark$$

$$13 = 4(R_{\text{ext}} + 1,31) \checkmark$$

$$R_{\text{ext}} = 1,94 \Omega \quad (1,92 \Omega)$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{1,94} = \frac{1}{5,6} + \frac{1}{R_2} \checkmark$$

$$R_2 = 2,97 \Omega \quad (2,92 \Omega)$$

$$X = \frac{1}{2}(2,97) \checkmark$$

$$= 1,49 \Omega \checkmark \quad (1,46 - 1,49 \Omega)$$

OPTION 2/OPSIE 2

$$\mathcal{E} = I(R + r) \checkmark$$

$$13 = 4(R_{\text{ext}} + 1,31) \checkmark$$

$$R_{\text{ext}} = 1,94 \Omega \quad (1,92 \Omega)$$

$$R_p = \frac{R_1 R_2}{R_1 + R_2}$$

$$1,94 = \frac{5,6 R_2}{5,6 + R_2} \checkmark$$

$$R_2 = 2,97 \Omega \quad (2,92 \Omega)$$

$$X = \frac{1}{2}(2,97) \checkmark$$

$$= 1,49 \Omega \checkmark \quad (1,46 - 1,49 \Omega)$$

OPTION 3/OPSIE 3

$$\mathcal{E} = I(R + r) \checkmark$$

$$13 = 4(R_{\text{ext}} + 1,31) \checkmark$$

$$R_{\text{ext}} = 1,94 \Omega \quad (1,92 \Omega)$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\left[\frac{1}{1,94} = \frac{1}{5,6} + \frac{1}{2X} \right] \checkmark$$

$$X = 1,49 \Omega \checkmark \quad (1,46 - 1,49 \Omega)$$

OPTION 4/OPSIE 4

$$\mathcal{E} = I(R + r) \checkmark$$

$$13 = 4(R_{\text{ext}} + 1,31) \checkmark$$

$$R_{\text{ext}} = 1,94 \Omega \quad (1,92 \Omega)$$

$$R_p = \frac{R_1 R_2}{R_1 + R_2}$$

$$\left[1,94 = \frac{(5,6)(2X)}{5,6 + 2X} \right] \checkmark$$

$$X = 1,49 \Omega \checkmark$$

OPTION 5/OPSIE 5

$$\mathcal{E} = I(R + r) \checkmark$$

$$V_{\text{ext}} = 13 - (4)(1,31) \checkmark$$

$$= 7,76 \text{ V}$$

$$V_p = IR_{5,6}$$

$$7,76 = I(5,6)$$

$$I_{5,6\Omega} = 1,37 \text{ A}$$

$$I_T = I_{2X} + I_{5,6}$$

$$4 = I_{2X} + 1,37$$

$$I_{2X} = 2,63 \text{ A}$$

$$V = IR_{2X}$$

$$[7,76 = (2,63)2X] \checkmark$$

$$X = 1,46 \Omega \checkmark$$

OPTION 6/OPSIE 6

$$\mathcal{E} = I(R + r) \checkmark$$

$$V_{\text{ext}} = 13 - (4)(1,31) \checkmark$$

$$V_{\text{ext}} = 7,76 \text{ V}$$

$$I_{5,6\Omega} = \frac{7,76}{5,6} = 1,39 \text{ A}$$

$$I_{2X} = 4 - 1,39 = 2,61 \text{ A}$$

$$V_{2X} = I_{2X}R_{2X}$$

$$[7,76 = (2,61)2X] \checkmark$$

$$2X = 2,97 \Omega$$

$$X = 1,49 \Omega \checkmark$$

$$V_X = I_X R_X$$

$$3,88 \checkmark = (2,61)R_X \checkmark$$

$$R_X = 1,49 \Omega \checkmark$$

OPTION 7/OPSIE 7

$$\mathcal{E} = I(R + r) \checkmark$$

$$V_{\text{ext}} = 13 - (4)(1,31) \checkmark$$

$$= 7,76 \text{ V}$$

$$V_{\text{ext}} = IR_{\text{ext}}$$

$$7,76 = (4) \left(\frac{1}{2X} + \frac{1}{5,6} \right)^{-1} \checkmark$$

$$X = 1,48 \, \Omega \checkmark$$

(5)
[19]**QUESTION 9/VRAAG 9**

9.1

9.1.1 DC/GS ✓

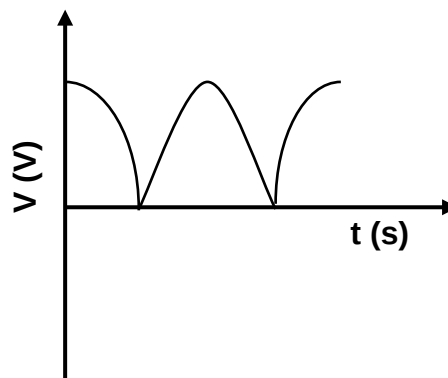
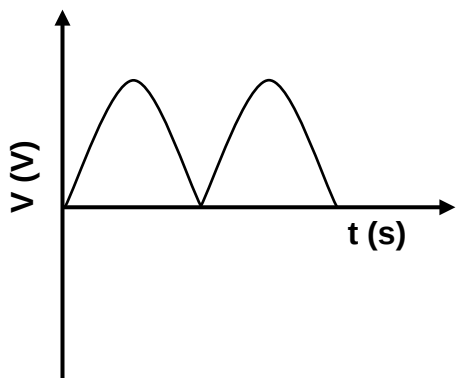
(1)

9.1.2

NOTE: -1 mark for each key word/phrase omitted in correct context.**LET WEL:** -1 punt vir elke sleutel woord/frase weggelaat in die korrekte konteks.Emf is induced as a result of change of magnetic flux (linked) with the coil. ✓✓Emk word geïnduseer as gevolg van verandering van die magnetiese vloedkoppeling.

(2)

9.1.3

POSITIVE MARKING FROM QUESTION 9.1.1**POSITIEWE NASIEN VANAF VRAAG 9.1.1**

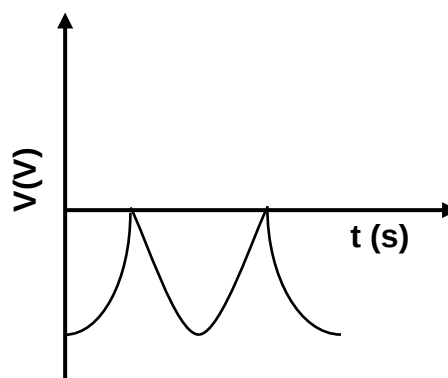
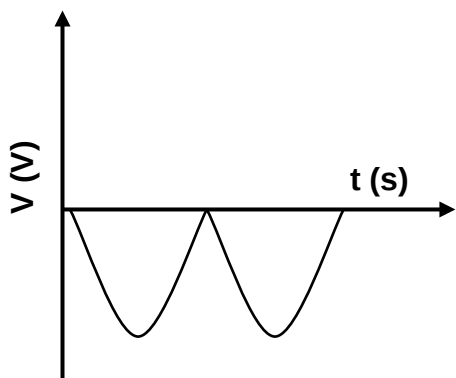
OR/OF

Marking criteria for graph:Correct shape *Korrekte vorm*

✓

One complete cycle/*Een volledige siklus*

✓



(2)

- 9.2.1 The AC potential difference/voltage which dissipates the same amount of energy ✓ as DC potential difference. ✓

Die WS potensiaalverskil/spanning wat dieselfde hoeveelheid energie verbruik as GS potensiaalverskil/spanning

OR/OF

(The rms value of AC is) the DC potential difference/voltage which dissipates the same amount of energy ✓ as AC potential difference/voltage. ✓

Dit is die GS potensiaalverskil/spanning wat dieselfde hoeveelheid energie verbruik as WS potensiaalverskil/spanning.

(2)

9.2.2

OPTION 1 / OPSIE 1 $W = \frac{V^2}{R} \Delta t \checkmark$ $500 = \frac{V^2}{200} (10) \checkmark$ $V = V_{\text{rms}} = 100 \text{ V}$ $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $100 = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $V_{\text{max}} = 141,42 \text{ V} \checkmark$	OPTION 2 / OPSIE 2 $W = I^2 R \Delta t$ $500 = I^2 (200) (10)$ $I = I_{\text{rms}} = 0,5 \text{ A}$ $P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$ $\frac{500}{10} = \frac{V_{\text{rms}} (0,5)}{10} \checkmark$ $V_{\text{rms}} = 100 \text{ V}$ $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $100 = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $V_{\text{max}} = 141,42 \text{ V} \checkmark$	OPTION 3 / OPSIE 3 $P_{\text{ave}} = I_{\text{rms}}^2 R$ $\frac{500}{10} = I_{\text{rms}}^2 (200)$ $I_{\text{rms}} = 0,5 \text{ A}$ $P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$ $\frac{500}{10} = \frac{V_{\text{rms}} (0,5)}{10} \checkmark$ $V_{\text{rms}} = 100 \text{ V}$ $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $100 = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $V_{\text{max}} = 141,42 \text{ V} \checkmark$	OPTION 4 / OPSIE 4 $R = \frac{V_{\text{rms}}}{I_{\text{rms}}} \checkmark$ $200 = \frac{V_{\text{rms}}}{0,5} \checkmark$ $V_{\text{rms}} = 100 \text{ V}$ $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $100 = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $V_{\text{max}} = 141,42 \text{ V} \checkmark$
OPTION 5 / OPSIE 5 $P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark$ $\frac{500}{10} = \frac{V_{\text{rms}}^2}{200} \checkmark$ $V_{\text{rms}} = 100 \text{ V}$ $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $100 = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $V_{\text{max}} = 141,42 \text{ V} \checkmark$	OPTION 6 / OPSIE 6 $P_{\text{ave}} = \frac{P_{\text{max}}}{2} \checkmark$ $\frac{500}{10} = \frac{P_{\text{max}}}{2} \checkmark$ $P_{\text{max}} = 100 \text{ W}$ $P_{\text{max}} = \frac{V_{\text{max}}^2}{R} \checkmark$ $100 = \frac{V_{\text{max}}^2}{200} \checkmark$ $V_{\text{max}} = 141,42 \text{ V} \checkmark$	OPTION 7 / OPSIE 7 $P = \frac{W}{\Delta t} = \frac{500}{10}$ $= 50 \text{ W}$ $P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark$ $50 = \frac{V_{\text{rms}}^2}{200} \checkmark$ $V_{\text{rms}} = 100 \text{ V}$ $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $100 = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $V_{\text{max}} = 141,42 \text{ V} \checkmark$	OPTION 8 / OPSIE 8 $P_{\text{ave}} = I_{\text{rms}}^2 R \checkmark$ $\frac{500}{10} = I_{\text{rms}}^2 (200) \checkmark$ $I_{\text{rms}} = 0,5 \text{ A}$ $I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}} \checkmark$ $0,5 = \frac{I_{\text{max}}}{\sqrt{2}} \checkmark$ $I_{\text{max}} = 0,71 \text{ A}$ $V_{\text{max}} = I_{\text{max}} R \checkmark$ $= (0,71)(200) \checkmark$ $= 142 \text{ V} \checkmark$

(5)

[12]

QUESTION 10/VRAAG 10

10.1

Note: -1 mark for each key word/phrase omitted in correct context.**Let Wel:** -1 punt vir elke sleutel woord/frase weggelaat in die korrekte konteks.

The process whereby electrons are ejected from a metal / surface when light (of suitable frequency) is incident on that surface. ✓✓

Die proses waarby elektrone vanaf 'n (metaal)oppervlak vrygestel word wanneer lig (van geskikte frekwensie) daarop skyn/inval. (2)

10.2

7,48 x 10⁻¹⁹ (J) ✓ $E = W_o + E_{k(max)} (= W_o + \frac{1}{2}mv_{max}^2)$ ✓

When/Wanneer $E_{k(max)} = 0$ / $v = 0$ / $v^2 = 0$ / $E = W_o$ / W_o is the y-intercept / is die y-afsnit ✓ (3)

10.3

Mass (of photo-electron)/Massa (van foto-elektron)/m ✓

ACCEPT/AANVAAR: $\frac{1}{2}m$

(1)

10.4

OPTION 1/OPSIE 1Gradient = $\frac{1}{2}m$

$$\frac{11,98 \times 10^{-19} - 7,48 \times 10^{-19}}{X - 0} = \frac{1}{2}(9,11 \times 10^{-31}) \quad \checkmark$$

$$X = 0,9879 \quad \checkmark \quad (0,99 \text{ or } 0,988)$$

ACCEPT/AANVAAR

$$X = 0,9879 \times 10^{12} \text{ (m}^2 \cdot \text{s}^{-2}\text{)}$$

POSITIVE MARKING FROM 10.2/POSITIEWE NASIEN VANAF 10.2**OPTION 2/ OPSIE 2**

$$\left. \begin{aligned} E &= W_o + E_{k(max)} \\ E &= W_o + \frac{1}{2}mv_{(max)}^2 \end{aligned} \right\} \quad \checkmark \text{ Any one / Enige een}$$

$$11,98 \times 10^{-19} \checkmark = 7,48 \times 10^{-19} \checkmark + \frac{1}{2}(9,11 \times 10^{-31}) v^2 \checkmark \quad [\text{or/of } \frac{1}{2}(9,11 \times 10^{-31})X]$$

$$4,5 \times 10^{-19} = 4,56 \times 10^{-31} v^2$$

$$v^2 = 0,9868 \times 10^{12}$$

$$X/v^2 = 0,9868 \quad \checkmark \quad (0,99)$$

$$\text{Range/gebied } (0,9868 - 0,9879 / 9,87 \times 10^{11} - 9,88 \times 10^{11})$$

ACCEPT/AANVAAR:

$$X = 0,9868 \times 10^{12} \text{ (m}^2 \cdot \text{s}^{-2}\text{)} / 9,868 \times 10^{11} \text{ (m}^2 \cdot \text{s}^{-2}\text{)}$$

(5)

10.5.1

Remains the same / Bly dieselfde ✓

(1)

10.5.2

Increases / Neem toe ✓

(1)

[13]**TOTAL/TOTAAL:****150**



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS
SENIORSERTIFIKAAT-EKSAMEN/
NASIONALE SENIORSERTIFIKAAT-EKSAMEN**

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

2019

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

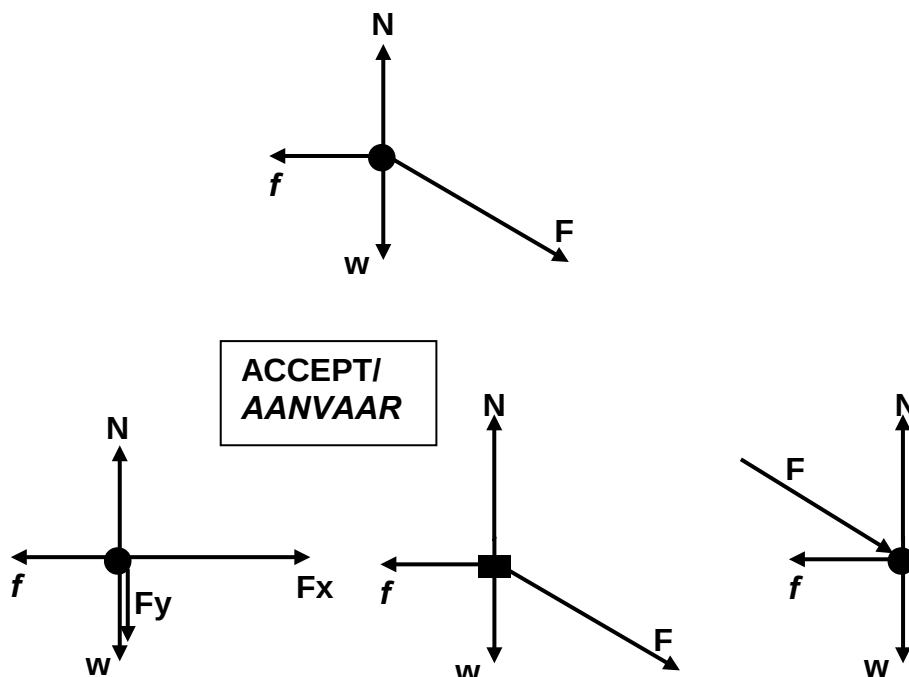
**These marking guidelines consist of 28 pages./
Hierdie nasienriglyne bestaan uit 28 bladsye.**

QUESTION 1/VRAAG 1

1.1	A ✓✓	(2)
1.2	B ✓✓	(2)
1.3	D ✓✓	(2)
1.4	C ✓✓	(2)
1.5	C ✓✓	(2)
1.6	C ✓✓	(2)
1.7	D ✓✓	(2)
1.8	D ✓✓	(2)
1.9	C ✓✓	(2)
1.10	A ✓✓	(2)
		[20]

QUESTION 2/VRAAG 2

2.1.1



Accepted labels/Aanvaarde benoemings	
F	$F_A/90\text{ N}/F_{90}$
w	$F_g / F_w/\text{weight} / mg / \text{gravitational force}$ $F_g / F_w/\text{gewig} / mg / \text{gravitasiekrag}$
f	(Kinetic) Friction / $F_f / f_k / \text{wrywing} / F_w$
N	$F_{\text{Normal}} / \text{Normal}/\text{Normaal} / F_N$

Notes/Aantekeninge

- Mark awarded for label and arrow / Punt toegeken vir benoeming en pyltjie
- Do not penalise for length of arrows since drawing is not to scale. / Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie
- Any other additional force(s) / Enige ander addisionele krag(te) Max/Maks $\frac{3}{4}$
- If force(s) do not make contact with body / Indien krag(te) nie met die voorwerp kontak maak nie: Max/Maks: $\frac{3}{4}$
- Deduct 1 mark for an arrow/arrows omitted / trek 1 punt af indien pyl/pyle weggelaat

(4)

2.1.2

It is moving at constant speed in a straight line/, the acceleration is zero/ the net force (resultant) acting on it is zero/it is moving at constant velocity ✓

Dit beweeg teen konstante spoed in 'n reguit lyn / versnelling is nul / netto krag (resultant) wat daarop inwerk is nul/ dit beweeg teen konstante snelheid

(1)

2.1.3

$$\begin{array}{l}
 F_{\text{net}} = ma \\
 F_{\text{net}} = 0 \\
 F_x = f \\
 F_x - f = 0 \\
 F \cos 40^\circ - f = 0
 \end{array}
 \left. \vphantom{\begin{array}{l} F_{\text{net}} = ma \\ F_{\text{net}} = 0 \\ F_x = f \\ F_x - f = 0 \\ F \cos 40^\circ - f = 0 \end{array}} \right\} \begin{array}{l} \checkmark \text{ any one} \\ \text{enige een} \end{array}$$

$$\begin{array}{l}
 90 \cos 40^\circ - f = 0 \checkmark \\
 f = 68,94 \text{ N} \checkmark
 \end{array}$$

OR/OF

$$\begin{array}{l}
 F_{\text{net}} = ma \\
 F_{\text{net}} = 0 \\
 F_x = f \\
 F_x - f = 0 \\
 F \cos 320^\circ - f = 0
 \end{array}
 \left. \vphantom{\begin{array}{l} F_{\text{net}} = ma \\ F_{\text{net}} = 0 \\ F_x = f \\ F_x - f = 0 \\ F \cos 320^\circ - f = 0 \end{array}} \right\} \begin{array}{l} \checkmark \text{ any one} \\ \text{enige een} \end{array}$$

$$\begin{array}{l}
 90 \cos 320^\circ - f = 0 \checkmark \\
 f = 68,94 \text{ N} \checkmark
 \end{array}$$

$$\begin{array}{l}
 F_{\text{net}} = ma \\
 F_{\text{net}} = 0 \\
 F_x = f \\
 F_x - f = 0 \\
 F \sin 50^\circ - f = 0
 \end{array}
 \left. \vphantom{\begin{array}{l} F_{\text{net}} = ma \\ F_{\text{net}} = 0 \\ F_x = f \\ F_x - f = 0 \\ F \sin 50^\circ - f = 0 \end{array}} \right\} \begin{array}{l} \checkmark \text{ any one} \\ \text{enige een} \end{array}$$

$$\begin{array}{l}
 90 \sin 50^\circ - f = 0 \checkmark \\
 f = 68,94 \text{ N} \checkmark
 \end{array}$$

(3)

NOTE:

1 mark for formula/equation, 1 mark substitution with zero, 1 mark answer.

LW:1 punt vir formule/vergelyking, 1 punt substitusie, 1 punt antwoord.

2.1.4

**POSITIVE MARKING FROM 2.1.3 / POSITIEWE NASIEN VANAF 2.1.3
OPTION 1/OPSIE 1**

$$\begin{array}{l}
 v_f = v_i + a\Delta t \\
 2 = 0 \checkmark + a(3) \checkmark \\
 a = 0,67 \text{ m}\cdot\text{s}^{-2}
 \end{array}$$

$$\begin{array}{l}
 F_{\text{net}} = ma \checkmark \\
 F \cos 40^\circ \checkmark - 68,94 \checkmark = 15(0,67)
 \end{array}$$

$$F = 103,11 \text{ N} \checkmark (103,05 \text{ N} - 103,11 \text{ N})$$

$$\begin{array}{l}
 F_{\text{net}} = ma \checkmark \\
 F \cos 320^\circ - f = 15(0,67) \\
 F \cos 320^\circ \checkmark - 68,94 \checkmark = 15(0,67) \\
 F = 103,11 \text{ N} \checkmark
 \end{array}$$

**POSITIVE MARKING FROM 2.1.3 / POSITIEWE NASIEN VANAF 2.1.3
OPTION 2/OPSIE 2**

$$F_{\text{net}} \cdot \Delta t = \Delta p \checkmark$$

$$F \cos 40^\circ \checkmark - (68,94) \checkmark (3) \checkmark = 15(2 - 0) \checkmark$$

$$F = 103,11 \text{ N} \checkmark$$

POSITIVE MARKING FROM 2.1.3 / POSITIEWE NASIEN VANAF 2.1.3
OPTION 3 / OPSIE 3

$$F_{\text{net}} = ma$$

$$F_x - f_k = ma$$

✓ any one
 enige een

$$F_x - 68,94 \checkmark = 15 \frac{(2-0) \checkmark}{3 \checkmark}$$

$$F_x = 78,94 \text{ N}$$

$$\tan \theta = \frac{F_y}{F_x}$$

$$\tan 40^\circ = \frac{F_y}{78,94}$$

$$F_y = 66,24 \text{ N}$$

$$F^2 = F_x^2 + F_y^2$$

$$F^2 = (78,94)^2 + (66,24)^2 \checkmark$$

$$F = 103,05 \text{ N} \checkmark$$

POSITIVE MARKING FROM 2.1.3 / POSITIEWE NASIEN VANAF 2.1.3
OPTION 4 / OPSIE 4

$$\Delta x = \frac{v_i + v_f}{2} \Delta t$$

$$= \frac{(2+0) \checkmark}{2} (3) \checkmark$$

$$\Delta x = 3 \text{ m}$$

$$W_{\text{net}} = \Delta K$$

$$W_F + W_f = \Delta K \checkmark$$

$$F \Delta x \cos \theta + f \Delta x \cos \theta = \Delta K$$

$$\underline{F(3) \cos 40^\circ} \checkmark + \underline{68,94(3) \cos 180^\circ} \checkmark = \frac{1}{2} (15)(2^2) - \frac{1}{2} (15)(0)^2$$

$$F = 103,06 \text{ N} \checkmark$$

(6)

2.2

OPTION 1/OPSIE 1

$$F = G \frac{m_1 m_2}{r^2} \checkmark$$

$$20 \checkmark = (6,67 \times 10^{-11}) \frac{m_{\text{planet}} (10)}{(6 \times 10^5)^2} \checkmark$$

$$m_{\text{planet}} = 1,08 \times 10^{22} \text{ kg} \checkmark$$

OPTION 2/OPSIE 2

$$w = mg$$

$$20 = (10)(g) \checkmark$$

$$g = 2 \text{ m} \cdot \text{s}^{-2}$$

$$g = \frac{GM}{R^2}$$

$$2 = \frac{(6,67 \times 10^{-11})M}{(6 \times 10^5)^2} \checkmark$$

$$M = 1,08 \times 10^{22} \text{ kg} \checkmark$$

✓ Any one
Enige een

(4)
[18]

QUESTION 3/VRAAG 3

- 3.1 Motion of an object under the influence of gravity/gravitational force (weight) only ✓✓.

Beweging van 'n voorwerp slegs onder die invloed van gravitasie/gravitasie krag (gewig).

OR/OF

Motion in which the only force acting on the object is gravity/weight. ✓✓

Beweging waar die enigste krag wat op die voorwerp inwerk, gravitasie/gewig is.

ACCEPT/AANVAAR

Vertical motion in which friction/air resistance is absent. ✓✓

Vertikale beweging waar wrywing/lugweerstand afwesig is.

Motion in air with an acceleration of $9,8 \text{ m}\cdot\text{s}^{-2}$. ✓✓

Beweging in lug met 'n versnelling van $9,8 \text{ m}\cdot\text{s}^{-2}$.

NOTE: 2 OR ZERO/ 2 of nul

(2)

- 3.2.1

OPTION 1/OPSIE 1

Upwards positive/Opwaarts positief:

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$0 = v_i + (-9,8)(1,53) \quad \checkmark$$

$$\therefore v_i = 14,99 \text{ m}\cdot\text{s}^{-1} (15 \text{ m}\cdot\text{s}^{-1}) \quad \checkmark$$

Downwards positive/Afwaarts positief

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$0 = v_i + (9,8)(1,53) \quad \checkmark$$

$$\therefore v_i = -14,99 \text{ m}\cdot\text{s}^{-1}$$

$$v_i = 14,99 \text{ m}\cdot\text{s}^{-1} (15 \text{ m}\cdot\text{s}^{-1}) \quad \checkmark$$

OPTION 2/OPSIE 2

$$F_{\text{net}} = ma$$

$$= 9,8 \text{ (m)}$$

$$F_{\text{net}} \Delta t = m\Delta v \quad \checkmark$$

$$(9,8)(\text{m})(1,53) = (\text{m})(v_f - 0) \quad \checkmark$$

$$v_f = 14,99 \text{ m}\cdot\text{s}^{-1} (15 \text{ m}\cdot\text{s}^{-1}) \quad \checkmark$$

OPTION 3/OPSIE 3

Upwards positive/Opwaarts positief:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$0 = v_i(3,06) + \frac{1}{2}(-9,8)(3,06)^2 \quad \checkmark$$

$$v_i = 14,99 \text{ m}\cdot\text{s}^{-1} \quad \checkmark (15 \text{ m}\cdot\text{s}^{-1})$$

Downwards positive/Afwaarts positief

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$0 = v_i(3,06) + \frac{1}{2}(9,8)(3,06)^2 \quad \checkmark$$

$$v_i = 14,99 \text{ m}\cdot\text{s}^{-1} \quad \checkmark (15 \text{ m}\cdot\text{s}^{-1})$$

NOTE: initial and final velocities can be swapped if starting from top, as long as sign of g is changed accordingly.

LW: v_f en v_i kan omgeruil word indien van bopunt begin, solank teken van g dienoreenkomstig verander word.

(3)

3.2.2

OPTION 1/OPSIE 1**POSITIVE MARKING FROM 3.2.1/ Positiewe nasien vanaf 3.2.1****Upwards positive/Opwaarts positief:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= 14,99 (1,53) + \frac{1}{2} (-9,8)(1,53)^2 \checkmark$$

$$= 11,47 \text{ m} \checkmark (11,46-11,48)$$

Maximum height is/Maksimum hoogte is 11,47 m

Downwards positive/Afwaarts positief

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= -14,99 (1,53) + \frac{1}{2} (9,8)(1,53)^2 \checkmark$$

$$= -11,47 \text{ m} (11,46-11,48)$$

Maximum height is /Maksimum hoogte is 11,47 m✓

OPTION 2/OPSIE 2**POSITIVE MARKING FROM 3.2.1/ Positiewe nasien vanaf 3.2.1****Upwards positive/Opwaarts positief:**

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0 = (14,99)^2 + 2(-9,8)(\Delta y) \checkmark$$

$$\Delta y = 11,47 \text{ m} \checkmark (11,46-11,48)$$

Maximum height reached is/Maksimum hoogte bereik is 11,47 m

Downwards positive/Afwaarts positief:

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0 = (-14,99)^2 + 2(9,8)(\Delta y) \checkmark$$

$$\Delta y = -11,47 \text{ m} \cdot (11,46-11,48)$$

Maximum height reached is/Maksimum hoogte bereik is 11,47 m✓

OPTION 3/OPSIE 3**POSITIVE MARKING FROM 3.2.1/ Positiewe nasien vanaf 3.2.1****Upwards positive/Opwaarts positief:**

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{(14,99 + 0)}{2} \right) (1,53) \checkmark$$

$$\Delta y = 11,47 \text{ m} \checkmark$$

Maximum height reached is /Maksimum hoogte bereik is 11,47 m

Downwards positive/Afwaarts positief:

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{(-14,99 + 0)}{2} \right) (1,53) \checkmark$$

$$\Delta y = -11,47 \text{ m} (11,46-11,48)$$

Maximum height reached is /Maksimum hoogte bereik is 11,47 m✓

OPTION 4/OPSIE 4**POSITIVE MARKING FROM 3.2.1**

$$\Delta E = \Delta K + \Delta U$$

$$\frac{1}{2} m v_i^2 + m g h_i = \frac{1}{2} m v_f^2 + m g h_f$$

1 mark for any✓
1 punt vir enige

$$\frac{1}{2} (14,994)^2 + (9,8)(0) = 0 + 9,8 h_f \checkmark$$

$$h_f = 11,47 \text{ m} \checkmark (11,46-11,48)$$

Maximum height reached is /Maksimum hoogte bereik is 11,47 m

OR/OF

$$\Delta K = - \Delta U \checkmark$$

$$\frac{1}{2} m (v_f^2 - v_i^2) = - m g (h_f - h_i)$$

$$\frac{1}{2} (0 - 14,99^2) = - 9,8 (h_f - 0) \checkmark$$

$$h_f = 11,47 \text{ m} (11,46-11,48)$$

Maximum height reached is /Maksimum hoogte bereik is 11,47 m✓

(3)

3.3

OPTION 1/OPSIE 1**POSITIVE MARKING FROM 3.2.1**

Upwards positive/Opwaarts positief:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= (14,99) (4) + \frac{1}{2} (- 9,8)(4)^2 \checkmark$$

$$= -18,4 \text{ m}$$

Position is 18,4 m downwards (below the edge of the roof) ✓ / Posisie is 18,4 m afwaarts (onder die kant van die dak).

Downwards positive/Afwaarts positief

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= (-14,99) (4) + \frac{1}{2} (9,8)(4)^2 \checkmark$$

$$= 18,4 \text{ m}$$

Position is 18,4 m downwards (below the edge of the roof) ✓ / Posisie is 18,4 m afwaarts (onder die kant van die dak)

OPTION 2/OPSIE 2**POSITIVE MARKING FROM 3.2.1****Upwards positive/Opwaarts positief:**

$$v_f = v_i + a\Delta t$$

$$= (14,99) + (-9,8) (4)$$

$$= -24,2 \text{ m}\cdot\text{s}^{-1}$$

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$(-24,2)^2 = (14,99)^2 + 2(-9,8)(\Delta y) \checkmark$$

$$\Delta y = -18,4 \text{ m}$$

Ball is 18,4 m downwards (below the edge of the roof) / Bal is 18,4 m afwaarts (onder die kant van die dak) ✓

Downwards positive/Afwaarts positief:

$$v_f = v_i + a\Delta t$$

$$= (-14,99) + (9,8) (4)$$

$$= 24,2 \text{ m}\cdot\text{s}^{-1}$$

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$(24,2)^2 = (-14,99)^2 + 2(9,8)(\Delta y) \checkmark$$

$$\Delta y = 18,4 \text{ m}$$

Ball is 18,4 m downwards (below the edge of the roof) ✓ / Bal is 18,4 m afwaarts (onder die kant van die dak)

OPTION 3/OPSIE 3**POSITIVE MARKING FROM 3.2.1****Upwards positive/Opwaarts positief:**

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{(14,99 - 24,2)}{2} \right) (4) \checkmark$$

$$v_f = v_i + a\Delta t$$

$$= (14,99) + (-9,8) (4)$$

$$= -24,2 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = -18,4 \text{ m}$$

Ball is 18,4 m downwards (below the edge of the roof) ✓ / Bal is 18,4 m afwaarts (onder die kant van die dak).

Downwards positive/Afwaarts positief:

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{(-14,99 + 24,2)}{2} \right) (4) \checkmark$$

$$v_f = v_i + a\Delta t$$

$$= (-14,99) + (9,8) (4)$$

$$= 24,2 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = 18,4 \text{ m}$$

Ball is 18,4 m downwards (below the edge of the roof) ✓ / Bal is 18,4 m afwaarts (onder die kant van die dak.)

OPTION 4/OPSIE 4Total time to return to starting point/*totale tyd terug na beginpunt*

$$= 2(1,53) = 3,06 \text{ s}$$

∴ time from reference point to ground/ *tyd vanaf verwysingspunt tot by grond*

$$= (4 - 3,06) = 0,94 \text{ s}$$

$$\Delta y = v_i \Delta t + \frac{1}{2} (g) \Delta t^2 \checkmark$$

$$= (14,99)(0,94) + \frac{1}{2}(9,8)(0,94)^2 \checkmark$$

$$= 18,43 \text{ m} \checkmark \text{ downwards (below the edge of the roof) /afwaarts (onder die kant van die dak.}$$

(3)

3.4

No/Nee✓

The motion of the ball is only dependent on its initial velocity✓✓/the initial velocity depends on the time taken to reach maximum height.

Die beweging van die bal is slegs afhanklik van sy beginsnelheid./die aanvanklike snelheid hang af van die tyd wat dit neem om maksimum hoogte te bereik.

ACCEPT for 1 mark/ AANVAAR vir 1 punt:

The ball will still be in the air.✓

Die bal sal nog steeds in die lug wees.

OR/OF

The ball is still falling.✓

Die bal is steeds besig om te val.

OR/OF

The ball would not have reached the ground.✓

Die bal sal nog nie die grond bereik het nie.

OR/OF

The motion of the ball is independent of the height of the building. ✓

Die beweging van die bal is onafhanklik van die hoogte van die gebou.

NOTE: If learners gave separate answers for 3.2 and 3.3, mark them together. Thus, if one answer is correct and the other incorrect 0/3

LW: Indien leerders twee afsonderlike antwoorde gee vir 3.2 en 3.3, sien as geheel na. Dus, indien een verkeerd is, 0/3

(3)

[14]

QUESTION 4/VRAAG 4

- 4.1 The total (linear) momentum in a isolated/closed system remains constant./ is conserved ✓✓

Die totale lineêre momentum in 'n geslote sisteem bly konstant/behoue.

OR/OF

In an isolated/closed system the total momentum before a collision is equal to the total momentum after the collision. ✓✓

In 'n geslote/geïsoleerde sisteem is die totale momentum voor die botsing gelyk aan die totale momentum na die botsing.

NOTE/LET WEL:

-1 for each key word/phrase omitted.

-1 vir elke sleutel woorde/frase weggelaat.

Take the whole statement in context /Vat die hele stelling in konteks.

(2)

- 4.2

OPTION 1/OPSIE 1

$$\sum p_i = \sum p_f$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$$

1 mark for any
1 punt vir enige

$$\{0,45(9) + 0,20(0)\} \checkmark = (0,45 + 0,20)v \checkmark$$

$$v = 6,23 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OR

$$\Delta p_{\text{ball/bal}} = - \Delta p_{\text{cont/houer}} \checkmark$$

$$0,45(v - 9) \checkmark = - 0,2(v - 0) \checkmark$$

$$v = 6,23 \text{ m} \cdot \text{s}^{-1} \checkmark$$

If – sign omitted from formula 0/4
Indien – teken weggelaat uit
formula 0/4

OPTION 2/OPSIE 2

$$\sum p_i = \sum p_f$$

$$p_{f \text{ Total}} = p_{i \text{ Total}}$$

1 mark for any✓
1 punt vir enige

(Thus change in total momentum = 0 /Dus verandering in momentum is=0))

$$0 \checkmark = (0,65v_f) - (9)(0,45) \checkmark$$

$$v_f = 6,23 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(4)

4.3

POSITIVE MARKING FROM 4.2/POSITIEWE NASIEN VANAF 4.2

$$K = \frac{1}{2} mv^2 \checkmark \text{ (or } E_K = \frac{1}{2} mv^2 \text{)}$$

Total kinetic energy before collision: / *Totale kinetiese energie voor botsing:*

$$\frac{1}{2} (0,45)(9)^2 + 0 \checkmark = 18,225\text{J}$$

Total kinetic energy after collision: / *Totale kinetiese energie na botsing:*

$$\frac{1}{2} (0,45 + 0,20)(6,23)^2 \checkmark = 12,614\text{J}$$

$$\sum K_{\text{before/voor}} \neq \sum K_{\text{after/na}}$$

Collision is inelastic. / *Botsing is onelasties* ✓✓If start with/ *indien begin met* $\sum E_{Ki} = \sum E_{Kf}$ 4/5 max/maksNo calculation/ *geen berekening*: 0

Do not accept a conclusion of inelastic collision based on any other calculation (such as that of momentum or mechanical energy). / *Moet geen afleiding van 'n onelastiese botsing aanvaar wat op enige ander berekening gebaseer is nie (soos byvoorbeeld momentum of meganiese energie).*

(5)
[11]

QUESTION 5/VRAAG 5

5.1 Tension/Spansing✓

(1)

5.2 There is friction/ tension in the system ✓

Daar is wrywing/spanning in die sisteem

OR/OF

Friction/tension is a non-conservative force ✓

Wrywing/spanning 'n 'n nie-konserwatiewekrag

OR/OF

The system is not isolated because there is friction/tension ✓

Die sisteem is nie geïsoleerd nie omdat daar wrywing/spanning is

OR/OF

The internal energy increases because of friction ✓

Die interne energie neem toe as gevolg van wrywing.

OR

The applied force is non-conservative✓

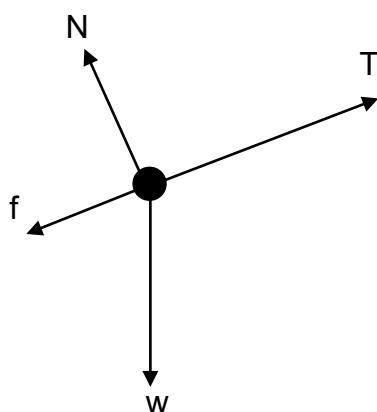
Die toegepaste krag is nie-konservatief

OR

It is not an isolated system✓

(1)

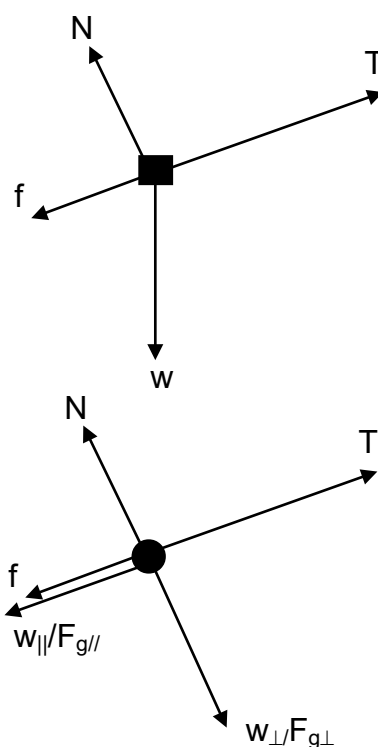
5.3



NOTE: maximum $\frac{3}{4}$ if friction and tension are not on a straight line

LW: maksimum $\frac{3}{4}$ indien wrywing en spanning nie in 'n reguitlyn nie.

ACCEPT/AANVAAR



NOTE: maximum $\frac{3}{4}$ if N and $w_{\perp}$ are not on a straight line
LW: maksimum $\frac{3}{4}$ indien N en $w_{\perp}$ nie in 'n reguitlyn nie.

Accepted labels/Aanvaarde benoemings		
w	F_g/F_w /weight/mg/gravitational force F_g/F_w /gewig/mg/gravitasiekrag	✓
f	Friction/ F_f/f_k /178,22 N/wrywing/ F_w	✓
N	Normal (force)/ F_{normal} / F_N / $F_{normaal}$ / $F_{reaction}$ /reaksie	✓
T	F_T/F_A / $F_{applied}$ /toegepas/700 N/Tension	✓

Notes/Aantekeninge

- Mark awarded for label and arrow / Punt toegeken vir benoeming en pyltjie
- Do not penalise for length of arrows since drawing is not to scale. /Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie
- Any other additional force(s) / Enige ander addisionele krag(te) Max/Maks $\frac{3}{4}$
- If force(s) do not make contact with body / Indien krag(te) nie met die voorwerp kontak maak nie: Max/Maks: $\frac{3}{4}$

Deduct 1 mark for an arrow/arrows omitted / trek 1 punt af indien pyl/pyle weggelaat

(4)

5.4

$$W = F\Delta x \cos\theta \checkmark$$

$$W_f = [178,22(4)\cos 180^\circ] \checkmark$$

$$= -712,88 \text{ J} \checkmark$$

(3)

5.5

OPTION 1/OPSIE 1**POSITIVE MARKING FROM QUESTIONS 5.4 POSITIEWE NASIEN VANAF VRAE 5.4**

$$W_{\text{net}} = \Delta E_K$$

$$W_f + W_g + W_T = \Delta K$$

$$W_f + mgsin\theta\Delta x \cos\theta + W_T = \Delta K$$

1 mark for any one ✓ /
1 punt vir enige een

$$-712,88 + (70)(9,8)(\sin 30^\circ)(4) \cos 180^\circ \checkmark + (700 \times 4 \times \cos 0^\circ) \checkmark = \frac{1}{2} 70(v_f^2 - 0) \checkmark$$

$$v_f = 4,52 \text{ m}\cdot\text{s}^{-1} \checkmark$$

NOTE: W_g can be obtained using any of the following formulae:

LW: w_g kan verkry word deur enige een van die volgende formules:

$$W_{\text{gravity/gravitasie}} = mg\Delta x \cos\theta$$

$$= (70)(9,8)(4) \cdot (\cos 120^\circ)$$

$$\therefore -712,88 + (70)(9,8)(4)\cos 120^\circ \checkmark + (700 \times 4 \times \cos 0^\circ) \checkmark = \frac{1}{2} 70(v_f^2 - 0) \checkmark$$

$$v_f = 4,52 \text{ m}\cdot\text{s}^{-1} \checkmark$$

$$W_{\text{gravity/gravitasie}} = -\Delta mgh = -mg(h_f - h_0)$$

$$= mg\Delta y \cos\theta$$

$$= ((70)(9,8) 4(\sin 30^\circ) \cdot \cos 180^\circ$$

$$W_{\text{gravity/gravitasie}} = mgsin\theta\Delta x \cos\theta$$

$$= (70)(9,8)(\sin 30^\circ)(4) \cdot \cos 180^\circ$$

OPTION 2/OPSIE 2**POSITIVE MARKING FROM 5.4 / POSITIEWE NASIEN VANAF 5.4**

$$W_{nc} = \Delta E_K + \Delta E_p \checkmark$$

$$W_T + W_f = \Delta E_K + \Delta E_p$$

$$(700)(4) \cos 0^\circ \checkmark + (-712,88) = [(70)(9,8) 4(\sin 30^\circ) - 0] \checkmark + \frac{1}{2} 70(v_f^2 - 0) \checkmark$$

$$v_f = 4,52 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 3

$$F_{net} = F_T - [mg \sin \theta + f_k]$$

$$= 700 - [(70 \times 9,8 \sin 30^\circ) + 178,22] \checkmark$$

$$= 178,78 \text{ N}$$

$$W_{net} = \Delta E_K \checkmark$$

$$F_{net} \cdot \Delta x \cos \theta = \Delta E_K$$

$$(178,78)(4) \cos 0^\circ \checkmark = \frac{1}{2} 70(v_f^2 - 0) \checkmark$$

$$v_f = 4,52 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(5)

5.5

WHERE EQUATIONS OF MOTION ARE USED: / WAAR**BEWEGINGSVERGELYKING GEBRUIK: MAXIMAKS $\frac{1}{5}$**

$$F_{net} = ma$$

$$F_T - [mg \sin \theta + f_k] = ma$$

$$700 - [(70 \times 9,8 \sin 30^\circ) + 178,22] \checkmark = 70a$$

$$a = 2,554 \text{ ms}^{-2}$$

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$= 0 + 2(2,554)(4)$$

$$v_f = 4,52 \text{ m}\cdot\text{s}^{-1}$$

5.6

POSITIVE MARKING FROM 5.4 / POSITIEWE NASIEN VANAF 5.4

$$2(-712,88) = -1425,76 \text{ J} \checkmark$$

OR/OF

Double the answer (in question 5.4). $\checkmark$ *Dubbel die antwoord (in vraag 5.4)*

(1)

[15]

QUESTION 6/VRAAG 6

6.1.1

$$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$300 = v_i (10) \checkmark$$

$$v_i = 30 \text{ m} \cdot \text{s}^{-1} \checkmark$$

$$v = \frac{d}{t} = \frac{300}{10} \checkmark = 30 \text{ m} \cdot \text{s}^{-1} \checkmark$$

NOTE/LET WEL:Accept/Aanvaar $\Delta x = v_i \Delta t$

(2)

6.1.2

The change in frequency (or pitch) (of the sound) detected by a listener because the source and the listener have different velocities relative to the medium of sound propagation. $\checkmark \checkmark$

Die verandering in die frekwensie (of toonhoogte) (van die klank) waargeneem deur 'n luisteraar omdat die bron en die luisteraar verskillende snelhede relatief tot die voortplantingsmedium het.

OR/OF

An (apparent) change in observed/detected frequency (pitch), (wavelength) as a result of the relative motion between a source and an observer (listener). $\checkmark \checkmark$

'n Skynbare verandering in waargenome frekwensie (toonhoogte), (golflengte) as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/luisteraar.

NOTE/LET WEL:

-1 for each key word/phrase omitted.

-1 vir elke sleutel woorde/frase weggelaat

(2)

6.1.3

Car/source (just) passes observer $\checkmark \checkmark$

Motor beweeg net verby die waarnemer

Accept:Car moves away from observer $\checkmark \checkmark$ No relative motion between car and observer $\checkmark \checkmark$ Car and observer at the same place/position $\checkmark \checkmark$ **Aanvaar:**

Motor beweeg verby waarnemer

Geen relatiewe beweging tussen motor en waarnemer

Motor en waarnemer by dieselfde plek/posisie.

(2)

6.1.4

POSITIVE MARKING FROM 6.1.1/POSITIEWE NAISEN VANF 6.1.1

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \checkmark \quad \text{OR/OF} \quad f_L = \frac{v}{v - v_s} f_s$$

$$932 = \frac{340}{340 - 30} f_s \quad \checkmark$$

$$f_s = 849,76 \text{ Hz} \quad \checkmark$$

(4)

Notes/Aantekeninge:

- Any other Doppler formula, e.g. /Enige ander Doppler formula b.v.

$$f_L = \frac{v - v_L}{v - v_s} f_s \quad \text{Max/Maks. } \frac{3}{4}$$

Marking rule 1.5: No penalisation if zero substitutions are omitted.

Nasienreël 1.5. Geen penalisering indien nul vervangings uitgelaat word

6.2

Doppler / Blood flow meter

Dopplervloeimeter/ bloedvloeimeter

Measuring the heartbeat of a foetus

Meting van hartklop van 'n fetus

Radar

Sonar

Used to determine whether stars are receding or approaching earth/

Gebruik om te bepaal of sterre na of weg van die aarde beweeg

Any 2 ✓✓
Enige 2

(2)
[12]

QUESTION 7/VRAAG 7

- 7.1 The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point. ✓✓

Die elektriese veld by 'n punt is die elektrostatische krag wat per eenheid positiewe lading wat by daardie punt geplaas word, ervaar word. ✓✓

NOTE/LET WEL:

-1 for each key word/phrase omitted. If definition of electric field: 0/2

-1 vir elke sleutel woorde/frase weggelaat. Indien definisie van elektriese veld 0/2

(2)

- 7.2  q_2 is positive_✓

The electric field due to q_1 points to the right because q_1 is negative. ✓ Since the net field is zero, field due to q_2 must point to the left away from q_2 , ✓ hence q_2 is positive.

q_2 is positief

Die elektriese veld as gevolg van q_1 is na regs gerig omdat q_1 negatief is. Aangesien die net veld nul is, moet die veld as gevolg van q_2 na links weg van q_2 wees.

OR/OF

q_2 is positive_✓

 Since E_{net} is zero, E_1 and E_2 are in opposite directions ✓ therefore q_1 and q_2 are oppositely charged. ✓

q_2 is positief ✓

Omdat E_{net} nul is, is E_1 en E_2 in teenoorgestelde rigtings ✓ daarom is q_1 en q_2 teenoorgesteld gelaai. ✓

(3)

7.3

$$E = k \frac{Q}{r^2} \checkmark$$

$$E_{\text{net}} = 0$$

$$\therefore k \frac{q_1}{r_1^2} = k \frac{q_2}{r_2^2} \text{ OR}$$

$$\frac{q_1}{r_1^2} = \frac{q_2}{r_2^2}$$

$$\frac{(9 \times 10^9)(3 \times 10^{-9})}{(0,1)^2} \checkmark = \frac{(9 \times 10^9)q_2}{(0,4)^2} \checkmark$$

$$q_2 = + 4,8 \times 10^{-8} \text{ C} \checkmark$$

1 mark for formula
1 mark for equating the two fields
1 mark for both substitutions
1 mark for answer
1 punt vir vergelyking
1 punt vir twee velde gelyk gestel
1 punt vir altwee substitusies
1 punt vir antwoord

(4)

7.4

The electrostatic force (of attraction/repulsion) between two point charges is directly proportional to the product of the charges and inversely proportional to the square of the distance between them. ✓✓

Die elektrostatische krag(aantekking/afstotend) tussen twee puntladings is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.

(2)

NOTE/LET WEL:

-1 for each key word/phrase omitted. If masses used instead of charges 0

-1 vir elke sleutel woorde/frase weggelaat Indien massas gebruik 0

7.5

POSITIVE MARKING FROM 7.3/POSITIEWE NASIEN VANAF 7.3

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$F = \frac{(9 \times 10^9)(3 \times 10^{-9})(4,8 \times 10^{-8})}{(0,3)^2} \checkmark$$

$$= 1,44 \times 10^{-5} \text{ N} \checkmark$$

(3)

7.6

POSITIVE MARKING FROM 7.2 AND 7.3/POSITIEWE NASIEN van 7.2 en 7.3

YES/JA ✓

Both charges are equal and positive ✓

Beide ladings is gelyk en positief

Accept calculation which shows charges the same and positive/ *Aanvaar berekening wat toon dat ladings dieselfde en positief is.*

If the answer is YES, mark according to the memo, if NO check 7.2 first for sign of charge. If stated NEGATIVE at 7.2, then answer is:

No✓, the direction is incorrect. ✓

Positiewe nasien vanaf 7.2: Indien antwoord vir 7.2 NEGATIEF, dan is hierdie antwoord: Nee ✓, die rigting is verkeerd. ✓

(2)

[16]

QUESTION 8/VRAAG 8

8.1.1 The rate at which (electrical) energy is converted (to other forms) (in a circuit)

The rate at which energy is used/Energie used per second

The rate at which work is done ✓✓

(2 or zero)

*Die tempo waarteen elektriese energie omgesit word (in ander vorms) in 'n stroombaan.**Die tempo waarteen energie verbruik word.**Die tempo waarteen arbeid verrig word.*

(2 of nul)

(2)

8.1.2

$P = \frac{V^2}{R} \checkmark$ $6 = \frac{(12)^2}{R} \checkmark$ $R = 24 \Omega \checkmark$	$W = \frac{V^2 \Delta t}{R} \checkmark$ $6 = \frac{(12)^2 (1)}{R} \checkmark$ $R = 24 \Omega \checkmark$	$P = VI$ $6 = (12)(I)$ $\therefore I = 0,5 \text{ A}$ $P = I^2 R \checkmark$ $6 = (0,5)^2 R \checkmark$ $R = 24 \Omega \checkmark$	$P = VI \checkmark$ $6 = (12)(I)$ $\therefore I = 0,5 \text{ A}$ $V = IR$ $12 = (0,5)R \checkmark$ $R = 24 \Omega \checkmark$

(3)

8.1.3

**POSITIVE MARKING FROM 8.1.2/POSITIEWE NASIEN VANAF 8.1.2
OPTION 1/OPSIE 1**

$$\frac{1}{R_{//}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$= \frac{1}{24} + \frac{1}{24} \checkmark$$

$$R_{//} = 12 \Omega$$

$$R_{\text{ext}} = (R_s + R_{//})$$

$$R_{\text{ext}} = (24 + 12) \checkmark$$

$$= 36 \Omega$$

$$V = IR$$

OR

$$\varepsilon = I(R + r)$$

$$12 = I(36 + 2) \checkmark$$

$$I = 0,32 \text{ A} \checkmark (0,316 \text{ A})$$

$R_{\text{tot}} = \left(R_s + \frac{R_1 R_2}{R_1 + R_2} \right)$
 $R_{\text{tot}} = \left\{ 24 + \frac{(24)(24)}{48} \right\} \checkmark$
 $= 36 \Omega$

$\checkmark$ any one
Enige 1

POSITIVE MARKING FROM 8.1.2/POSITIEWE NASIEN VANAF 8.1.2
OPTION 2/OPSIE 2

$$R_{\text{ext}} = (R_s + R_{//})$$

$$\frac{1}{R_{//}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$= \frac{1}{24} + \frac{1}{24} \checkmark$$

$$R_{//} = 12 \Omega$$

$$R_{\text{ext}} = (24 + 12) \checkmark$$

$$= 36 \Omega$$

$$P = I^2 R = \frac{V^2}{R} \checkmark$$

$$I^2 (36 + 2) = \frac{(12)^2}{38} \checkmark$$

$$I = 0,32 \text{ A} \checkmark (0,316) \checkmark$$

$$R_{\text{ext}} = R_s + \frac{R_1 R_2}{R_1 + R_2}$$

$$R_{\text{ext}} = \left\{ 24 + \frac{(24)(24)}{48} \right\} \checkmark$$

$$= 36 \Omega$$

$$I^2 R = \frac{V^2}{R}$$

$$I^2 R^2 = V^2$$

$$V = IR$$

$$12 = I(38) \checkmark$$

$$I = 0,316 \text{ A} \checkmark$$

(5)

8.1.4

POSITIVE MARKING FROM 8.1.3
POSITIEWE NASIEN VANAF 8.1.3
OPTION 1/OPSIE 1

$$V = IR$$

$$V = I(R_A + r)$$

$$= 0,316(26) \checkmark$$

$$= 8,216 \text{ V} (8,32 \text{ V})$$

$$V_{//} = (12 - 8,216) \checkmark$$

$$= 3,784 \text{ V} (3,68 \text{ V})$$

$$\therefore V_C = 3,78 \text{ V} (3,68 \text{ V}) \checkmark$$

POSITIVE MARKING FROM 8.1.3
POSITIEWE NASIEN VANAF 8.1.3
OPTION 2/OPSIE 2

$$V = IR$$

For the parallel portion (or from 8.1.3):
Vir die parallel gedeelte (of vanaf 8.1.3)

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \text{ OR } R = \frac{R_1 R_2}{R_1 + R_2}$$

$$R = \frac{(24)(24)}{48}$$

$$= 12 \Omega$$

$$V_{//} = V_C \checkmark$$

$$V = IR_{//}$$

$$= (0,316)(12) \checkmark$$

$$= 3,79 \text{ V} (3,84 \text{ V}) \checkmark$$

(3)

POSITIVE MARKING FROM 8.1.3
POSITIEWE NASIEN VANAF 8.1.3
OPTION 3/OPSIE 3

$$I_A = I_B + I_C$$

$$= 2 I_B$$

$$0,316 = 2 I_B \checkmark$$

$$I_B = 0,158 \text{ A}$$

$$V = 0,158 (24) \checkmark$$

$$= 3,79 \text{ V} \checkmark$$

(3)

8.1.5 OPTION 1/OPSIE 1

The power rating (output voltage) of the bulb is 6 W, 12 V. /Die gloeilamp is gemerk 6W ; 12 V

$$P = \frac{V^2}{R}$$

[For a given resistance, power is directly proportional to V^2] ✓

[of Vir 'n gegewe resistor is drywing direk eweredig aan V^2] ✓

Since the potential difference across light bulb C is less than the operating voltage, ✓ the output/power will be less, ✓ / Omdat die potensiaalverskil oor gloeilamp C minder is as die benodigde spanning sal die uitset/drywing minder wees.

OPTION 2/OPSIE 2

$$P = \frac{V^2}{R}$$

The potential difference across light bulb C is less than the operating voltage.

✓ Thus for the same resistance, ✓ brightness decreases.

Die potensiaalverskil oor gloeilamp C is minder as die benodigde potensiaalverskil. Dus vir dieselfde weerstand, sal die helderheid afneem.

OPTION 3/OPSIE 3

$$P = I^2 R$$

For a given resistance ✓, power is directly proportional to I^2 Since current decreases ✓, brightness decreases.]

[vir 'n gegewe resistor is drywing direk eweredig aan I^2 Omdat stroom afneem sal die helderheid afneem]

OPTION 4/OPSIE 4

$$P = I^2 R$$

In the circuit, the total current in light bulb C is less than the optimum current required (0,5 A). ✓ Thus for the same resistance, ✓ the power will be less ✓ hence brightness will decrease.

In die stroombaan is die totale stroom in gloeilamp C minder as die optimum stroom benodig (0,5 A). Dus vir dieselfde weerstand, is die drywing minder en die helderheid sal afneem.

OPTION 5/OPSIE 5

$$P = IV$$

[Power is directly proportional/equal to product of V and I. ✓

Since current decreases ✓, brightness decreases/

drywing is direk eweredig/gelyk aan produk van V en I. Omdat stroom afneem sal die helderheid afneem]

OR/OF

The voltage across light bulb C, as well as the current in the bulb are all less ✓ than the optimum values ✓ hence power is less ✓ and brightness is less.

Die potensiaalverskil oor gloeilamp C sowel as die stroom in die gloeilamp is almal minder as die optimum waardes, dus is die drywing minder en die helderheid minder.

NOTE: No mark if only equation is given.

(3)

- 8.2.1 The total current passes through resistor A. ✓ For the parallel portion, the current branches, therefore only a portion of the total current passes through resistor C. ✓

Die totale stroom vloei deur resistor A. Vir die parallelle gedeelte verdeel die stroom, dus vloei slegs 'n gedeelte van die stroom deur resistor C.

(2)

ACCEPT for 1 mark: Resistor C is connected parallel to resistors B and D together. Current is dividing ✓ at the junction.

AANVAAR vir 1 punt: Resistor C is in parallel geskakel met B en D saam. Die stroom breek op ✓ by die koppeling.

- 8.2.2 The current in B is equal ✓ to the current in A. The circuit becomes a series circuit. ✓

Die stroom in B is gelyk aan die stroom in A. Die stroombaan word 'n serie stroombaan.

(2)

[21]

QUESTION 9/VRAAG 99.1 Slip rings/*Sleep ringe* ✓

(1)

9.2 B ✓

(1)

9.3

$$\begin{aligned}
 V_{\text{rms/wgk}} &= \frac{V_{\text{max/maks}}}{\sqrt{2}} \quad \checkmark \\
 &= \frac{312}{\sqrt{2}} \quad \checkmark \\
 &= 220,62 \text{ V} \quad \checkmark
 \end{aligned}$$

(3)

9.4.1

POSITIVE MARKING FROM 9.3/POSITIEWE NASIEN VANAF 9.3
OPTION 1/OPSIE 1

$$\begin{aligned}
 P_{\text{aver / gemid}} &= \frac{V_{\text{rms / wgk}}^2}{R} \quad \checkmark \\
 &= \frac{(220,62)^2}{40} \quad \checkmark \\
 &= 1216,83 \text{ W} \quad \checkmark
 \end{aligned}$$

POSITIVE MARKING FROM 9.3/POSITIEWE NASIEN VANAF 9.3
OPTION 2/OPSIE 2

$$\begin{aligned}
 I_{\text{rms}} &= \frac{V_{\text{rms / wgk}}}{R} \\
 &= \frac{(220,62)}{40} \\
 &= 5,515 \\
 P_{\text{ave}} &= I_{\text{rms}}^2 R \\
 &= (5,515)^2 (40) \quad \checkmark \\
 &= 1216,61 \text{ W} \quad \checkmark
 \end{aligned}$$

OR

$$\begin{aligned}
 P_{\text{ave}} &= V_{\text{rms}} I_{\text{rms}} \\
 &= (220,62)(5,515) \quad \checkmark \\
 &= 1216,72 \text{ W} \quad \checkmark
 \end{aligned}$$

✓ for any/ *vir enige*

OPTION 3/OPSIE 3

$$I_{\max} = \frac{V_{\max}}{R}$$

$$= \frac{312}{40}$$

$$= 7,80 \text{ A}$$

$$P_{\text{ave}} = \frac{I_{\max} V_{\max}}{2}$$

$$= \frac{(7,8)(312)}{2} \quad \checkmark$$

$$= 1216,80 \text{ W} \quad \checkmark$$

✓ for any/ vir enige

(3)

9.4.2

OPTION 1/OPSIE 1

$$I_{\max/\text{maks}} = \frac{V_{\max/\text{maks}}}{R} \quad \checkmark$$

$$= \frac{312}{40} \quad \checkmark$$

$$= 7,8 \text{ A} \quad \checkmark$$

Accept/ Aanvaar: $I = \frac{V}{R}$ **POSITIVE MARKING FROM 9.3 AND 9.4.1/POSITIEWE NASIEN VANAF 9.3 EN 9.4.1****OPTION 2/OPSIE 2**

$$P_{\text{ave/gemid}} = V_{\text{rms/wgk}} I_{\text{rms/wgk}} \quad \checkmark$$

$$1\,216,83 = 220,62 I_{\text{rms/wgk}} \quad \checkmark$$

$$I_{\text{rms/wgk}} = 5,515 \text{ A}$$

$$I_{\text{rms/wgk}} = \frac{I_{\max/\text{maks}}}{\sqrt{2}}$$

$$5,515 = \frac{I_{\max/\text{maks}}}{\sqrt{2}} \quad \checkmark$$

$$I_{\max/\text{maks}} = 7,8 \text{ A} \quad \checkmark$$

✓ for any/ vir enige

OPTION 3/OPSIE 3

$$P_{\text{ave/gemid}} = I_{\text{rms/wgk}}^2 R$$

$$1\,216,83 = I_{\text{rms/wgk}}^2 (40) \quad \checkmark$$

$$I_{\text{rms/wgk}} = 5,515 \text{ A}$$

$$I_{\text{rms/wgk}} = \frac{I_{\max/\text{maks}}}{\sqrt{2}}$$

$$5,515 = \frac{I_{\max/\text{maks}}}{\sqrt{2}} \quad \checkmark$$

$$I_{\max/\text{maks}} = 7,8 \text{ A} \quad \checkmark$$

✓ for any/ vir enige

(4)
[12]

QUESTION 10/VRAAG 10

- 10.1 The minimum frequency of light needed to eject electrons from a metal (surface) ✓✓.

Minimum frekwensie van lig benodig om elektrone vanaf 'n metaal (oppervlak) vry te stel.

NOTE/LET WEL:

-1 for each key word/phrase omitted.

-1 vir elke sleutel woorde/frase weggelaat.

(2)

10.2

<u>OPTION 1/OPSIE 1</u>	<u>OPTION 2/OPSIE 2</u>
$E = h \frac{c}{\lambda} \checkmark$ $= \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{5 \times 10^{-7}} \checkmark$ $= 3,98 \times 10^{-19} \text{ J} \checkmark$	$c = f\lambda$ $3 \times 10^8 = f(5 \times 10^{-7})$ $f = 6 \times 10^{14} \text{ Hz}$ $E = hf$ $= (6,63 \times 10^{-34})(6 \times 10^{14}) \checkmark$ $= 3,98 \times 10^{-19} \text{ J} \checkmark$
✓ Both equations Beide vergelykings	
<u>NOTE:</u> do not penalise if v is used in place of c .	

(3)

10.3

<u>OPTION 1/OPSIE 2</u>
POSITIVE MARKING FROM QUESTION 10.2/POSITIEWE NASIEN VANAF VRAAG 10.2
$E = W_0 + E_{\text{kmax}}$ $hf = W_0 + \frac{1}{2}mv_{\text{max}}^2$ $h \frac{c}{\lambda} = W_0 + E_{\text{K(max/maks)}}$ $h \frac{c}{\lambda} = hf_0 + E_{\text{K(max/maks)}}$ $\underline{3,98 \times 10^{-19} = (6,63 \times 10^{-34})(5,55 \times 10^{14}) + E_{\text{K(max/maks)}}} \checkmark$ $E_{\text{K(max/maks)}} = 3,0 \times 10^{-20} \text{ J} \checkmark$ $E_{\text{K(max/maks)}} > 0 \checkmark$ (The electrons emitted from the metal plate have kinetic energy to move between the plates, hence the ammeter registers a reading. <i>Die elektrone vrygestel vanaf die metaalplaat het kinetiese energie om tussen die plate te beweeg en gevolglik registreer die ammeter 'n lesing)</i>

1 mark any one/1 punt vir enige

OPTION 2/OPSIE 2**POSITIVE MARKING FROM QUESTION 10.2/POSITIEWE NASIEN VANAF VRAAG 10.2**

$$W_o = hf_o \checkmark$$

$$= (6,63 \times 10^{-34})(5,55 \times 10^{14}) \checkmark$$

$$= 3,68 \times 10^{-19} \text{ J}$$

$$E_{\text{photon}} > W_o \checkmark$$

(The energy of the incident photon is greater than the work function of potassium. From the equation $hf = W_o + E_{K\text{max}}$, the ejected photoelectrons will move between the plates, $\checkmark$ hence the ammeter registers a reading.

Die energie van die invallende foton is hoër as die arbeidsfunksie van kalium. Vanaf die vergelyking $hf = hf_o + E_{K(\text{maks})}$, sal die vrygestelde foto-elektrone tussen die plate te beweeg en gevolglik registreer die ammeter 'n lesing.)

OPTION 3/OPSIE 3

$$c = f\lambda \checkmark$$

$$3 \times 10^8 = f(5 \times 10^{-7}) \checkmark$$

$$f = 6 \times 10^{14} \text{ Hz}$$

$$f > f_o \checkmark$$

The frequency of the incident photon is higher than the threshold frequency. From the equation $hf = hf_o + E_{K(\text{max})}$, the ejected photoelectrons will be able to move between the plates $\checkmark$ (for the given frequency), hence the ammeter registers a reading.

Die frekwensie van die invallende foton is hoër as die drumpelfrekwensie. Vanaf die vergelyking $hf = hf_o + E_{K(\text{maks})}$, sal die vrygestelde foto-elektrone tussen die plate kan beweeg en gevolglik registreer die ammeter 'n lesing.)

10.4

The increase in intensity increases the number of photons per second. $\checkmark$
Soos die intensiteit toeneem, neem die aantal fotone per sekonde toe.

Since each photon releases one electron $\checkmark$ the number of ejected electrons per second increases. $\checkmark$

Aangesien elke foton een elektron vrystel, neem die aantal vrygestelde elektrone per sekonde toe.

ACCEPT: Flow of electrons per unit time increases $\checkmark$ (1 mark)

AANVAAR: vloeï van elektrone per eenheidstyd neem toe (1 punt)

This causes the current /ammeter reading to increase.

Dit veroorsaak dat die stroom/ammeterlesing toeneem.

(4)

(3)
[12]**TOTAL/TOTAAL:****150**



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

NOVEMBER 2018

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 29 pages.
*Hierdie nasien riglyne bestaan uit 29 bladsye.***

QUESTION 1/VRAAG 1

1.1	C /D ✓✓	(2)
1.2	C ✓✓	(2)
1.3	C ✓✓	(2)
1.4	B ✓✓	(2)
1.5	B ✓✓	(2)
1.6	A ✓✓	(2)
1.7	A ✓✓	(2)
1.8	D ✓✓	(2)
1.9	D ✓✓	(2)
1.10	C ✓✓	(2)
		[20]

QUESTION 2/VRAAG 2

2.1

When a (non-zero) resultant/net force acts on an object, the object will accelerate in the direction of the force with an acceleration that is directly proportional to the force and inversely proportional to the mass of the object.

✓✓

Wanneer 'n (nie-nul) resultante/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel teen 'n versnelling wat direk eweredig is aan die (netto) krag en omgekeerd eweredig aan die massa van die voorwerp.

OR/OF

The (non-zero) resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force.

✓✓ (2 or 0)

Die (nie-nul) netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum.

ACCEPT/AANVAAR

Acceleration is directly proportional to the net force and inversely proportional to the mass of the object.

Versnelling direk eweredig is aan die netto krag en omgekeerd eweredig aan die massa van die voorwerp.

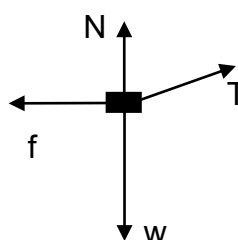
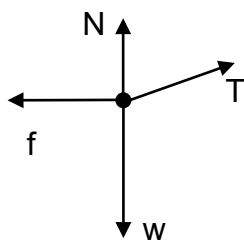
NOTE/LET WEL

If any of the underlined key words in the **correct context** is omitted deduct 1 mark.

Indien enige van die onderstreepte sleutel woorde in die **korrekte konteks** uitgelaat is, trek 1 punt af.

(2)

2.2

**Notes/Aantekeninge**

- Mark is awarded for label and arrow
Punt word toegeken vir byskrif en pyltjie
- Do not penalise for length of arrows
Moenie vir die lengte van die pyltjies penaliseer nie.
- If T is not shown but $T_{\parallel}$ and $T_{\perp}$ are shown, give 1 mark for both
Indien T nie aangetoon is nie maat $T_{\parallel}$ en $T_{\perp}$ is getoon. Ken 1 punt toe vir beide.
- If force(s) do not make contact with body/*Indien krag(te) nie met die voorwerp kontak maak nie: Max/Maks: $\frac{3}{4}$*
- Deduct 1 mark for any additional force /*Trek 1 punt af vir enige addisionele krag*

(4)

	Accept the following symbols /Aanvaar die volgende simbole.
N	F_N ; Normal; Normal force /Normaal; Normaalkrag ✓
f	F_f / f_k / frictional force/wrywingskrag/kinetic frictional force/ kinetiese wrywingskrag ✓
w	F_g ; mg; Weight; $F_{\text{Earth on block}}$; Fw / Gewig ; Gravitational force / Gravitasiekrag/ 78,4 N ✓
T	Tension/Spanning; F_T / F_A , F /16,96 N ✓

2.3.1

The 2/8 kg block /system is accelerating/Die 2/8 kg blok / sisteem is besig om te versnel ✓

OR/OF

The acceleration is not zero / $a \neq 0$ ($\text{m} \cdot \text{s}^{-2}$) / $a = 1,32 \text{ m} \cdot \text{s}^{-2}$ / Die versnelling is nie nul nie ✓

OR/OF

Velocity is /increasing/changing/not constant/Snelheid neem toe/ verander/is nie konstant nie ✓

OR/OF

F_{net} is not equal to zero / F_{net} is nie gelyk aan nul nie / $F_{\text{net}} \neq 0$ (N) ✓

OR/OF

The acceleration is changing / Die versnelling verander ✓

Accept/Aanvaar

An unbalanced force is acting on it / 'n Ongebalanseerde krag werk in op die liggaam ✓

(1)

2.3.2

For 2 kg/Vir die 2 kg massa

$$\left. \begin{array}{l} F_{\text{net}} = ma \\ mg - T = ma \end{array} \right\} \checkmark$$

1 mark for any
1 punt vir

$$(2)(9,8) - T = 2(1,32) \checkmark$$

$$T = 16,96 \text{ N} \checkmark$$

$$F_{\text{net}} = ma$$

$$mg + T = ma$$

$$(2)(-9,8) + T = 2(-1,32) \checkmark$$

$$T = 16,96 \text{ N} \checkmark$$

(3)

2.3.3

POSITIVE MARKING FROM 2.3.2/POSITIEWE NASIEN VANAF 2.3.2

$$\left. \begin{array}{l} F_{\text{net}} = ma \\ T \cos 15^\circ - f = ma \end{array} \right\} \checkmark$$

$$T_x = T \cos 15^\circ$$

$$= 16,96 \cos 15^\circ$$

$$= 16,38 \text{ N} (16,382 \text{ N}) \rightarrow$$

$$16,382 - f \checkmark = (8)(1,32) \checkmark$$

$$f = 5,82 \text{ N (to the left/na links)} \checkmark$$

OR/OF

$$\left. \begin{array}{l} F_{\text{net}} = ma \\ T \cos 15^\circ + f = ma \end{array} \right\} \checkmark$$

$$\begin{aligned} T_x &= T \cos 15^\circ \\ &= 16,96 \cos 15^\circ \\ &= 16,38 \text{ N } (16,382 \text{ N}) \end{aligned}$$

$$\begin{aligned} -16,382 + f &= (8)(-1,32) \checkmark \\ f &= 5,82 \text{ N (to the left/na links)} \checkmark \end{aligned}$$

(4)

2.4

ANY ONE/ENIGE EENNormal force changes/decreases ✓ / *Normaalkrag verander/neem af*The angle (between string and horizontal) changes/increases. / *Die hoek (tussen die toutjie en die horisontaal) verander/neem toe*The vertical component of the tension changes/increases / *Die vertikale komponent van die spanning verander / neem toe.*

(1)

2.5

Yes ✓ / *Ja*

The frictional force (coefficient of friction) depends on the nature of the surfaces in contact. ✓

*Die wrywingskrag (wrywingskoëffisiënt) is afhanklik van die aard van die oppervlaktes in kontak met mekaar.***ACCEPT/AANVAAR**The nature of the surface changes / μ_k changes*Die aard van die oppervlakte verander / μ_k verander*

(2)

[17]

QUESTION 3/VRAAG 33.1 **Downwards/Afwaarts ✓**

The only force acting on the object is the gravitational force/weight which acts downwards. ✓ / Die enigste krag wat op die voorwerp inwerk is die gravitasiekrag/gewig wat afwaarts inwerk.

ACCEPT/AANVAAR:

The only force acting is gravitational/weight. ✓ / Die enigste krag wat inwerk is gravitasie/gewig

OR/OF

Gravitational force/weight acts downwards. ✓ / Gravitasiekrag/gewig werk afwaarts

OR/OF

The ball is in free-fall / Die bal in vry-val ✓

OR/OF

(Gravitational) acceleration is downwards / (Gravitasionele) versnelling is afwaarts

(2)

3.2

OPTION 1/OPSIE 1**Upward positive/Opwaarts positief**

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$0 = 7,5 + (-9,8)\Delta t \quad \checkmark$$

$$\Delta t = 0,77 \text{ s} \quad \checkmark$$

Downward positive/Afwaarts positief

$$v_f = v_i + a\Delta t \quad \checkmark$$

$$0 = -7,5 + (9,8)\Delta t \quad \checkmark$$

$$\Delta t = 0,77 \text{ s} \quad \checkmark$$

OPTION 2/OPSIE 2**Upward positive****Opwaarts positief**At highest point v_f is zeroBy hoogste punt is v_f nul

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$0 = (7,5)^2 + (2)(-9,8)\Delta y$$

$$\Delta y = 2,87 \text{ (2,869) m}$$

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \quad \checkmark$$

$$2,87 = \frac{7,5 + 0}{2} \Delta t \quad \checkmark$$

$$\Delta t = 0,77 \text{ s} \quad \checkmark$$

OPTION 2/OPSIE 2**Downward positive****Afwaarts positief**At highest point v_f is zeroBy hoogste punt is v_f nul

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$0 = (-7,5)^2 + (2)(9,8)\Delta y$$

$$\Delta y = -2,87 \text{ (-2,869) m}$$

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \quad \checkmark$$

$$-2,87 = \frac{-7,5 + 0}{2} \Delta t \quad \checkmark$$

$$\Delta t = 0,77 \text{ s} \quad \checkmark$$

<u>OPTION 3/OPSIE 3</u> Upward positive Opwaarts positief $F_{\text{net}}\Delta t = m(v_f - v_i) \checkmark$ $mg\Delta t = m(v_f - v_i)$ $(-9,8)\Delta t = 0 - 7,5 \checkmark$ $\therefore \Delta t = 0,76531 \text{ s } (0,77 \text{ s}) \checkmark$	<u>OPTION 3/OPSIE 3</u> Downward positive Afwaarts positief $F_{\text{net}}\Delta t = m(v_f - v_i) \checkmark$ $mg\Delta t = m(v_f - v_i)$ $(9,8)\Delta t = 0 - (-7,5) \checkmark$ $\therefore \Delta t = 0,76531 \text{ s } (0,77 \text{ s}) \checkmark$
<u>OPTION 4/OPSIE 4</u> Upward positive Opwaarts positief <u>(Top to Bottom / Bo na onder)</u> $v_f = v_i + a\Delta t \checkmark$ $-7,5 = 0 + (-9,8)\Delta t \checkmark$ $\therefore \Delta t = 0,76531 \text{ s } (0,77 \text{ s}) \checkmark$	<u>OPTION 4/OPSIE 4</u> Downward positive Afwaarts positief <u>(Top to Bottom / Bo na onder)</u> $v_f = v_i + a\Delta t \checkmark$ $7,5 = 0 + (9,8)\Delta t \checkmark$ $\therefore \Delta t = 0,76531 \text{ s } (0,77 \text{ s}) \checkmark$
<u>OPTION 5/OPSIE 5</u> Upward positive Opwaarts positief <u>(Top to Bottom / Bo na onder)</u> $v_f^2 = v_i^2 + 2a\Delta y$ $(7,5)^2 = (0)^2 + 2(-9,8)\Delta y$ $\Delta y = -2,87 \text{ m}$ $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $-2,87 = (0)\Delta t + \frac{1}{2}(-9,8)(\Delta t)^2 \checkmark$ $\Delta t = 0,765 \text{ s } \checkmark$	<u>OPTION 5/OPSIE 5</u> Downward positive Afwaarts positief <u>(Top to Bottom / Bo na onder)</u> $v_f^2 = v_i^2 + 2a\Delta y$ $(7,5)^2 = (0)^2 + 2(9,8)\Delta y$ $\Delta y = 2,87 \text{ m}$ $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $2,87 = (0)\Delta t + \frac{1}{2}(9,8)\Delta t^2 \checkmark$ $\Delta t = 0,765 \text{ s } \checkmark$

(3)

NOTES for marking QUESTION 3.3 AANTEKENINGE vir merk van VRAAG 3.3	
Formula mark/Formule punt	✓
Substitution mark /Vervangingspunt	✓✓
Mark for height/distance / Punt vir hoogte/afstand	✓
Mark for comparison/Punt vir vergelyking	✓
Mark for conclusion/Punt vir gevolgtrekking	✓

3.3

OPTION 1/OPSIE 1**Upward positive/Opwaarts positief**At highest point v_f is zero/By hoogste punt is v_f nul

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$0 \checkmark = (7,5)^2 + (2)(-9,8)\Delta y \quad \checkmark$$

$$\Delta y = 2,87 \text{ (2,869) m} \quad \checkmark$$

This is higher than height needed to reach point T (2,1 m) ✓ therefore the ball will pass point T. ✓

Dit is hoer as die hoogte benodig om punt T (2,1 m) te bereik dus sal die bal punt T verbygaan.

Downward positive/Afwaarts positiefAt highest point v_f is zero/By hoogste punt is v_f nul

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$0 \checkmark = (-7,5)^2 + (2)(9,8)\Delta y \quad \checkmark$$

$$\Delta y = -2,87 \text{ (-2,869) m} \quad \checkmark$$

This is higher than height needed to reach point T (2,1 m) ✓ therefore the ball will pass the target. ✓

Dit is hoer as die hoogte benodig om punt T (2,1 m) te bereik dus sal die bal punt T verbygaan.

OPTION 2/OPSIE 2 (POSITIVE MARKING FROM 3.2)**Upward positive/Opwaarts positief**

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad \checkmark$$

$$\Delta y = (7,5)(0,77) \quad \checkmark + \frac{1}{2}(-9,8)(0,77)^2 \quad \checkmark$$

$$\Delta y = 2,87 \text{ m (2,86 m)} \quad \checkmark$$

This is higher than height needed to reach point T (2,1 m) ✓ therefore the ball will pass point T. ✓

Dit is hoer as die hoogte benodig om punt T (2,1 m) te bereik dus sal die bal punt T verbygaan.

Downward positive/Afwaarts positief

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad \checkmark$$

$$\Delta y = (-7,5)(0,77) \quad \checkmark + \frac{1}{2}(9,8)(0,77)^2 \quad \checkmark$$

$$\Delta y = -2,87 \text{ m (2,869 m)} \quad \checkmark$$

This is higher than the height needed to reach point T (2,1 m) ✓ therefore the ball will pass point T. ✓

Dit is hoer as die hoogte benodig om punt T (2,1 m) te bereik dus sal die bal punt T verbygaan.

OPTION 3/OPSIE 3

$$(E_{\text{mech}})_{\text{Top/Bo}} = (E_{\text{mech}})_{\text{Ground/Grond}}$$

$$(E_P + E_K)_{\text{Top}} = (E_P + E_K)_{\text{Bottom/Onder}}$$

$$(mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}} = (mgh + \frac{1}{2}mv^2)_{\text{Bottom/Onder}}$$

$$(9,8)(h) + 0 \checkmark = 0 + (\frac{1}{2})(7,5)^2 \checkmark$$

$$h = 2,87 \text{ m } (2,869 \text{ m}) \checkmark$$

1 mark for any
1 punt vir enige

This is higher than height needed to pass the target (2,1 m) therefore the ball will pass the target. ✓

Dit is hoer as die hoogte benodig om punt T (2,1 m) verby te gaan dus sal die bal punt T verbygaan.

OPTION 4/OPSIE 4

$$W_{\text{net}} = \Delta E_K$$

$$mg\Delta x \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark$$

$$(9,8)\Delta x \cos 180^\circ \checkmark = 0 - \frac{1}{2}(7,5)^2 \checkmark$$

$$\Delta x = 2,87 \text{ m } (2,869 \text{ m}) \checkmark$$

This is higher than point height needed to pass point T (2,1 m) therefore the ball will pass point T. ✓

Dit is hoer as die hoogte benodig om punt T (2,1 m) verby te gaan dus sal die bal punt T verbygaan.

OPTION 5/OPSIE 5**Upward positive/Opwaarts positief**

If the highest point is y_f then $\Delta y = (y_f - y_{1,6})$ At highest point v_f is zero

Indien die hoogste punt y_f is, dan is $\Delta y = (y_f - y_{1,6})$. By hoogste punt is v_f nul

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0 \checkmark = [(7,5)^2 + (2)(-9,8)(y_f - 1,6)] \checkmark$$

$$y_f = 4,47 \text{ (4,469) m} \checkmark$$

Yes ✓✓

OR/OF

This point (4,47m) is higher than point T ✓✓ (or even the required height of 2,1 m) therefore the ball will pass point T.

Ja ✓✓

Dit is hoer as die hoogte benodig om punt T (2,1 m) te bereik dus sal die bal punt T verbygaan.

Downward positive/Afwaarts positief

If the highest point is y_f then $\Delta y = (y_f - y_{1,6})$ At highest point v_f is zero

Indien die hoogste punt y_f is, dan is $\Delta y = (y_f - y_{1,6})$. By hoogste punt is v_f nul

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0 \checkmark = [(-7,5)^2 + (2)(9,8)\{y_f - (-1,6)\}] \checkmark$$

$$y_f = -4,47 \text{ (-4,469) m} \checkmark$$

height is/hoogte is 4,47 m.

This point (4,47 m) is higher than point T ✓✓ (or even the required height of 2,1 m) therefore the ball will pass point T.

Hierdie punt (4,47 m) is hoer as punt T (of selfs die benodigde hoogte van 2,1 m) dus sal die bal punt T verbygaan.

OPTION 6/OPSIE 6 (POSITIVE MARKING FROM 3.2)**Upward positive/Opwaarts positief**

If the highest point is y_f then $\Delta y = (y_f - y_{1,6})$ At highest point v_f is zero
Indien die hoogste punt y_f is, dan is $\Delta y = (y_f - y_{1,6})$. By hoogste punt is v_f nul

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$(y_f - 1,6) = (7,5)(0,77) \checkmark + \frac{1}{2} (-9,8)(0,77)^2 \checkmark$$

$$y_f = 4,47 \text{ m } (4,469 \text{ m}) \checkmark$$

This point (4,47m) is higher than point **T** $\checkmark \checkmark$ (or even the required height of 2,1 m) therefore the ball will pass point T.

Hierdie punt (4,47 m) is hoer as punt T (of selfs die benodigde hoogte van 2,1 m) dus sal die bal punt T verbygaan.

Downward positive/Afwaarts positief

If the highest point is y_f then $\Delta y = (y_f - y_{1,6})$ At highest point v_f is zero
Indien die hoogste punt y_f is, dan is $\Delta y = (y_f - y_{1,6})$. By hoogste punt is v_f nul

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$\{y_f - (-1,6)\} = (-7,5)(0,765) \checkmark + \frac{1}{2} (9,8)(0,765)^2 \checkmark$$

$$y_f = -4,47 \text{ m } (-4,469 \text{ m}) \checkmark$$

This point (4,47m) is higher than point **T** $\checkmark \checkmark$ (or even the required height of (2,1m) therefore the ball will pass point T.

Hierdie punt (4,47 m) is hoer as punt T (of selfs die benodigde hoogte van 2,1 m) dus sal die bal punt T verbygaan.

OPTION 7/OPSIE 7 (POSITIVE MARKING FROM 3.2)**Upward positive/Opwaarts positief**

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{0 + 7,5}{2} \right) (0,77) \checkmark \checkmark$$

$$= 2,89 \text{ m } \checkmark$$

This is higher than height needed to pass the target (2,1 m) therefore the ball will pass the target. $\checkmark$

Dit is hoer as die hoogte benodig om die teiken verby te gaan (2,1 m) dus sal die bal die teiken verbygaan.

OPTION 7/OPSIE 7 (POSITIVE MARKING FROM 3.2)**Downward positive/Afwaarts positief****MARKING FROM 3.2**

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$= \frac{0 - 7,5}{2} (0,77) \checkmark \checkmark$$

$$= -2,89 \text{ m } \checkmark$$

Height /Hoogte is 2,89m

This is higher than height needed to pass the target (2,1 m) therefore the ball will pass the target. $\checkmark$

Dit is hoer as die hoogte benodig om die teiken verby te gaan (2,1 m) dus sal die bal die teiken verbygaan.

OPTION 8/OPSIE 8**Upward positive/Opwaarts positief**

At highest point v_f is zero/By hoogste punt is v_f nul

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$0 \checkmark = v_i^2 - (2)(9,8)(2,1) \quad \checkmark$$

$$v_i = 6,42 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

This is the actual velocity needed to reach the target.

The given velocity is greater than the actual velocity needed. $\checkmark$

The ball will pass the target. $\checkmark$

Dit is die werklike snelheid benodig is om die teiken te bereik

Die gegewe snelheid is groter as die werklike snelheid benodig

Die bal sal die teiken verbygaan.

Downward positive/Afwaarts positief

At highest point v_f is zero

$$v_f^2 = v_i^2 + 2a\Delta y \quad \checkmark$$

$$0 \checkmark = v_i^2 + (2)(9,8)(-2,1) \quad \checkmark$$

$$v_i = 6,42 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

This is the actual velocity needed to pass the target.

The given velocity is greater than the actual velocity needed. $\checkmark$

The ball will reach the target. $\checkmark$

Dit is die werklike snelheid benodig is om die teiken te verby te gaan.

Die gegewe snelheid is groter as die werklike snelheid benodig

Die bal sal die teiken verbygaan.

OPTION 9/OPSIE 9

$$W_{nc} = \Delta E_p + \Delta E_k \quad \checkmark$$

$$0 = mgh_f - mgh_i + \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$0 \checkmark = (9,8)h_f - (9,8)(1,6) + \frac{1}{2}(0)^2 - \frac{1}{2}(7,5)^2 \checkmark$$

$$0 = (9,8)h_f - 43,805$$

$$\therefore h_f = 4,47 \text{ m} \quad \checkmark$$

$\therefore$ The ball will pass point **T** $\checkmark\checkmark$

Die bal sal punt T verbygaan.

OPTION 10/OPSIE 10**POSITIVE MARKING FROM 3.2 / POSITIEWE NASIEN VANAF 3.2****Upward positive/Opwaarts positief**

$$\Delta t(\text{max. height/maks. hoogte}) = 0,77 \text{ s}$$

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$2,1 \checkmark = (7,5) \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$$

$$\therefore \Delta t = 0,36 \text{ s} \checkmark$$

$\therefore \Delta t(\text{max height/maks. hoogte}, 0,77 \text{ s}) > \Delta t(\text{to pass point T/ om T verby te gaan}, 0,36 \text{ s}) \checkmark$

$\therefore$ The ball passed point **T** $\checkmark$

Die bal het punt T verbygegaan.

Downward positive/Afwaarts positief

$$\Delta t(\text{max height}) = 0,77 \text{ s}$$

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$2,1 \checkmark = (7,5) \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$$

$$\therefore \Delta t = 0,36 \text{ s} \checkmark$$

$\therefore \Delta t(\text{max height}, 0,77 \text{ s}) > \Delta t(\text{to reach point T}, 0,36 \text{ s}) \checkmark$

$\therefore$ The ball passed point **T** $\checkmark$

Die bal het punt T verbygegaan

OPTION 11/OPSIE 11**Upward positive/Opwaarts positief**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$(3,7 - 1,6) \checkmark = 7,5 \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$$

$$\Delta t = 0,375 \text{ s} \checkmark$$

The time to pass point **T** is less than time to reach maximum height $\checkmark$. Ball will pass point **T**. $\checkmark$

Die tyd om punt T verby te gaan, is minder as tyd om maksimum hoogte te bereik.. Bal sal punt T verbygaan

Downward positive/Afwaarts positief

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$(3,7 - 1,6) \checkmark = -7,5 \Delta t + \frac{1}{2} (9,8) \Delta t^2 \checkmark$$

$$\Delta t = 0,375 \text{ s} \checkmark$$

The time to reach point **T** is less than time to reach maximum height $\checkmark$. Ball will pass point **T**. $\checkmark$

Die tyd om punt T verby te gaan, is minder as tyd om maksimum hoogte te bereik.. Bal sal punt T verbygaan

OPTION 12/OPSIE 12**Upward positive/Opwaarts positief**

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$v_f^2 = (7,5)^2 + 2(-9,8)(2,1) \checkmark$$

$$v_f = 3,88 \text{ m}\cdot\text{s}^{-1} \checkmark$$

Velocity at **T** is $3,88 \text{ m}\cdot\text{s}^{-1}$ therefore the ball still moving towards its maximum height $\checkmark\checkmark$

Snelheid by T is $3,88 \text{ m}\cdot\text{s}^{-1}$ dus beweeg die bal steeds opwaarts na maksimum hoogte

Downward positive/Afwaarts positief

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$v_f^2 = (-7,5)^2 + 2(9,8)(-2,1) \checkmark$$

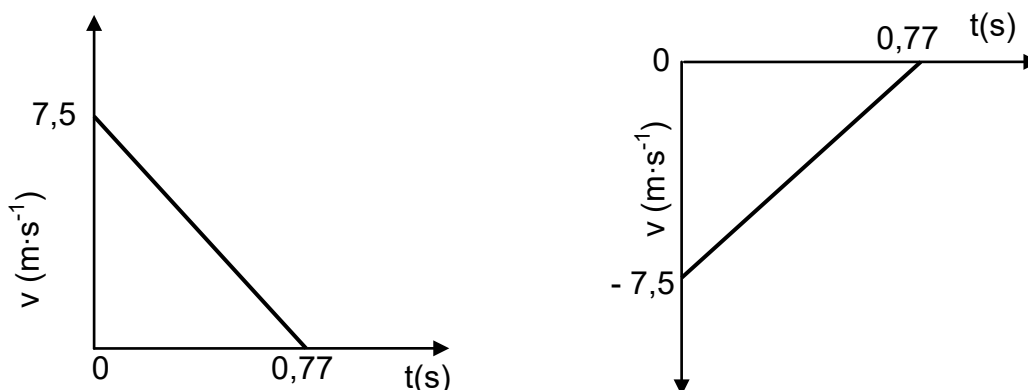
$$v_f = -3,88 \text{ m}\cdot\text{s}^{-1} \checkmark$$

Velocity at **T** is $-3,88 \text{ m}\cdot\text{s}^{-1}$ therefore the ball is still moving towards its maximum height $\checkmark\checkmark$

Snelheid by T is $-3,88 \text{ m}\cdot\text{s}^{-1}$ dus beweeg die bal steeds opwaarts na maksimum hoogte

(6)

3.4

POSITIVE MARKING FROM 3.2 / POSITIEWE NASIEN VANAF 3.2

Notes/Notas:	
Initial velocity and time for final velocity shown <i>Beginsnelheid en tyd vir finale snelheid aangedui.</i>	$\checkmark$
Correct straight line (including orientation) drawn <i>Korrekte reguitlyn (insluitend oriëntasie) geteken.</i>	$\checkmark$

(2)
[13]**QUESTION 4/VRAAG 4**

- 4.1 Momentum is the product of the mass of an object and its velocity $\checkmark\checkmark$
Momentum is die produk van die massa van 'n voorwerp en sy snelheid.
[NOTE/LET WEL: 2 or/of 0]

(2)

- 4.2  To the left/Na links $\checkmark$
 Newton's third law/Newton se derde wet $\checkmark$

ACCEPT/AANVAAR:

Principle of conservation of linear momentum / law of action-reaction

Beginsel van behoud van lineêre momentum/wet van aksie-reaksie

Newton's third law **and** Newton's second law/Newton se derde wet **en**

Newton se tweede wet

(2)

NOTE: For QUESTION 4.3 and 4.4 motion to the right has been taken as positive. Candidates may use the opposite direction.

LET WEL: Vir VRAAG 4.3 en 4.4 word beweging na regs as positief geneem. Kandidate mag die teenoorgestelde rigting gebruik.

4.3

OPTION 1/OPSIE 1

$$\sum p_i = \sum p_f \quad \checkmark$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{2f} + m_2 v_{2f} \quad \checkmark$$

mass of girl is m / massa van meisie is m

Allocate mark if 0 is substituted on left hand side/Ken punt toe indien 0 aan linkerkant vervang is.

$$\{(m+2)(0)\} + \{8(0)\} \checkmark = \{(m+2)(-0,6)\} \checkmark + (8)(4) \checkmark$$

$$m = 51,33 \text{ kg} \quad \checkmark$$

OPTION 2/OPSIE 2

$$\sum p_i = \sum p_f \quad \checkmark$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{2f} + m_2 v_{2f} \quad \checkmark$$

$$0 = m_1 v_{1f} + m_2 v_{2f}$$

$$0 \checkmark = (8)(4) \checkmark + m_2(-0,6) \checkmark$$

$$\therefore m_2 = 53,33 \text{ kg}$$

$$\therefore m_{\text{girl}} = 53,33 - 2$$

$$\therefore m_{\text{girl}} = 51,33 \text{ kg} \quad \checkmark$$

NOTE: Penalise only once for the incorrect sign of the 0,6.
LET WEL: Penaliseer slegs eenmaal die die inkorrekte teken van 0,6

OPTION 3/OPSIE 3

$$\Delta p_{\text{girl}} = -\Delta p_{\text{parcel}} \quad \checkmark$$

$$m(v_f - v_i) = -m(v_f - v_i)$$

$$(m+2)(-0,6 - 0) \checkmark = -8(4 - 0) \checkmark$$

$$m = 51,33 \text{ kg} \quad \checkmark$$

(5)

4.4

POSITIVE MARKING FROM 4.3/POSITIEWE NASIEN VANAF 4.3

$$\text{Impulse} = \Delta p = m(v_f - v_i) \quad \checkmark$$

$$= (51,33 + 2)(-0,6 - 0) \quad \checkmark$$

$$= -32 \text{ N}\cdot\text{s} / \text{kg}\cdot\text{m}\cdot\text{s}^{-1}$$

Magnitude of impulse/Grootte van die impuls is 32 N·s / 32 kg·m·s⁻¹ ✓

OR/OF

$$\text{Impulse} = \Delta p_{\text{parcel/pakket}} = m(v_f - v_i) \quad \checkmark$$

$$\Delta p = (8)(4 - 0) \checkmark = 32 \text{ kg m}\cdot\text{s}^{-1}$$

$$\therefore \Delta p_{\text{girl/meisie}} = 32 \text{ kg m}\cdot\text{s}^{-1} \quad \checkmark$$

(3)

4.5

POSITIVE MARKING FROM 4.4 /POSITIEWE NASIEN VANAF 4.4

32 kg·m·s⁻¹ / N·s ✓ to the right/opposite direction /na regs /teenoorgestelde rigting ✓

(2)

[14]

QUESTION 5/VRAAG 5

- 5.1 A force is non-conservative if the work it does on an object which is moving between two points depends on the path taken. ✓✓
'n Krag is nie-konserwatief indien die arbeid wat dit verrig op 'n voorwerp wat tussen twee punte beweeg van die pad afhang.

OR/OF

A force is non-conservative if the work it does on an object depends on the path taken. ✓✓
'n Krag is nie-konserwatief indien die arbeid wat dit verrig afhang van die pad wat dit neem.

OR/OF

A force is non-conservative if the work it does in moving an object around a closed path is non-zero. ✓✓
'n Krag is nie-konserwatief indien die arbeid wat dit verrig om 'n voorwerp op 'n geslote pad te beweeg nie-nul is.

(2)

NOTE/LET WEL

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark. If the word work is omitted 0 marks
*Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af. Indien die woord arbeid uitgelaat is 0 punte.*

- 5.2 No/Nee ✓

(1)

- 5.3

OPTION 1/ OPSIE 1

$$\begin{aligned} P &= \frac{W}{\Delta t} \checkmark \\ &= \frac{4,8 \times 10^6}{(90)} \checkmark \\ &= 53\,333,33 \text{ W} \\ &= 5,33 \times 10^4 \text{ W (53,33 kW)} \checkmark \end{aligned}$$

OPTION 2/ OPSIE 2

$$\begin{aligned} \Delta x &= \left(\frac{v_f + v_i}{2} \right) \Delta t \\ &= \left(\frac{0 + 25}{2} \right) (90) \\ &= 1\,125 \text{ m} \end{aligned}$$

$$\begin{aligned} W_F &= F \Delta x \cos \theta \\ 4,80 \times 10^6 &= F (1\,125) \cos 0^\circ \\ F &= 4\,266,667 \text{ N} \\ P_{\text{ave}} &= F v_{\text{ave}} \checkmark \\ &= (4\,266,667) (12,5) \checkmark \\ &= 53\,333,33 \text{ W} \checkmark \end{aligned}$$

(3)

- 5.4 The net/total work done on an object is equal to the change in the object's kinetic energy ✓✓

Die netto/totale arbeid verrig op 'n voorwerp is gelyk aan die verandering in die voorwerp se kinetiese energie.

OR/OF

The work done on an object by a net force ✓ is equal to the change in the object's kinetic energy. ✓

Die arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie.

(2)

NOTE/LET WEL

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark.

Indien enige van die onderstreepte sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.

- 5.5

OPTION 1/OPSIE 1

$$W_{\text{net}} = \Delta K \checkmark$$

$$W_w + W_f + W_F = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$$

$$mg\Delta x \cos\theta + W_f + W_F = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$$

$$(1\,500)(9,8)200\cos 180^\circ \checkmark + W_f + 4,8 \times 10^6 \checkmark = \frac{1}{2}(1\,500)(25^2 - 0) \checkmark$$

$$-2\,940\,000 + W_f + 4,8 \times 10^6 = 468\,750$$

$$W_f = -1\,391\,250 \text{ J}$$

$$= -1,39 \times 10^6 \text{ J} \checkmark$$

OR/OF

$$W_{\text{net}} = \Delta K \checkmark$$

$$W_w + W_f + W_F = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$$

$$-\Delta E_p + W_f + W_F = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$$

$$-(1\,500)(9,8)(200 - 0) \checkmark + W_f + 4,8 \times 10^6 \checkmark = \frac{1}{2}(1\,500)(25^2 - 0) \checkmark$$

$$-2\,940\,000 + W_f + 4,8 \times 10^6 = 468\,750$$

$$W_f = -1\,391\,250 \text{ J}$$

$$= -1,39 \times 10^6 \text{ J} \checkmark$$

(5)

NOTE/LET WEL

0 can be omitted in above substitutions.

0 kan in bogenoemde vervangings weggelaat word.

OPTION 2/OPSIE 2

$$W_{nc} = \Delta K + \Delta U$$

$$W_{nc} = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2 + mgh_f - mgh_i$$

$$= \frac{1}{2} m (v_f^2 - v_i^2) + mg(h_f - h_i)$$

$$W_{nc} = \frac{1}{2} mv_f^2 + mgh_f - \frac{1}{2} mv_i^2 - mgh_i$$

$$W_f + W_F = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2 + mgh_f - mgh_i$$

$$W_f + 4,8 \times 10^6 \checkmark = \left[\frac{1}{2} (1\,500)(25)^2 + -0 \right] \checkmark + \left[(1\,500)(9,8)(200) - 0 \right] \checkmark$$

$$W_f = -1,39 \times 10^6 \text{ J } (-1,40 \times 10^6 \text{ J}) \checkmark$$

1 mark for any of these/
1 punt vir enige van hierdie

OR/OF

$$W_{nc} = \Delta K + \Delta U$$

$$W_{nc} = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2 + mgh_f - mgh_i$$

$$= \frac{1}{2} m (v_f^2 - v_i^2) + mg(h_f - h_i)$$

$$W_{nc} = \frac{1}{2} mv_f^2 + mgh_f - \frac{1}{2} mv_i^2 - mgh_i$$

$$W_f + 4,8 \times 10^6 \checkmark = \left[\frac{1}{2} (1\,500)(25)^2 \checkmark + (1\,500)(9,8)(200) \checkmark \right] - [0 + 0]$$

$$W_f = -4,8 \times 10^6 + 3,4 \times 10^6$$

$$= -1,39 \times 10^6 \text{ J } (-1,40 \times 10^6 \text{ J}) \checkmark$$

1 mark for any of these/
1 punt vir enige van hierdie

(5)

ACCEPT THE FOLLOWING FOR: /AANVAAR DIE VOLGENDE VIR: $\left(\frac{3}{5}\right)$ **POSITIVE MARKING FROM 5.3/POSITIEWE NASIEN VANAF 5.3**

$$v_f = v_i + a\Delta t$$

$$25 = 0 + a(90)$$

$$a = 0,277... \text{ m} \cdot \text{s}^{-2}$$

$$F_{\text{net}} = ma$$

$$= (1\,500)(0,2777...) = 416,66... \text{ N}$$

$$F + (w_{\parallel}) + (-f_k) = 416,666...$$

$$4\,266,6667 - 1\,500(9,8)\sin\theta - f_k = 416,666...$$

$$f_k = 1\,236,6667 \text{ N}$$

$$W_f = f_k \Delta x \cos\theta \checkmark$$

$$= (1\,236,6667)(1\,125)(\cos 180^\circ) \checkmark$$

$$= -1\,391\,250 \text{ J } \checkmark$$

(5)

[13]

QUESTION 6/VRAAG 6

- 6.1 The change in frequency (or pitch), of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓

Die verandering in frekwensie (of toonhoogte) (golflengte) van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klank voortplanting het.

OR/OF

An (apparent) change in observed/detected frequency (pitch), as a result of the relative motion between a source and an observer ✓✓ (listener).

'n (Skynbare) verandering in waargenome frekwensie (toonhoogte), (golflengte) as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/luisteraar

(2)

NOTE/LET WEL

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark.

Indien enige van die onderstreepte sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.

- 6.2 Away from/Weg vanaf ✓

Observed frequency lower/Waargenome frekwensie is laer ✓

(2)

- 6.3

$$v = f\lambda \quad \checkmark$$

$$340 = f(0,34) \quad \checkmark$$

$$f = 1\,000 \text{ Hz} \quad \checkmark$$

(3)

- 6.4

POSITIVE MARKING FROM 6.3/POSITIEWE NASIEN VANAF 6.3

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \checkmark$$

OR/OF

$$f_L = \frac{v - v_L}{v} f_s$$

$$950 = \frac{340 - v_L}{340 + 0} 1\,000 \quad \checkmark$$

$$v_L = 17 \text{ m} \cdot \text{s}^{-1}$$

$$\begin{aligned} \text{distance/afstand } x &= v\Delta t \\ &= (17)(10) \quad \checkmark \\ &= 170 \text{ m} \quad \checkmark \end{aligned}$$

OR/OF

$$f_L = \frac{v - v_L}{v} f_s \quad \checkmark$$

$$950 = \frac{340 - \frac{x}{10}}{340 + 0} (1000) \quad \checkmark$$

$$\text{distance/afstand } x = 170 \text{ m} \quad \checkmark$$

ACCEPT/AANVAAR

$$v_L = \Delta f \lambda \checkmark$$

$$= (50) \checkmark \checkmark (0,34) \checkmark$$

$$= 17 \text{ m} \cdot \text{s}^{-1}$$

$$\text{distance/afstand } x = v \Delta t$$

$$= (17)(10) \checkmark$$

$$= 170 \text{ m} \checkmark$$

(6)

[13]

QUESTION 7/VRAAG 7

7.1

$$Q_{\text{net/netto}} = \frac{Q_1 + Q_2 + Q_3}{3}$$

$$-3 \times 10^{-9} = \frac{-15 \times 10^{-9} + Q + 2 \times 10^{-9}}{3} \checkmark$$

$$Q = +4 \times 10^{-9} \text{ C} \checkmark$$

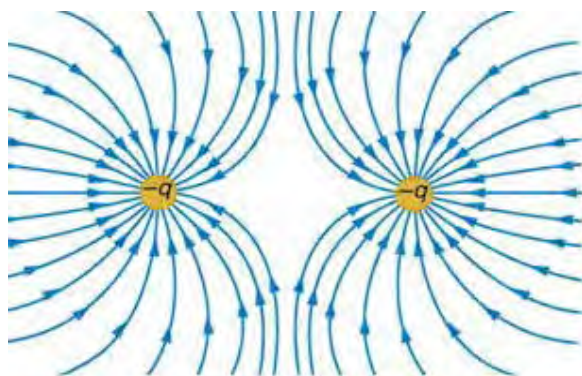
NOTE/LET WEL

✓ for addition of the three correct charges

✓ correct answer

(2)

7.2



NOTES/NOTAS

Correct shape /Korrekte vorm ✓

Correct direction/Korrekte rigting ✓

Lines must not cross and must touch spheres ✓

Lyne moet nie kruis nie en moet die sfere raak

(3)

7.3

The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the (magnitudes) of the charges and inversely proportional to the square of the distance (r) between them ✓✓

Die grootte van die elektrostatiese krag uitgeoefen deur een puntlading (Q_1) op 'n ander puntlading (Q_2) is direk eweredig aan die produk van die (groottes) van die ladings en omgekeerde eweredig aam die kwadraat van die afstand (r) tussen hulle.

(2)

NOTE/LET WEL

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark. If masses used (0/2)

Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af. Indien massas gebruik word, (0/2)

7.4

OPTION 1/OPSIE 1

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$F_{SP} = \frac{(9 \times 10^9)(3 \times 10^{-9})(3 \times 10^{-9})}{(0,1)^2} \checkmark$$

$$= 8,1 \times 10^{-6} \text{ N downwards/afwaarts}$$

$$F_{TP} = \frac{(9 \times 10^9)(3 \times 10^{-9})(3 \times 10^{-9})}{(0,3)^2} \checkmark$$

$$= 9 \times 10^{-7} \text{ N left/links } (0,9 \times 10^{-6} \text{ N to the left/na links})$$

$$F_{\text{net}}^2 = (F_{SP})^2 + (F_{TP})^2$$

$$F_{\text{net}} = \sqrt{(F_{SP})^2 + (F_{TP})^2} \quad \checkmark \text{ for either}$$

$$F_{\text{net}} = \sqrt{(8,1 \times 10^{-6})^2 + (0,9 \times 10^{-6})^2}$$

$$F_{\text{net}} = 8,15 \times 10^{-6} \text{ N } \checkmark$$

OPTION 2/OPSIE 2

$$E_s = \frac{kQ}{r^2} \checkmark$$

$$= \frac{(9 \times 10^9)(3 \times 10^{-9})}{(0,1)^2}$$

$$= 2700 \text{ N.C}^{-1}$$

$$E_T = \frac{kQ}{r^2}$$

$$= \frac{(9 \times 10^9)(3 \times 10^{-9})}{(0,3)^2}$$

$$= 300 \text{ N.C}^{-1}$$

✓ both substitutions
beide vervangings

$$E_{\text{net}} = \sqrt{E_s^2 + E_T^2}$$

$$= \sqrt{(2700)^2 + (30)^2} \checkmark$$

$$= 2716,62 \text{ N.C}^{-1}$$

$$F = Eq$$

$$= (2716,62)(3 \times 10^{-9}) \checkmark$$

$$= 8,15 \times 10^{-6} \text{ N } \checkmark$$

(5)

7.5

POSITIVE MARKING FROM 7.4 / POSITIEWE NASIEN VANAF 7.4

OPTION 1/OPSIE 1

$$E = \frac{F}{q} \checkmark$$

$$= \frac{8,15 \times 10^{-6}}{3 \times 10^{-9}} \checkmark$$

$$= 2,72 \times 10^3 \text{ N.C}^{-1} \checkmark$$

(3)

OPTION 2/OPSIE 2

$$E_s = \frac{kQ}{r^2} \checkmark$$

$$= \frac{(9 \times 10^9)(3 \times 10^{-9})}{(0,1)^2} \checkmark$$

$$= 2\,700 \text{ N.C}^{-1}$$

$$E_T = \frac{kQ}{r^2}$$

$$= \frac{(9 \times 10^9)(3 \times 10^{-9})}{(0,3)^2} \checkmark$$

$$= 300 \text{ N.C}^{-1}$$

$$E_{\text{net}} = \sqrt{E_s^2 + E_T^2}$$

$$= \sqrt{(2700)^2 + (30)^2}$$

$$= 2\,716,62 \text{ N.C}^{-1} \checkmark$$

NOTE/LET WEL

Mark Allocation/Puntetoekenning

- ✓ correct formula/korrekte formula
- ✓ both substitutions/beide vervangings
- ✓ correct answer/korrekte antwoord

If calculation done in 7.4 award full marks for answer written here. / Indien berekening in 7.4 gedoen is, moet volle punte vir die antwoord wat hier geskryf is, toegeken word.

7.6.1 Sphere/Sfeer P or/of T ✓

(1)

7.6.2 **SPHERE P/SFEER P**

$$n_e = \frac{Q}{q_e} \text{ or/of } n_e = \frac{Q}{e}$$

$$= \frac{-15 \times 10^{-9}}{-1,6 \times 10^{-19}} \checkmark = 9,38 \times 10^{10}$$

mass gained/massa gewin = $n_e m_e$
 m gained /gewin = $(9,38 \times 10^{10})(9,11 \times 10^{-31}) \checkmark$
 $= 8,55 \times 10^{-20} \text{ kg} \checkmark$

SPHERE T/SFEER T

$$n_e = \frac{Q}{q_e} \text{ or/of } n_e = \frac{Q}{e}$$

$$= \frac{-5 \times 10^{-9}}{-1,6 \times 10^{-19}} \checkmark = 3,125 \times 10^{10}$$

mass gained/massa gewin = $n_e m_e$
 m gained /gewin = $(3,125 \times 10^{10})(9,11 \times 10^{-31}) \checkmark$
 $= 2,85 \times 10^{-20} \text{ kg} \checkmark$

(3)
[19]

QUESTION 8/VRAAG 8

- 8.1 The battery supplies 12 J per coulomb/12 J per unit charge. ✓✓
Die battery verskaf 12 J per coulomb lading

OR /OF

The potential difference of the battery in an open circuit is 12 V. ✓✓
Die potensiaal verskil van die battery in 'n oop stroombaan is 12 V

OR/OF

The battery does 12 J of work per coulomb of charge. ✓✓
Die battery verrig 12 J arbeid per coulomb lading

OR/OF

Maximum work done by the battery per unit charge is 12 J
Maksimum arbeid verrig deur die battery per eenheidslading is 12 J

OR/OF

Maximum energy supplied by the battery per unit charge is 12 J
Maksimum energie verskaf deur die battery per eenheidslading is 12 J

OR/OF

The battery supplies 12 J of energy per coulomb/ 12 J of energy per unit charge
Die battery verskaf 12 J energie per coulomb/12 J energie per eenheidslading

OR/OF

The greatest potential difference that can be generated by a battery is 12V
Die grootste potensiaalverskil wat deur 'n battery gelewer word, is 12 V

OR/OF

The total energy transferred by a battery to a unit electric charge is 12 J
Die totale energie oorgedra deur die battery aan 'n eenheid elektriese lading is 12 J

OR/OF

The total amount of electric energy supplied by the battery per coulomb/per unit charge is 12 J
Die totale hoeveelheid elektriese energie verskaf deur die battery per coulomb/per eenheid lading is 12 J

NOTE/LET WEL

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark.

*Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af*

8.2.1

OPTION 1/OPSIE 1

$$\begin{aligned} V_{\text{lost/verlore}} &= I r \checkmark \\ &= (2) (0,5) \\ &= 1 \text{ V} \\ V_{\text{ext/eks}} &= \text{Emf/emk} - V_{\text{lost/verlore}} \\ &= (12 - 1) \checkmark \\ &= 11 \text{ V} \checkmark \end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned}\varepsilon &= I(R + r) \checkmark \\ 12 &= V_{\text{ext/eks}} + (2)(0,5) \checkmark \\ V_{\text{ext/eks}} &= 11 \text{ V} \checkmark\end{aligned}$$

OPTION 3/OPSIE 3

$$\begin{aligned}\varepsilon &= I(R + r) \checkmark \\ 12 &= 2(R + 0,5) \\ R &= 5,5 \Omega \\ V &= IR \\ &= 2(5,5) \checkmark \\ &= 11 \text{ V} \checkmark\end{aligned}$$

(3)

8.2.2

POSITIVE MARKING FROM 8.2.1/POSITIEWE NASIEN VANAF 8.2.1

OPTION 1/OPSIE 1

$$\begin{aligned}R &= \frac{V}{I} \\ &= \frac{11}{2} \checkmark \\ &= 5,5 \Omega \checkmark\end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned}0,5:R \\ 1:11 \quad \left. \vphantom{\begin{matrix} 0,5:R \\ 1:11 \end{matrix}} \right\} \checkmark \\ R &= 5,5 \Omega \checkmark\end{aligned}$$

OPTION 3/OPSIE 3

$$\begin{aligned}\frac{1}{0,5} &= \frac{11}{R} \checkmark \\ R &= 5,5 \Omega \checkmark\end{aligned}$$

OPTION 4/OPSIE 4

$$\begin{aligned}V_{\text{total}} &= IR_{\text{total}} \\ 12 &= (2)R_{\text{total}} \\ R_{\text{total}} &= 6 \Omega \\ R &= 6 - 0,5 \checkmark \\ &= 5,5 \Omega \checkmark\end{aligned}$$

OPTION 5/OPSIE 5

$$\begin{aligned}\varepsilon &= I(R + r) \\ 12 &= 2(R + 0,5) \checkmark \\ R &= 5,5 \Omega \checkmark\end{aligned}$$

(2)

8.3 Decreases /Neem af ✓

➤ Total resistance decreases /Totale weerstand neem af ✓

Current increases/Stroom neem toe ✓

"Lost volts" increases, ✓(emf the same)/"Verlore volts" neem toe, (emk dieselfde)

External potential difference decreases/eksterne potensiaal verskil neem af

OR/OF

Decreases /Neem af ✓

Total resistance decreases /Totale weerstand neem af ✓

Current increases/Stroom neem toe ✓

$$\varepsilon = V_{\text{ext/eks}} + Ir$$

Ir increases/Ir neem toe ✓

ε is constant/is konstant

$\therefore V_{\text{ext/eks}}$ decreases/neem af

(4)
[11]

QUESTION 9/VRAAG 9

9.1 Temperature/Temperatuur ✓

(1)

9.2.1 $r = 3 \Omega$ or/of $1,5 \Omega$ ✓✓

Accept for one mark only: !Aanvaar vir slegs een punt

$r = -3 \Omega$ ✓ or/of $-1,5 \Omega$

(2)

9.2.2

ε = slope (gradient) of the graph/helling(gradient)van die grafiek ✓

$$\varepsilon = \frac{7,5 - (-3)}{1,5 - 0} \checkmark$$

$$= 7 \text{ V} \checkmark$$

Accept any correct values from the graph
Aanvaar enige korrekte waardes vanaf die grafiek

OR/OF

POSITIVE MARKING FROM 9.2.1 / POSITIEWE NASIEN VANAF 9.2.1

$$R = \frac{\varepsilon}{I} - r \checkmark$$

$$7,5 = 1,5\varepsilon - 3 \checkmark$$

$$\varepsilon = 7 \text{ V} \checkmark$$

Accept any correct values on the line from the graph
Aanvaar enige korrekte waardes op die lyn vanaf die grafiek

OR/OF

$$\varepsilon = I(R + r) \checkmark$$

$$= 0,5(11 + 3) \checkmark$$

$$\varepsilon = 7 \text{ V} \checkmark$$

(3)
[6]

QUESTION 10/VRAAG 10

10.1.1 Y to/na X ✓ (1)

10.1.2 Faraday's Law Electromagnetic Induction ✓
Faraday se wet van Elektromagnetiese Induksie

OR/OF

Electromagnetic induction/Faraday's Law ✓
Elektromagnetiese induksie/Faraday se wet (1)

10.1.3 Mechanical (kinetic) energy ✓ to electrical energy ✓
Meganiese (kinetiese) energie na elektriese energie (2)

10.2.1 340 V ✓
Accept / Aanvaar (1)
-340 V

10.2.2 **POSITIVE MARKING FROM 10.2.1/POSITIEWE NASIEN VANAF 10.2.1**

$$V_{\text{rms/wgk}} = \frac{V_{\text{max/maks}}}{\sqrt{2}} \checkmark$$

$$= \frac{340}{\sqrt{2}} \checkmark$$

$$V_{\text{rms/wgk}} = 240,42 \text{ V} \checkmark$$

(3)

10.2.3 **POSITIVE MARKING FROM 10.2.2 / POSITIEWE NASIEN VANAF 10.2.3**

OPTION 1/OPSIE 1

$$P_{\text{ave/gemid}} = \frac{V_{\text{rms/wgk}}^2}{R} \checkmark$$

$$1\,600 = \frac{(240,42)^2}{R} \checkmark$$

$$R = 36,13 \, \Omega \text{ (36,126 } \Omega) \checkmark$$

OR/OF

$$R = 36,12 \, \Omega \text{ (36,124 } \Omega)$$

OPTION 2/ OPSIE 2

$$P_{\text{ave/gemid}} = \frac{V_{\text{rms/wgk}}^2}{R} = \frac{V_{\text{max/maks}}^2}{2R} = \frac{V_{\text{max/maks}}^2}{2R} \checkmark$$

$$1\,600 = \frac{(340)^2}{2R} \checkmark$$

$$R = 36,13 \, \Omega \text{ (36,125 } \Omega) \checkmark$$

OPTION 3/OPSIE 3	OPTION 4/OPSIE 4
$P_{\text{ave/gemid}} = V_{\text{rms/wgk}} I_{\text{rms/wgk}}$ $1600 = (240,416) I_{\text{rms/wgk}}$ $I_{\text{rms/wgk}} = 6,66 \text{ A}$ $R = \frac{V_{\text{rms}}}{I_{\text{rms}}} \checkmark$ $= \frac{240,416}{6,66} \checkmark$ $= 36,1 \Omega (36,09 \Omega) \checkmark$	$P_{\text{ave/gemid}} = \frac{V_{\text{max/maks}} I_{\text{max/maks}}}{2}$ $1600 = \frac{340 I_{\text{max/maks}}}{2}$ $I_{\text{max/maks}} = 9,412 \text{ A}$ $R = \frac{V_{\text{max}}}{I_{\text{max}}} \checkmark$ $= \frac{340}{9,412} \checkmark$ $= 36,12 \Omega \checkmark$
(Do not penalise if rms is omitted in $R = \frac{V_{\text{rms}}}{I_{\text{rms}}}$ / Moenie penaliseer indien wgk uitgelaat is nie.)	(Do not penalise if max is omitted in $R = \frac{V_{\text{max}}}{I_{\text{max}}}$ / Moenie penaliseer indien maks uitgelaat

(3)
[11]

QUESTION 11/VRAAG 11

- 11.1 Work function of a metal is the minimum energy needed to eject an electron from the metal surface ✓✓
Arbeidsfunksie van 'n metaal is die minimum energie benodig om 'n elektron uit die oppervlakte van 'n metaal vry te stel.
- NOTE/LET WEL**
 If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark.
*Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

(2)

- 11.2 Potassium / Kalium / K ✓
- f_0 for potassium is greater than f_0 for caesium ✓
 f_0 vir kalium is groter as f_0 vir sesium
- OR/OF**
 Work function is directly proportional to threshold frequency ✓
Arbeidsfunksie is direk eweredig aan die drumpel frekwensie
- ACCEPT/AANVAAR**
 $W_0 = hf_0$
 $W_0 \propto f_0$

(2)

- 11.3 **OPTION 1/OPSIE 1**
 $c = f\lambda$ ✓
 $3 \times 10^8 = f(5,5 \times 10^{-7})$ ✓
 $f = 5,45 \times 10^{14} \text{ Hz}$
 $f_{\text{uv}} < f_0 \text{ of K(potassium)}$
 $\therefore$ Ammeter in circuit **B** will not show a reading ✓
 $\therefore$ Ammeter in stroombaan **B** sal nie 'n lesing toon nie.

OPTION 2/OPSIE 2

$$E = \frac{hc}{\lambda} = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{5,5 \times 10^{-7}} \\ = 3,6164 \times 10^{-19} \text{ J}$$

$$W_o = hf_o = (6,63 \times 10^{-34})(5,55 \times 10^{14}) = 3,68 \times 10^{-19} \text{ J}$$

$$W_o > E \text{ or/of } hf_o > hf$$

∴ The ammeter will not register a current / *ammeter sal nie lesing registreer* ✓

Mark allocation / Punttoekening

- ✓ both correct formulae/*beide korrekte formules*: $E = \frac{hc}{\lambda}$ and $W_o = hf_o$
- ✓ both substitutions/*beide vervangings*: $\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{5,5 \times 10^{-7}}$ and/en $(6,63 \times 10^{-34})(5,55 \times 10^{14})$
- ✓ correct conclusion

OPTION 3/OPSIE 3

$$c = f_o \lambda_o \quad \checkmark$$

$$3 \times 10^8 = (5,55 \times 10^{14}) \lambda \quad \checkmark$$

$$\lambda_o = 5,41 \times 10^{-7} \text{ m}$$

$$\lambda_o \text{ (threshold wavelength)} < \lambda \text{ (incident wavelength)}$$

$$\lambda_o \text{ (drumpelgolflengte)} < \lambda \text{ (invallende golflengte)}$$

∴ the ammeter will not register a current / *ammeter sal nie lesing registreer* ✓

(3)

11.4

OPTION 1/OPSIE 1

$$E = W_o + E_{k(\max)}$$

$$hf = hf_o + \frac{1}{2}mv_{\max}^2$$

$$h \frac{c}{\lambda} = h \frac{c}{\lambda_o} + E_{k(\max)}$$

NOTE: If E_K of the incorrect photocell is calculated, candidate forfeit the mark for the final answer.

LET WEL: Indien E_k van verkeerde fotosel bereken is, verbeur kandidaat die punt vir finale antwoord

$$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{5,5 \times 10^{-7}} \checkmark = \frac{(6,63 \times 10^{-34})(5,07 \times 10^{14})}{5,5 \times 10^{-7}} + E_{k(\max)} \checkmark$$

$$E_K = 2,55 \times 10^{-20} \text{ J} \quad \checkmark \quad (\text{Range/Gebied: } 2,52 \times 10^{-20} - 2,6 \times 10^{-20} \text{ J})$$

OPTION 2/OPSIE 2

POSITIVE MARKING FROM 11.3/POSITIEWE NASIEN VANAF 11.3

$$\left. \begin{aligned} E &= W_0 + E_{k(\max)} \\ hf &= hf_0 + \frac{1}{2}mv_{\max}^2 \\ h\frac{c}{\lambda} &= h\frac{c}{\lambda_0} + E_{k(\max)} \end{aligned} \right\} \checkmark$$

NOTE: If E_K of the incorrect photocell is calculated, candidate forfeit the mark for the final answer.

LET WEL: Indien E_k van verkeerde fotosel bereken is, verbeur kandidaat die punt vir finale antwoord

$$(6,63 \times 10^{-34})(5,45 \times 10^{14}) \checkmark\checkmark = (6,63 \times 10^{-34})(5,07 \times 10^{14}) + E_{k(\max)} \checkmark$$

$$E_K = 2,52 \times 10^{-20} \text{ J } \checkmark \quad (\text{Range/Gebied: } 2,52 \times 10^{-20} - 2,6 \times 10^{-20} \text{ J})$$

(5)

11.5 Remains the same/Bly dieselfde $\checkmark$

(1)
[13]

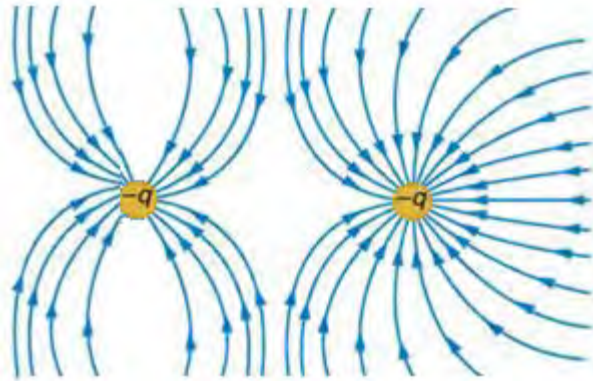
TOTAL/TOTAAL: 150

ADDENDUM

QUESTION 7.2

Accept the following electric field diagram which would be formed if the effect of the third charge is considered.

Aanvaar die volgende elektrieseveld diagram wat gevorm sal word indien die effek van die derde lading in ag geneem is.





basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

FEBRUARY/MARCH/FEBRUARIE/MAART 2018

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 13 pages.
Hierdie nasienriglyne bestaan uit 13 bladsye.**

QUESTION 1/VRAAG 1

1.1	A✓✓	(2)
1.2	B✓✓	(2)
1.3	C✓✓	(2)
1.4	B✓✓	(2)
1.5	A✓✓	(2)
1.6	B✓✓	(2)
1.7	C✓✓	(2)
1.8	C✓✓	(2)
1.9	D✓✓	(2)
1.10	B✓✓	(2)
		[20]

QUESTION 2/VRAAG 2

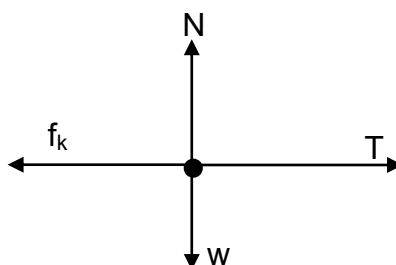
- 2.1. A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it. ✓✓

'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid in 'n reguitlyn volhard tensy 'n nie-nul resulterende/netto krag daarop inwerk.

(2)

2.2

Accepted labels/Aanvaarde benoemings	
W	F_g / F_w /weight / mg / gravitation force F_g / F_w /gewig / mg / gravitasiekrag
T	F_T /tension F_s /spanning
f_k	(Kinetic) Friction / $F_f / 4 \text{ N} / f / \text{wrywing} / F_w$
N	F_{Normal} / Normal / F_N



(4)

Notes/Aantekeninge

- Mark awarded for label and arrow/Punt toegeken vir benoeming en pyltjie
- Do not penalise for length of arrows since drawing is not to scale./Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie
- Any other additional force(s)/Enige ander addisionele krag(te) Max/Maks $\frac{3}{4}$
- If force(s) do not make contact with body/Indien krag(te) nie met die voorwerp kontak maak nie: Max/Maks: $\frac{3}{4}$

2.3 Object Q/Voorwerp Q

$$\left. \begin{array}{l} F_{\text{net}} = ma \\ F_{\text{net}} = 0 \\ T + (f_k) = ma \\ T - 3 = 0 \end{array} \right\} \checkmark$$

$$T = 3 \text{ N}$$

Object P/Voorwerp Q

$$\begin{aligned} F_{\text{net}} &= ma \\ F_{\text{hor}} - (f_k + T) &= ma \checkmark \\ (F \cos 30^\circ) - 5 - 3 &= 0 \checkmark \\ F &= 9,24 \text{ N} \checkmark (9,238 \text{ N}) \end{aligned}$$

(6)

2.4 3 s✓

(1)

2.5 Y✓

Graph Y represents the motion of Q after the string breaks.

The graph Y shows a decreasing velocity ✓ with a negative acceleration. ✓This is because the net force (friction) acting on Q is in the opposite direction to its motion, ✓ (accept: only frictional force acts on Q).*Grafiek Y verteenwoordig die beweging van Q na die toutjie breek**Die versnelling is negatief vir grafiek Y en toon 'n afnemende snelheid**Dit is omdat wrywing op Q inwerk*

(4)

[17]

QUESTION 3/VRAAG 33.1 10 m·s⁻¹✓

(1)

3.2 The gradient represents the acceleration due to gravity (g) which is constant
for free fall. ✓*Die helling verteenwoordig die versnelling as gevolg van gravitasie (g) wat konstant vir vry-val is.*

[The graphs represent free fall/Die grafieke verteenwoordig vryval]

(1)

3.3.1

POSITIVE MARKING FROM QUESTION 3.1**POSITIEWE NASIEN VANAF VRAAG 3.1****OPTION 1/OPSIE 1**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= (10)(2) + \frac{1}{2} (9,8)(2^2) \checkmark$$

$$= 39,6 \text{ m}$$

$$\text{Height/Hoogte} = 39,6 \text{ m} \checkmark$$

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= (-10)(2) + \frac{1}{2} (-9,8)(2^2) \checkmark$$

$$= -39,6 \text{ m}$$

$$\text{Height/Hoogte} = 39,6 \text{ m} \checkmark$$

OPTION 2/OPSIE 2

$$\Delta x = \frac{(v_i + v_f)}{2} \Delta t \checkmark$$

$$\Delta x = \left(\frac{10 + 29,6}{2} \right) (2) \checkmark$$

$$\Delta x = 39,6 \text{ m} \checkmark$$

OPTION 3/OPSIE 3

$$v_f^2 = v_i^2 + 2a\Delta x \checkmark$$

$$(29,6)^2 = (10)^2 + 2(9,8)\Delta x \checkmark$$

$$\Delta x = 39,6 \text{ m} \checkmark$$

OPTION 4/OPSIE 4

Height = Area under the graph

Hoogte = Area onder die grafiek

= Area of/van $\square$ + Area of/van $\triangle$

$$= (10)(2) + \left(\frac{1}{2}\right)(2)(19,6) \checkmark$$

$$= 39,6 \text{ m} \checkmark$$

Any one/Enige een✓

OPTION 5/OPSIE 5

Height = Area of trapezium = Hoogte = Area van trapesium ✓

$$= \frac{1}{2} (10 + 29,6) \times 2 \checkmark = 39,6 \text{ m} \checkmark$$

(3)

3.3.2

OPTION 1/OPSIE 1 $v_f = v_i + a\Delta t \checkmark$ $0 = -25 + (9,8)(\Delta t) \checkmark$ $\Delta t = 2,55 \text{ s}$ $\text{Total time T/Totale tyd} = 8 + 2,55 \checkmark$ $= 10,55 \text{ s} \checkmark$	OPTION 2/OPSIE 2 $v_f = v_i + a\Delta t \checkmark$ $0 = 25 + (-9,8)(\Delta t) \checkmark$ $\Delta t = 2,55 \text{ s}$ $\text{Total time T/Totale tyd} = 8 + 2,55 \checkmark$ $= 10,55 \text{ s} \checkmark$
OPTION 3/OPSIE 3 $v_f^2 = v_i^2 + 2a\Delta x$ $\Delta x = 31,89 \text{ m}$ $\Delta x = \frac{(v_i + v_f)}{2} \Delta t$ $31,89 = \left(\frac{25 + 0}{2}\right) \Delta t \checkmark$ $\Delta t = 2,55 \text{ s}$ $\text{Total time T/Totale tyd} = 8 + 2,55 \checkmark$ $= 10,55 \text{ s} \checkmark$	OPTION 4/OPSIE 4 $E_{Mi} = E_{Mf}$ $W_{nc} = 0$ $W_{net} = \Delta E_K$ $W_{con} = \Delta E_K$ $\Delta E_K + \Delta E_P = 0$ $E_{Ki} + E_{Pi} = E_{Kf} + E_{Pf}$ $\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$ $\frac{1}{2}(25)^2 + 0 = 0 + 9,8h_f$ $\Delta x = 31,89 \text{ m}$ $\Delta x = \frac{(v_i + v_f)}{2} \Delta t$ $31,89 = \left(\frac{25 + 0}{2}\right) \Delta t \checkmark$ $\Delta t = 2,55 \text{ s}$ $\text{Total time T/Totale tyd} = 8 + 2,55 \checkmark$ $= 10,55 \text{ s} \checkmark$
OPTION 5/OPSIE 5 Slope of graph = 9,8 $\checkmark$ $= \frac{0 - (-25)}{T - 8} \checkmark \checkmark$ Total time T/Totale tyd $= 10,55 \text{ s} \checkmark$	If values of v_i and v_f are swapped around, and a negative time is obtained, give 1 mark for formula and 1 mark for adding calculated time to 8 s, (max 2/4).

(4)

3.4.1 0,2 s $\checkmark$

(1)

3.4.2 4,955 s $\checkmark \checkmark$

(2)

3.4.3 - 27 (m·s⁻¹) $\checkmark$ [Must include the negative/Moet negatief insluit]

(1)

3.5 Inelastic./Onelasties✓

The speeds at which it strikes and leaves the ground are not the same/The kinetic energies will not be the same ✓

Die spoed waarmee dit die grond tref en die grond verlaat is nie dieselfde nie./Die kinetiese energieë sal nie dieselfde wees nie

(2)

[16]**QUESTION 4/VRAAG 4**

- 4.1 The total linear momentum of a closed (isolated) system remains constant (is conserved). ✓✓

Die totale lineêre momentum in 'n geslote sisteem bly konstant (bly behoue)

OR/OF

In an isolated system, the total linear momentum before collision is equal to the total linear momentum after collision ✓✓

In 'n geïsoleerde sisteem is die totale lineêre momentum voor botsing gelyk aan die totale lineêre momentum na botsing.

(If key words isolated and total missing -1 mark for each.)

(2)

- 4.2

$$\Sigma p_i = \Sigma p_f$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

Any one/ Enige een ✓

For the system cat-skate board **A/Vir die sisteem kat-skaatsplank**

$$(3,5)(0) + (2,6)(0) \checkmark = (3,5)v_{\text{skateboard/skaatsplank}} + (2,6)(3) \checkmark$$

$$v_{\text{skateboard/skaatsplank}} = 2,23 \text{ m}\cdot\text{s}^{-1} \checkmark \text{ to the left/na links} \checkmark$$

ACCEPT/AANVAAR $v = -2,23 \text{ m}\cdot\text{s}^{-1} \checkmark \checkmark$

(5)

- 4.3

$$F_{\text{net}} \Delta t = \Delta p = mv_f - mv_i \checkmark$$

$$= (3,5)(1,28 - 0) \checkmark$$

$$= 4,48 \text{ N}\cdot\text{s} \text{ (4,48 kg}\cdot\text{ms}^{-1}) \checkmark$$

OR/OF

$$F_{\text{net}} \Delta t = \Delta p = mv_f - mv_i \checkmark$$

$$= (2,6)(1,28 - 3) \checkmark$$

$$= -4,48 \text{ N}\cdot\text{s} \text{ (4,48 kg}\cdot\text{ms}^{-1})$$

$$\therefore \Delta p = 4,48 \text{ N}\cdot\text{s} \checkmark$$

(3)

[10]

QUESTION 5/VRAAG 5

- 5.1 The total mechanical energy/sum of kinetic and gravitational potential energy in a closed/isolated system is constant (conserved).✓✓

Die totale meganiese energie/som van kinetiese en gravitasionele potensiele energie in 'n geslote sisteem bly behoue.

(If key words isolated and total missing -1 mark for each.)

(2)

5.2 $E_{\text{MECH P}} = E_{\text{MECH Q}}$
 $(E_P + E_K)_P = (E_P + E_K)_Q$

$$W_{\text{net}} = \Delta E_K$$

$$W_{\text{con}} = \Delta E_K$$

$$\Delta E_K + \Delta E_P = 0$$

$$(mgh + \frac{1}{2}mv^2)_P = (mgh + \frac{1}{2}mv^2)_Q$$

$$50(9,8)(3) + 0 \checkmark = 0 + \frac{1}{2}(50)v^2 \checkmark$$

$$v = 7,67 \text{ m}\cdot\text{s}^{-1} \checkmark (7,668 \text{ m}\cdot\text{s}^{-1})$$

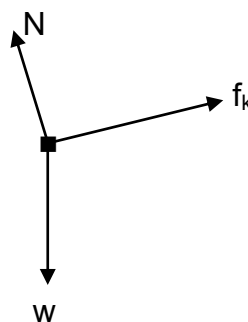
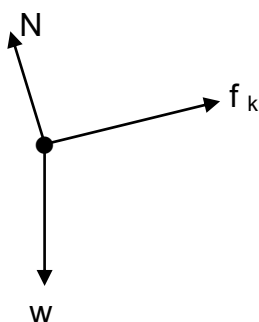
✓ 1 mark for any of the three/
1 punt vir enige van die drie

(4)

5.3

Accepted labels/Aanvaarde benoemings		
w	$F_g / F_w / \text{weight} / mg / \text{gravitational force}$ $F_g / F_w / \text{gewig} / mg / \text{gravitasiekrag}$	✓
N	F_N	✓
f_k	$F_f / \text{friction} / f$	✓

(3)

**Notes/Aantekeninge**

- Mark awarded for label and arrow/Punt toegeken vir benoeming en pyltjie
- Do not penalise for length of arrows since drawing is not to scale./Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie
- Any other additional force(s)/Enige ander addisionele krag(te) Max/Maks $\frac{2}{3}$
- If force(s) do not make contact with body/Indien krag(te) nie met die voorwerp kontak maak nie: Max/Maks: $\frac{2}{3}$

5.4 $f_k = \mu_k N$
 $= \mu_k (mg \cos \theta)$ } ✓ Any one/Enige een

$$= 0,08 (50 \times 9,8) \cos 30^\circ \checkmark$$

$$= 33,95 (33,948) \text{ N} \checkmark$$

(3)

NOTE/LET WEL:

IN ALL THE OPTIONS FOR QUESTION 5.5 BELOW, ACCEPT THE SUBSTITUTION://IN AL DIE OPSIES VIR VRAAG 5.5 HIERONDER, AANVAAR DIE VERVANGING

5 cos 60° IN PLACE OF//IN PLAAS VAN 5 sin 30°

5.5

OPTION 1/OPSIE 1

POSITIVE MARKING FROM QUESTION 5.4/POSITIEWE NASIEN VANAF VRAAG 5.4

$$W = F_{\text{net}} \Delta x \cos \theta$$

$$W_{\text{net}} = W_f + W_w + W_N$$

$$W_{\text{net}} = W_f + (-\Delta E_p) + W_N$$

$$W_{\text{net}} = f_k \Delta x \cos 180^\circ + mg \sin \theta \Delta x \cos 0 + 0$$

$$W_{\text{net}} = \Delta E_k / \Delta K$$

✓ 1 mark for any one/
1 punt vir enige van die drie

$$W_{\text{net}} = [33,948](5)(-1)] \checkmark + [(50)(9,8) (5) \sin 30^\circ + 0] \checkmark$$

$$= 1055,26 \text{ (1055,259)}$$

$$1055,259 = \frac{1}{2} (50) (v_f^2 - 7,668^2) \checkmark$$

$$v_f = 10,05 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 2/OPSIE 2

POSITIVE MARKING FROM QUESTION 5.2/POSITIEWE NASIEN VANAF VRAAG 5.3

$$W_{\text{nc}} = \Delta E_p + \Delta E_k$$

$$f \Delta x \cos \theta = (mgh_f - mgh_i) + \left(\frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2 \right)$$

1 mark for any of the two/
1 punt vir enige van die twee

$$\mu mg \Delta x \cos 180^\circ = [0 - (mg \Delta x \sin 30^\circ)] + \frac{1}{2} m (v_f^2 - v_i^2)$$

$$[33,948](5)(-1)] \checkmark = [0 - 50(9,8) (5) \sin 30^\circ] \checkmark + \frac{1}{2} (50) (v_f^2 - 7,668^2) \checkmark$$

$$v_f = 10,05 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 3/OPSIE

POSITIVE MARKING FROM QUESTION 5.2 AND 5.4/POSITIEWE NASIEN VANAF VRAAG 5.2 EN 5.4

$$W_{\text{nc}} = \Delta E_p + \Delta E_k$$

$$f \Delta x \cos \theta = (mgh_f - mgh_i) + \left(\frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2 \right)$$

$$(33,95)(5) \cos 180^\circ \checkmark = [(50)(9,8) \{0 - 5 \sin 30^\circ\}] \checkmark + \frac{1}{2} (50) (v_f^2 - 7,668^2) \checkmark$$

$$v_f = 10,05 \text{ m} \cdot \text{s}^{-1} \checkmark$$

1 mark for any of the two/
1 punt vir enige van die twee

(5)

[17]

QUESTION 6/VRAAG 6

- 6.1 An (apparent) change in the observed frequency (pitch), (wavelength) ✓ as a result of the relative motion between a source and an observer ✓ (listener).
 'n (Waarskynlike) verandering in die waargenome frekwensie (toonhoogte) (golflengte) as gevolg van die relatiewe beweging tussen bron en waarnemer (luisteraar) (2)

- 6.2 Towards A./Na A ✓
 Recorded frequency higher./Aangetekende frekwensie is hoër ✓ (2)

6.3
$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \checkmark$$

FOR A/VIR A

$$690 = \frac{340}{340 - v_s} f_s \quad \checkmark \quad (1)$$

FOR B/VIR B:

$$610 = \frac{340}{340 + v_s} f_s \quad \checkmark \quad (2)$$

$$\frac{690}{610} = \frac{340 + v_s}{340 - v_s}$$

$$1,131 (340 - v_s) = 340 + v_s$$

$$v_s = 20,90 \text{ m.s}^{-1} \checkmark (20.90 \text{ to } 20.92 \text{ m.s}^{-1}) \quad (6)$$

- 6.4 **ANY ONE/ENIGE EEN**
 Doppler flow meter/Doppler-vloeimeter ✓
 Measuring foetal heartbeat/Meet van fetale hartslag
 Measure speed of blood flow
 Ultra sound/Ultraklank
 Sonar
 Radar (for speeding/vir jaag) (1)

[11]

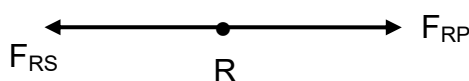
QUESTION 7/VRAAG 7

- 7.1 The magnitude of the electrostatic force exerted by one point charge on another point charge is directly proportional to the product (of the magnitudes) of the charges and inversely proportional to the square of the distance between them. ✓✓

Die grootte van die elektrostatiese krag uitgeoefen deur een puntlading op 'n ander puntlading is direk eweredig aan die produk (van die groottes) van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle

(2)

7.2

**NOTE/LET WEL:**

One mark for each force, correctly shown./Een punt vir elke krag korrek getoon.

(2)

- 7.3 Taking right as positive/Neem regs as positief

$$F = k \frac{Q_1 Q_2}{r^2} \quad \checkmark$$

$$F_{\text{net}R} = F_{PR} + F_{SR}$$

$$F_{\text{net}} = \frac{kQ_1 Q_2}{r^2} + \frac{kQ_1 Q_2}{r^2}$$

$$-1,27 \times 10^{-6} = \left\{ \frac{(9 \times 10^9)(1,5 \times 10^{-9})(Q)}{(0,3)^2} - \frac{(9 \times 10^9)(2 \times 10^{-9})(Q)}{(0,2)^2} \right\}$$

$$-1,27 \times 10^{-6} = 150Q - 450Q \quad (\text{for subtraction/vir aftrekking})$$

$$Q = 4,23 \times 10^{-9} \text{ C} \quad \checkmark$$

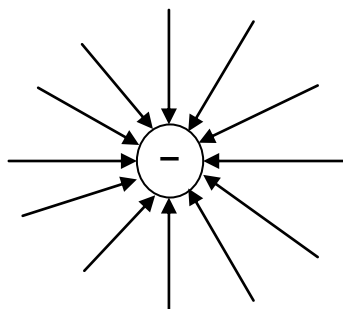
Accept answers where left is taken as positive.

(7)

[11]

QUESTION 8/VRAAG 8

8.1



Shape (radial)/Vorm (radiaal)✓
 Polarity (sign) of A/Polariteit (Teken) van A✓
 Do not penalize for incorrect direction/Moet
 nie penaliseer vir verkeerde rigting nie

(2)

8.2

$$E = \frac{kQ}{r^2} \checkmark$$

$$3 \times 10^7 = \frac{(9 \times 10^9)(Q)}{(0,5)^2}$$

$$Q = 8,33 \times 10^{-4} \text{ C} \checkmark$$

(3)

8.3

$$Q = ne \checkmark$$

$$= (10^5)(1,6 \times 10^{-19}) \checkmark$$

$$= 1,6 \times 10^{-14} \text{ C}$$

$$E = \frac{F}{Q} \checkmark$$

$$3 \times 10^7 = \frac{F}{1,6 \times 10^{-14}} \checkmark$$

$$F = 4,8 \times 10^{-7} \text{ N} \checkmark \text{ Right/Regs} \checkmark$$

(Positive marking from 8.2 for this option)

$$F = k \frac{Q_1 Q_2}{r^2} \checkmark$$

$$F = (9 \times 10^9) \frac{(8,33 \times 10^{-4})(1,6 \times 10^{-14})}{(0,5)^2} \checkmark$$

$$= 4,8 \times 10^{-7} \text{ N} \checkmark \text{ Right/Regs} \checkmark$$

(6)
[11]

QUESTION 9/VRAAG 9

- 9.1.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature. ✓✓.

Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur.

OR/OF

The current in a conductor is directly proportional to the potential difference across the conductor at constant temperature. ✓✓

Die stroom in 'n geleier is direk eweredig aan die potensiaalverskil oor die geleier by konstante temperatuur

(2)

- 9.1.2 Graph X./Grafiek X✓

Graph X is a straight line (passing through the origin) therefore potential difference is directly proportional to current. ✓

/Grafiek X is lineêr

(2)

- 9.2.1

$$\frac{1}{R_{//}} = \frac{1}{R_{10}} + \frac{1}{R_{15}}$$

$$\frac{1}{R_{//}} = \frac{1}{10} + \frac{1}{15} \checkmark$$

$$R_{//} = 6 \Omega$$

$$\therefore R = (10 + 6 + 2) \checkmark \text{ (for the addition/vir optelling)}$$

$$= 18 \Omega$$

$$R = \frac{V}{I}$$

$$I = \frac{6}{18} \checkmark$$

$$= 0,33 \text{ A} \checkmark$$

$$R_{//} = \frac{R_{10} \times R_{15}}{R_{10} + R_{15}}$$

$$R_{//} = \frac{10 \times 15}{25} \checkmark$$

$$= 6 \Omega$$

$$R_{\text{ext}} = (10 + 6) = 16 \Omega$$

$$\mathcal{E} = I(R + r)$$

$$6 = I(16 + 2) \checkmark$$

$$I = 0,33 \text{ A} \checkmark$$

(5)

- 9.2.2 Decrease. ✓

The total resistance of the circuit increases✓.

Afneem

Die totale weerstand van die stroombaan neem toe.

(2)

- 9.2.3 Increase/Neem toe ✓

(1)

- 9.2.4 The total resistance in the external circuit increases./Die totale weerstand in die eksterne stroombaan neem toe✓
 Current decreases/Stroom neem af✓
 "Lost" volts decreases/"Verlore" volts neem af✓

OR/OF

The total resistance in the external circuit increases./Die totale weerstand in die eksterne stroombaan neem toe ✓
 $V \propto R$ ✓ for constant/vir konstante I ✓
 Therefore V increases./Dus neem V toe

(3)
[15]

QUESTION 10/VRAAG10

10.1 ANY THREE/ENIGE DRIE

- I. Permanent magnets/Permanente magnete
- II. coils (armature)/spoel
- III. commutator/kommutator
- IV. brushes/borsels
- V. power supply/battery/kragbron

(3)

- 10.2.1 The rms voltage of AC is the potential difference which dissipates the same amount of energy as the equivalent DC potential difference. ✓✓
 Die wgk spanning/potensiaalverskil van WS is die potensiaalverskil wat dieselfde aantal energie verkwis as GS.
 Accept formula for V_{rms} as 1 mark.

(2)

10.2.2 OPTION 1/OPSIE 1

$$\begin{aligned}
 V_{rms} &= I_{rms} R \\
 I_{rms} &= \frac{V_{rms}}{R} \\
 I_{rms} &= \frac{240}{11} \checkmark \\
 &= 21,82 \text{ A} \\
 I_{rms} &= \frac{I_{max}}{\sqrt{2}} \\
 I_{max} &= (21,82) \sqrt{2} \checkmark \\
 I_{max} &= 30,86 \text{ A} \checkmark
 \end{aligned}$$

OPTION 3/OPSIE 3

$$\begin{aligned}
 P_{ave} &= \frac{V_{rms}^2}{R} \\
 P_{ave} &= \frac{(240)^2}{11} \checkmark \\
 P_{ave} &= 5236,36 \text{ W} \\
 P_{ave} &= I_{rms} V_{rms} \\
 5236,36 &= I_{rms} 240 \\
 I_{rms} &= 21,82 \text{ A} \\
 I_{rms} &= \frac{I_{max}}{\sqrt{2}} \\
 21,82 &= \frac{I_{max}}{\sqrt{2}} \checkmark \\
 I_{max} &= 30,86 \text{ A} \checkmark
 \end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned}
 V_{rms} &= \frac{V_{max}}{\sqrt{2}} \\
 V_{max} &= (240) \sqrt{2} \checkmark \\
 &= 339,41 \\
 V_{max} &= I_{max} R \\
 339,41 &= I_{max} 11 \checkmark \\
 I_{max} &= 30,86 \text{ A} \checkmark
 \end{aligned}$$

(4)

$$\begin{aligned}
 P_{ave} &= \frac{I_{max} V_{max}}{2} \\
 P_{ave} &= \frac{I_{max} V_{rms} \sqrt{2}}{2} \\
 5236,36 &= \frac{I_{max} (240) \sqrt{2}}{2} \checkmark \\
 I_{max} &= 30,86 \text{ A} \checkmark
 \end{aligned}$$

[9]

QUESTION 11/VRAAG 11**11.1.1 Greater than/Groter as✓**

Electrons are ejected from the metal plate./*Elektrone word vrygestel vanaf die metaalplaat* ✓ Accept: a current is registered on the ammeter. (2)

11.1.2 Increase in intensity means that (for the same frequency) the number of photons per second increases (ammeter reading increases)✓but the energy of the photons stays the same ✓ (Therefore the statement is incorrect).

OR

An increase in the energy of the photons only increases the kinetic energy of the photoelectrons and not the number of photoelectrons, thus the ammeter reading will not change.

Toename in intensiteit beteken dat (vir dieselfde frekwensie) die aantal fotone neem toe (ammeterlesing neem toe) maar die energie van die fotone bly dieselfde. (Dus is die stelling verkeerd) (2)

11.1.3 Light has a particle nature/Lig het 'n deeltjies aard

Accept light energy is quantized/Aanvaar ligenergie is gekwantiseer✓ (1)

11.2.1 The minimum frequency needed for the emission of electrons (from a metal surface).

Die minimum energie benodig vir die vrystelling van elektrone (vanaf die metaaloppervlak) (2)

11.2.2 $W_0 = hf_0$ ✓

$$= \frac{(6,63 \times 10^{-34})(5,73 \times 10^{14})}{1} \checkmark$$

$$= 3,8 \times 10^{-19} \text{ J} \checkmark [3,799 \times 10^{-19} \text{ J}]$$
 (3)

11.2.3 POSITIVE MARKING FROM QUESTION 11.2.2

POSITIEWE NASIE VANAF VRAAG 11.2.2

OPTION 1/OPSIE 1

$$E = W_0 + E_{k(\text{max/maks})}$$

$$hf = hf_0 + E_{k(\text{max/maks})}$$

$$hf = hf_0 + \frac{1}{2} mv^2$$

$$E = W_0 + \frac{1}{2} mv^2$$

✓ Any one/Enige een

$$(6,63 \times 10^{-34})f = 3,8 \times 10^{-19} + [\frac{1}{2}(9,11 \times 10^{-31})(4,19 \times 10^5)^2] \checkmark$$

$$f = 6,94 \times 10^{14} \text{ Hz} \checkmark [7 \times 10^{14} \text{ Hz}]$$

OPTION 2/OPSIE 2

$$E = W_0 + E_{k(\text{max/maks})}$$

$$hf = hf_0 + E_{k(\text{max/maks})}$$

$$hf = hf_0 + \frac{1}{2} mv^2$$

$$E = W_0 + \frac{1}{2} mv^2$$

✓ Any one/Enige een

$$E = 3,8 \times 10^{-19} + [\frac{1}{2}(9,11 \times 10^{-31})(4,19 \times 10^5)^2] \checkmark$$

$$hf = 4,599 \times 10^{-19}$$

$$(6,63 \times 10^{-34})f = 4,599 \times 10^{-19}$$

$$f = 6,94 \times 10^{14} \text{ Hz} \checkmark [7 \times 10^{14} \text{ Hz}]$$

(3)

[13]

150

TOTAL/TOTAAL:



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS SENIORSERTIFIKAAT-EKSAMEN

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

2018

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 20 pages.
*Hierdie nasienriglyne bestaan uit 20 bladsye.***

QUESTION 1/VRAAG 1

1.1	C✓✓	(2)
1.2	A✓✓	(2)
1.3	D✓✓	(2)
1.4	A✓✓	(2)
1.5	C✓✓	(2)
1.6	A✓✓	(2)
1.7	B✓✓	(2)
1.8	B✓✓	(2)
1.9	D✓✓	(2)
1.10	A✓✓	(2)
		[20]

QUESTION 2/VRAAG 2

- 2.1 The rate of change of velocity. ✓✓
 Die tempo van verandering van snelheid.

Accept/AanvaarChange in velocity per unit timeVerandering in snelheid per eenheidstyd

(2)

NOTE:/LET WEL

If any one of the underlined key words in the **correct context** is omitted deduct 1 mark.

Indien enige van die onderstreepte woorde in die **korrekte konteks** uitgelaat is trek 1 punt af.

- 2.2

OPTION 1/OPSIE 1

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$0,5 = (0)(3) + \frac{1}{2} (a)(3^2) \checkmark$$

$$a = 0,11 \text{ m} \cdot \text{s}^{-2} \checkmark$$

(3)

OPTION 2/OPSIE 2

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$0,5 = \left(\frac{0 + v_f}{2} \right) (3)$$

$$v_f = 0,333 \text{ m} \cdot \text{s}^{-1}$$

$$v_f = v_i + a \Delta t$$

$$0,33 = 0 + a(3) \checkmark$$

$$a = 0,11 \text{ m} \cdot \text{s}^{-2} \checkmark$$

1 mark for either of the two/
1 punt vir enige van die twee

(3)

OPTION 3/OPSIE 3

$$v_f = v_i + a \Delta t$$

$$= 0 + 3a$$

$$v_f = 3a \dots \dots \dots (i)$$

$$v_f^2 = v_i^2 + 2a \Delta y$$

$$= 0^2 + 2a(0,5)$$

$$v_f = \sqrt{a} \dots \dots \dots (ii)$$

$$9a^2 = a \checkmark$$

$$\therefore a = 0,11 \text{ m} \cdot \text{s}^{-2} \checkmark$$

1 mark for either of the two/
1 punt vir enige van die twee

(3)

- 2.3

POSITIVE MARKING FROM 2.2 / POSITIEWE NASIEN VANAF 2.2**OPTION 1/OPSIE 1**

For the 3 kg mass/vir die 3 kg massa:

$$F_{\text{net}} = ma$$

$$(mg - T)/(mg + T) = ma \checkmark$$

$$(3)(9,8) - T = (3)(0,11) \checkmark$$

$$T = 29,07 \text{ N} \checkmark$$

(3)

OPTION 2/OPSIE 2

For the 3 kg mass/vir die 3 kg massa:

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$0,5 = \left(\frac{0 + v_f}{2} \right) (3)$$

$$v_f = 0,333 \text{ m} \cdot \text{s}^{-1}$$

OR/OF**POSITIVE MARKING FROM 2.2/POSITIEWE NASIEN VANAF 2.2**

$$v_f = v_i + a\Delta t$$

$$= 0 + (0,11)(3)$$

$$= 0,33 \text{ m} \cdot \text{s}^{-1}$$

$$W_{\text{net}} = \Delta E_K \checkmark$$

$$W_w + W_T = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$$

$$mg\Delta x \cos\theta + T\Delta x \cos\theta = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$$

$$(3)(9,8)(0,5)\cos 0^\circ + T(0,5)\cos 180^\circ = \frac{1}{2} (3)(0,33^2 - 0^2) \checkmark$$

$$14,7 - 0,5T = -0,16$$

$$T = 29,72 \text{ N} \checkmark$$

(3)

OPTION 3/OPSIE 3

$$W_{\text{nc}} = \Delta E_K + \Delta E_p \checkmark$$

$$T\Delta x \cos 180^\circ = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2 + mgh_f - mgh_i$$

$$T(0,5)\cos 180^\circ = \frac{1}{2} (3)(0)^2 - \frac{1}{2} (3)(0,33)^2 + (3)(9,8)(0) - (3)(9,8)(0,5) \checkmark$$

$$T = 29,72 \text{ N} \checkmark$$

(3)

2.4

Accepted labels/Aanvaarde benoemings		
w	F_g / F_w / weight / mg / gravitational force F_g / F_w / gewig / mg / gravitasiekrag	✓
f	Friction/ F_f / f_k / 27 N/ wrywing / F_w	✓
N	Normal (force) / F_{normal} / F_N / $F_{normaal}$ / $F_{reaction}$ / $F_{reasië}$	✓
T	F_T /tension/spanning	✓

Notes/Aantekeninge

- Mark awarded for label and arrow / Punt toegeken vir benoeming en pyltjie
- Do not penalise for length of arrows since drawing is not to scale. / Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie
- Any other additional force(s) / Enige ander addisionele krag(te) Max/Maks $\frac{3}{4}$
- If force(s) do not make contact with body / Indien krag(te) nie met die voorwerp kontak maak nie: Max/Maks: $\frac{3}{4}$

(4)

2.5

POSITIVE MARKING FROM 2.2 AND 2.3/POSITIEWE NASIEN VANAF 2.2 EN 2.3	
For/ Vir P $F_{net} = ma$ $T - f = ma$ } ✓ $29,07 - 27 = m(0,11)$ ✓ $m = 18,82 \text{ kg}$ ✓ (Range: 18,60 – 18,82)	OR/OF For/ Vir P $F_{net} = ma$ $T - f = ma$ } ✓ $29,72 - 27 = m(0,11)$ ✓ $m = 24,73 \text{ kg}$ ✓

(3)

[15]

QUESTION 3/VRAAG 3

- 3.1 Motion under the influence of gravity/weight/gravitational force only. ✓✓
Beweging slegs onder die invloed van gravitasie/gewig/gravitasiekrag.

OR/OF

Motion in which the only force considered is gravitational. ✓✓

Beweging waar die enigste krag wat in ag geneem word, gravitasie is.

(2)

NOTE:/LET WEL

If ONLY is omitted minus 1 mark.

Indien SLEGS uitgelaat is, trek 1 punt af.

- 3.2

OPTION 1/OPSIE 1**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= (0)(1) + \frac{1}{2} (-9,8)(1^2) \checkmark$$

$$= -4,9 \text{ m}$$

$$\text{Height/hoogte} = 2\Delta y$$

$$= (2)(4,9)$$

$$= 9,8 \text{ m} \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$= (0)(1) + \frac{1}{2} (9,8)(1^2) \checkmark$$

$$= 4,9 \text{ m}$$

$$\text{Height/hoogte} = 2\Delta y$$

$$= (2)(4,9)$$

$$= 9,8 \text{ m} \checkmark$$

OPTION 2/OPSIE 2**UPWARD POSITIVE/OPWAARTS POSITIEF**

$$v_f = v_i + a \Delta t$$

$$= 0 + (-9,8)(1)$$

$$= -9,8 \text{ m} \cdot \text{s}^{-1}$$

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{0 + (-9,8)}{2} \right) (1) \checkmark$$

$$= -4,9 \text{ m}$$

$$\text{Height/hoogte} = (2)(4,9)$$

$$= 9,8 \text{ m} \checkmark$$

DOWNWARD POSITIVE/AFWAARTS POSITIEF

$$v_f = v_i + a \Delta t$$

$$= 0 + (9,8)(1)$$

$$= 9,8 \text{ m} \cdot \text{s}^{-1}$$

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{0 + (9,8)}{2} \right) (1) \checkmark$$

$$= 4,9 \text{ m}$$

$$\text{Height/hoogte} = (2)(4,9)$$

$$= 9,8 \text{ m} \checkmark$$

OPTION 3/OPSIE 3**UPWARD POSITIVE/OPWAARTS POSITIEF**

$$v_f = v_i + a\Delta t$$

$$= 0 + (-9,8)(1)$$

$$= -9,8 \text{ m}\cdot\text{s}^{-1}$$

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$\underline{(-9,8)^2 = 0 + (2)(-9,8)\Delta y} \checkmark$$

$$\Delta y = -4,9 \text{ m}$$

$$\text{Height/hoogte} = 2\Delta y$$

$$= (2)(4,9)$$

$$\text{Height/hoogte} = 9,8 \text{ m} \checkmark$$

DOWNWARD POSITIVE/AFWAARTS POSITIEF

$$v_f = v_i + a\Delta t$$

$$= 0 + (9,8)(1)$$

$$= 9,8 \text{ m}\cdot\text{s}^{-1}$$

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$\underline{(9,8)^2 = 0 + (2)(9,8)\Delta y} \checkmark$$

$$\Delta y = 4,9 \text{ m}$$

$$\text{Height/hoogte} = 2\Delta y$$

$$= (2)(4,9)$$

$$\text{Height/hoogte} = 9,8 \text{ m} \checkmark$$

OPTION 4/OPSIE 4**UPWARD POSITIVE/OPWAARTS POSITIEF**

$$v_f = v_i + a\Delta t$$

$$= 0 + -9,8(1)$$

$$v_f = -9,8 \text{ m}\cdot\text{s}^{-1}$$

DOWNWARD POSITIVE/AFWAARTS POSITIEF

$$v_f = v_i + a\Delta t$$

$$= 0 + 9,8(1)$$

$$= 9,8 \text{ m}\cdot\text{s}^{-1}$$

$$\left. \begin{aligned} E_{(\text{mech/meg})\text{Top/Bo}} &= E_{(\text{mech/meg at/by B})} \checkmark \\ (E_p + E_k)_{\text{Top}} &= (E_p + E_k)_{\text{at B}} \end{aligned} \right\} \checkmark$$

$$(mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}} = (mgh + \frac{1}{2}mv^2)_{\text{at/by B}}$$

$$\underline{(9,8)(h) + 0 = (9,8)(\frac{1}{2}h) + (\frac{1}{2})(9,8^2)} \checkmark$$

$$h = 9,8 \text{ m} \checkmark$$

OPTION 5/OPSIE 5**UPWARD POSITIVE/OPWAARTS POSITIEF**

$$v_f = v_i + a\Delta t$$

$$= 0 + -9,8(1)$$

$$v_f = -9,8 \text{ m}\cdot\text{s}^{-1}$$

DOWNWARD POSITIVE/AFWAARTS POSITIEF

$$v_f = v_i + a\Delta t$$

$$= 0 + 9,8(1)$$

$$= 9,8 \text{ m}\cdot\text{s}^{-1}$$

$$W_{\text{net}} = \Delta K \checkmark$$

$$mg\Delta x \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$\underline{(9,8)(\frac{1}{2}h \cos 0^\circ) = \frac{1}{2}(9,8^2 - 0)} \checkmark$$

$$h = 9,8 \text{ m} \checkmark$$

OPTION 6/OPSIE 6**UPWARD POSITIVE/OPWAARTS POSITIEF**

$$v_f = v_i + a\Delta t$$

$$= 0 + -9,8(1)$$

$$v_f = -9,8 \text{ m}\cdot\text{s}^{-1}$$

DOWNWARD POSITIVE/AFWAARTS POSITIEF

$$v_f = v_i + a\Delta t$$

$$= 0 + 9,8(1)$$

$$v_f = 9,8 \text{ m}\cdot\text{s}^{-1}$$

$$W_{\text{nc}} = \Delta K + \Delta U \checkmark$$

$$0 = (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) + (mg\frac{1}{2}h - mgh)$$

$$\underline{(9,8)(\frac{1}{2}h) = (\frac{1}{2})(9,8^2 - 0)} \checkmark$$

$$h = 9,8 \text{ m} \checkmark$$

(3)

3.3

OPTION 1/OPSIE 1**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$= 0 + (2)(-9,8)(-9,8) \checkmark$$

$$v_f = 13,86 \text{ m}\cdot\text{s}^{-1} \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$= 0 + (2)(9,8)(9,8) \checkmark$$

$$v_f = 13,86 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OR/OF**FROM POINT B/ VANAF PUNT B****UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$= (-9,8)^2 + (2)(-9,8)(-4,9) \checkmark$$

$$v_f = -13,86 \text{ m}\cdot\text{s}^{-1}$$

$$\text{Magnitude} = 13,86 \text{ m}\cdot\text{s}^{-1} \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$= (9,8)^2 + (2)(9,8)(4,9) \checkmark$$

$$v_f = 13,86 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(3)

OPTION 2/OPSIE 2

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$-9,8 = 0 + \frac{1}{2}(-9,8)\Delta t^2$$

$$\Delta t = 1,41 \text{ s}$$

1 mark for either of the two/
1 punt vir enige van die twee

$$v_f = v_i + a\Delta t$$

$$= 0 + (-9,8)(1,41) \checkmark$$

$$= -13,82 \text{ m}\cdot\text{s}^{-1}$$

$$\text{Magnitude} = 13,82 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(3)

3.4

OPTION 1/OPSIE 1**POSITIVE MARKING FROM 3.3/POSITIEWE NASIEN VANAF 3.3****UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF**

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0 = v_i^2 + (2)(-9,8)(4,9) \checkmark$$

$$v_i = 9,8 \text{ m}\cdot\text{s}^{-1}$$

$$F_{\text{net}}\Delta t = m\Delta v$$

$$F_{\text{net}}\Delta t = m(v_f - v_i) \checkmark$$

$$F_{\text{net}}(0,2) \checkmark = 0,4[9,8 - (-13,86)] \checkmark$$

$$F_{\text{net}} = 47,32 \text{ N} \checkmark$$

1 mark for any
1 punt vir enige een

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0 = v_i^2 + (2)(9,8)(-4,9) \checkmark$$

$$v_i = -9,8 \text{ m}\cdot\text{s}^{-1}$$

$$F_{\text{net}}\Delta t = m\Delta v$$

$$F_{\text{net}}\Delta t = m(v_f - v_i) \checkmark$$

$$F_{\text{net}}(0,2) \checkmark = 0,4[-9,8 - (13,86)] \checkmark$$

$$F_{\text{net}} = -47,32 \text{ N}$$

$$F_{\text{net}} = 47,32 \text{ N} \checkmark$$

1 mark for any
1 punt vir enige een

If calculation of $9,8 \text{ m}\cdot\text{s}^{-1}$ is not shown and it is substituted **correctly** award 1 mark/Indien berekening van $9,8 \text{ m}\cdot\text{s}^{-1}$ nie getoon is nie en dit is **korrek** vervang ken 1 punt toe

OPTION 2/OPSIE 2**POSITIVE MARKING FROM 3.3/ POSITIEWE NASIEN VANAF 3.3**

$$E_{\text{mech top/bo}} = E_{\text{(mech ground/meg grond)}}$$

$$(E_p + E_k)_{\text{top}} = (E_p + E_k)_{\text{bottom/onder}}$$

$$(mgh + \frac{1}{2}mv^2)_{\text{top/bo}} = (mgh + \frac{1}{2}mv^2)_{\text{bottom/onder}}$$

$$(0,4)(9,8)(4,9) + 0 = \frac{1}{2}(0,4)v_f^2 \checkmark$$

$$v_i = 9,8 \text{ m}\cdot\text{s}^{-1}$$

$$F_{\text{net}}\Delta t = m\Delta v$$

$$F_{\text{net}}\Delta t = m(v_f - v_i) \checkmark$$

$$F_{\text{net}}(0,2) \checkmark = 0,4[9,8 - (-13,86)] \checkmark$$

$$F_{\text{net}} = 47,32 \text{ N} \checkmark$$

1 mark for any
1 punt vir enige een

1 mark for any
1 punt vir enige een

If calculation of $9,8 \text{ m}\cdot\text{s}^{-1}$ is not shown and it is substituted **correctly** award 1 mark/Indien berekening van $9,8 \text{ m}\cdot\text{s}^{-1}$ nie getoon is nie en dit is **korrek** vervang ken 1 punt toe

(6)

OPTION 3/OPSIE 3**POSITIVE MARKING FROM 3.3/ POSITIEWE NASIEN VANAF 3.3**

$$v_f = v_i + a\Delta t \checkmark$$

$$9,8 = -13,86 \checkmark + a(0,2) \checkmark$$

$$a = 118,3 \text{ m}\cdot\text{s}^{-2}$$

$$F_{\text{net}} = ma \checkmark$$

$$= (0,4)(118,3) \checkmark$$

$$= 47,32 \text{ N} \checkmark$$

(6)

[14]

QUESTION 4/VRAAG 4

4.1

$E_{(\text{mech top/meg bo})} = E_{(\text{mech bottom/meg onder})}$ $(E_p + E_k)_{\text{top/bo}} = (E_p + E_k)_{\text{bottom/onder}}$ $(mgh + \frac{1}{2}mv^2)_{\text{top/bo}} = (mgh + \frac{1}{2}mv^2)_{\text{bottom/onder}}$ $(1,5)(9,8)(2) + 0 \checkmark = 0 + \frac{1}{2}(1,5)v^2 \checkmark$ $v = 6,26 \text{ m}\cdot\text{s}^{-1} \checkmark$	$\left. \vphantom{\begin{array}{l} E_{(\text{mech top/meg bo})} = E_{(\text{mech bottom/meg onder})} \\ (E_p + E_k)_{\text{top/bo}} = (E_p + E_k)_{\text{bottom/onder}} \\ (mgh + \frac{1}{2}mv^2)_{\text{top/bo}} = (mgh + \frac{1}{2}mv^2)_{\text{bottom/onder}} \\ (1,5)(9,8)(2) + 0 \checkmark = 0 + \frac{1}{2}(1,5)v^2 \checkmark \\ v = 6,26 \text{ m}\cdot\text{s}^{-1} \checkmark \end{array}} \right\}$	1 mark for any 1 punt vir enigeen

(4)

4.2 In a/an closed/isolated✓ system, the total✓ linear momentum is conserved.
 /In 'n geïsoleerde/geslote sisteem bly die totale liniêre momentum behoue. (2)

4.3

POSITIVE MARKING FROM 4.1/POSITIEWE NASIEN VANAF 4.1		
$\Sigma p_i = \Sigma p_f$ $m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$ $m_1v_{1i} + m_2v_{2i} = (m_1 + m_2)v$ $(1,5)(6,26) + 0 \checkmark = (1,5 + 2)v_f \checkmark$ $v_f = 2,68 \text{ m}\cdot\text{s}^{-1} \checkmark$	$\left. \vphantom{\begin{array}{l} \Sigma p_i = \Sigma p_f \\ m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f} \\ m_1v_{1i} + m_2v_{2i} = (m_1 + m_2)v \\ (1,5)(6,26) + 0 \checkmark = (1,5 + 2)v_f \checkmark \\ v_f = 2,68 \text{ m}\cdot\text{s}^{-1} \checkmark \end{array}} \right\}$	1 mark for any 1 punt vir enige een

(4)

4.4 **POSITIVE MARKING FROM 4.3/POSITIEWE NASIEN VANAF 4.3**

OPTION 1/OPSIE 1

$$\Delta x = v\Delta t \checkmark$$

$$= (2,68)(3) \checkmark$$

$$= 8,04 \text{ m} \checkmark$$

OPTION 2/OPSIE 2

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{(2,68 + 2,68)}{2} \right) (3) \checkmark$$

$$= 8,04 \text{ m}$$

OPTION 3/OPSIE 3

$$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$= (2,68)(3) + \frac{1}{2}(0)(3)^2 \checkmark$$

$$= 8,04 \text{ m} \checkmark$$

(Range 8,04 – 8,05)

(2)
[13]

QUESTION 5/VRAAG 5

5.1



Accepted labels/Aanvaarde benoemings	
w	F_g/F_w /weight/mg/gravitational force/N/19,6 N F_g/F_w /gewig/mg/gravitasiekrag/19,6 N
T	Tension/ F_T / F_A / <i>Spanning</i>

Notes/Aantekeninge:

- Mark awarded for label and arrow/*Punt toegeken vir benoeming en pyltjie*
- Do not penalise for length of arrows since drawing is not to scale./*Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie*
- Any other additional force(s)/*Enige ander addisionele krag(te)* Max/Maks $\frac{1}{2}$
- If force(s) do not make contact with body/*Indien krag(te) nie met die voorwerp kontak maak nie*: Max/Maks: $\frac{1}{2}$

(2)

5.2 Tension✓/Spanning

Accept/Aanvaar F_{applied} / F_{toegepas}

(1)

5.3

$$\begin{aligned}
 W &= F \Delta x \cos \theta \\
 W_w &= mg \Delta x \cos \theta \\
 &= 75(9,8)(12) \cos 180^\circ \checkmark \\
 &= -8\,820 \text{ J} \checkmark
 \end{aligned}$$

1 mark for any of these/1 punt vir enige van hierdie

OR/OF

$$\begin{aligned}
 W_w &= -\Delta E_p \checkmark \\
 &= -(mgh - 0) \\
 &= -(75)(9,8)(12) \checkmark \\
 &= -8\,820 \text{ J} \checkmark
 \end{aligned}$$

(3)

- 5.4 The work done on an object by a net force is equal to the change in the object's kinetic energy. ✓✓

Die arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie.

OR/OF

The net work done on an object is equal to the change in the object's kinetic energy. ✓✓

Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in die voorwerp se kinetiese energie.

(2)

NOTE:/LET WEL

If any one of the underlined key words in the **correct context** is omitted deduct 1 mark.

*Indien enige van die onderstreepte woorde in die **korrekte konteks** uitgelaat is trek 1 punt af.*

- 5.5

POSITIVE MARKING FROM 5.3/POSITIEWE NASIEN VANAF 5.3

OPTION 1/OPSIE 1

$$W_{\text{net}} = \Delta K$$

$$F_{\text{net}} \Delta x \cos \theta = \left(\frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \right)$$

1 mark for any of these
1 punt vir enige van hierdie

$$(75)(0,65)(12) \checkmark \cos 0^\circ \checkmark = \frac{1}{2}(75)(v_f^2 - 0) \checkmark$$

$$v_f = 3,95 \text{ m} \cdot \text{s}^{-1} (3,949 \text{ m} \cdot \text{s}^{-1}) \checkmark$$

POSITIVE MARKING FROM 5.2/POSITIEWE NASIEN VANAF 5.2

OPTION 2/OPSIE 2

$$W_{\text{net}} = \Delta K$$

$$W_{\text{nc/nk}} = \Delta K + \Delta U$$

$$W_T + W_g = \Delta K$$

1 mark for any of these/1 punt vir enige van hierdie

$$T - mg = ma$$

$$T - 75(9,8) = 75(0,65) \checkmark$$

$$T = 783,75 \text{ N}$$

$$W_T = 783,75 (12) \cos 0^\circ \checkmark$$

$$= 9405 \text{ J}$$

$$9405 - (8820) = \frac{1}{2} (75)(v_f^2 - 0) \checkmark$$

$$v_f = 3,95 \text{ m} \cdot \text{s}^{-1} (3,949 \text{ m} \cdot \text{s}^{-1}) \checkmark$$

$$W_{\text{nc/nk}} = \left(\frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \right) + (mgh_f - mgh_i)$$

$$9405 \checkmark = \left(\frac{1}{2} (75) v_f^2 - 0 \right) \checkmark + (75)(9,8)(12 - 0) \checkmark$$

$$v_f = 3,95 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(5)
[13]

QUESTION 6/VRAAG 6

- 6.1 It is the (apparent) change in frequency (or pitch) of the sound (detected by a listener) ✓ because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓

Dit is die verandering in frekwensie (of toonhoogte) van die klank (waargeneem deur 'n luisteraar) omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klankvoortplanting het.

OR/OF

An (apparent) change in (observed/detected) frequency (pitch), (wavelength) ✓ as a result of the relative motion between a source and an observer ✓ (listener).

'n Skynbare verandering in (waargenome) frekwensie (toonhoogte), (golflengte) as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer / luisteraar.

(2)

NOTE:/LET WEL

If any one of the underlined key words in the **correct context** is omitted deduct 1 mark.

*Indien enige van die onderstreepte woorde in die **korrekte konteks** uitgelaat is trek 1 punt af.*

- 6.2

OPTION 1/OPSIE 1

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \checkmark$$

OR/OF

$$f_L = \frac{v}{v - v_s} f_s$$

$$(5100) = \frac{340}{(340 - 240)} f_s \quad \checkmark$$

$$f_s = 1\,500 \text{ Hz}$$

$$v = f\lambda \quad \checkmark$$

$$340 = (1\,500)\lambda \quad \checkmark$$

$$\lambda = 0,23 \text{ m} \quad \checkmark$$

(7)

OPTION 2/OPSIE 2

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \checkmark$$

OR/OF

$$f_L = \frac{v}{v - v_s} \left(\frac{v}{\lambda_s} \right)$$

$$(5100) = \left(\frac{340}{(340 - 240)} \right) \left(\frac{340}{\lambda_s} \right) \quad \checkmark \checkmark$$

$$\lambda = 0,23 \text{ m} \quad \checkmark$$

(7)

- 6.3 Greater than ✓ / Groter as

(1)

[10]

QUESTION 7/VRAAG 7

- 7.1 The two forces must be equal in magnitude ✓ but in opposite directions ✓/Die twee kragte moet gelyke groottes hê maar in teenoorgestelde rigtings werk.

OR/OF

The force experienced by Q due to P, must be equal in magnitude ✓ but opposite in direction to the force experienced by Q due to V. ✓/Die krag wat Q agv P ondervind moet gelyk in grootte maar teenoorgesteld in rigting wees met die krag wat Q agv V ondervind

(2)

- 7.2 The magnitude of the electrostatic force exerted by one point charge on another point charge is directly proportional to the product of the (magnitudes of the) charges ✓ and inversely proportional to the square of the distance (r) between them. ✓

Die grootte van die elektrostatische krag uitgeoefen deur een puntlading op 'n ander puntlading is direk eweredig aan die produk van die (groottes van die) ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle.

OR/OF

The force of attraction or repulsion between two point charges is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between them. ✓

Die aantrekkings- of afstotingskrag tussen twee puntladings is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle

(2)

NOTE: ILET WEL

If mass is mentioned instead of charges. $\frac{0}{2}$

Indien massa in plaas van ladings genoem word. $\frac{0}{2}$

NOTE: ILET WEL

If any one of the underlined key words in the **correct context** is omitted deduct 1 mark.

Indien enige van die onderstreepte woorde in die **korrekte konteks** uitgelaat is trek 1 punt af.

7.3

OPTION 1/OPSIE 1

$$F = k \frac{Q_1 Q_2}{r^2} \checkmark$$

$$F_{PQ} = \frac{(9 \times 10^9)(Q)(5 \times 10^{-6})}{(x)^2} \checkmark$$

$$= \frac{45 \times 10^3 Q}{x^2}$$

$$F_{VQ} = \frac{(9 \times 10^9)(Q)(7 \times 10^{-6})}{(1-x)^2} \checkmark$$

$$= \frac{63 \times 10^3 Q}{(1-x)^2}$$

$$(F_{\text{net}} = F_{PQ} - F_{VQ} = 0)$$

$$\frac{45 \times 10^3 Q}{x^2} = \frac{63 \times 10^3 Q}{(1-x)^2} \checkmark \text{ (equating two equations)}$$

$$6,708(1-x) = 7,937x$$

$$x = 0,458 \text{ m}$$

x is 0,46 m ✓ (away from P/weg van P)

(5)

OPTION 2/OPSIE 2

$$E = \frac{kQ_p}{r^2} \checkmark$$

$$E_{\text{net}} = \frac{kQ_p}{r^2} - \frac{kQ_v}{r^2}$$

$$(E_{\text{net}} = E_p - E_v = 0)$$

$$0 = \frac{(9 \times 10^9)(5 \times 10^{-6})}{x^2} \checkmark - \frac{(9 \times 10^9)(7 \times 10^{-6})}{(1-x)^2} \checkmark$$

$$\frac{(9 \times 10^9)(5 \times 10^{-6})}{x^2} = \frac{(9 \times 10^9)(7 \times 10^{-6})}{(1-x)^2} \checkmark \text{ (equating two equations)}$$

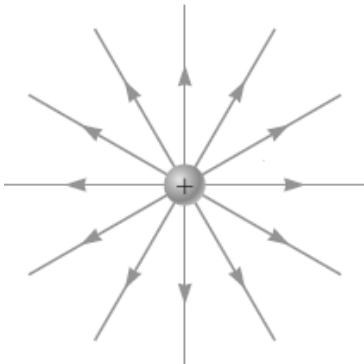
$\therefore x = 0,46 \text{ m} \checkmark$ (away from P/weg van P)

(5)
[9]

QUESTION 8/VRAAG 8

8.1

(2)



Criteria for sketch/ <i>Kriteria vir skets</i>	Marks/ Punte
Lines are directed away from the charge / <i>Lyne is weg vanaf die lading</i>	✓
Lines are radial, start on sphere and do not cross./ <i>Lyne is radiaal, begin op die sfeer en kruis nie</i>	✓

8.2

$$\begin{aligned}
 Q &= ne \checkmark \\
 &= (8 \times 10^{13})(-1,6 \times 10^{-19}) \checkmark \text{ or/of } (8 \times 10^{13})(1,6 \times 10^{-19}) \\
 &= -12,8 \times 10^{-6} \\
 \text{Net charge on the sphere} &= (+6 \times 10^{-6}) + (-12,8 \times 10^{-6}) \checkmark \\
 Q_{\text{net}} &= -6,8 \times 10^{-6} \text{ C} \\
 E &= \frac{kQ}{r^2} \checkmark \\
 E &= \frac{(9 \times 10^9)(6,8 \times 10^{-6})}{(0,5)^2} \checkmark \\
 &= 2,45 \times 10^5 \text{ N} \cdot \text{C}^{-1} \checkmark \text{ towards sphere } \checkmark / \text{na die sfeer}
 \end{aligned}$$

(7)
[9]**QUESTION 9/VRAAG 9**

- 9.1.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature.
Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur.

OR/OF

The ratio of potential difference across a conductor to the current in the conductor is constant, provided the temperature remains constant.
Die verhouding van potensiaalverskil oor die geleier tot stroom in die geleier is konstant indien die temperatuur konstant bly.

(2)

NOTE:/LET WEL

If any one of the underlined key words in the **correct context** is omitted deduct 1 mark.

*Indien enige van die onderstreepte woorde in die **korrekte konteks** uitgelaat is trek 1 punt af.*

9.1.2

$$\begin{aligned}
 V_1 &= IR \checkmark \\
 &= (0,6)(4) \checkmark \\
 &= 2,4 \text{ V } \checkmark
 \end{aligned}$$

(3)

9.1.3	POSITIVE MARKING FROM 9.1.2/ POSITIEWE NASIEN VANAF 9.1.2 $I_{6\Omega} = \frac{V}{R}$ $= \frac{2,4}{6} \checkmark$ $= 0,4 \text{ A} \checkmark$	OR/OF $\frac{6}{10}(I) = 0,6 \checkmark$ $I = 1 \text{ A}$ $I_{6\Omega} = 0,4 \text{ A} \checkmark$	OR/OF $V_{4\Omega} = V_{6\Omega}$ $I_{4\Omega} R_1 = I_{6\Omega} R_2$ $\frac{(0,6)(4)}{6} = I_{6\Omega} \checkmark$ $I_{6\Omega} = 0,4 \text{ A} \checkmark$	(2)

9.1.4	POSITIVE MARKING FROM 9.1.3 / POSITIEWE NASIEN VANAF 9.1.3 $V_2 = IR$ $= (0,4 + 0,6)(5,8) \checkmark$ $= 5,8 \text{ V} \checkmark$	(2)

9.1.5	POSITIVE MARKING FROM 9.1.4 AND 9.1.2/ POSITIEWE NASIEN VANAF 9.1.4 EN 9.1.2 OPTION 1/ OPSIE 1 $V_{\text{ext}} = (5,8 + 2,4) \checkmark$ $= 8,2 \text{ V}$ $V_{\text{int}} = Ir$ $= (1)(0,8) \checkmark$ $= 0,8 \text{ V}$ $\text{Emf} = 0,8 + 8,2 = 9 \text{ V} \checkmark$	

OPTION 2/ OPSIE 2 $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ $= \frac{1}{6} + \frac{1}{4}$ $= \frac{5}{12}$ $R_p = 2,4 \Omega$ $R_{\text{ext}} = (2,4 + 5,8) \checkmark$ $= 8,2 \Omega$ $\text{Emf} = I(R + r)$ $= 1(8,2 + 0,8) \checkmark$ $= 9 \text{ V} \checkmark$		$R_{//} = \frac{R_1 R_2}{R_1 + R_2}$ $= \frac{(6)(4)}{(6+4)}$ $= 2,4 \Omega$	(3)

9.1.6	POSITIVE MARKING FROM 9.1.5 AND 9.1.3/ POSITIEWE NASIEN VANAF 9.1.5 EN 9.1.3		
$W = V I \Delta t \checkmark$ $= (0,8)(1)(15) \checkmark$ $= 12 \text{ J} \checkmark$	$W = I^2 R \Delta t \checkmark$ $= (1)^2 (0,8)(15) \checkmark$ $= 12 \text{ J} \checkmark$	$W = \frac{V^2 \Delta t}{R} \checkmark$ $= \frac{0,8^2 (15)}{0,8} \checkmark$ $= 12 \text{ J} \checkmark$	(3)

9.2.1

$$\begin{aligned}
 R &= \frac{V}{I} \\
 &= \frac{2,8}{0,7} \checkmark \\
 &= 4 \, \Omega \checkmark
 \end{aligned}$$

(2)

9.2.2

Increases ✓/Neem toe

Total resistance decreases, ✓ current/power increases✓, motor turns faster/

Totale weerstand neem af, stroom/drywing neem toe, motor draai vinniger

(3)

[20]

QUESTION 10/VRAAG 10

10.1

10.1.1 Split ring / commutator ✓/Spleetring/ kommutator

(1)

10.1.2 Anticlockwise ✓✓/Antikloksgewys

(2)

10.1.3 Electrical energy ✓to mechanical(kinetic) energy ✓

Elektriese energie na meganiese (kinetiese) energie

(2)

10.2

10.2.1 DC generator: split ring/commutator and AC generator has slip rings✓

GS-generator spleetringe/kommutator en WS-generator sleepinge

OR/OF

AC generator: slip ring and DC generator has split rings✓

WS-generator sleepinge en GS-generator spleetringe

(1)

10.2.2

$$\begin{aligned}
 V_{\text{rms}} &= \frac{V_{\text{max}}}{\sqrt{2}} \checkmark \\
 &= \frac{320}{\sqrt{2}} \checkmark \\
 &= 226,27 \, \text{V} \checkmark
 \end{aligned}$$

(3)

10.2.3

OPTION 2/OPSIE 12

$$\begin{aligned}
 I_{\text{max}} &= \frac{V_{\text{max}}}{R} \\
 &= \frac{320}{35} \checkmark \\
 &= 9,14 \, \text{A} \\
 I_{\text{rms}} &= \frac{I_{\text{max}}}{\sqrt{2}} \checkmark \\
 &= \frac{9,14}{\sqrt{2}} \checkmark \\
 &= 6,46 \, \text{A} \checkmark
 \end{aligned}$$

POSITIVE MARKING FROM 10.2.2/ POSITIEWE NASIEN VANAF 10.2.2.2.**OPTION 2/OPSIE 2**

$$\begin{aligned}
 P_{\text{average}} &= \frac{V_{\text{rms}}^2}{R} \\
 &= \frac{226,27^2}{35} \checkmark \\
 &= 1462,80 \text{ W}
 \end{aligned}$$

$$\begin{aligned}
 P_{\text{average}} &= V_{\text{rms}} I_{\text{rms}} \checkmark \\
 1\,462,80 &= (226,27) I_{\text{rms}} \checkmark \\
 I_{\text{rms}} &= 6,46 \text{ A} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 P_{\text{average}} &= I_{\text{rms}}^2 R \checkmark \\
 1\,462,80 &= I_{\text{rms}}^2 (35) \checkmark \\
 I_{\text{rms}} &= 6,46 \text{ A} \checkmark
 \end{aligned}$$

(4)

POSITIVE MARKING FROM 10.2.2/ POSITIEWE NASIEN VANAF 10.2.2.2**OPTION 1/OPSIE 1**

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \checkmark = \frac{226,27}{35} \checkmark = 6,46 \text{ A} \checkmark$$

(4)

[13]**QUESTION 11/VRAAG 11**

- 11.1 Work function (of a metal) is the minimum energy needed to eject an electron from the metal/surface

Werksfunksie (van 'n metaal) is die minimum energie benodig om 'n elektron vanaf die metaal/oppervlak vry te stel.

(2)

NOTE:/LET WEL

If any one of the underlined key words in the **correct context** is omitted deduct 1 mark.

*Indien enige van die onderstreepte woorde in die **korrekte konteks** uitgelaat is trek 1 punt af.*

- 11.2 (Maximum) kinetic energy of the ejected electrons ✓
(Maksimum) kinetiese energie van die vrygestelde elektrone.

(1)

- 11.3 Wavelength/Frequency (of light) ✓
Golflengte/frekwensie (van lig)

(1)

- 11.4 Silver ✓ / Silwer



According to Photoelectric equation, $hf = W_0 + \frac{1}{2} mv^2$

(For a given constant frequency), as the work function increases the kinetic energy decreases. ✓ Silver has the smallest kinetic energy ✓ and hence the highest work function./

Volgens die fotoelektriese vergelyking $hf = W_0 + \frac{1}{2} mv^2$:

(Vir 'n gegewe konstante frekwensie) as die werksfunksie verhoog, verlaag die kinetiese energie. Silwer het die kleinste kinetiese energie en dus die hoogste werksfunksie.

(3)

11.5

$$\begin{aligned}
 hf &= W_o + \frac{1}{2}mv_{\text{max/maks}}^2 \\
 h \frac{c}{\lambda} &= W_o + E_{k(\text{max/maks})} \quad \checkmark \\
 \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{2 \times 10^{-8}} \checkmark &= W_o + 9,58 \times 10^{-18} \checkmark \\
 9,945 \times 10^{-18} &= W_o + 9,58 \times 10^{-18} \\
 W_o &= 3,65 \times 10^{-19} \text{ J} \checkmark
 \end{aligned}$$

(4)

11.6 REMAINS THE SAME ✓ / BLY DIESELFDE



Increasing intensity increases number of photons(per unit time) but frequency stays constant ✓

the energy of the photon is the same ✓ therefore the kinetic energy does not change.

Verhoging van die intensiteit verhoog die aantal fotone(per eenheidstyd) maar die frekwensie bly konstant

Foton se energie is dieselfde, daarom verander die kinetiese energie nie.

(3)

[14]

TOTAL/TOTAAL:**150**



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

NOVEMBER 2017

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**These marking guidelines consist of 20 pages.
Hierdie nasienriglyne bestaan uit 20 bladsye.**

QUESTION 1 / VRAAG 1

1.1	B ✓✓	(2)
1.2	D ✓✓	(2)
1.3	A ✓✓	(2)
1.4	C ✓✓	(2)
1.5	B ✓✓	(2)
1.6	A ✓✓	(2)
1.7	D ✓✓	(2)
1.8	B ✓✓	(2)
1.9	C ✓✓	(2)
1.10	D ✓✓	(2)
		[20]

QUESTION 2 / VRAAG 2

- 2.1.1 An object continues in its state of rest or uniform motion (moving with constant velocity) unless it is acted upon by an unbalanced (resultant/net) force.✓✓

OR

A body will remain in its state of rest or motion at constant velocity unless a resultant/net force acts on it.✓✓

OR

A body will remain in its state of rest or of uniform motion in a straight line at constant velocity/speed unless a non-zero resultant/net force acts on it.✓✓

'n Liggaam sal in sy toestand van rus of uniforme beweging (teen konstante snelheid) volhard tensy 'n ongebalanseerde (resulterende/netto) krag daarop inwerk.

OF

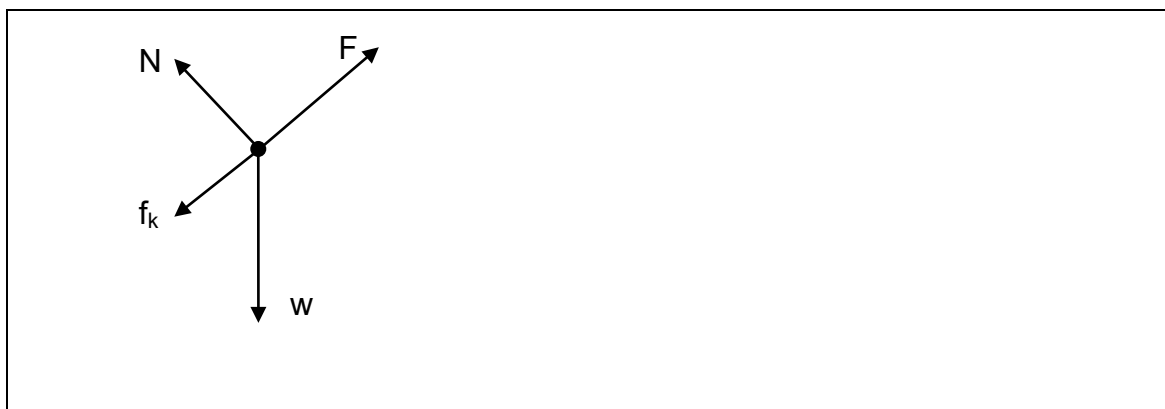
'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid bly tensy 'n resulterende/netto krag daarop inwerk

OF

'n Liggaam sal in sy toestand van rus of uniforme beweging in 'n reguitlyn teen konstante snelheid/spoed volhard tensy 'n nie-nul resulterende/netto krag daarop inwerk.

(2)

- 2.1.3



Accepted Labels/Aanvaarde benoemings	
w	F_g / F_w /weight/mg /78,4 N/gravitational force F_g / F_w /gewig/mg/78,4 N/gravitasiekrag
F	F_{app} / F_A / applied force (Accept T / tension) $F_{toegepas}$ / F_T / toegepaste krag (Aanvaar T / spanning)
f_k	(kinetic) Friction/ F_f / f /(kineties) wrywing/ F_w
N	F_N /Normal (force)/Normaal(krag)/ 67,9 N

(4)

2.1.3

$$\begin{aligned}
 F_{\text{net}} &= ma \checkmark \\
 F_{\text{net}} &= 0 \\
 F + (-f_k) + (-F_{\text{gll}}) &= ma \\
 F - (f_k + F_{\text{gll}}) &= ma \\
 F - 20,37 \checkmark - (8)(9,8)\sin 30^\circ \checkmark &= 0 \\
 F &= 59,57 \text{ N} \checkmark
 \end{aligned}$$

(5)

2.1.4

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$ \begin{aligned} F_{\text{net}} &= ma \\ (F_{\text{gll}} - f_k) &= ma \checkmark \\ (8)(9,8)\sin 30^\circ - 20,37 \checkmark &= 8a \checkmark \\ \therefore \text{magnitude/grootte: } a &= 2,35 \text{ m}\cdot\text{s}^{-2} \checkmark \end{aligned} $	$ \begin{aligned} F_{\text{net}} &= ma \\ (f_k - F_{\text{gll}}) &= ma \checkmark \\ 20,37 + [-(8)(9,8)\sin 30^\circ] \checkmark &= 8a \checkmark \\ \therefore a &= -2,35 \text{ m}\cdot\text{s}^{-2} \\ \therefore \text{magnitude/grootte: } a &= 2,35 \text{ m}\cdot\text{s}^{-2} \checkmark \end{aligned} $

(4)

2.2.1

Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses $\checkmark$ and inversely proportional to the square of the distance between their centres. $\checkmark$

Elke liggaam in die heelal trek elke ander liggaam aan met 'n krag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul middelpunte.

OR/OF

Every particle in the universe attracts every other particle with a force along a line joining them. The force is directly proportional to the product of the masses $\checkmark$ of the particles and inversely proportional to the square of the distance between them. $\checkmark$

Elke partikel in die heelal trek elke ander partikel aan met 'n krag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hulle.

(2)

2.2.2

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$ \begin{aligned} g &= \frac{GM}{r^2} \checkmark \\ \checkmark 6 &= \frac{(6,67 \times 10^{-11})M}{(700 \times 10^3)^2} \checkmark \\ M &= 4,41 \times 10^{22} \text{ kg} \checkmark \end{aligned} $	$ \begin{aligned} F &= G \frac{m_1 m_2}{r^2} \\ mg &= \frac{GmM}{r^2} \checkmark \\ (200)(6) &= \frac{(6,67 \times 10^{-11})(200)M}{(700 \times 10^3)^2} \checkmark \\ M &= 4,41 \times 10^{22} \text{ kg} \checkmark \end{aligned} $

(4)

[21]

QUESTION 3 / VRAAG 3

3.1

OPTION 1/OPSIE 1	
Upwards positive Opwaarts positief: $v_f = v_i + a\Delta t$ ✓ $0 = (12) + (-9,8)(\Delta t)$ ✓ $\Delta t = 1,22 \text{ s}$ ✓	Downwards positive Afwaarts positief: $v_f = v_i + a\Delta t$ ✓ $0 = (-12) + (9,8)(\Delta t)$ ✓ $\Delta t = 1,22 \text{ s}$ ✓

OPTION 2/OPSIE 2	
Upwards positive Opwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ $0 = 12^2 + 2(-9,8)\Delta y$ ✓ $\Delta y = 7,35$ $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $7,35 = 12\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ $\Delta t = 1,22 \text{ s}$ ✓	Downwards positive Afwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ $0 = (-12)^2 + 2(9,8)\Delta y$ ✓ $\Delta y = -7,35$ $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $-7,35 = -12\Delta t + \frac{1}{2}(9,8)\Delta t^2$ $\Delta t = 1,22 \text{ s}$ ✓

OPTION 3/OPSIE 3	
Upwards positive Opwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ $0 = 12^2 + 2(-9,8)\Delta y$ ✓ $\Delta y = 7,35 \text{ m}$ $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $7,35 = \frac{(12 + 0)}{2}\Delta t$ $\Delta t = 1,22 \text{ s}$ ✓	Downwards positive Afwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ $0 = (-12)^2 + 2(9,8)\Delta y$ ✓ $\Delta y = -7,35 \text{ m}$ $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $-7,35 = \frac{(-12 + 0)}{2}\Delta t$ $\Delta t = 1,22 \text{ s}$ ✓

OPTION 4/OPSIE 4	
$(E_{\text{mech}})_A = (E_{\text{mech}})_{\text{top}}$ $(\frac{1}{2}mv^2 + mgh)_A = (\frac{1}{2}mv^2 + mgh)_{\text{top}}$ $\frac{1}{2}m(12)^2 + 0 = 0 + m(9,8)(h)$ ✓ $\therefore h = \Delta y = 7,35 \text{ m}$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $7,35 = \frac{(12 + 0)}{2}\Delta t$ $\Delta t = 1,22 \text{ s}$ ✓
OR/OF $W_{\text{net}} = \Delta E_k$ $F_{\text{net}}\Delta y \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2)$ $m(9,8)\Delta y \cos 180^\circ = \frac{1}{2}m(0^2 - (12)^2)$ ✓ $\Delta y = 7,35 \text{ m}$	
OR/OF $\Delta E_p + \Delta E_k = 0$ $mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2) = 0$ $m(9,8)(h - 0) + \frac{1}{2}m(0 - 12^2) = 0$ ✓ $\therefore h = \Delta y = 7,35 \text{ m}$	

OPTION 5/OPSIE 5	
Upwards positive Opwaarts positief: $F_{\text{net}}\Delta t = m(v_f - v_i) \checkmark$ $mg\Delta t = m(v_f - v_i)$ $(-9,8)\Delta t = (0 - 12) \checkmark$ $\Delta t = 1,2245 \text{ s} \checkmark$	Downwards positive Afwaarts positief: $F_{\text{net}}\Delta t = m(v_f - v_i) \checkmark$ $mg\Delta t = m(v_f - v_i)$ $(9,8)\Delta t = (0 - (-12)) \checkmark$ $\Delta t = 1,2245 \text{ s} \checkmark$

OPTION 6/OPSIE 6	
Upwards positive Opwaarts positief: $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $0 = 12\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ $\Delta t = 2,4490 \text{ s}$ $\Delta t = \frac{1}{2}(2,4490) \checkmark$ $= 1,2245 \text{ s} \checkmark$	Downwards positive Afwaarts positief: $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $0 = -12\Delta t + \frac{1}{2}(9,8)\Delta t^2$ $\Delta t = 2,4490 \text{ s}$ $\Delta t = \frac{1}{2}(2,4490) \checkmark$ $= 1,2245 \text{ s} \checkmark$

(3)

3.2

OPTION 1/OPSIE 1

Upwards positive Opwaarts positief: $v_f = v_i + a\Delta t \checkmark$ $-3v = -v \checkmark + (-9,8)(1,22) \checkmark$ $v = 5,98 \text{ m}\cdot\text{s}^{-1} \checkmark (5,978 - 6,03 \text{ m}\cdot\text{s}^{-1})$	Downwards positive Afwaarts positief: $v_f = v_i + a\Delta t \checkmark$ $3v = v \checkmark + (9,8)(1,22) \checkmark$ $v = 5,98 \text{ m}\cdot\text{s}^{-1} \checkmark (5,978 - 6,03 \text{ m}\cdot\text{s}^{-1})$

OPTION 2/OPSIE 2	
Upwards positive Opwaarts positief: $F_{\text{net}}\Delta t = m(v_f - v_i) \checkmark$ $mg\Delta t = m(v_f - v_i)$ $(-9,8)(1,2245) \checkmark = -3v - (-v) \checkmark$ $v = 6,00 \text{ m}\cdot\text{s}^{-1} \checkmark$	Downwards positive Afwaarts positief: $F_{\text{net}}\Delta t = m(v_f - v_i) \checkmark$ $mg\Delta t = m(v_f - v_i)$ $(9,8)(1,2245) \checkmark = 3v - v \checkmark$ $v = 6,00 \text{ m}\cdot\text{s}^{-1} \checkmark$

(4)

3.3

OPTION 1/OPSIE 1

Upwards positive Opwaarts positief: $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $= (-5,98)(2,44) + \frac{1}{2}(-9,8)(2,44)^2 \checkmark$ $= -43,764$ $\therefore h = 43,76 \text{ m} \checkmark (43,764 - 44,08 \text{ m})$	Downwards positive Afwaarts positief: $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $= (5,98)(2,44) + \frac{1}{2}(9,8)(2,44)^2 \checkmark$ $= 43,764$ $\therefore h = 43,76 \text{ m} \checkmark (43,764 - 44,08)$

OPTION 2/OPSIE 2	
Upwards positive Opwaarts positief $v_f = v_i + a\Delta t$ $v_f = -5,98 + (-9,8)(2,44)$ $v_f = -29,892 \text{ m}\cdot\text{s}^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $(-29,892)^2 = (-5,98)^2 + 2(-9,8)\Delta y \checkmark$ $\Delta y = -43,763 \text{ m}$ $\therefore h = 43,76 \text{ m} \checkmark (43,764 - 44,08)$	Downwards positive Afwaarts positief: $v_f = v_i + a\Delta t$ $v_f = 5,98 + 9,8(2,44)$ $= 29,892 \text{ m}\cdot\text{s}^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $(29,892)^2 = (5,98)^2 + 2(9,8)\Delta y \checkmark$ $\Delta y = 43,76 \text{ m}$ $\therefore h = 43,76 \text{ m} \checkmark (43,764 - 44,08)$

OPTION 3/OPSIE 3	
Upwards positive Opwaarts positief $v_f = v_i + a\Delta t$ $v_f = -5,98 + (-9,8)(2,44)$ $v_f = -29,892 \text{ m}\cdot\text{s}^{-1}$ $\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $= \left(\left(\frac{-30 + (-6,00)}{2} \right) (2,4490) \right) \checkmark$ $\Delta x = -44,082 \text{ m}$ $h = 44,082 \text{ m} \checkmark$	Downwards positive Afwaarts positief: $v_f = v_i + a\Delta t$ $v_f = 5,98 + 9,8(2,44)$ $= 29,892 \text{ m}\cdot\text{s}^{-1}$ $\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $= \left(\left(\frac{30 + 6,00}{2} \right) (2,4490) \right) \checkmark$ $\Delta x = 44,082 \text{ m}$ $h = 44,082 \text{ m} \checkmark$

OPTION 4/OPSIE 4	
Upwards positive Opwaarts positief For A/ Vir A $v_f = v_i + a\Delta t$ $-12 = 12 + (-9,8)\Delta t$ $\Delta t = 2,45 \text{ s}$ For B/ Vir B $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $= (-5,98)(2,45) + \frac{1}{2}(-9,8)(2,45)^2 \checkmark$ $= -44,06 \text{ m}$ $h = 44,06 \text{ m} \checkmark$	Downwards positive Afwaarts positief: For A/ Vir A $v_f = v_i + a\Delta t$ $12 = -12 + (9,8)\Delta t$ $\Delta t = 2,45 \text{ s}$ For B/ Vir B $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $= (5,98)(2,45) + \frac{1}{2}(9,8)(2,45)^2 \checkmark$ $= 44,06 \text{ m}$ $h = 44,06 \text{ m} \checkmark$

(3)

OPTION 5/OPSIE 5	
Upwards positive Opwaarts positief $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $\Delta y_A = 12\Delta t + \frac{1}{2}a\Delta t^2$ $\Delta y_B = -6\Delta t + \frac{1}{2}a\Delta t^2$ $\Delta y_A - \Delta y_B = 12\Delta t - (-6\Delta t)$ $0 - \Delta y_B = 18\Delta t \checkmark$ $= 18(2,44)$ $= 43,92 \text{ m}$ $h = 43,92 \text{ m} \checkmark$	Downwards positive Afwaarts positief: $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $\Delta y_A = -12\Delta t + \frac{1}{2}a\Delta t^2$ $\Delta y_B = 6\Delta t + \frac{1}{2}a\Delta t^2$ $\Delta y_A - \Delta y_B = 12\Delta t - (-6\Delta t)$ $0 - \Delta y_B = -18\Delta t \checkmark$ $= -18(2,44)$ $= 43,92 \text{ m}$ $h = 43,92 \text{ m} \checkmark$

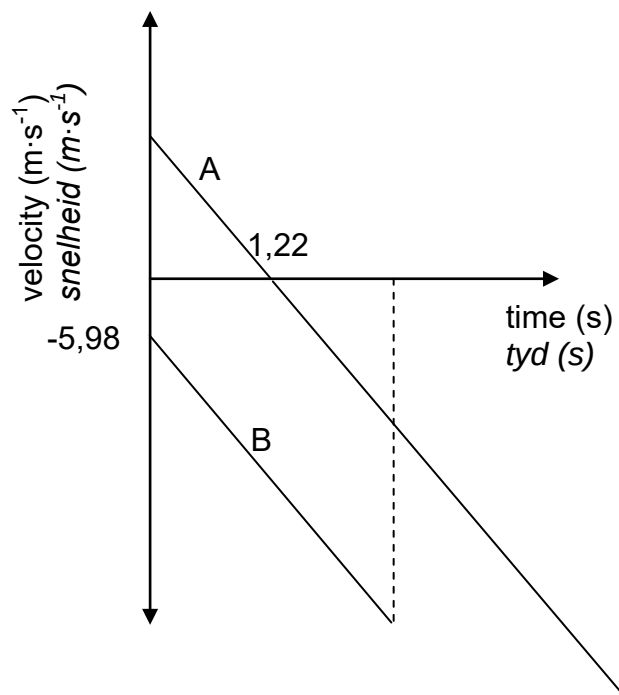
(3)

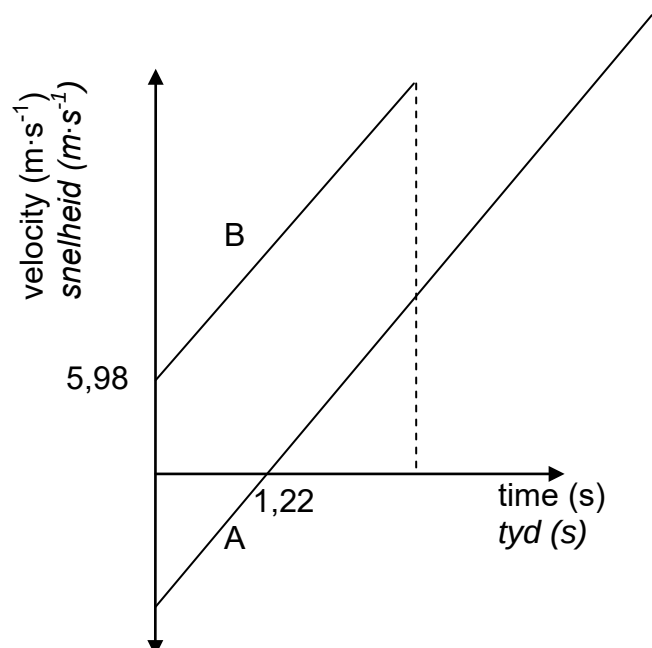
OPTION 6/OPSIE 6	
Upwards positive Opwaarts positief $W_{\text{net}} = \Delta E_k \checkmark$ $mg\Delta y \cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$ $(-9,8)h \cos 0^\circ = \frac{1}{2} (-20)^2 - \frac{1}{2} (-6)^2 \checkmark$ $h = 44,082 \text{ m} \checkmark$	Downwards positive Afwaarts positief: $W_{\text{net}} = \Delta E_k \checkmark$ $mg\Delta y \cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$ $(9,8)h \cos 0^\circ = \frac{1}{2} (20)^2 - \frac{1}{2} (6)^2 \checkmark$ $h = 44,082 \text{ m} \checkmark$

OPTION 7/OPSIE 7
$(E_p + E_k)_{\text{top/bo}} = (E_p + E_k)_{\text{bottom/onder}} \checkmark$ $mgh_i + \frac{1}{2} mv_i^2 = mgh_f + \frac{1}{2} mv_f^2 \checkmark$ $(9,8)h + \frac{1}{2} (6)^2 = (9,8)(0) + \frac{1}{2} (30)^2 \checkmark$ $h = 44,082 \text{ m} \checkmark$

(3)

3.4

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF

Criteria for graph/Kriteria vir grafiek	Marks/Punte
Time 1,22 s shown correctly /Tyd 1,22 s korrek getoon	✓
Initial velocity for stone B at time $t = 0$ correctly shown with correct signs / Aanvanklike snelheid vir klip B korrek met korrekte tekens getoon	✓
Two sloping parallel lines with A crossing the time axis / Twee skuins parallelle lyne met A wat die tyd-as kruis	✓
Straight line graph for A parallel to graph B, extending beyond the time when B hits the ground/ Reguitlyn grafiek A parallel aan grafiek B verleng verby die tyd wanneer B die grond tref	✓

(4)
[14]**QUESTION 4 /VRAAG 4**

- 4.1 The total linear momentum in an isolated/closed system is constant. ✓✓
 Die totale liniêre momentum in 'n geïsoleerde (geslote) sisteem is konstant

OR/OF

In an isolated/closed system, total linear momentum before collision is equal to total linear momentum after collision. ✓✓

In 'n geïsoleerde (geslote) sisteem is die totale liniêre momentum voor die botsing gelyk aan die totale momentum na die botsing.

(2)

4.2 $\Sigma p_i = \Sigma p_f$ ✓

$$m_B v_{Bi} + m_b v_{bi} = m_B v_{Bf} + m_b v_{bf}$$

$$\Delta p_{\text{bullet}} = -\Delta p_{\text{block}}$$

$$(0,015)(400)✓ + 0 = (0,015)v_{Bf} + 2(0,7)✓$$

$$V_{Bf} = 306,67 \text{ (306,666) m} \cdot \text{s}^{-1}✓$$

(4)

4.3

OPTION 1/OPSIE 1

$$\left. \begin{aligned} F_{\text{net}}\Delta t &= \Delta p \\ \Delta p &= mv_f - mv_i \end{aligned} \right\} \checkmark$$

For bullet / Vir koeël

$$\begin{aligned} \Delta p &= (0,015)(306,666 - 400) \checkmark \\ &= -1,4 \text{ kg}\cdot\text{m}\cdot\text{s}^{-1} \\ F_{\text{net}}(0,002) &= -1,4 \\ F_{\text{net}} &= -700 \text{ N} \end{aligned}$$

For block / Vir blok

$$\begin{aligned} \Delta p &= (2)(0,7 - 0) \checkmark \\ &= 1,4 \text{ kg}\cdot\text{m}\cdot\text{s}^{-1} \\ F_{\text{net}}(0,002) &= 1,4 \\ F_{\text{net}} &= 700 \text{ N} \end{aligned}$$

$$\begin{aligned} W_{\text{net}} &= \Delta E_k \\ F_{\text{net}}\Delta x \cos\theta &= \frac{1}{2} m(v_f^2 - v_i^2) \\ (700)\Delta x \cos 180^\circ &\checkmark = \frac{1}{2} (0,015)(306,67^2 - 400^2) \checkmark \\ \Delta x &= 0,71 \text{ m} \checkmark \end{aligned}$$

$$\begin{aligned} F_{\text{net}} &= ma \\ -700 &= (0,015)a \end{aligned}$$

OR/OF

$$\begin{aligned} F_{\text{net}} &= ma \\ 700 &= (0,015)a \end{aligned}$$

$$\begin{aligned} a &= -46\,666,67 \\ \text{or/of } 46\,665 \text{ m}\cdot\text{s}^{-2} \end{aligned}$$

$$\begin{aligned} \Delta x &= v_i\Delta t + \frac{1}{2} a\Delta t^2 \\ &= (400)(0,002) \checkmark + \frac{1}{2} (-46\,666,67)(0,002)^2 \checkmark \\ &= 0,71 \text{ m (0,70667) m} \checkmark \end{aligned}$$

OR/OF

$$\begin{aligned} v_f^2 &= v_i^2 + 2a\Delta x \\ (306,67)^2 \checkmark &= 400^2 + 2(-46\,666,67)\Delta x \checkmark \\ \Delta x &= 0,71 \text{ m (0,70667) m} \checkmark \end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned} v_f &= v_i + a\Delta t \checkmark \\ 306,666 &= 400 + a(0,002) \checkmark \\ a &= -46\,667 \text{ m}\cdot\text{s}^{-2} \end{aligned}$$

$$\begin{aligned} v_f^2 &= v_i^2 + 2a\Delta x \\ (306,666)^2 \checkmark &= 400^2 + 2(-46\,667)\Delta x \checkmark \\ \Delta x &= 0,71 \text{ m (0,706 m)} \checkmark \end{aligned}$$

OPTION 3/OPSIE 3

$$\begin{aligned} \Delta x &= \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark \\ &= \left(\frac{400 + 306,666}{2} \right) (0,002) \checkmark \\ &= 0,71 \text{ m (0,707) m} \checkmark \end{aligned}$$

OPTION 4/OPSIE 4

$$W_{\text{net}} = \Delta K / \Delta E_k \checkmark$$

$$F_{\text{net}} \Delta x \cos \theta = ma \Delta x \cos \theta = \Delta K / \Delta E_k$$

$$v_f = v_i + a \Delta t$$

$$306,666 = 400 + a (0,002) \checkmark$$

$$a = -46\,667 \text{ m} \cdot \text{s}^{-2}$$

$$W_{\text{net}} = \Delta K / \Delta E_k$$

$$F_{\text{net}} \Delta x \cos \theta = ma \Delta x \cos \theta = \Delta K / \Delta E_k$$

$$(0,015)(46\,667) \Delta x \cos 180^\circ \checkmark = \frac{1}{2}(0,015)(306,666^2 - 400^2) \checkmark$$

$$\Delta x = 0,71 \text{ m} (0,707) \checkmark$$

OR/OF

$$W_{\text{nc}} = \Delta E_p + \Delta E_k$$

$$(0,015)(46\,667) \Delta x \cos 180^\circ \checkmark = \frac{1}{2}(0,015)(306,666^2 - 400^2) \checkmark$$

$$\Delta x = 0,71 \text{ m} (0,707) \checkmark$$

(5)
[11]**QUESTION 5/VRAAG 5**

- 5.1 The net/total work done (on an object) is equal to the change in the object's kinetic energy. ✓✓

Die netto/totale arbeid wat (op 'n voorwerp) verrig is is gelyk aan die verandering in die voorwerp se kinetiese energie.

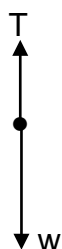
OR/OF

The work done on an object by a resultant/net force is equal to the change in the object's kinetic energy. ✓✓

Die arbeid verrig op in voorwerp deur die resultante/netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie.

(2)

5.2



Accepted labels/Aanvaarde benoemings	
w	F_g / F_w / weight / mg/ 58,8N / gravitational force / $F_{\text{earth on block}}$ F_g / F_w / gewig / mg / 58,8 N/ gravitasiekrag / $F_{\text{aarde op blok}}$
T	F_T / Tension/ spanning

5.3

$$\begin{aligned} W_w &= w \Delta x \cos \theta \checkmark \\ &= mg \Delta x \cos \theta \\ &= (6)(9,8)(1,6) \cos 0^\circ \checkmark \\ \therefore W &= 94,08 \text{ J} \checkmark \end{aligned}$$

$$\begin{aligned} W_w &= -\Delta E_p \checkmark \\ &= -mg(h_f - h_i) \\ &= -(6)(9,8)(0 - 1,6) \checkmark \\ &= 94,08 \text{ J} \checkmark \end{aligned}$$

(3)

5.4

OPTION 1/OPSIE 1

$$W_{\text{net}} = \Delta E_K / \Delta K \checkmark = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$W_{\text{net}} = F_{\text{net}}\Delta x \cos \theta$$

$$W_{\text{net}} = W_f + W_g + W_N$$

$$= \mu_k N \Delta x \cos \theta + W_g + W_N$$

$$W_{\text{net}} = (0,4)(4)(9,8)(1,6)\cos 180^\circ \checkmark + 94,08 + 0$$

$$= 68,992 \text{ J}$$

$$W_{\text{net}} = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$68,992 \checkmark = \frac{1}{2}(4)(v_f^2 - 0) + \frac{1}{2}(6)(v_f^2 - 0) \checkmark$$

$$v_f = 3,71 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 2/OPSIE 2

$$W_{\text{nc}} = \Delta E_p + \Delta E_K \checkmark$$

$$f\Delta x \cos \theta = (m_1gh_f - m_1gh_i) + (\frac{1}{2}m_1v_f^2 - \frac{1}{2}m_1v_i^2) + (\frac{1}{2}m_2v_f^2 - \frac{1}{2}m_2v_i^2)$$

$$(0,4)(4)(9,8)(1,6)\cos 180^\circ \checkmark = [0 - (6)(9,8)(1,6)] \checkmark + (\frac{1}{2}(6)v_f^2 + \frac{1}{2}(4)v_f^2 - 0) \checkmark$$

$$68,992 = 5v_f^2$$

$$v_f = 3,71 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 3/OPSIE 3

$$f_k = \mu_k N = (0,4)(4)(9,8) = 15,68 \text{ N}$$

$$T - f_k = ma$$

$$w - T = ma$$

$$T - 15,68 = 4a \dots \dots \dots \text{(i)}$$

$$(6)(9,8) - T = 6a \dots \dots \dots \text{(ii)}$$

$$\therefore a = 4,312 \text{ m}\cdot\text{s}^{-2}$$

$$\therefore T = 32,928 \text{ N}$$

$$F_{\text{net}} = ma$$

$$= (6)(4,312)$$

$$= 25,872$$

$$W_{\text{net}} = F_{\text{net}}\Delta x \cos \theta$$

$$= (25,872)(1,6)\cos 0^\circ \checkmark$$

$$= 41,3952 \text{ J}$$

$$W_{\text{net}} = \Delta E_K \checkmark$$

$$41,3952 = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$41,3952 = \frac{1}{2}(6)(v_f^2 - 0) \checkmark$$

$$v_f = 3,7146 \text{ m}\cdot\text{s}^{-1} \checkmark$$

Above calculations can be done with 4 kg or 10 kg /
Bostaande berekeninge kan met 4 kg of 10 kg gedoen word

4 kg block

$$W_{\text{net}} = \Delta E_K / \Delta K \checkmark$$

$$W_f + W_T = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$f\Delta x \cos 180^\circ + T\Delta x \cos 0^\circ = \frac{1}{2}(4)(v_f^2 - 0)$$

$$(15,68)(1,6)(-1) \checkmark + (32,928)(1,6)(1) \checkmark = 2v_f^2$$

$$v_f = 3,72 \text{ m}\cdot\text{s}^{-1} \checkmark$$

6 kg block

$$W_{\text{net}} = \Delta E_K / \Delta K \checkmark$$

$$W_w + W_T = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$mg\Delta x \cos 0^\circ + T\Delta x \cos 180^\circ = \frac{1}{2}(6)(v_f^2 - 0)$$

$$(6)(9,8)(1,6)(1) \checkmark + (32,928)(1,6)(-1) \checkmark = 3v_f^2$$

$$v_f = 3,72 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 4/OPSIE 4

$$W_{\text{net}} = \Delta E_K / \Delta K \checkmark$$

For the 4 kg mass / Vir die 4 kg massa

$$T(1,6)\cos 0^\circ + [(0,4)(9,8)(4)](1,6)\cos 180^\circ \checkmark = \frac{1}{2}(4)v^2 - 0)$$

For the 6 kg mass/Vir die 6 kg massa

$$(6)(9,8)(1,6)]\cos 0^\circ + T(1,6)\cos 180^\circ \checkmark = \frac{1}{2}(6)(v^2 - 0)$$

Adding the two equations / Optel van twee vergelykings

$$68,992 = \frac{1}{2}(4)v^2 + \frac{1}{2}(6)v^2 \checkmark$$

$$5v^2 = 68,992$$

$$v = 3,71 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 5/OPSIE 5

$$W_{\text{net}} = \Delta E_K \checkmark$$

$$F_{\text{net}} \Delta x \cos \theta = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$(F_g - f)\Delta x \cos \theta = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$[(6)(9,8) - (0,4)(4)(9,8)] \checkmark (1,6)\cos 0^\circ \checkmark = \frac{1}{2}(10)(v_f^2 - 0) \checkmark$$

$$v_f = 3,71 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(5)

[12]**QUESTION 6 / VRAAG 6**

- 6.1 It is the (apparent) change in frequency (or pitch) of the sound (detected by a listener) ✓ because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓

Dit is die verandering in frekwensie (of toonhoogte) van die klank (waargeneem deur 'n luisteraar) omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klankvoortplanting het.

OR/OF

An (apparent) change in (observed/detected) frequency (pitch), (wavelength) ✓ as a result of the relative motion between a source and an observer ✓ (listener).

'n Skynbare verandering in (waargenome) frekwensie (toonhoogte), (golflengte) as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer / luisteraar.

(2)

- 6.2.1 170 Hz ✓

(1)

- 6.2.2 130 Hz ✓

(1)

- 6.3 **POSITIVE MARKING FROM QUESTIONS 6.2.1 and 6.2.2/**

POSITIEWE NASIEN VANAF VRAAG 6.2.1 en 6.2.2

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \checkmark$$

$$170 = \frac{(340 + 0)}{(340 - v_s)} \times f_s \text{-----} \textcircled{1}$$

$$130 = \frac{(340 - 0)}{340 + v_s} \times f_s \text{-----} \textcircled{2}$$

$$v_s = 45,33 \text{ m}\cdot\text{s}^{-1} \checkmark (45,33 - 45,45 \text{ m}\cdot\text{s}^{-1})$$

(6)

[10]

QUESTION 7 / VRAAG 7

- 7.1 The magnitude of the electrostatic force exerted by one point charge on another point charge is directly proportional to the product of the (magnitudes of the) charges ✓ and inversely proportional to the square of the distance (r) between them. ✓

Die grootte van die elektrostatiese krag uitgeoefen deur een puntlading op 'n ander puntlading is direk eweredig aan die produk van die (groottes van die) ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle.

OR/OF

The force of attraction or repulsion between two point charges is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between them. ✓

Die aantrekkings- of afstotingskrag tussen twee puntladings is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.

(2)

- 7.2

OPTION 1/ OPSIE 1

$$F = k \frac{Q_1 Q_2}{r^2} \checkmark$$

$$= \frac{(9 \times 10^9)(6 \times 10^{-6})(8 \times 10^{-6})}{(0,2)^2} \checkmark$$

$$= 10,8 \text{ N} \checkmark$$

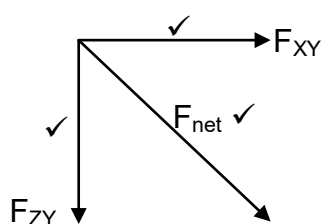
OPTION 2/ OPSIE 2

$$E = \frac{kQ}{r^2} = \frac{(9 \times 10^9)(8 \times 10^{-6})}{(0,2)^2} \checkmark = 1,8 \times 10^4 \text{ N} \cdot \text{C}^{-1}$$

$$F = Eq = (1,8 \times 10^4)(6 \times 10^{-6}) \checkmark = 10,8 \text{ N} \checkmark$$

(4)

- 7.3



(3)

7.4

OPTION 1 / OPSIE 1

$$F_{\text{net}}^2 = F_{XY}^2 + F_{ZY}^2$$

$$15,20^2 = 10,8^2 + F_{ZY}^2$$

$$F_{ZY} = 10,696 \text{ N}$$

$$F_{ZY} = k \frac{Q_Z Q_Y}{r^2}$$

$$10,696 \checkmark = 9 \times 10^9 \times \frac{8 \times 10^{-6} \times Q_Z}{(0,30)^2} \checkmark$$

$$Q_Z = 1,34 \times 10^{-5} \text{ C} \checkmark$$

OPTION 2 / OPSIE 2

$$\cos \theta = \frac{10,8}{15,2}$$

$$\theta = 44,72^\circ$$

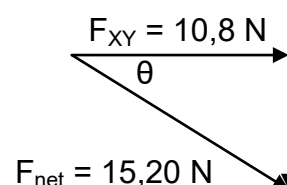
$$\sin 44,72 = \frac{F_{ZY}}{15,2} \checkmark \quad \text{OR/OF} \quad \tan 44,72 = \frac{F_{ZY}}{F_{XY}}$$

$$F_{ZY} = 10,696 \text{ N}$$

$$F_{ZY} = k \frac{Q_Z Q_Y}{r^2}$$

$$10,696 \checkmark = 9 \times 10^9 \times \frac{8 \times 10^{-6} \times Q_Z}{(0,30)^2} \checkmark$$

$$Q_Z = 1,34 \times 10^{-5} \text{ C} \checkmark$$

(4)
[13]**QUESTION 8 / VRAAG 8**

- 8.1 Electric field at a point is the force per unit positive charge placed at that point. $\checkmark \checkmark$

Elektriese veld by 'n punt is die krag per eenheids positiewe lading geplaas by daardie punt.

(2)

8.2

$$E = \frac{kQ}{r^2} \checkmark$$

$$E_{\text{net}} = (E_A + E_B)$$

$$= 9 \times 10^9 \frac{(1,5 \times 10^{-6})}{(0,4)^2} + 9 \times 10^9 \frac{(2,0 \times 10^{-6})}{(0,3)^2} \checkmark$$

$$= 2,84 \times 10^5 \text{ N} \cdot \text{C}^{-1} \checkmark$$

(4)

8.3

OPTION 1 / OPSIE 1

$$F_E = qE \checkmark$$

$$= (3,0 \times 10^{-9})(2,84 \times 10^5) \checkmark$$

$$= 8,52 \times 10^{-4} \text{ N} \checkmark$$

OPTION 2/OPSIE 2

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$F_{\text{net}} = (F_A + F_B)$$

$$= \left(\frac{(9 \times 10^9)(3 \times 10^{-6})(1,5 \times 10^{-6})}{(0,4)^2} + \frac{(9 \times 10^9)(3 \times 10^{-6})(2,0 \times 10^{-6})}{(0,3)^2} \right) \checkmark$$

$$= 8,53 \times 10^{-4} \text{ N } \checkmark$$

(3)

[9]

QUESTION 9 / VRAAG 9

- 9.1.1 The potential difference (voltage) across a conductor is directly proportional to the current in the conductor at constant temperature. ✓✓

Die potensiaalverskil (spanning) oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur.

OR/OF

The current in a conductor is directly proportional to the potential difference (voltage) across the conductor if temperature is constant. ✓✓

Die stroom in 'n geleier is direk eweredig aan die potensiaalverskil (spanning) oor die geleier indien die temperatuur konstant is.

(2)

- 9.1.2 (Equivalent) resistance/ (Ekwivalente) weerstand ✓

(1)

- 9.1.3

$$\begin{aligned} \text{Gradient/Helling} &= \frac{\Delta V}{\Delta I} \\ &= \frac{2-0}{0,5-0} \checkmark = 4 \text{ (}\Omega\text{)} \checkmark \end{aligned}$$

(2)

- 9.1.4 **OPTION 1/OPSIE 1**

In series $R_1 + R_2 = 4 \text{ } \Omega$ ✓(1)

In parallel $\frac{R_1 R_2}{R_1 + R_2} = 1 \text{ } \Omega$ ✓✓(2)

$$R_1 R_2 = 4 \text{ } \Omega$$

$$\therefore R_1 = R_2 = 2 \text{ } \Omega \checkmark$$

OPTION 2/OPSIE 2

For graph X/Vir grafiek X:

$$R_1 + R_2 = 4 \text{(1) } \checkmark$$

For graph Y/Vir grafiek Y

$$\frac{1}{R_{//}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\left\{ \left(\frac{1}{R_1} + \frac{1}{R_2} \right) = \left(\frac{1}{1} \right) \right\} \checkmark \checkmark \text{(2)}$$

$$R_1^2 - 4R_1 + 4 = 0$$

$$R_1 = 2 \text{ } \Omega \checkmark$$

(4)

9.2.1

$$\begin{aligned}
 I &= \frac{V}{R} \\
 &= \frac{5}{(R_M + R_N)} \\
 &= \frac{5}{(6)} \checkmark \\
 &= 0,83 \text{ A} \checkmark
 \end{aligned}$$

(3)

9.2.2

OPTION 1/OPSIE 1

$$\begin{aligned}
 \mathcal{E} &= I(R + r) \checkmark \\
 &= 0,83[(6 + 1,5) \checkmark + 0,9 \checkmark] \\
 &= 6,997 \text{ V} \\
 &= 7(,00) \text{ V} \checkmark \quad (6,972 - 7,00 \text{ V})
 \end{aligned}$$

OPTION 2/OPSIE 2

$$\begin{aligned}
 \mathcal{E} &= (V_s + V_{//} + V_r) \checkmark / V_{\text{ext/eks}} + V_{\text{int}} \\
 &= [5 + (0,833 \times 1,5) \checkmark + (0,9 \times 0,833)] \checkmark \\
 &= 6,999 \text{ V} \\
 &= 7(,00) \text{ V} \checkmark \quad (6,972 - 7,00 \text{ V})
 \end{aligned}$$

9.2.3

The resistance R_N will be 3Ω ✓

The voltage divides (proportionately) in a series circuit. Since the voltage across **M** is half the total voltage, it means the resistances of **M** and **N** are equal. ✓

Die weerstand R_N sal 3Ω wees.

*Die potensiaalverskil verdeel (eweredig) in 'n serie stroombaan. Aangesien die potensiaalverskil oor **M** die helfte is van die totale potensiaalverskil, beteken dit dat die weerstande van **M** en **N** gelyk is.*

(2)

[18]

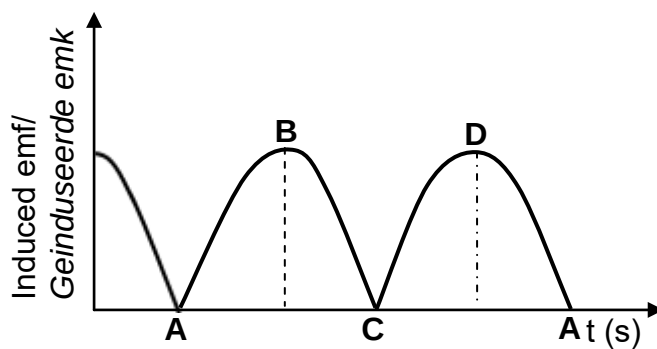
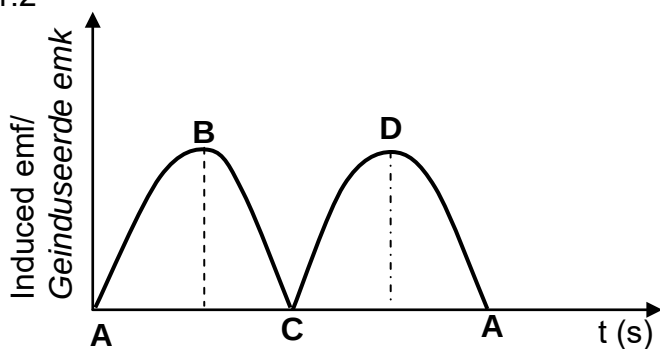
QUESTION 10 / VRAAG10

10.1

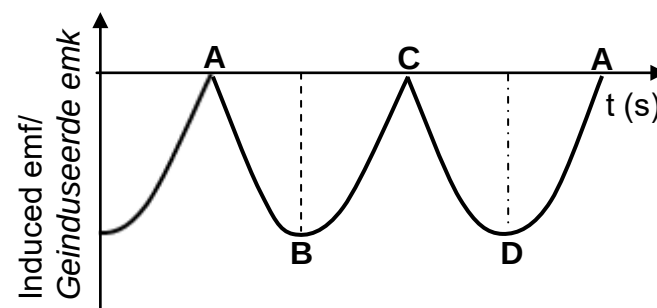
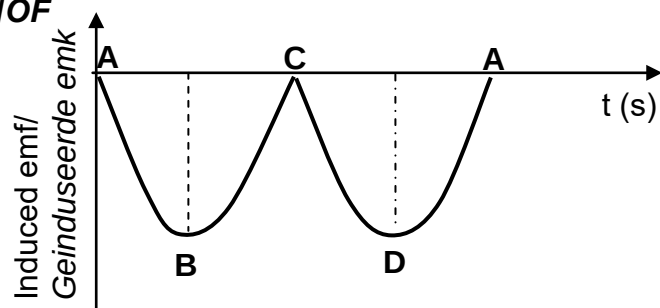
10.1.1 Mechanical to electrical / Meganies na elektries ✓

(1)

10.1.2



OR/OF



Criteria for graph/Kriteria vir grafiek	Marks/Punte
Correct DC shape, starting from zero/Korrekte GS vorm wat by nul begin	✓
Positions ABCDA correctly indicated on the graph/Posisies ABCDA of grafiek aangedui	✓

(2)

10.2.1 $20,5 \Omega$ ✓

(1)

10.2.2

OPTION 1/OPSIE 1

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{R} = \frac{25}{20,5} \checkmark$$

$$= 1,22 \text{ (1,2195) A}$$

$$P_{\text{ave}} = I_{\text{rms}}^2 R$$

$$= (1,22)^2 (0,5)$$

$$= 0,74 \text{ W}$$

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark$$

$$P_{\text{ave}} = \frac{(25)^2}{20,5} \checkmark$$

$$P_{\text{ave}} = 30,49 \text{ W}$$

Actual energy delivered per second(power) / *Energie aan toestel gelewer per sekonde (drywing)*

$$= (30,49 - 0,74)$$

$$= 29,75 \text{ W} \checkmark$$

$$P_{\text{ave}} = I_{\text{rms}}^2 R \checkmark$$

$$= (1,22)^2 (20) \checkmark$$

$$= 29,77 \text{ W} \checkmark$$

OR/OF

$$V_{\text{rms/wgk device/toestel}} = \frac{20}{20,5} \times 25 = 24,39 \text{ V} \checkmark$$

$$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$$

$$= (24,39)(1,22)$$

$$= 29,76 \text{ W} \checkmark$$

$$W = I_{\text{rms}}^2 R \Delta t$$

$$= (1,22)^2 (0,5)(1)$$

$$= 0,74 \text{ J}$$

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark$$

$$P_{\text{ave}} = \frac{(25)^2}{20,5} \checkmark$$

$$P_{\text{ave}} = 30,49 \text{ W}$$

Actual energy delivered per second(power) / *Energie aan toestel gelewer per sekonde (drywing)*

$$= (30,49 - 0,74)$$

$$= 29,75 \text{ W} \checkmark$$

OPTION 2/OPSIE 2

$$V_{\text{rms/wgk device/toestel}} = \frac{20}{20,5} \times 25 = 24,39 \text{ V} \checkmark$$

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} = \frac{(24,39)^2}{20} \checkmark = 29,74 \text{ W} \checkmark$$

(5)
[9]**QUESTION 11 / VRAAG 11**11.1.1 (Line) emission (spectrum) / *(Lyn) emissiespektrum* ✓

(1)

11.1.2 (Line) absorption (spectrum) / *(Lyn) absorpsiespektrum* ✓

(1)

11.2.1 Emission ✓ / *Emissie*

(1)

11.2.2 Energy released in the transition from E_4 to $E_2 = E_4 - E_2$
Energie vrygestel in die oorgang vanaf E_4 na $E_2 = E_4 - E_2$
 $E_4 - E_2 = (2,044 \times 10^{-18} - 1,635 \times 10^{-18}) \checkmark = 4,09 \times 10^{-19} \text{ J}$

$$E = hf \checkmark$$

$$\frac{4,09 \times 10^{-19}}{6,63 \times 10^{-34}} = f \checkmark$$

$$f = 6,17 \times 10^{14} \text{ Hz} \checkmark$$

(4)

11.2.3

$$E = W_0 + E_{k(\max)}$$

$$hf = hf_0 + E_{k(\max)}$$

$$hf = hf_0 + \frac{1}{2} m v_{\max}^2$$

$$E = W_0 + \frac{1}{2} m v_{\max}^2$$

✓ Any one/Enige een

$$4,09 \times 10^{-19} \checkmark = (6,63 \times 10^{-34})(4,4 \times 10^{14}) \checkmark + E_{k(\max)}$$

$$E_{k(\max)} = 1,17 \times 10^{-19} \text{ J} \checkmark$$

OR/OF

$$E_{k(\max)} = E_{\text{light/lig}} - W_0$$

$$= hf_{\text{light/lig}} - hf_0$$

✓ Any one/Enige een

$$= (6,63 \times 10^{-34})(6,17 \times 10^{14}) \checkmark - (6,63 \times 10^{-34})(4,4 \times 10^{14}) \checkmark$$

$$= 1,17 \times 10^{-19} \text{ J} \checkmark$$

(4)

11.2.4

No✓ / Nee

The threshold frequency is greater than the frequency of the photon. ✓

*Die drumpelfrekwensie is groter as die frekwensie van die foton***OR/OF**

The frequency of the photon is less than the threshold frequency ✓

*Die frekwensie van die foton is minder as die drumpelfrekwensie***OR/OF**

Energy of the photon is less than the work function of the metal ✓

Energie van foton is minder as die van die arbeidsfunksie van die metaal(2)
[13]**TOTAL/TOTAAL:****150**



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

FEBRUARY/MARCH/FEBRUARIE/MAART 2017

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 26 pages.
*Hierdie memorandum bestaan uit 26 bladsye.***

GENERAL MARKING GUIDELINES PAPER 1
ALGEMENE NASIEN RIGLYNE VRAESTEL 1

1. CALCULATIONS/BEREKENINGE

- 1.1 **Marks will be awarded for:** correct formula, correct substitution, correct answer with unit.
Punte sal toegeken word vir: korrekte formule, korrekte substitusie, korrekte antwoord met eenheid.
- 1.2 **No marks** will be awarded if an **incorrect or inappropriate formula is used**, even though there may be relevant symbols and applicable substitutions.
When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.
Geen punte sal toegeken word waar 'n verkeerde of ontoepaslike formule gebruik word nie, selfs al is daar relevante simbole en relevante substitusies.
Wanneer 'n fout gedurende substitusie in 'n korrekte formule begaan word, sa 'n punt vir die korrekte formule en vir korrekte substitusies toegeken word, maar geen verdere punte sal toegeken word nie.
- 1.3 If **no formula** is given, but **all substitutions are correct**, a candidate will **forfeit one mark**.
Indien geen formule gegee is nie, maar al die substitusies is korrek, verloor die kandidaat een punt.
- 1.4 **No penalisation if zero substitutions are omitted** in calculations where **correct formula/principle** is given correctly.
Geen penalisering indien nulwaardes nie getoon word nie in berekeninge waar die formule/beginsel korrek gegee is nie.
- 1.5 Mathematical manipulations and change of subject of appropriate formulae carry no marks, but if a candidate starts off with the correct formula and then changes the subject of the formula incorrectly, marks will be awarded for the formula and the correct substitutions. The mark for the incorrect numerical answer is forfeited.
Wiskundige manipulasies en verandering van die onderwerp van toepaslike formules tel geen punte nie, maar indien 'n kandidaat met die korrekte formule begin en dan die onderwerp van die formule verkeerd verander, sal punte vir die formule en korrekte substitusies toegeken word. Die punt vir die verkeerde numeriese antwoord word verbeur

- 1.6 Marks are only awarded for a formula if a **calculation has been attempted**, i.e. substitutions have been made or a numerical answer given.
Punte word slegs vir 'n formule toegeken indien 'n poging tot 'n berekening aangewend is, d.w.s. substitusies is gedoen of 'n numeriese antwoord is gegee.
- 1.7 Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.
Punte kan slegs toegeken word vir substitusies wanneer waardes in formule ingestel is en nie vir waardes wat voor 'n berekening gelys is nie.
- 1.8 All calculations, when not specified in the question, must be done to a minimum of TWO decimal places.
Alle berekenings, wanneer nie in die vraag gespesifiseer word nie, moet tot 'n minimum van twee desimale plekke gedoen word.
- 1.9 If a final answer to a calculation is correct, full marks will not automatically be awarded. Markers will always ensure that the correct/appropriate formula is used and that workings, including substitutions, are correct.
Indien 'n finale antwoord van 'n berekening korrek is, sal volpunte nie outomaties toegeken word nie. Nasieners sal altyd verseker dat die korrekte/toepaslike formule gebruik word en dat bewerkings, insluitende substitusies korrek is.
- 1.10 Questions where a series of calculations have to be made (e.g. a circuit diagram question) do not necessarily always have to follow the same order. FULL MARKS will be awarded provided it is a valid solution to the problem. However, any calculation that will not bring the candidate closer to the answer than the original data, will not count any marks.
Vrae waar 'n reeks berekenings gedoen moet word (bv. 'n stroomdiagramvraag) hoef nie noodwendig dieselfde volgorde te hê nie. VOLPUNTE sal toegeken word op voorwaarde dat dit 'n geldige oplossing vir die probleem is. Enige berekening wat egter nie die kandidaat nader aan die antwoord as die oorspronklike data bring nie, sal geen punte tel nie.

2. UNITS/EENHEDE

- 2.1 Candidates will only be penalised once for the repeated use of an incorrect unit **within a question**.
'n Kandidaat sal slegs een keer gepeenaliseer word vir die herhaaldelike gebruik van 'n verkeerde eenheid in 'n vraag.
- 2.2 Units are only required in the final answer to a calculation.
Eenhede word slegs in die finale antwoord op 'n vraag verlang.
- 2.3 Marks are only awarded for an answer, and not for a unit *per se*. Candidates will therefore forfeit the mark allocated for the answer in each of the following situations:
- Correct answer + wrong unit
 - Wrong answer + correct unit
 - Correct answer + no unit
- Punte word slegs vir 'n antwoord en nie vir 'n eenheid per se toegeken nie. Kandidaat sal derhalwe die punt vir die antwoord in die volgende gevalle verbeur:*
- Korrekte antwoord + verkeerde eenheid
 - Verkeerde antwoord + korrekte eenheid
 - Korrekte antwoord + geen eenheid
- 2.4 SI units must be used except in certain cases, e.g. $V \cdot m^{-1}$ instead of $N \cdot C^{-1}$, and $cm \cdot s^{-1}$ or $km \cdot h^{-1}$ instead of $m \cdot s^{-1}$ where the question warrants this.
SI-eenhede moet gebruik word, behalwe in sekere gevalle, bv. $V \cdot m^{-1}$ in plaas van $N \cdot C^{-1}$, en $cm \cdot s^{-1}$ of $km \cdot h^{-1}$ in plaas van $m \cdot s^{-1}$ waar die vraag dit regverdig.

3. GENERAL/ALGEMEEN

- 3.1 If one answer or calculation is required, but two given by the candidate, only the first one will be marked, irrespective of which one is correct. If two answers are required, only the first two will be marked, etc.
Indien een antwoord of berekening verlang word, maar twee word deur die kandidaat gegee, sal slegs die eerste een nagesien word, ongeag watter een korrek is. Indien twee antwoorde verlang word, sal slegs die eerste twee nagesien word, ens.
- 3.2 For marking purposes, alternative symbols (s, u, t, etc.) will also be accepted.
Vir nasiendoeleindes sal alternatiewe simbole (s, u, t, ens.) ook aanvaar word.
- 3.3 Separate compound units with a multiplication dot, not a full stop, for example, $m \cdot s^{-1}$. For marking purposes $m \cdot s^{-1}$ and m/s will also be accepted.
Skei saamgestelde eenhede met 'n vermenigvuldigpunt en nie met 'n punt nie, byvoorbeeld, $m \cdot s^{-1}$. Vir nasiendoeleindes sal $m \cdot s^{-1}$ en m/s ook aanvaar word.

4. POSITIVE MARKING

Positive marking regarding calculations will be followed in the following cases:
Positiewe nasien met betrekking tot berekenings sal in die volgende gevalle geld:

- 4.1 **Subquestion to subquestion:** When a certain variable is incorrectly calculated in one subquestion (e.g. 3.1) and needs to be substituted into another subquestion (3.2 or 3.3), **full marks** are to be awarded for the subsequent subquestions

*Subvraag na subvraag: Wanneer 'n sekere veranderlike in een subvraag (bv. 3.1) bereken word en dan in 'n ander vervang moet word (3.2 of 3.3), bv. indien die antwoord vir 3.1 verkeerd is en word korrek in 3.2 of 3.3 vervang, word **volpunte** vir die daaropvolgende subvraag toegeken.*

- 4.2 **Multi-step question in a subquestion:** If the candidate has to calculate, for example, current in the first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer will be forfeited.

'n Vraag met veelvuldige stappe in 'n subvraag: Indien 'n kandidaat byvoorbeeld, die stroom verkeerd bereken in 'n eerste stap as gevolg van 'n substitusiefout, verloor die kandidaat die punt vir die substitusie sowel as die finale antwoord.

5. NEGATIVE MARKING/NEGATIEWE NASIEN

Normally an incorrect answer cannot be correctly motivated if based on a conceptual mistake. If the candidate is therefore required to motivate in QUESTION 3.2 the answer given to QUESTION 3.1, and 3.1 is incorrect, no marks can be awarded for QUESTION 3.2. However, if the answer for e.g. QUESTION 3.1 is based on a calculation, the motivation for the incorrect answer in QUESTION 3.2 should be considered.

'n Verkeerde antwoord, indien dit op 'n konsepsuele fout gebaseer is, kan normaalweg nie korrek gemotiveer word nie. Indien 'n kandidaat gevra word om in VRAAG 3.2 die antwoord op VRAAG 3.1 te motiveer en VRAAG 3.1 is verkeerd, kan geen punte vir VRAAG 3.2 toegeken word nie. Indien die antwoord op bv. VRAAG 3.1 egter op 'n berekening gebaseer is, kan die motivering vir die verkeerde antwoord in VRAAG 3.2 oorweeg word.

QUESTION 1/VRAAG 1

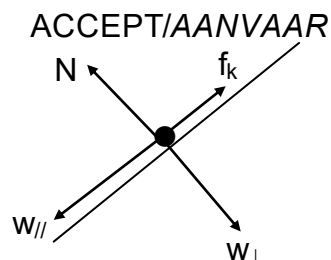
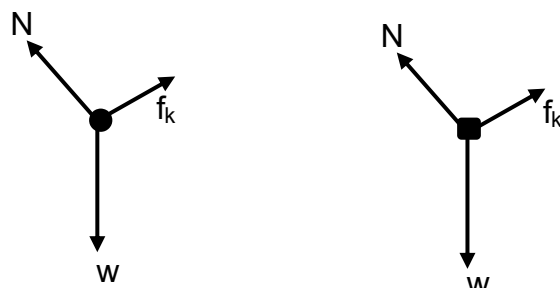
1.1	D✓✓	(2)
1.2	C✓✓	(2)
1.3	A✓✓	(2)
1.4	D✓✓	(2)
1.5	B✓✓	(2)
1.6	C✓✓	(2)
1.7	B✓✓	(2)
1.8	A✓✓	(2)
1.9	D✓✓	(2)
1.10	B✓✓	(2)
		[20]

QUESTION 2/VRAAG 2

2.1 0 N/zero/nul✓

(1)

2.2



Accepted labels/Aanvaarde benoemings	
w	F_g/F_w /weight/mg/gravitational force/N/19,6 N F_g/F_w /gewig/mg/gravitasiekrag/19,6 N
f	F_{friction}/F_f /friction/ f_k F_{wrywing}/F_w /wrywing/ f_k
N	F_N/F_{normal} /normal force F_N/F_{normaal} /normaalkrag
	Deduct 1 mark for any additional force. Trek een punt af vir enige addisionel krag
	Mark is given for both arrow and label Punt word toegeken vir beide pylpunt en benoeming

1 mark if BOTH components of weight are shown.
All other rules in the table apply.
1 punt indien BEIDE komponente van die gewig getoon is
Al die ander reëls in die tabel geld

(3)

$$\left. \begin{aligned} F_{\text{net}} &= ma \\ f_k - mg \sin \theta &= 0 \\ f_k &= mg \sin \theta \end{aligned} \right\} \checkmark$$

1 mark for any of these/1 punt vir enige van hierdie

$$\begin{aligned} f_k &= (2)(9,8) \sin 7^\circ \checkmark \\ f_k &= 2,39 \text{ N} \checkmark \quad (2,389) \text{ N} \end{aligned}$$

(3)

2.3.2 **POSITIVE MARKING FROM QUESTION 2.3.1/POSITIEWE NASIEN VANAF VRAAG 2.3.1**

$$\left. \begin{aligned} f_k &= \mu_k N \\ &= \mu_k mg \cos 7^\circ \end{aligned} \right\} \checkmark$$

1 mark for any of these/1 punt vir enige van hierdie

$$\begin{aligned} 2,389 &= \mu_k (2)(9,8) \cos 7^\circ \checkmark \\ \mu_k &= 0,12 \checkmark \end{aligned}$$

(3)

2.3.3 **POSITIVE MARKING FROM QUESTION 2.3.2/POSITIEWE NASIEN VANAF VRAAG 2.3.2**
OPTION 1/OPSIE 1

$$\left. \begin{array}{l} F_{\text{net}} = ma \\ - f_k = ma \\ - \mu_k N = ma \\ - \mu_k(mg) = ma \end{array} \right\} \checkmark \quad \boxed{1 \text{ mark for any of these/1 punt vir enige van hierdie}}$$

$$\frac{-(0,12)(2)(9,8)}{a = -1,176 \text{ m.s}^{-2}} \checkmark = 2a \checkmark \quad (-1,18)$$

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$0 = (1,5)^2 + 2(-1,176)\Delta x \checkmark$$

$$\Delta x = 0,96 \text{ m}$$

Distance is/Afstand is 0,96 m ✓

OPTION 2/OPSIE 2

$$\left. \begin{array}{l} W_{\text{net}} = \Delta K \\ W_{\text{net}} = \Delta E_K \\ W_{\text{nc}} = \Delta K + \Delta U \\ W_{\text{nc}} = \Delta E_K + \Delta E_P \\ \mu_k N \Delta x \cos \theta = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \end{array} \right\} \quad \boxed{1 \text{ mark for any of these/ 1 punt vir enige van hierdie}}$$

NOTE: substituting into any of the above equations will lead to the following:
LET WEL: vervanging in enige van hierdie vergelyking sal lei to die volgende

$$(0,12)(2)(9,8) \checkmark \Delta x \cos 180^\circ \checkmark = 0 - \frac{1}{2}(2)(1,5)^2 \checkmark$$

$$\Delta x = 0,957 \text{ m} \checkmark$$

(5)
[15]

QUESTION 3/VRAAG 3

- 3.1 (Motion of) an object in which the only force acting is the gravitational force. ✓✓

Beweging van 'n voorwerp waarop die gravitasiekrag die enigste krag is wat op die voorwerp inwerk.

OR/OF

(Motion of) an object which has been given an initial velocity and which follows a path *entirely* determined by the effects of gravitational acceleration/force. ✓✓

Beweging van 'n voorwerp waaraan 'n beginsnelheid gegee is en wat 'n baan volg wat deur die effekte van gravitasionele versnelling bepaal word/gravitasiekrag.

OR/OF

The (motion of) an object that is projected, thrown or shot either upwards or downwards into the air and on which the only force considered/acting is gravitational. ✓✓

Die beweging van 'n voorwerp wat geprojekteer word, gegooi word of wat opwaarts geskiet is of afwaarts geskiet is in die lug en waar die enigste krag op die voorwerp inwerk, gravitasie is.

(2)

Note: Let Wel 2 or/of 0

- 3.2

No/Nee ✓

The balloon is not accelerating at the rate of $9,8 \text{ m}\cdot\text{s}^{-2}$ /moving with constant velocity/acceleration is $0 \text{ m}\cdot\text{s}^{-2}$ ✓

Die ballon versnel nie teen $9,8 \text{ m}\cdot\text{s}^{-2}$ nie/beweeg teen konstante snelheid dus is versnelling $0 \text{ m}\cdot\text{s}^{-2}$

(2)

OR/OF

There are other forces (e.g., friction) acting on the balloon besides gravity./Daar is ander kragte wat op die ballon inwerk behalwe (buiten) gravitasie ✓

Net force acting on the balloon is zero/Die nettokrag (resultante krag) op die ballon is nul

- 3.3

OPTION 1/OPSIE 1

Upward positive/Opwaarts positief

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$-22 \checkmark = (-1,2) \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$$

$$\Delta t = 2 \text{ s} \checkmark$$

Downward positive/Afwaarts positief

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$22 \checkmark = (1,2) \Delta t + \frac{1}{2} (9,8) \Delta t^2 \checkmark$$

$$\Delta t = 2 \text{ s} \checkmark$$

OPTION 2/OPSIE 2

Upward positive/Opwaarts positief

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = (-1,2)^2 + (2)(-9,8)(-22) \checkmark$$

$$v_f = -20,8 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$-20,8 = -1,2 + -9,8\Delta t \checkmark$$

$$\Delta t = 2 \text{ s} \checkmark$$

For both equations/vir beide vergelykings✓

Downward positive/Afwaarts positief

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = (1,2)^2 + (2)(9,8)(22) \checkmark$$

$$v_f = 20,8 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$20,8 = 1,2 + 9,8\Delta t \checkmark$$

$$\Delta t = 2 \text{ s} \checkmark$$

For both equations/vir beide vergelykings✓

OPTION 3/OPSIE 3

Upward positive/Opwaarts positief

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = [(-1,2)^2 + (2)(-9,8)(-22)] \checkmark$$

$$v_f = -20,8 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = \frac{v_i + v_f}{2} \Delta t$$

$$-22 = \left(\frac{-1,2 + -20,8}{2} \right) \Delta t \checkmark$$

$$\Delta t = 2 \text{ s} \checkmark$$

Downward positive/Afwaarts positief

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = [1,2^2 + (2)(9,8)(22)] \checkmark$$

$$v_f = 20,8 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = \frac{v_i + v_f}{2} \Delta t$$

$$22 = \left(\frac{1,2 + 20,8}{2} \right) \Delta t \checkmark$$

$$\Delta t = 2 \text{ s} \checkmark$$

For both equations/vir beide vergelykings✓

For both equations/vir beide vergelykings✓

OPTION 4/ OPSIE 4

$$\begin{aligned}(E_{\text{mech}})_{\text{Top/Bo}} &= (E_{\text{mech}})_{\text{Ground/Grond}} \\ (E_P + E_K)_{\text{Top}} &= (E_P + E_K)_{\text{Bottom/Onder}} \\ (mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}} &= (mgh + \frac{1}{2}mv^2)_{\text{Bottom/Onder}} \\ W_{\text{net}} &= \Delta E_K\end{aligned}$$

1 mark for any
1 punt vir enige

$$\begin{aligned}(9,8)(22) + \frac{1}{2}(1,2)^2 &= 0 + (\frac{1}{2})(v_f^2) \checkmark \\ v_f &= 20,80 \text{ m}\cdot\text{s}^{-1} \\ v_f &= v_i + a\Delta t \\ 20,8 &= 1,2 + 9,8\Delta t \checkmark \\ \Delta t &= 2 \text{ s} \checkmark\end{aligned}$$

NOTES/AANTEKENINGE:

Each substitution must include the correct values of 22 m and the velocity of $1,2 \text{ m}\cdot\text{s}^{-1}$

Elke vervanging moet die korrekte waardes van 22 m en die snelheid van $1,2 \text{ m}\cdot\text{s}^{-1}$ insluit.

The values of v_f and v_i can also be used with $F_{\text{net}}\Delta t = \Delta p = (p_f - p_i) = (mv_f - mv_i)$ Die waardes van v_f en v_i kan ook met $F_{\text{net}}\Delta t = \Delta p = (p_f - p_i) = (mv_f - mv_i)$ gebruik word.

(4)

3.4

Upward positive/Opwaarts positief

POSITIVE MARKING FROM QUESTION 3.3/POSITIEWE NASIEN VANAF VRAAG 3.3

$$\begin{aligned}v_f &= v_i + a\Delta t \checkmark \\ 0 &= 15 + (-9,8)\Delta t \checkmark \\ \Delta t &= 1,53 \text{ s}\end{aligned}$$

$$\text{Total time elapsed} = 2 + 1,53 + 0,3 \checkmark$$

$$\text{Totale tyd verstryk} = 3,83 \text{ s}$$

For addition/vir optelling

OR/OF

OR/OF

Displacement of the balloon/
Verplasing van ballon:

$$\begin{aligned}\Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \\ &= -(1,2)(3,83) \checkmark \\ &= -4,6 \text{ m}\end{aligned}$$

Height /Hoogte:

$$\begin{aligned}&= 22 - 4,6 \checkmark \\ &= 17,4 \text{ m} \checkmark\end{aligned}$$

$$\begin{aligned}y_f &= y_i + \Delta y \\ &= [22 - (1,2)(3,83)] \checkmark \checkmark \\ &= 17,4 \text{ m} \\ \text{Height/Hoogte} &= 17,4 \text{ m} \checkmark\end{aligned}$$

Downward Positive/Afwaarts positief
POSITIVE MARKING FROM QUESTION 3.3/POSITIEWE NASIEN VANAF
VRAAG 3.3

$$v_f = v_i + a\Delta t \checkmark$$

$$0 = -15 + (9,8)\Delta t \checkmark$$

$$\Delta t = 1,53 \text{ s}$$

$$\text{Total time elapsed} = 2 + 1,53 + 0,3 \checkmark$$

$$\text{Totale tyd verstryk} = 3,83 \text{ s}$$

For addition/vir optelling

OR/OF

OR/OF

Displacement of the balloon/
Verplasing van ballon:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$= (1,2)(3,83) \checkmark$$

$$= 4,6 \text{ m}$$

Height /Hoogte:

$$= 22 - 4,6 \checkmark$$

$$= 17,4 \text{ m} \checkmark$$

$$\begin{aligned} y_f &= y_i + \Delta y \\ &= [-22 + (1,2)(3,83)] \checkmark \checkmark \\ &= -17,4 \text{ m} \\ \text{Height/Hoogte} &= 17,4 \text{ m} \checkmark \end{aligned}$$

(6)
[14]

QUESTION 4/VRAAG 4

- 4.1 It is the product of the resultant/net force acting on an object✓ and the time the resultant/net force acts on the object. ✓

Dit is die produk van die resulterende/netto krag wat op die voorwerp inwerk en die tyd wat die resulterende/netto krag op die voorwerp inwerk.

(2)

NOTE: ONLY 1 MARK FOR “CHANGE IN MOMENTUM”/SLEGS 1 PUNT VIR VERANDERING IN MOMENTUM

4.2.1

$$\begin{aligned} p &= mv \checkmark \\ &= (0,03)(700) \checkmark \\ &= 21 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark \end{aligned}$$

Note: 2/3 if $\Delta p = (p_f - p_i) = (mv_f - mv_i)$ is used.

Let Wel: 2/3 indien $\Delta p = (p_f - p_i) = (mv_f - mv_i)$ gebruik is.

(3)

4.2.2

OPTION 1/OPSIE 1

POSITIVE MARKING FROM 4.2.1/POSITIEWE NASIEN VANAF 4.2.1

$$\Delta t \text{ for a bullet} = \frac{60}{220} \checkmark = 0,27 \text{ s}$$

$$F_{\text{net}}\Delta t = \Delta p = (p_f - p_i) = (mv_f - mv_i)$$

$$F_{\text{ave gun on bullet/gem gew eer op koeël}} = \frac{\Delta p}{\Delta t}$$

$$= \frac{21 - 0}{0,27} \checkmark$$

$$= 77,01 \text{ N} \checkmark (77,78 \text{ N})$$

1 mark for any one/1 punt vir enige een

∴ average force of bullet on gun/gemiddelde krag van koeël op geweer

= 77,01 N / 77,8 N to the west/na wes ✓ OR/OF

-77,01 N / - 77,78 N

OPTION 2/OPSIE 2

POSITIVE MARKING FROM 4.2.1/POSITIEWE NASIEN VANAF 4.2.1

$$F_{\text{net}}\Delta t = \Delta p = (p_f - p_i) = (mv_f - mv_i)$$

$$F_{\text{av}} = \frac{\Delta p}{\Delta t}$$

$$\Delta p_{\text{tot}} = (21)(220) \checkmark = 4\,620 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$$

$$F_{\text{ave gun on bullet/gem gew eer op koeël}} = \frac{4\,620 - 0}{60} \checkmark$$

$$= 77,00 \text{ N} \checkmark$$

1 mark for any one/1 punt vir enige een

∴ average force of bullet on gun/gemiddelde krag van koeël op geweer

= 77,01 N / 77,78 N to the west/na wes ✓

OR/OF

- 77,01 N / -77,78 N

OPTION 3/OPSIE 3

$$v_f = v_i + a\Delta t$$

$$a = \frac{700 - 0}{(60/220)} \checkmark$$

$$a = 2592,59 \text{ m} \cdot \text{s}^{-2}$$

$$F_{\text{net}} = ma \checkmark$$

$$F_{\text{net}} = (0,03)(2592,59) \checkmark$$

$$F_{\text{av}} = 77,78 \text{ N} \checkmark$$

∴ average force of bullet on gun/gemiddelde krag van koeël op geweer

= 77,01 N / 77,78 N to the west/na wes ✓ OR

= - 77,01 N / -77,78

NOTE: ACCEPT RANGE: 77 N - 77,78 N

(5)

4.3

POSITIVE MARKING FROM 4.2.2/POSITIEWE NASIEN VANAF 4.2.2

77 N/77,78 N ✓ to the east/na oos ✓

(2)
[12]

QUESTION 5/VRAAG 5

- 5.1 The rate at which work is done/ Rate at which energy is expended. ✓✓
Die tempo waarteen arbeid verrig word / Die tempo waarteen energie verbruik is. (2)

- 5.2.1 **OPTION 1/OPSIE 1**
 $W = F \Delta x \cos \theta$ ✓
 $W_{\text{gravity/gravitasie}} = mg \Delta y \cos \theta$
 $= (1\,200)(9,8)(55) \cos 180^\circ$ ✓
 $= -646\,800 \text{ J } (6,47 \times 10^5 \text{ J})$ ✓

OPTION 2/OPSIE 2 $W = -\Delta E_p$ ✓ $= -(1200)(9,8)(55 - 0)$ ✓ $= -646800 \text{ J}$ ✓	-1 if either negative is omitted or $E_p = mgh$ is used instead of W / -1 indien negatief weggelaat is of indien $E_p = mgh$ gebruik is in plaas van W

(3)

- 5.2.2 $W_{\text{counterweight}} = mg \Delta y \cos \theta$
 $= (950)(9,8)(55) \cos 0^\circ$ ✓
 $= 512\,050 \text{ J } (5,12 \times 10^5 \text{ J})$ ✓ (2)

- 5.3 **OPTION 1/OPSIE 1**
POSITIVE MARKING FROM QUESTIONS 5.2.1 AND 5.2.2
POSITIEWE NASIEN VANAF VRAE 5.2.1 en 5.2.2
 $W_{\text{net}} = \Delta E_K$
 $W_{\text{gravity}} + W_{\text{counterweight}} + W_{\text{motor}} = 0$
 $W_{\text{motor}} = -(W_{\text{gravity}} + W_{\text{counterweight}})$
 $W_{\text{nc}} = \Delta E_K + \Delta E_p$ } ✓

1 mark for any one/ 1 punt vir enige een

NOTE: Substituting into any of the above equations will lead to:
 LET WEL: Vervanging in enige van die bogenoemde vergelykings sal lei tot
 $-646800 \checkmark + 512050 \checkmark + W_{\text{motor}} = 0$
 $\therefore W_{\text{motor}} = 134\,750 \text{ J}$
 $P_{\text{ave motor}} = \frac{W}{\Delta t}$ ✓
 $= \frac{134750}{180}$ ✓
 $= 748,61 \text{ W}$ ✓

OPTION 2/OPSIE 2

$$\left. \begin{aligned} F_{\text{net}} &= 0 \\ F_{\text{gcage}} + F_{\text{gcount}} + F_{\text{motor}} &= F_{\text{net}} \end{aligned} \right\}$$

✓ 1 mark for any one/1 punt vir enige een

$$-117600\checkmark + 9310\checkmark + F_{\text{motor}} = 0$$

$$F_{\text{motor}} = 2450 \text{ N}$$

$$P_{\text{ave}} = Fv_{\text{ave}}\checkmark$$

$$= 2450 \frac{55}{180}\checkmark$$

$$= 748,61 \text{ W}$$

OPTION 3/OPSIE 3

$$P_{\text{ave}} = Fv_{\text{ave}}\checkmark\checkmark$$

$$= [1200(9,8) - 950(9,8)] \frac{55}{180}\checkmark$$

$$= 748,61 \text{ W}\checkmark$$

(6)
[13]

QUESTION 6/VRAAG 6

6.1.1 The Doppler effect./Die Doppler-effek✓

(1)

6.1.2 Measuring the rate of blood flow/Meet die tempo van bloedvloei

OR/OF

Ultrasound (scanning)/Ultraklank (skandering)✓

(1)

6.1.3

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR/OF } f_L = \frac{v}{v - v_s} f_s \text{ OR/OF } f_L = \frac{v}{v + v_s} f_s \checkmark$$

$$2600\checkmark = \frac{340\checkmark}{(340 - v_s)\checkmark} f_s$$

$$1750 = \frac{340}{(340 + v_s)\checkmark} f_s$$

$$2600(340 - v_s) = 1750(340 + v_s)$$

$$v_s = 66,44 \text{ m}\cdot\text{s}^{-1}\checkmark$$

(6)

6.1.4 (a) Increase/Toeneem✓

(1)

(b) Decrease/Afneem ✓

(1)

6.2.1 The spectral lines (light) from the star are shifted towards longer wavelengths. ✓✓

(2)

Die spektraallyne van die ster (lig) is na ander golflengtes toe verskuif.

6.2.2 Decrease/Neem af✓

(1)

[13]

QUESTION 7/VRAAG 7

7.1.1 Removed/Verwyder ✓

(1)

7.1.2

$$n = \frac{Q}{e} \checkmark$$

$$= \frac{6 \times 10^{-6}}{1,6 \times 10^{-19}} \checkmark$$

$$= 3,75 \times 10^{13} \checkmark \text{electrons/elektrone}$$

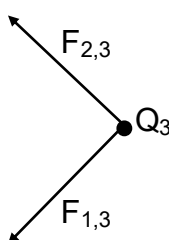
Do not penalise for negative sign of charge used in calculation

(3)

7.2.1 Negative/Negatief ✓

(1)

7.2.2



NOTE/LET WEL:

Vectors not drawn to scale/Vektore nie volgens skaal geteken nie.

Learners forfeit 1 mark for:/Kandidate sal 1 punt verbeur vir:

(i) Wrong directions/verkeerde rigtings

OR/OF

(ii) Arrows not shown/Pyltjies nie aangedui nie

Give credit to the required forces even if a triangle of forces is drawn./Gee krediet vir die vereiste kragte

ACCEPT/AANVAAR: two separate diagrams /twee aparte diagramme

ACCEPT/AANVAAR: correctly drawn vector but no labels/korrek getekende vektore sonder byskifte

(2)

7.2.3

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$F_{1,3x} = \frac{(9 \times 10^9)(2 \times 10^{-6})(6 \times 10^{-6})}{r^2} (\cos 45^\circ) \checkmark = \frac{(0,0764)}{r^2} \checkmark$$

ACCEPT/AANVAAR

$$F = \frac{kQ_1Q_2}{r^2}$$

$$F_{1,3x} = \frac{k(Q_1)(Q_3)}{r^2} (\cos 45^\circ)$$

(3)

7.2.4

POSITIVE MARKING FROM QUESTION 7.2.3/POSITIEWE NASIEN VANAF VRAAG 7.2.3

OPTION 1/OPSIE 1

$$F = \frac{kQ_1Q_2}{r^2}$$

$$F_{2,3x} = \frac{(9 \times 10^9)(2 \times 10^{-6})(6 \times 10^{-6})}{r^2} (\cos 45^\circ) \checkmark = \frac{0,0764}{r^2}$$

$$F_x = F_{1,3x} + F_{2,3x}$$

$$F_x = \frac{0,0764}{r^2} + \frac{0,0764}{r^2} = 2 \frac{0,0764}{r^2}$$

1 mark for the addition
1 punt vir optelling

$$(0,12) \checkmark = \frac{0,1528}{r^2}$$

$$r = 1,128 \text{ m} \checkmark$$

NOTE/LET WEL: $F_{y \text{ net}} = 0$

OPTION 2/OPSIE 2

$$F_{\text{net}}^2 = (F_{1,3})^2 + (F_{2,3})^2$$

$$= \left(k \frac{Q_1Q_3}{r^2}\right)^2 + \left(k \frac{Q_2Q_3}{r^2}\right)^2$$

$$= 2 \left(k \frac{Q_1Q_3}{r^2}\right)^2$$

1 mark for any of the three
1 punt vir enige van die vier

$$= 2 \left[(9 \times 10^9) \frac{(2 \times 10^{-6})(6 \times 10^{-6})}{r^2} \right]^2 \checkmark$$

$$= 2 \frac{(0,108)^2}{r^4}$$

$$(0,12)^2 \checkmark = 2 \frac{(0,108)^2}{r^4}$$

$$\therefore r = 1,128 \text{ m} \checkmark$$

NOTE/LET WEL

$F_{\text{net}} = F_{\text{net}(x)}$ since/aangesien $F_{\text{net}(y)} = 0$

(4)

7.3.1

The electric field at a point is the (electrostatic) force experienced $\checkmark$ per unit positive charge $\checkmark$ placed at that point

Die elektriese veld by 'n punt is die (elektrostatiese) krag $\checkmark$ wat per eenheid positiewe lading $\checkmark$ wat by daardie punt $\checkmark$ geplaas word, ervaar word.

(2)

7.3.2

OPTION 1/OPSIE 1

$$E = \frac{kQ}{r^2} \checkmark$$

$$100 = \frac{(9 \times 10^9)Q}{(0,6)^2} \checkmark$$

$$Q = 4 \times 10^{-9} \text{ C}$$

When the electric field strength 50 is $\text{N}\cdot\text{C}^{-1}$ /
Waar die elektrieseveld sterkte $50 \text{ N}\cdot\text{C}^{-1}$ is

$$E = \frac{kQ}{r^2}$$

$$50 = \frac{(9 \times 10^9)(4 \times 10^{-9})}{r^2} \checkmark$$

$$r = 0,85 \text{ m (0,845) m} \checkmark$$

For the equation/vir die vergelyking

OPTION 2/OPSIE 2

$$E = \frac{kQ}{r^2} \checkmark$$

$$\therefore \frac{E_1}{E_2} = \frac{r_2^2}{r_1^2}$$

$$\frac{100}{50} \checkmark = \frac{r^2}{(0,6)^2} \checkmark$$

$$\therefore r = 0,85 \text{ m (0,849 m)} \checkmark$$

(5)
[21]

QUESTION 8/VRAAG 8

NEGATIVE MARKING FOR 8.1.1, 8.1.2 AND 8.1.3/NEGATIEWE NASIEN VIR VRAAG 8.1.1, 8.1.2 EN 8.1.3

8.1.1 P and Q burn with the same brightness ✓ same potential difference/same current ✓
P en Q brand met dieselfde helderheid ✓ dieselfde potensiaalverskil / dieselfde stroom ✓ (2)

8.1.2 P is dimmer (less bright) than R/P is minder helder as P
OR/OF
R is brighter than P/R is helderder as P ✓
R is connected across the battery alone therefore the voltage (terminal pd) is the same as the emf source (energy delivered by the source). ✓
R is alleen aan die battery gekoppel ✓ dus is die potensiaalverskil (terminale potensiaalverskil) dieselfde as die emk bron (energie gelewer deur die bron). ✓

OR/OF

The potential difference across **R** is twice (larger/greater than) that of **P**./The current through **R** is twice (larger/greater than) that of **P**.

Die potensiaalverskil oor R is twee maal dié van P./Die stroom deur R is twee maal dié van P.

OR/OF

P and Q are in series and are both connected across the same battery, ✓ hence the voltage (terminal pd) is shared equally ✓ (P and Q are potential dividers) Therefore R is brighter.

P en Q is in serie en beide is oor dieselfde battery gekoppel, ✓ dus word die potensiaalverskil gelyk verdeel ✓ (P en Q is potensiaal verdelers) Dus is R helderder.

OR/OF

Potential difference across **P** is half that across **R**/Die potensiaalverskil oor **P** is die helfte die oor **R** (2)

8.1.3 T does not light up at all✓

T brand glad nie

ACCEPT/AANVAAR

T is dimmer (less bright) than R/T *is minder helder as R*✓

R is brighter than T✓

R is helderder as T

Reason/Rede

The wire acts as a short circuit. ✓

Die draad dien as 'n kortsluiting

OR/OF

The potential difference across T / current in T is zero.✓

Die potensiaalverskil oor T/stroom in T is nul.

(2)

8.2.1

OPTION 1/OPSIE 1

$$\frac{1}{R_{//}} = \frac{1}{R_5} + \frac{1}{R_{10}} \checkmark$$

$$\frac{1}{R_{//}} = \frac{1}{5} + \frac{1}{10} \checkmark$$

$$\therefore R_{//} = 3,33 \, \Omega \, (3,333 \, \Omega)$$

$$R_{//} = \frac{R_5 R_{10}}{R_5 + R_{10}} \checkmark$$

$$= \frac{(5)(10)}{(5+10)} \checkmark = 3,33 \, (3,333) \, \Omega$$

$$\begin{aligned} R_{\text{tot}} &= R_8 + R_{//} + r \\ &= (8 + 3,33 + 1) \checkmark \\ &= 12,33 \, \Omega \end{aligned}$$

$$I = \frac{V}{R} \checkmark$$

$$I_{\text{tot}} = \frac{20}{12,33} \checkmark = 1,62 \, \text{A}$$

$$\therefore I_8 = 1,62 \, \text{A} \checkmark$$

$$\mathcal{E} = I(R + r) \checkmark$$

$$20 = I[(11,33 + 1) \checkmark] \checkmark$$

$$I = 1,62 \, \text{A} \checkmark$$

OPTION 2/OPSIE 2

$$\frac{1}{R_{//}} = \frac{1}{R_5} + \frac{1}{R_{10}} \checkmark$$

$$\frac{1}{R_{//}} = \frac{1}{5} + \frac{1}{10} \checkmark$$

$$\therefore R_{//} = 3,33 \, \Omega \, (3,333 \, \Omega)$$

$$\begin{aligned} R_{//} &= \frac{R_5 R_{10}}{R_5 + R_{10}} \checkmark \\ &= \frac{(5)(10)}{(5+10)} \checkmark = 3,33 \, (3,333) \, \Omega \end{aligned}$$

$$\begin{aligned} R_{\text{tot}} &= R_8 + R_{//} + r \\ &= (8 + 3,33 + 1) \checkmark \\ &= 12,33 \, \Omega \end{aligned}$$

$$V_8 = \frac{8}{12,33} \times 20 = 12,973 \, \text{V}$$

$$I = \frac{V}{R} \checkmark$$

$$\begin{aligned} \therefore I_{\text{tot}} = I_8 &= \frac{12,973}{8} \checkmark \\ &= 1,62 \, \text{A} \checkmark \end{aligned}$$

(6)

8.2.2

OPTION 1/OPSIE 1

$$V = IR$$

$$V_5 = \mathcal{E} - (V_8 + V_1)$$

$$\begin{aligned} &= 20 \checkmark - [1,62(8 + 1)] \checkmark \\ &= 5,42 \, \text{V} \checkmark \end{aligned}$$

Any one/Enige een ✓

OPTION 2/OPSIE 2

POSITIVE MARKING FROM 8.2.1/POSITIEWE NASIEN VANAF 8.2.1

$$R_{//} = \frac{(5)(10)}{(5+10)} = 3,33 \, \Omega$$

$$\begin{aligned} V_{//} &= IR_{//} \checkmark \\ &= (1,62)(3,33) \checkmark \checkmark \\ &= 5,39 \, \text{V} \checkmark \end{aligned}$$

$$V_{R_{//}} = \frac{R_{//}}{R_{\text{tot}}} \times V_{\text{tot}} \checkmark$$

$$\begin{aligned} V_{R_{//}} &= \frac{(3,33)}{(12,33)} (20) \checkmark \checkmark \\ &= 5,41 \, \text{V} \checkmark \end{aligned}$$

OPTION 3/OPSIE 3

POSITIVE MARKING FROM 8.2.1/POSITIEWE NASIEN VANAF 8.2.1

$$I_5 R_5 = I_{10} R_{10} \checkmark$$

$$5I_5 = 10(1,62 - I_5) \checkmark$$

$$I_5 = 1,08 \, \text{A}$$

$$\begin{aligned} V_5 &= (1,08)(5) \checkmark \\ &= 5,4 \, \text{V} \checkmark \end{aligned}$$

(4)

POSITIVE MARKING FROM 8.2.1/POSITIEWE NASIEN VANAF 8.2.1
OPTION 4/OPSIE 4

$$I_5 = \frac{10}{15} \times I_{\text{tot}} \checkmark$$

$$= \frac{2}{3}(1,62)$$

$$= 1,08 \text{ A}$$

$$V_5 = I_5 R_5 \checkmark$$

$$V_5 = (1,08)(5) \checkmark$$

$$= 5,4 \text{ V} \checkmark$$

(4)

8.2.3

POSITIVE MARKING FROM 8.2.1/POSITIEWE NASIEN VANAF 8.2.1
OPTION 1/OPSIE 1

$$P = IV = I\mathcal{E} \checkmark$$

$$= (1,62)(20) \checkmark$$

$$= 32,4 \text{ W} \checkmark$$

POSITIVE MARKING FROM 8.2.1/POSITIEWE NASIEN VANAF 8.2.1
OPTION 2/OPSIE 2

$$P = IV \checkmark$$

$$P_{\text{tot}} = P_{8\Omega} + P_{//} + P_{1\Omega}$$

$$= IV_8 + IV_{//} + IV_1$$

$$= I^2(R_8 + R_{//} + R_1) \checkmark$$

$$= (1,62)^2[8 + 3,33 + 1] \checkmark$$

$$= 32,36 \text{ W} \checkmark$$

POSITIVE MARKING FROM 8.2.1 AND 8.2.2/POSITIEWE NASIEN VANAF
OPTION 3/OPSIE 3

8.2.1 EN 8.2.2

$$P = I^2 R \checkmark$$

$$I_5 = \frac{V_5}{R_5} = \frac{5,4}{5} = 1,08 \text{ A}$$

$$\therefore I_{10} = 0,54 \text{ A}$$

$$P_{\text{tot}} = I_8^2 R_8 + I_1^2 R_1 + I_5^2 R_5 + I_{10}^2 R_{10}$$

$$= (1,62)^2[8 + 1] + (1,08)^2(5) + (0,54)^2(10) \checkmark = 32,37 \text{ W} \checkmark$$

OPTION 4/OPSIE 4

$P = \frac{V^2}{R} \checkmark$ $P = \frac{20^2}{(8+1+3,33)} \checkmark$ $= 32,44 \text{ W} \checkmark$	$P = I^2 R_{\text{tot}} \checkmark$ $= (1,62)^2(12,33) \checkmark$ $= 32,36 \text{ W} \checkmark$

(3)

NOTE/LET WEL: Range/Gebied 32,35- 32,45

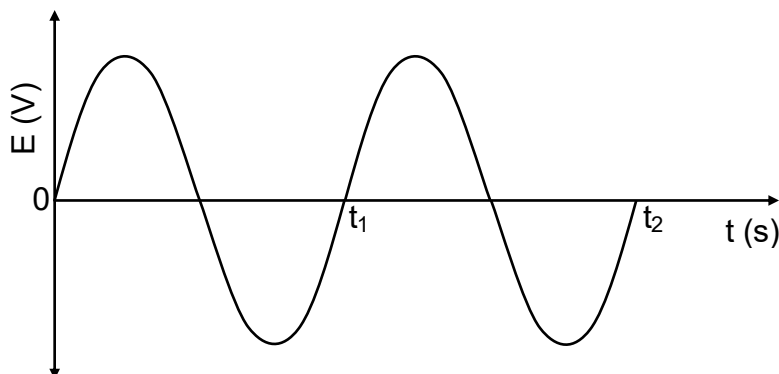
[19]

QUESTION 9/VRAAG 9

9.1 Slip rings/Sleepringe ✓

(1)

9.2



Marking criteria/Nasienriglyne	
Sine graph starts from 0. <i>Sinusgrafiek begin by 0</i>	✓
Two complete waves (between t_0 and t_2) <i>Twee volledige golwe tussen (t_0 en t_2)</i>	✓

(2)

9.3 Any TWO/Enige TWEE

Increase the speed of rotation/Verhoog die rotasie speed ✓

Increase the number of coils (turns)/Verhoog die getal spoele ✓

Use stronger magnets/Gebruik sterker magnete

ACCEPT/AANVAAR: Increase surface area/Verhoog die oppervlakarea

(2)

9.4 The rms value of an AC voltage is that value of the AC voltage which will dissipate the same amount of energy as DC.

Die wgk waarde van WS potensiaalverskil/stroom hoeveelheid energie as GS verkwis

OR/OF

The rms value of an AC voltage is that value of the AC voltage which will produce the same joule heating effect as DC.

Die wgk waarde van WS potensiaalverskil is die waarde van die WS potensiaalverskil wat dieselfde joule verhittingseffek as GS lewer.

(2)

9.5

<u>OPTION 1/OPSIE 1</u>	<u>OPTION 2/OPSIE 2</u>
$P_{\text{ave/gem}} = I_{\text{rms/w gk}} V_{\text{rms/w gk}} \checkmark$ $1500 = I_{\text{rms/w gk}} (240) \checkmark$ $I_{\text{rms/w gk}} = \frac{1500}{240}$ $= 6,25 \text{ A} \checkmark$	$P_{\text{ave}} = \frac{V^2}{R} \checkmark$ $1500 = \frac{240^2}{R}$ $R = 38,4 \, \Omega$ $I_{\text{rms}} = \frac{V}{R}$ $= \frac{240}{38,4} \checkmark$ $= 6,25 \text{ A} \checkmark$

(3)
[10]

QUESTION 10/VRAAG 10

- 10.1 The minimum frequency of light ✓ needed to emit electrons from a certain metal surface. ✓

Die minimum frekwensie van lig benodig om elektrone vanaf die oppervlak van 'n sekere metaal vry te stel.

OR/OF

The minimum frequency of light ✓ below which electrons will not be emitted from the surface of a certain metal. ✓

Die minimum frekwensie van lig waaronder elektrone nie vanaf die oppervlak van 'n sekere metaal vrygestel sal word nie.

(2)

- 10.2 The speed remains unchanged. ✓

Die spoed bly onveranderd.

(1)

- 10.3

OPTION 1/OPSIE 1

$$c = f\lambda \checkmark,$$

$$3 \times 10^8 = f(6 \times 10^{-7}) \checkmark$$

$$\therefore f = 5 \times 10^{14} \text{ Hz} \checkmark$$

The value of f is less than the threshold frequency of the metal, ✓ therefore photoelectric effect is not observed. ✓

Die waarde van f is laer as die drumpelfrekwensie van die metaal, ✓ en gevolglik sal foto-nie waargeneem word nie. ✓

OPTION 2/OPSIE 2

For the given metal/*Vir die gegewe metaal*

$$W_0 = hf_0 \checkmark$$

$$= (6,63 \times 10^{-34})(6,8 \times 10^{14}) \checkmark$$

$$= 4,51 \times 10^{-19} \text{ J}$$

For the given wavelength/*Vir die gegewe golflengte*

$$E_{\text{photon/foton}} = \frac{hc}{\lambda}$$

$$= \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{6 \times 10^{-7}} \checkmark$$

$$= 3,32 \times 10^{-19} \text{ J}$$

$$E_{\text{photon/foton}} = hf$$

$$= (6,63 \times 10^{-34})(5 \times 10^{14}) \checkmark$$

$$= 3,32 \times 10^{-19} \text{ J}$$

This energy is less than the work function ✓ of the metal, therefore photoelectric effect is not observed. ✓

Hierdie energie is minder as die werksfunksie ✓ of die metaal, en gevolglik sal foto-elektriese nie waargeneem word nie. ✓

(5)

OPTION 3/OPSIE 3

$$c = f_0 \lambda_0 \checkmark$$

$$3 \times 10^8 = 6,8 \times 10^{14} (\lambda_0) \checkmark$$

$$\lambda_0 = 4,41 \times 10^{-7} \text{ m} \checkmark$$

The threshold wavelength (λ_0) is smaller than $6 \times 10^{-7} \text{ m}$ $\checkmark$ therefore photoelectric effect is not observed. $\checkmark$

Die drumpelgolflengte (λ_0) is kleiner as $6 \times 10^{-7} \text{ m}$ $\checkmark$ en gevolglik sal foto-elektriese effek nie waargeneem word nie. $\checkmark$

10.4

$$E = W_o + E_{k(\text{max})}$$

$$E = W_o + \frac{1}{2} m v_{\text{max}}^2$$

$$h \frac{c}{\lambda} = h f_0 + \frac{1}{2} m v_{\text{max}}^2$$

$$h f = h f_0 + \frac{1}{2} m v_{\text{max}}^2$$

Any one of the three/Enige van die drie $\checkmark$

$$(6,63 \times 10^{-34})(7,8 \times 10^{14}) \checkmark = (6,63 \times 10^{-34})(6,8 \times 10^{14}) + \frac{1}{2} m v_{\text{max}}^2$$

$$\frac{1}{2} m v_{\text{max}}^2 = 6,63 \times 10^{-20} \text{ J}$$

$$\frac{1}{2} (9,11 \times 10^{-31}) v_{\text{max/maks}}^2 \checkmark = 6,63 \times 10^{-20}$$

$$v_{\text{max/maks}} = 3,82 \times 10^5 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(5)
[13]

TOTAL/TOTAAL: 150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATION SENIORSERTIFIKAAT-EKSAMEN

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

2017

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

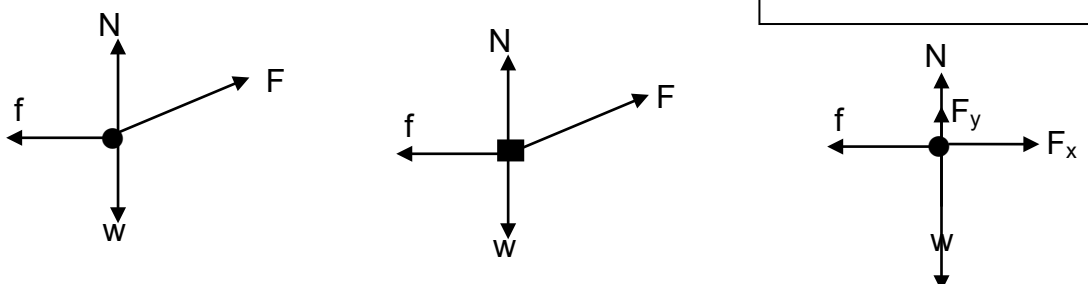
**These marking guidelines consist of 23 pages.
Hierdie nasienriglyne bestaan uit 23 bladsye.**

QUESTION/VRAAG 1

1.1	D ✓✓	(2)
1.2	B ✓✓	(2)
1.3	D ✓✓	(2)
1.4	C ✓✓	(2)
1.5	D ✓✓	(2)
1.6	B ✓✓	(2)
1.7	C ✓✓	(2)
1.8	C ✓✓	(2)
1.9	B ✓✓	(2)
1.10	B ✓✓	(2)
		[20]

QUESTION/VRAAG 2

2.1.1



ACCEPT/AANVAAR

Accepted labels/Aanvaarde benoemings		
w	F_g/F_w /weight/mg/gravitational force F_g/F_w /gewig/mg/gravitasiekrag	✓
f	Friction/ F_f/f_k /3 N/wrywing/ F_w	✓
N	Normal (force)/ F_{normal} / F_N / F_{normaal} / F_{reaction} /reaksie	✓
F	F_A / F_{applied} /toegepas	✓

Notes/Aantekeninge

- Mark awarded for label and arrow/Punt toegeken vir benoeming en pyltjie
- Deduct 1 mark if arrow(s) is (are) missing/Trek 1 punt af indien pylpunt(e) nie aangeheg is nie
- Do not penalise for length of arrows since drawing is not to scale./Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie
- Any other additional force(s)/Enige ander addisionele krag(te) Max/Maks $\frac{3}{4}$
- If force(s) do not make contact with body/Indien krag(te) nie met die voorwerp kontak maak nie: Max/Maks: $\frac{3}{4}$

(4)

2.1.2 $f_k = \mu_k N$ ✓ (can use F_N for N in equation/ kan F_N vir N gebruik in vergelyking)
 $3 = (0,2)N$ ✓
 $N = 15 \text{ N}$ ✓

(3)

2.1.3 **POSITIVE MARKING FROM QUESTION 2.1.2**
POSITIEWE NASIEN VANAF VRAAG 2.1.2

$$\left. \begin{array}{l} F_{\text{net}} = ma \\ N + F_{\text{vert}} - w = 0 \\ N + F_{\text{vert}} = w \end{array} \right\} \quad \checkmark \text{any of the three/enige van die drie}$$

$$F \sin 20^\circ \checkmark = (2)(9,8) - 15 \checkmark$$

$$F = 13,45 \text{ N} \checkmark$$

(4)

2.1.4 **POSITIVE MARKING FROM QUESTION 2.1.3**
POSITIEWE NASIEN VANAF VRAAG 2.1.3

$$\left. \begin{array}{l} F_{\text{net}} = ma \\ F \cos 20^\circ - f = ma \end{array} \right\} \quad \checkmark \text{any of the two/enige van die twee}$$

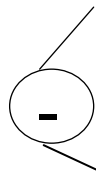
$$\frac{13,45 \cos 20^\circ - 3 = 2a \checkmark}{a = 4,82 \text{ m.s}^{-2} \checkmark}$$

(3)

2.2

- 2.2.1 Any two particles (objects) in the universe will attract each other with a force which is directly proportional to the product of the masses ✓ and inversely proportional to the square of the distance between them (their centres). ✓
Enige twee deeltjies (voorwerpe) in die heelal sal mekaar aantrek met 'n krag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul (middelpunte). (2)

2.2.2 Increases/Neem toe✓



Gravitational force is inversely proportional to the square of the distance between the (centres of the) objects✓
Gravitasiekrag is omgekeerd eweredig aan die kwadraat van die afstand tussen die voorwerpe se middelpunte

OR/OF

$$F \propto \frac{1}{r^2} \checkmark$$

(2)
[18]

QUESTION/VRAAG 3

- 3.1 The only force acting on the ball is the gravitational force. ✓✓
Die enigste krag wat op die bal inwerk is die gravitasiekrag.

OR/OF

The only force acting on the ball is its weight.
Die enigste krag wat op die bal inwerk is sy gewig.

ACCEPT/AANVAAR

The only force acting on the ball is gravity.
Die enigste krag wat op die bal inwerk is gravitasie. (2)

3.2.1

OPTION 1/OPSIE 1 UPWARDS AS POSITIVE OPWAARTS AS POSITIEF $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $= (10)(3) + \frac{1}{2}(-9,8)(3^2) \checkmark$ $= -14,10$ Height of building = 14,10 m ✓ <i>Hoogte van gebou = 14,10 m</i>	DOWNWARDS AS POSITIVE AFWAARTS AS POSITIEF $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $= (-10)(3) + \frac{1}{2}(9,8)(3^2) \checkmark$ $= 14,10 \text{ m} \checkmark$ Height of building = 14,10 m <i>Hoogte van gebou = 14,10 m</i>
OPTION 2/OPSIE 2 UPWARD AS POSITIVE OPWAARTS AS POSITIEF For maximum height <i>Vir maksimum hoogte</i> $v_f = v_i + a \Delta t$ $0 = 10 + (-9,8) \Delta t$ $\Delta t = 1,02 \text{ s}$ Time taken from point A to ground <i>Tyd geneem vanaf punt A tot grond</i> $= 3 - 2(1,02) = 0,96 \text{ s}$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $= (-10)(0,96) + \frac{1}{2}(-9,8)(0,96^2) \checkmark$ $= -14,1184$ Height of building = 14,12 m ✓ <i>Hoogte van gebou = 14,12 m</i>	UPWARD AS NEGATIVE OPWAARTS AS NEGATIEF For maximum height <i>Vir maksimum hoogte</i> $v_f = v_i + a \Delta t$ $0 = -10 + (9,8) \Delta t$ $\Delta t = 1,02 \text{ s}$ Time taken from point A to ground <i>Tyd geneem vanaf punt A tot grond</i> $= 3 - 2(1,02) = 0,96 \text{ s}$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $= (10)(0,96) + \frac{1}{2}(9,8)(0,96^2) \checkmark$ $= 14,1184 \text{ m} \checkmark$ Height of building = 14,12 m <i>Hoogte van gebou = 14,12 m</i>
OPTION 3/OPSIE 3 UPWARD AS POSITIVE OPWAARTS AS POSITIEF $v_f = v_i + a \Delta t$ $= 10 + (-9,8)(3)$ $= -19,40$ $v_f^2 = v_i^2 + 2 a \Delta y \checkmark$ $(-19,4)^2 = (10)^2 + 2(-9,8) \Delta y \checkmark$ $\Delta y = -14,10 \text{ m}$ Height of building = 14,10 m ✓ <i>Hoogte van gebou = 14,10 m</i>	UPWARD AS NEGATIVE OPWAARTS AS NEGATIEF $v_f = v_i + a \Delta t$ $= -10 + (9,8)(3)$ $= 19,40$ $v_f^2 = v_i^2 + 2 a \Delta y \checkmark$ $(19,4)^2 = (-10)^2 + 2(9,8) \Delta y \checkmark$ $\Delta y = 14,10 \text{ m} \checkmark$ Height of building = 14,10 m <i>Hoogte van gebou = 14,10 m</i>

OPTION 4/OPSIE 4 UPWARD AS POSITIVE OPWAARTS AS POSITIEF $v_f = v_i + a\Delta t$ $= (-10) + (-9,8)(0,96)$ $= -19,408$ $v_f^2 = v_i^2 + 2 a\Delta y \checkmark$ $(-19,408)^2 = (10)^2 + 2(-9,8)\Delta y \checkmark$ $\Delta y = 14,12 \text{ m}$ Height of building = 14,12 m ✓ Hoogte van gebou = 14,12 m	UPWARD AS NEGATIVE OPWAARTS AS NEGATIEF $v_f = v_i + a\Delta t$ $= 10 + (9,8)(0,96)$ $= 19,408$ $v_f^2 = v_i^2 + 2 a\Delta y \checkmark$ $(19,408)^2 = (-10)^2 + 2(9,8)\Delta y \checkmark$ $\Delta y = 14,12 \text{ m} \checkmark$ Height of building = 14,12 m Hoogte van gebou = 14,12 m
OPTION 5/OPSIE 5 $W_{\text{net}} = \Delta E_k = \Delta K$ $mg\Delta x \cos 0^\circ = \frac{1}{2} m(v_f^2 - v_i^2)$ $(9,8)\Delta x = \frac{1}{2} (19,408^2 - 10^2) \checkmark$ $\Delta x = 14,12 \text{ m}$ Height of building = 14,12 m ✓ Hoogte van gebou = 14,12 m	✓ any one/enige een $v_f = v_i + a\Delta t$ $= 10 + (9,8)(3)$ $= 19,40$
OPTION 6/OPSIE 6 $E_{\text{mechA}} = E_{\text{mechB}}$ $(E_k + E_p)_A = (E_k + E_p)_B$ $\frac{1}{2} mv^2 + mgh = \frac{1}{2} mv^2 + 0$ $\frac{1}{2}(10)^2 + (9,8)h = \frac{1}{2}(19,40)^2 \checkmark$ Height of building = 14,12 m ✓ Hoogte van gebou = 14,12 m	✓ any one/enige een $v_f = v_i + a\Delta t$ $= 10 + (9,8)(3)$ $= 19,40$
OPTION 7/OPSIE 7 $W_{\text{nc}} = \Delta E_p + \Delta E_k \checkmark$ $0 = mg(h_f - h_i) + \frac{1}{2} m(v_f^2 - v_i^2)$ $0 = m(9,8)(0 - h_i) + \frac{1}{2} m(19,408^2 - 10^2) \checkmark$ Height of building = 14,12 m ✓ Hoogte van gebou = 14,12 m	$v_f = v_i + a\Delta t$ $= 10 + (9,8)(3)$ $= 19,40$
OPTION 8/OPSIE 8 UPWARD AS POSITIVE OPWAARTS AS POSITIEF $v_f = v_i + a\Delta t$ $= (10) + (-9,8)(3)$ $= -19,40 \text{ m}\cdot\text{s}^{-1}$ $\Delta y = \frac{v_i + v_f}{2} \Delta t \checkmark$ $\Delta y = \frac{(10 - 19,40)}{2} 3 \checkmark$ Height of building = 14,12 m ✓ Hoogte van gebou = 14,12 m	UPWARD AS NEGATIVE OPWAARTS AS NEGATIEF $v_f = v_i + a\Delta t$ $= 10 + (9,8)(3)$ $= 19,40 \text{ m}\cdot\text{s}^{-1}$ $\Delta y = \frac{v_i + v_f}{2} \Delta t \checkmark$ $\Delta y = \frac{(-10 + 19,40)}{2} 3 \checkmark$ Height of building = 14,12 m ✓ Hoogte van gebou = 14,12 m

(3)

3.2.2 **OPTION 1/OPSIE 1**

UPWARDS AS POSITIVE OPWAARTS AS POSITIEF $v_f = v_i + a\Delta t \checkmark$ $= (10) + (-9,8)(3) \checkmark$ $= -19,40 \text{ m}\cdot\text{s}^{-1} \checkmark$ Speed = $19,40 \text{ m}\cdot\text{s}^{-1} \checkmark$ Spoed = $19,40 \text{ m}\cdot\text{s}^{-1}$	DOWNWARDS AS POSITIVE AFWAARTS AS POSITIEF $v_f = v_i + a\Delta t \checkmark$ $= (-10) + (9,8)(3) \checkmark$ $= 19,40 \text{ m}\cdot\text{s}^{-1} \checkmark$ Speed = $19,40 \text{ m}\cdot\text{s}^{-1}$ Spoed = $19,40 \text{ m}\cdot\text{s}^{-1}$
OPTION 2/OPSIE 2 UPWARDS AS POSITIVE OPWAARTS AS POSITIEF $v_f^2 = v_i^2 + 2a\Delta x \checkmark$ $= (-10)^2 + 2(-9,8)(-14,1) \checkmark$ $v_f = 19,4 \text{ m}\cdot\text{s}^{-1} \checkmark$	DOWNWARDS AS POSITIVE AFWAARTS AS POSITIEF $v_f^2 = v_i^2 + 2a\Delta x \checkmark$ $= (10)^2 + 2(9,8)(14,1) \checkmark$ $v_f = 19,4 \text{ m}\cdot\text{s}^{-1} \checkmark$

POSITIVE MARKING FROM QUESTION 3.2.1

POSITIEWE NASIEN VANAF VRAAG 3.2.1

OPTION 3/OPSIE 3

UPWARDS AS POSITIVE OPWAARTS AS POSITIEF $\Delta y = \frac{v_i + v_f}{2} \Delta t \checkmark$ $-14,12 = \frac{(10 + v_f)}{2} 3 \checkmark$ $v_f = 19,41 \text{ m}\cdot\text{s}^{-1}$ Speed = $19,41 \text{ m}\cdot\text{s}^{-1} \checkmark$ Spoed = $19,41 \text{ m}\cdot\text{s}^{-1}$	DOWNWARDS AS POSITIVE AFWAARTS AS POSITIEF $\Delta y = \frac{v_i + v_f}{2} \Delta t \checkmark$ $+14,12 = \frac{(-10 + v_f)}{2} 3 \checkmark$ $v_f = 19,41 \text{ m}\cdot\text{s}^{-1} \checkmark$ Speed = $19,41 \text{ m}\cdot\text{s}^{-1}$ Spoed = $19,41 \text{ m}\cdot\text{s}^{-1}$

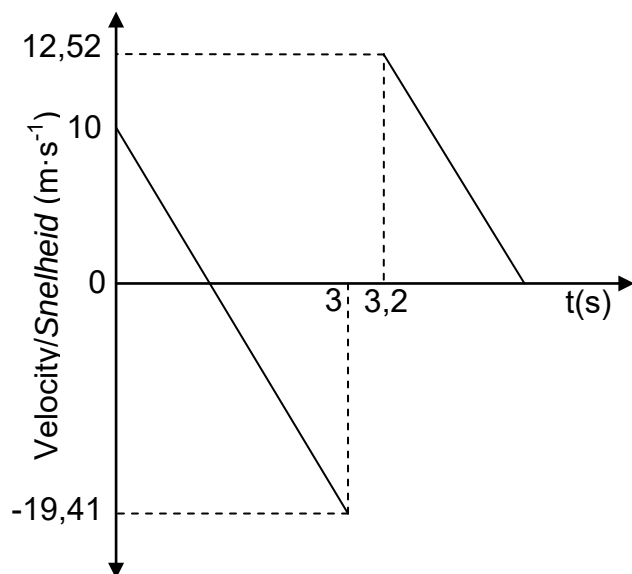
(3)

3.2.3

OPTION 1/OPSIE 1 UPWARDS AS POSITIVE OPWAARTS AS POSITIEF $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $0 = v_i^2 + (2)(-9,8)(8) \checkmark$ $v_i = 12,52 \text{ m}\cdot\text{s}^{-1} \checkmark$ Speed = $12,52 \text{ m}\cdot\text{s}^{-1}$ Spoed = $12,52 \text{ m}\cdot\text{s}^{-1}$	DOWNWARDS AS POSITIVE AFWAARTS AS POSITIEF $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $0 = v_i^2 + (2)(9,8)(-8) \checkmark$ $v_i = -12,52 \text{ m}\cdot\text{s}^{-1} \checkmark$ Speed = $12,52 \text{ m}\cdot\text{s}^{-1} \checkmark$ Spoed = $12,52 \text{ m}\cdot\text{s}^{-1}$
OPTION 2/OPSIE 2 UPWARDS AS POSITIVE OPWAARTS AS POSITIEF $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $-8 = 0 + \frac{1}{2}(-9,8)\Delta t^2$ $\Delta t = 1,28 \text{ s}$ $v_f = v_i + a\Delta t \checkmark$ $0 = v_i + (-9,8)(1,28) \checkmark$ $v_i = 12,52 \text{ m}\cdot\text{s}^{-1} \checkmark$ Speed = $12,52 \text{ m}\cdot\text{s}^{-1}$ Spoed = $12,52 \text{ m}\cdot\text{s}^{-1}$	DOWNWARDS AS POSITIVE AFWAARTS AS POSITIEF $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $8 = 0 + \frac{1}{2}(9,8)\Delta t^2$ $\Delta t = 1,28 \text{ s}$ $v_f = v_i + a\Delta t \checkmark$ $0 = v_i + (9,8)(1,28) \checkmark$ $v_i = -12,52 \text{ m}\cdot\text{s}^{-1} \checkmark$ Speed = $12,52 \text{ m}\cdot\text{s}^{-1} \checkmark$ Spoed = $12,52 \text{ m}\cdot\text{s}^{-1}$

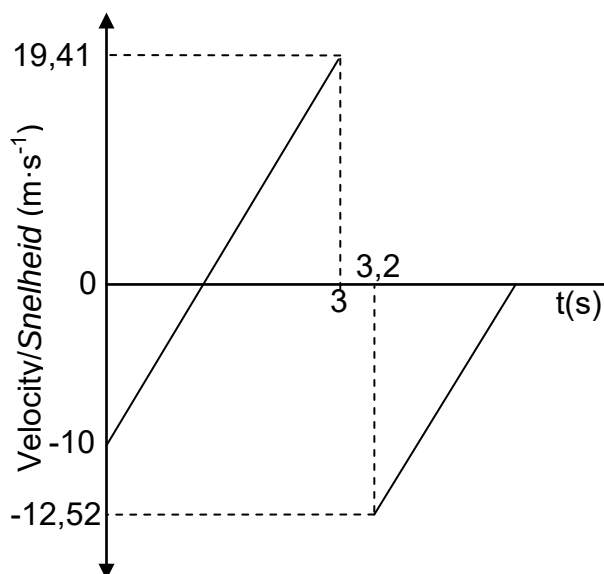
(3)

3.3 UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF

**CHECKLIST FOR MARKING
RIGLYNE VIR NASIEN**

Each line correctly drawn with calculated velocities. 1 x 2 <i>Elke lyn korrek geteken met berekende waardes 1 x 2</i>	✓✓
Mark for lines being parallel <i>Twee parallelle lyne korrek geteken</i>	✓
Times 3 s and 3,2 s correctly shown <i>Tye 3 s en 3,2 s korrek getoon</i>	✓

3.3 DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF

**CHECKLIST FOR MARKING
RIGLYNE VIR NASIEN**

Each line correctly drawn with calculated velocities. 1 x 2 <i>Elke lyn korrek geteken met berekende waardes 1 x 2</i>	✓✓
Mark for lines being parallel <i>Twee parallelle lyne korrek geteken</i>	✓
Times 3 s and 3,2 s correctly shown <i>Tye 3 s en 3,2 s korrek getoon</i>	✓

(4)
[15]

QUESTION/VRAAG 4

4.1

OPTION 1/OPSIE 1

$$v = \frac{\Delta x}{\Delta t}$$

$$= \frac{0,2}{0,4}$$

$$= 0,5 \text{ m} \cdot \text{s}^{-1}$$

OPTION 2/OPSIE 2

$$v = \frac{\Delta x}{\Delta t}$$

$$= \frac{0,4}{0,8}$$

$$= 0,5 \text{ m} \cdot \text{s}^{-1}$$

OPTION 2/OPSIE 2

$$v = \frac{\Delta x}{\Delta t}$$

$$= \frac{0,6}{1,2}$$

$$= 0,5 \text{ m} \cdot \text{s}^{-1}$$

✓ Formula/Formule

✓ Correct substitution in all three equations/Korrekte vervanging in al drie vergelykings

✓ Correct answer/korrekte antwoord

- If only two calculations used with correct answer, award 2/3
Indien slegs twee berekenings met korrekte antwoord gebruik word, ken 2/3 toe
- If unit(s) omitted lose 1 mark./Indien eenhede weggelaat is verbeur 1 punt

OPTION 2/OPSIE 2

Trolley moves with equal displacements in equal time (intervals). (Full marks or zero)

Trollie beweeg met gelyke verplasings in gelyke tydintervalle (Vol punte of nul)

(3)

4.2

The total linear momentum of a closed (isolated) system remains constant (is conserved).

*Die totale lineêre momentum in 'n geslote (geïsoleerde) sisteem bly konstant (is behoue).***OR/OF**

In an isolated system, the total linear momentum before collision is equal to the total linear momentum after collision

In 'n geslote (geïsoleerde) sisteem is die totale lineêre momentum voor botsing gelyk aan die totale lineêre momentum na botsing.

(2)

NOTE:/LET WEL

If the words “closed (isolated)” or “total” omitted, award 1/2.

Indien die woorde “geslote (geïsoleerde)” of totaal weggelaat is, ken 1/2 toe

4.3 POSITIVE MARKING FROM QUESTION 4.1/POSITIEWE NASIEN VANAF VRAAG 4.1

OPTION 1/OPSIE 1

$$\Sigma p_i = \Sigma p_f$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

✓ Any one/Enige een

$$(3,5)(0,5) \checkmark = (3,5 + 6)v_f \checkmark$$

$$v_f = v_{6\text{kg}}$$

$$= 0,184 \text{ m} \cdot \text{s}^{-1}$$

For trolley B:/Vir trollie B:

$$F_{\text{net}} \Delta t = \Delta p = m \Delta v \checkmark$$

$$F_{\text{net}}(0,5) = 6(0,184 - 0) \checkmark$$

$$F_{\text{net}} = 2,21 \text{ N (2,24 N)} \checkmark$$

$$F_{\text{net}} = ma$$

$$m \frac{(v_f - v_i)}{\Delta t} = (6) \frac{(0,184 - 0)}{0,05}$$

$$= 2,21 \text{ N}$$

OPTION 2/OPSIE 2

$$\Sigma p_i = \Sigma p_f$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

✓ Any one/Enige een

$$(3,5)(0,5) \checkmark = (3,5 + 6)v_f \checkmark$$

$$v_f = v_{6\text{kg}}$$

$$= 0,184 \text{ m} \cdot \text{s}^{-1}$$

For trolley B:/Trollie B:

$$F_{\text{net}} \Delta t = \Delta p = m \Delta v \checkmark$$

$$F_{\text{net}}(0,5) = 6(0,184 - 0) \checkmark$$

$$F_{\text{net}} = 2,21 \text{ N (2,24 N)} \checkmark$$

For trolley A:/Trollie A:

$$F_{\text{net}} \Delta t = \Delta p = m \Delta v \checkmark$$

$$F_{\text{net}}(0,5) = 3,5(0,184 - 0,5) \checkmark$$

$$F_{\text{net}} = -2,21 \text{ N (2,24 N)}$$

∴ Magnitude of the average net force experienced by trolley B = 2,21 N (2,24 N) ✓

∴ Grootte van die gemiddelde netto krag deur trollie B ondervind = 2,21 N (2,24 N)

(6)
[11]

OPTION 3/OPSIE 3

$$\Sigma p_i = \Sigma p_f$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

✓ Any one/Enige een

$$(3,5)(0,5) \checkmark = (3,5 + 6)v_{f\_} \checkmark$$

$$v_f = v_{6kg} \\ = 0,184 \text{ m} \cdot \text{s}^{-1}$$

For trolley B:/Trollie B:

$$v_f = v_i + a\Delta t$$

$$0,184 = 0 + a(0,5)$$

$$a = 0,368 \text{ ms}^{-1}$$

$$F_{\text{net}} = ma \checkmark$$

$$= (6)(0,368)$$

$$= 2,21 \text{ N}$$

For trolley A:/Trollie A:

$$v_f = v_i + a\Delta t$$

$$0,184 = 0,5 + a(0,5)$$

$$a = -0,632 \text{ ms}^{-1}$$

$$F_{\text{net}} = ma \checkmark$$

$$= (3,5)(-0,632)$$

$$= -2,21 \text{ N}$$

∴ Magnitude of the average net force experienced by trolley B = 2,21 N (2,24 N)✓

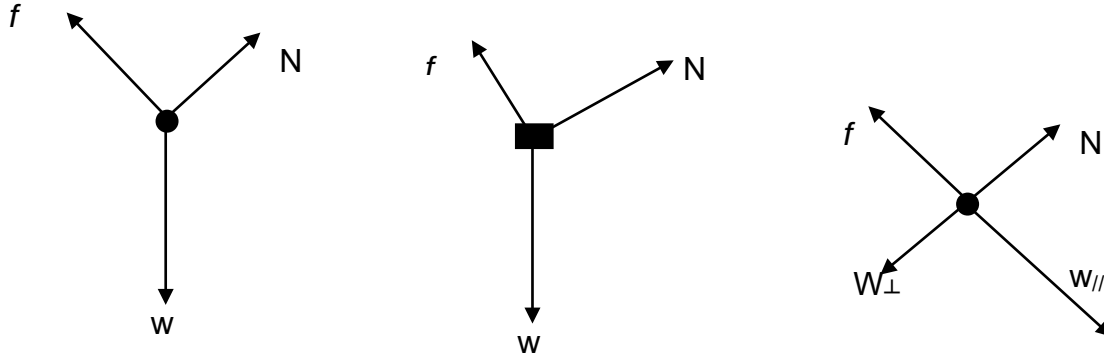
∴ Grootte van die gemiddelde netto krag deur trollie B ondervind = 2,21 N (2,24 N)

(6)
[11]

QUESTION/VRAAG 5

5.1

ACCEPT/AANVAAR



Accepted labels/Aanvaarde benoemings		
w	F_g/F_w /weight/mg/gravitational force F_g/F_w /gewig/mg/gravitasiekrag	✓
f	Friction/ F_f /50 N/wrywing/ F_w	✓
N	Normal force/ F_{NORMAL} / F_{NOR} / F_{NORMAAL}	✓

Notes/Aantekeninge

- Mark awarded for label and arrow/Punt toegeken vir benoeming en pyltjie
- Deduct 1 mark if arrow(s) is (are) missing/ Trek 1 punt af indien pylpunt(e) nie aangeheg is nie
- Do not penalise for length of arrows since drawing is not to scale./Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie Any other additional force(s)/Enige ander addisionele krag(te) Max/Maks 2
- If force(s) do not make contact with body/Indien krag(te) nie met die voorwerp kontak maak nie: Max/Maks: $\frac{3}{4}$
- Award 1 mark if both resolved components of w are correct/Ken 1 punt toe indien beide komponente van w korrek is.

5.2 The net/total work done on an object equals the change in the object's kinetic energy. ✓✓

Die netto/totale arbeid op 'n voorwerp verrig is gelyk aan die verandering in die voorwerp se kinetiese energie

OR/OF

The work done by the net force equals the change in the object's kinetic energy. ✓✓

Die arbeid verrig deur die netto krag is gelyk aan die voorwerp se verandering in kinetiese energie.

(2)

5.3

OPTION 1/OPSIE 1

$$W_{\text{net}} = \Delta E_K$$

$$f\Delta x \cos\theta + F_g \Delta x \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

✓ Any one/Enige een

$$(50)(25\cos 180^\circ) \checkmark + (60)(9,8)(25\cos 70^\circ) \checkmark = \frac{1}{2}(60)(15^2 - v_i^2) \checkmark$$

$$-1\,250 + 5\,027,696 = 6\,750 - 30v_i^2$$

$$v_i = 9,95(4) \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 2/OPSIE 2

$$W_{\text{net}} = \Delta E_K$$

$$f\Delta x \cos\theta + F_{g\parallel} \Delta x \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

✓ Any one/Enige een

$$(50)(25\cos 180^\circ) \checkmark + (60)(9,8\sin 20^\circ)(25\cos 0^\circ) \checkmark = \frac{1}{2}(60)(15^2 - v_i^2) \checkmark$$

$$-1\,250 + 5\,027,696 = 6\,750 - 30v_i^2$$

$$v_i = 9,95(4) \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 3/OPSIE 3

$$W_{\text{nc}} = \Delta E_K + \Delta E_P$$

$$f\Delta x \cos\theta = \frac{1}{2}(mv_f^2 - mv_i^2) + (mgh_Q - mgh_P)$$

$$E_{\text{mechP}} + E_{\text{mechQ}} + W_{\text{nc}} = 0$$

✓ Any one/Enige een

$$(50)(25\cos 180^\circ) \checkmark = \frac{1}{2}(60)(15^2 - v_i^2) \checkmark + (60)(9,8)(-25\sin 20^\circ) \checkmark$$

$$-1\,250 = 6\,750 - 30v_i^2 - 5\,027,696$$

$$v_i = 9,95 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(5)

OPTION 4/OPSIE 4

$$F_{\text{net}} = 201,11 - 50$$

$$= 151,11 \text{ N}$$

$$W_{\text{net}} = \Delta E_K \checkmark$$

$$F_{\text{net}} \Delta x \cos\theta = \frac{1}{2}(mv_f^2 - mv_i^2)$$

$$(151,11)(25)\cos 0^\circ \checkmark = \frac{1}{2}(15^2 - v_i^2) \checkmark$$

$$v_i = 9,95 \text{ m}\cdot\text{s}^{-1} \checkmark$$

5.4

POSITIVE MARKING FROM QUESTION 5.3
POSITIEWE NASIEN VANAF VRAAG 5.3

OPTION 1/OPSIE 1

$$P_{\text{ave/gemid}} = F v_{\text{ave/gemid}} \checkmark$$

$$= 50 \checkmark \frac{(9,95 + 15)}{2} \checkmark$$

$$= 623,75 \text{ W} \checkmark$$

OPTION 2/OPSIE 2

$$P = \frac{W}{\Delta t}$$

$$P_f = \frac{f \Delta x \cos \theta}{\Delta t}$$

$$= \frac{[50(25 \cos 180^\circ)]}{2,004} \checkmark$$

$$= -623,75 \text{ W} (-625 \text{ W})$$

$$P_{\text{boy/seun}} = 623,75 \text{ W} (625 \text{ W}) \checkmark$$

$\checkmark$ Any one/Enige een

$$\Delta x = \frac{(v_i + v_f)}{2} \Delta t$$

$$25 = \frac{(9,954 + 15)}{2} \Delta t \checkmark$$

$$\Delta t = 2,004 \text{ s}$$

$P_{\text{boy/seun}} = \frac{F \Delta x \cos \theta}{\Delta t} \checkmark$

$$= \frac{[50(25 \cos 0^\circ)]}{2,004} \checkmark$$

$$= 623,75 \text{ W} \checkmark$$

NOTE/LET WEL:

Candidates can substitute -1 250 from QUESTION 5.3 directly into the equation

Kandidate kan – 1 250 vanaf VRAAG 5.3 direk in die vergelyking vervang

(4)
[14]

QUESTION/VRAAG 6

6.1

- 6.1.1 It is the change in frequency (or pitch)✓ of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium ✓of sound propagation.

OR/OF

An apparent change in frequency (pitch), (wavelength) ✓as a result of the relative motion between a source and an observer ✓(listener).

Die skynbare verandering in frekwensie (toonhoogte) as gevolg van die relatiewe beweging tussen die bron en die waarnemer.

(2)

6.1.2

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \text{OR/OF} \quad f_L = \frac{v}{v - v_s} f_s \quad \checkmark$$

$$\checkmark \quad 365 = \frac{(340 + 0)}{(340 - v_s)} \checkmark \times 330 \quad \checkmark$$

$$v_s = 32,60 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

(5)

6.2

According to the Doppler Effect if the star moves away ✓from the observer a lower frequency/longer wavelength ✓is detected. This lower frequency/longer wavelength corresponds to the red end of the spectrum ✓

Volgens die Doppler-effek as die ster weg vanaf die waarnemer beweeg word 'n laer frekwensie/ langer golflengte waargeneem. Hierdie laer frekwensie/ langer golflengte stem ooreen met die rooi ent van die spektrum.

(3)

[10]**QUESTION/VRAAG 7**

7.1

The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the (magnitudes of the) charges ✓ and inversely proportional to the square of the distance (r) between them. ✓

Die grootte van die elektrostatische krag uitgeoefen deur een punt lading (Q_1) op 'n ander puntlading (Q_2) is direk eweredig aan die produk van die (groottes van die) ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle.

(2)

7.2.1 Negative/Negatief ✓✓

(2)

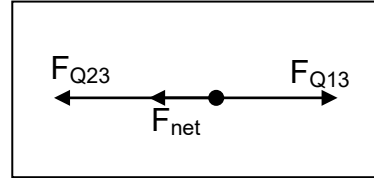
7.2.2 $F = k \frac{Q_1 Q_3}{r^2}$ ✓ (Accept/Aanvaar $F = k \frac{Q_1 Q_2}{d^2}$)

$$0,012 = \frac{(9 \times 10^9) Q_1 (2 \times 10^{-6})}{(2,5)^2} \quad \checkmark$$

$$Q_1 = 4,17 \times 10^{-6} \text{ C} \quad \checkmark$$

$$F_{\text{net}} = F_{Q13} + F_{Q23} \quad \checkmark$$

$$-0,3 = 0,012 - \frac{(9 \times 10^9)(Q_2)(2 \times 10^{-6})}{1^2} \quad \checkmark \checkmark$$

**OR/OF**

$$0,3 = -0,012 + \frac{(9 \times 10^9)(Q_2)(2 \times 10^{-6})}{1^2} \quad \checkmark \checkmark$$

$$Q_2 = 1,73 \times 10^{-5} \text{ C} \quad \checkmark$$

Do not penalise for the nature of the charges.
 Moenie vir die aard van die ladings penaliseer nie.

(7)
[11]

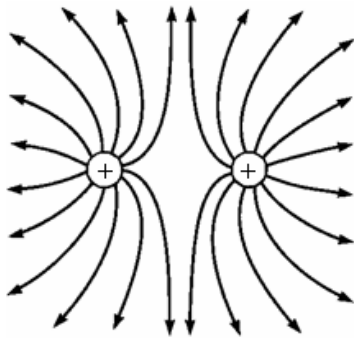
QUESTION/VRAAG 8

- 8.1 Electric field is a region of space in which an electric charge experiences a force. ✓✓

Elektriese veld is 'n gebied in die ruimte waarin 'n elektriese lading 'n krag ondervind.

(2)

8.2



Criteria for sketch/ <i>Kriteria vir skets</i>	Marks/ <i>Punte</i>
Correct shape as shown. <i>Korrekte vorm soos getoon.</i>	✓
Direction away from positive <i>Rigting weg van positief.</i>	✓
Field lines start on spheres and do not cross for correct diagram. <i>Veldlyne begin op elke sfeer en kruis nie.</i>	✓

(3)

8.3

$$\begin{aligned}
 E_{PA} &= \frac{kQ}{r^2} \checkmark \\
 &= \frac{(9 \times 10^9)(5 \times 10^{-6})}{(1,25)^2} \checkmark \\
 &= 2,88 \times 10^4 \text{ N} \cdot \text{C}^{-1} \text{ to the right/na regs}
 \end{aligned}$$

$$\begin{aligned}
 E_{PB} &= \frac{kQ}{r^2} \\
 &= \frac{(9 \times 10^9)(5 \times 10^{-6})}{(0,75)^2} \checkmark \\
 &= 8,00 \times 10^4 \text{ N} \cdot \text{C}^{-1} \text{ to the left/na links}
 \end{aligned}$$

$$\begin{aligned}
 E_{\text{net}} &= E_{PA} + E_{PB} \\
 &= 2,88 \times 10^4 + (-8,00 \times 10^4) \\
 &= 5,12 \times 10^4 \text{ N} \cdot \text{C}^{-1} \checkmark
 \end{aligned}$$

✓ Vector addition/ <i>Vektoroptelling</i>

(5)
[10]

QUESTION/VRAAG 9

- 9.1.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature ✓✓

Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom deur die geleier by konstante temperatuur.

NOTE/LET WEL

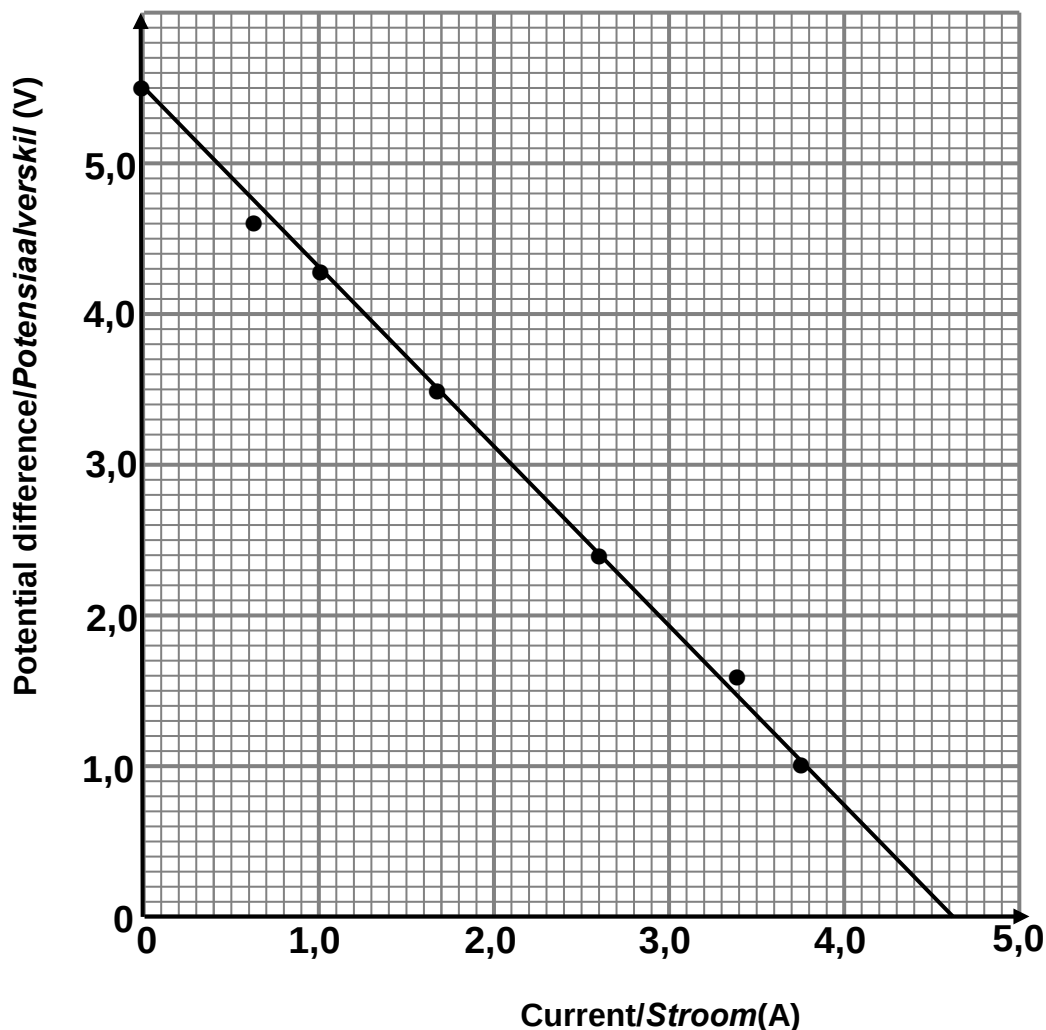
If constant temperature is omitted -1 mark

Indien konstante temperatuur weggelaat word -1 punt

(2)

- 9.1.2

Graph of potential difference versus current
Grafiek van potensiaalverskil teenoor stroom



Straight line passing through 4 or five points ✓.

Straight line with intercepts on both axes ✓.

Reguitlyn deur 4 of 5 punte

Reguitlyn met afsnitte op beide asse

(2)

- 9.1.3 5,5 V (accept any value from /aanvaar enige waarde vanaf 5,4 V to/tot 5,6 V based on graph drawn/op die grafiek gebaseer.)

NOTE /LET WEL :

The value must be the y-intercept./ Die waarde moet die y-afsnit wees.

(1)

9.1.4

$$\text{Slope/helling} = \frac{\Delta V}{\Delta I} \text{ or/of } \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{5,5-0}{0-4,6} = -1,2$$

Internal resistance/Interne weerstand (r) = 1,2 Ω ✓**NOTE/LET WEL:**

Any correct pair of coordinates chosen from the line drawn

*Enige korrekte paar koördinate vanaf die getekende lyne gekies*For the equation $\varepsilon = I(R + r)$ or $\varepsilon = V_{\text{ext}} + Ir$ marks are awarded only if the correct I and V values are used from the graph*Vir die vergelyking $\varepsilon = I(R + r)$ of $\varepsilon = V_{\text{ext}} + Ir$ sal punte slegs toegeken word indien die korrekte waardes van I and V vanaf die grafiek gebruik is.*

(3)

9.2.1

$$\left. \begin{aligned} R &= \frac{V}{I} \\ I &= \frac{V}{R} \\ V &= IR \end{aligned} \right\}$$

✓any of these/enige van hierdie

$$21,84 = I_{\text{tot}} (8) \quad \checkmark$$

$$I_{\text{tot}} = 2,73 \text{ A} \quad \checkmark$$

(3)

9.2.2

OPTION 1/OPSIE 1

$$\frac{1}{R_{\parallel}} = \frac{1}{R_{30}} + \frac{1}{R_{20}}$$

$$\frac{1}{R_{\parallel}} = \frac{1}{30} + \frac{1}{20} \quad \checkmark$$

$$R_{\parallel} = 12 \Omega \quad \checkmark$$

$$R_{\parallel} = \frac{R_{30} \times R_{20}}{R_{30} + R_{20}}$$

$$R_{\parallel} = \frac{30 \times 20}{50} \quad \checkmark$$

$$= 12 \Omega \quad \checkmark$$

(2)

9.2.3

POSITIVE MARKING FROM QUESTION 9.2.1 AND 9.2.2**POSITIEWE NASIEN VANAF VRAAG 9.2.1 EN 9.2.2****OPTION 1/OPSIE 1**

$$R_{\text{tot}} = (8 + 12 + r) \quad (\text{for the addition/vir optelling})$$

$$= (20 + r)$$

$$\varepsilon = I(R + r) \quad \checkmark$$

$$60 \quad \checkmark = (2,73)(20 + r) \quad \checkmark$$

$$\therefore r = 1,98 \Omega \quad \checkmark$$

POSITIVE MARKING FROM QUESTION 9.2.1**POSITIEWE NASIEN VANAF VRAAG 9.2.1****OPTION 2/OPSIE 2**

$$V_{||} = I_{\text{tot}} R_{||}$$

$$= (2,73)(12) \checkmark$$

$$= 32,76 \text{ V}$$

$$\therefore V_{\text{terminal}} = (32,76 + 21,84) \checkmark \text{ for addition/vir optelling}$$

$$= 54,6 \text{ V}$$

$$"V_{\text{lost}}" = 60 - 54,6 = 5,4 \text{ V}$$

$$R = \frac{V}{I}$$

$$I = \frac{V}{R}$$

$$V = IR$$

✓any of these/enige van hierdie

$$\mathcal{E} = V_{\text{lost}} + V_{||} + V_g$$

$$60 = (V_{\text{lost}} + 32,76 + 21,84) \checkmark$$

$$V_{\text{lost}} = 5,4 \text{ V}$$

$$5,4 = 2,73 r$$

$$r = 1,98 \Omega \checkmark$$

NOTE/LET WEL:

No penalisation for omitted subscripts

Geen penalisering vir weggelate onderskrifte nie

(4)

9.2.4

POSITIVE MARKING FROM 9.2.1 AND 9.2.2**POSITIEWE NASIEN VANAF VRAAG 9.2.1 EN 9.2.2****OPTION 1/OPSIE 1**

$$W = \frac{V^2}{R} \Delta t \checkmark$$

$$W = \frac{(54,6)^2}{20} (0,2) \checkmark$$

$$= 29,81 \text{ J} \checkmark$$

OPTION 2/OPSIE 2

$$W = I^2 R \Delta t \checkmark$$

$$= (2,73)^2 (20)(0,2) \checkmark$$

$$= 29,81 \text{ J} \checkmark$$

OPTION 3/OPSIE 3

$$W = VI \Delta t \checkmark$$

$$= (54,6)(2,73)(0,2) \checkmark$$

$$= 29,81 \text{ J} \checkmark$$

(3)

[20]

QUESTION/VRAAG10

- 10.1.1 **R:** armature/Coil(s)/Spoel✓
T: (Carbon/Koolstof) brushes/borsels✓
X: Slip rings/sleepringe✓

NOTE/LETWEL:

Answers must be in that order if R, T and X are omitted.

Antwoorde moet in hierdie orde wees as R, T en X weggelaat

(3)

- 10.1.2 Faraday's Law/Faraday se wet ✓

(1)

- 10.2.1 15 V✓

(1)

- 10.2.2

OPTION 1/OPSIE 1

$$V_{\text{rms}} = I_{\text{rms}} R$$

$$I_{\text{rms}} = \frac{15}{45} \checkmark$$

$$= 0,333 \text{ A}$$

$$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}}$$

$$I_{\text{max}} = (0,333) \sqrt{2} \checkmark$$

$$= 0,47 \text{ A} \checkmark$$

✓ any one/enige een

OPTION 2/OPSIE 2

$$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$$

$$V_{\text{max}} = (15) \sqrt{2} \checkmark$$

$$= 21,213 \text{ V}$$

$$V_{\text{max}} = I_{\text{max}} R$$

$$\frac{21,213}{45} \checkmark$$

$$I_{\text{max}} = \frac{21,213}{45}$$

$$= 0,47 \text{ A} \checkmark$$

✓ any one/enige een

OPTION 3/OPSIE 3

$$I_{\text{max}} = I_{\text{rms}} \sqrt{2}$$

$$= \sqrt{2} \frac{V_{\text{rms}}}{R}$$

$$= \sqrt{2} \frac{V_{\text{rms}}}{R}$$

$$= \sqrt{2} \frac{15}{45} \checkmark \checkmark$$

$$= 0,47 \text{ A} \checkmark$$

✓ any one/enige een

OPTION 4/OPSIE 4

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} = \frac{15^2}{45} = 5 \text{ W}$$

$$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}}$$

$$5 = (15) I_{\text{rms}} \checkmark$$

$$I_{\text{rms}} = 0,33 \text{ A}$$

$$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}}$$

$$0,33 = \frac{I_{\text{max}}}{\sqrt{2}} \checkmark$$

$$I_{\text{max}} = 0,47 \text{ A} \checkmark$$

✓any one/enige een

(4)
[9]

QUESTION/VRAAG 11

- 11.1 It is the process whereby electrons are ejected from a (metal) surface when light of suitable frequency is incident on that surface. ✓✓
Dit is die proses waarby elektrone vanaf die oppervlak van 'n metaal vrygestel word wanneer lig van geskikte frekwensie daarop skyn. (2)

- 11.2 INCREASE /TOENEEM ✓

–

Increase in intensity means that (for the same frequency) the number of photons incident per unit time increase. ✓ Therefore the number of electrons ejected per unit time increases. ✓

Thus current increases.

Toename in intensiteit beteken dat (vir dieselfde frekwensie) die aantal fotone per eenheid tyd neem toe. Dus sal die aantal elektrone per eenheid tyd vrygestel, toeneem. (3)

- 11.3

OPTION 1/OPSIE 1

$$E = W_0 + E_{k(\text{max})}$$

$$hf = hf_0 + E_{k(\text{max})}$$

$$hf = hf_0 + \frac{1}{2} mv^2$$

$$E = W_0 + \frac{1}{2} mv^2$$

✓Any one/Enige een

$$(6,63 \times 10^{-34} \times 5,9 \times 10^{14}) \checkmark = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{\lambda_0} + 2,9 \times 10^{-19} \checkmark$$

$$39,117 \times 10^{-20} - 2,9 \times 10^{-19} = \frac{19,89 \times 10^{-26}}{\lambda_0}$$

$$\lambda_0 = 1,97 \times 10^{-6} \text{ m} \checkmark$$

OPTION 2/OPSIE 2

$$\left. \begin{aligned} E &= W_o + E_{k(\max)} \\ hf &= hf_o + E_{k(\max)} \\ hf &= hf_o + \frac{1}{2} mv^2 \\ E &= W_o + \frac{1}{2} mv^2 \end{aligned} \right\} \checkmark \text{Any one/Enige een}$$

$$(6,63 \times 10^{-34} \times 5,9 \times 10^{14}) \checkmark = (6,63 \times 10^{-34})f_o + 2,9 \times 10^{-19} \checkmark$$

$$f_o = 1,52 \times 10^{14} \text{ Hz}$$

$$c = f_o \lambda_o$$

$$3 \times 10^8 = (1,52 \times 10^{14}) \lambda_o \checkmark$$

$$\lambda_o = 1,97 \times 10^{-6} \text{ m} \checkmark$$

(5)

OPTION 3/OPSIE 3

$$\left. \begin{aligned} E &= W_o + E_{k(\max)} \\ hf &= hf_o + E_{k(\max)} \\ hf &= hf_o + \frac{1}{2} mv^2 \\ E &= W_o + \frac{1}{2} mv^2 \end{aligned} \right\} \checkmark \text{Any one/Enige een}$$

$$(6,63 \times 10^{-34} \times 5,9 \times 10^{14}) \checkmark = W_o + 2,9 \times 10^{-19} \checkmark$$

$$W_o = 1,01 \times 10^{-19} \text{ J}$$

$$W_o = hf_o$$

$$1,01 \times 10^{-19} = (6,63 \times 10^{-34})f_o$$

$$f_o = 1,52 \times 10^{14} \text{ Hz}$$

$$c = f_o \lambda_o$$

$$3 \times 10^8 = (1,52 \times 10^{14}) \lambda_o \checkmark$$

$$\lambda_o = 1,97 \times 10^{-6} \text{ m} \checkmark$$

- 11.4 From the photo-electric equation, for a constant work function, ✓ the maximum kinetic energy of the photoelectrons is proportional to the energy of the photons.✓

Vanaf die foto-elektriese vergelyking is die maksimum kinetiese energie van die foto-elektrone eweredig aan die energie van die fotone vir 'n konstante arbeidsfunksie.

(2)
[12]



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

NOVEMBER 2016

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 19 pages.
*Hierdie memorandum bestaan uit 19 bladsye.***

QUESTION 1/VRAAG 1

- 1.1 A ✓✓ (2)
1.2 C ✓✓ (2)
1.3 C ✓✓ (2)
1.4 D ✓✓ (2)
1.5 B ✓✓ (2)
1.6 A ✓✓ (2)
1.7 C ✓✓ (2)
1.8 A ✓✓ (2)
1.9 B ✓✓ (2)
1.10 B ✓✓ (2)
[20]

QUESTION 2/VRAAG 2

- 2.1 When a resultant/net force acts on an object, the object will accelerate in the (direction of the net/resultant force). The acceleration is directly proportional to the net force ✓ and inversely proportional to the mass ✓ of the object.
Wanneer 'n netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die netto krag teen 'n versnelling direk eweredig aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

OR/OF

The resultant/net force acting on the object is equal (is directly proportional to) to the rate of change of momentum of an object (in the direction of the force). ✓✓

Die resulterende/netto krag wat op 'n voorwerp inwerk, is gelyk aan (is direk eweredig aan) die tempo van verandering van momentum van die voorwerp (in die rigting van die netto krag).

- 2.2 $f_k = \mu_k N \checkmark = \mu_k mg$
 $= (0,15)(3)(9,8) \checkmark$
 $= 4,41 \text{ N} \checkmark$ (3)

- 2.3



Accepted Labels/Aanvaarde benoemings	
W	F_g/F_w /force of Earth on block/weight/14,7 N/mg/gravitational force F_g/F_w /krag van Aarde op blok/gewig/14,7 N/mg/gravitasiekrag
N	F_N/F_{normal} /normal force F_N/F_{normaal} /normalekrag
T	Tension/ F_T <i>Spanning</i> / F_T
f_k	$f_{\text{kinetic friction/kinetiesewrywing}}$ / $f_{f/w}/f//F_{f/w}$ kinetic friction/kinetiesewrywing
25 N	$F_{\text{applied}}/F_A/F$ $F_{\text{toegepas}}/F_A/F$

2.4.1	OPTION 1/OPSIE 1 $f_k = \mu_k N = \mu_k (25 \sin 30^\circ + mg)$ $= 0,15[(25 \sin 30^\circ) \checkmark + (1,5)(9,8) \checkmark]$ $= 4,08 \text{ N} \checkmark$	OPTION 2/OPSIE 2 $f_k = \mu_k N = \mu_k (25 \cos 60^\circ + mg)$ $= 0,15[(25 \cos 60^\circ) \checkmark + (1,5)(9,8) \checkmark]$ $= 4,08 \text{ N} \checkmark$	(3)

2.4.2	POSITIVE MARKING FROM QUESTION 2.2 AND QUESTION 2.4.1 POSITIEWE NASIEN VANAF VRAAG 2.2 EN VRAAG 2.4.1 OPTION 1/OPSIE 1 For the 1,5 kg block/ <i>Vir die 1,5 kg blok</i> $F_{\text{net}} = ma$ $F_x + (-T) + (-f_k) = ma$ } $\checkmark$ $25 \cos 30^\circ - T - f_k = 1,5a$ $(25 \cos 30^\circ - T) - 4,08 \checkmark = 1,5a$ $17,571 - T = 1,5a \dots\dots\dots(1)$ For the 3 kg block <i>Vir die 3 kg blok</i> $T - f_k = 3a$ $T - 4,41 \checkmark = 3a \dots\dots\dots(2)$ $13,161 = 4,5 a$ $a = 2,925 \text{ m} \cdot \text{s}^{-2}$ $T = 13,19 \text{ N} \checkmark$ (13,17 N – 13,19 N)	$\checkmark$ either one enigeen

OPTION 2/OPSIE 2 For the 1,5 kg block/Vir die 1,5 kg blok $F_{\text{net}} = ma$ $F_x + (-T) + (-f_k) = ma$ ✓ $25 \cos 30^\circ - T - f_k = 1,5a$ $(25 \cos 30^\circ - T) - 4,08 \checkmark = 1,5a$ $17,571 - T = 1,5a \dots\dots\dots(1)$ For the 3 kg block Vir die 3 kg blok $T - f_k = 3a$ $T - 4,41 \checkmark = 3a \dots\dots\dots(2)$ $35,142 - 2T = T - 4,41$ $T = 13,18 \text{ N} \checkmark$	OPTION 3/OPSIE 3 For the 1,5 kg block/Vir die 1,5 kg blok $F_{\text{net}} = ma$ $F_x + (-T) + (-f_k) = ma$ ✓ $25 \cos 30^\circ - T - f_k = 1,5a$ $(25 \cos 30^\circ - T) - 4,08 \checkmark = 1,5a$ $17,571 - T = 1,5a \dots\dots\dots(1)$ $a = \frac{17,571 - T}{1,5}$ For the 3 kg block Vir die 3 kg blok $T - f_k = 3a$ $T - 4,41 \checkmark = 3a \dots\dots\dots(2)$ $a = \frac{T - 4,41}{3}$ $\frac{17,571 - T}{1,5} = \frac{T - 4,41}{3}$ $T = 13,18 \text{ N} \checkmark$

(5)
[18]

QUESTION 3/VRAAG 3

- 3.1 The motion of an object under the influence of gravity/weight/gravitational force only / Motion in which the only force acting is the gravitational force. ✓✓
 Die beweging van 'n voorwerp slegs onder die invloed van swaartekrag/gewig gravitasiekrag.
 Beweging waarin die enigste krag wat op die liggaam inwerk, die gravitasiekrag is.

(2)

3.2.1

OPTION 1/OPSIE 1 Upwards positive/Opwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $= 0^2 + (2)(-9,8) \checkmark (-20) \checkmark$ $v_f = 19,80 \text{ m}\cdot\text{s}^{-1} \checkmark$ Downwards positive Afwaarts positief $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $= 0^2 + (2)(9,8) \checkmark (20) \checkmark$ $v_f = 19,80 \text{ m}\cdot\text{s}^{-1} \checkmark$	OPTION 2/OPSIE 2 Upwards positive/Opwaarts positief: $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ $-20 = 0 + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$ $\Delta t = 2,02 \text{ s}$ $v_f = v_i + a\Delta t$ $= 0 + (-9,8)(2,02) \checkmark$ $= -19,80 \text{ m}\cdot\text{s}^{-1} \checkmark$ $= 19,80 \text{ m}\cdot\text{s}^{-1} \checkmark$ Downwards positive Afwaarts positief $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ $20 = 0 + \frac{1}{2} (9,8) \Delta t^2 \checkmark$ $\Delta t = 2,02 \text{ s}$ $v_f = v_i + a\Delta t$ $= 0 + (9,8)(2,02) \checkmark$ $= 19,80 \text{ m}\cdot\text{s}^{-1} \checkmark$

OPTION 3/OPSIE 3

$$\begin{aligned}(E_{\text{mech}})_{\text{Top/Bo}} &= (E_{\text{mech}})_{\text{Ground/Grond}} \\ (E_P + E_K)_{\text{Top}} &= (E_P + E_K)_{\text{Bottom/Onder}} \\ (mgh + \frac{1}{2}mv^2)_{\text{Top/Bo}} &= (mgh + \frac{1}{2}mv^2)_{\text{Bottom/Onder}} \\ (9,8)(20) + 0 &= (0 + \frac{1}{2}v_f^2) \\ v_f &= 19,80 \text{ m}\cdot\text{s}^{-1}\end{aligned}$$

✓ 1 mark for any
1 punt vir enige

OPTION 4/OPSIE 4

$$\begin{aligned}W_{\text{nc}} &= \Delta E_p + \Delta E_k \\ 0 &= mg\Delta h + \frac{1}{2}m\Delta v^2 \\ 0 &= m(9,8)(0 - 20) + \frac{1}{2}m(v_f^2 - 0) \\ v_f &= 19,80 \text{ m}\cdot\text{s}^{-1}\end{aligned}$$

OPTION 5/OPSIE 5

$$\begin{aligned}W_{\text{net}} &= \Delta E_k \\ mg\Delta x \cos 0^\circ &= \frac{1}{2}m(v_f^2 - 0) \\ m(9,8)(20)(1) &= \frac{1}{2}mv_f^2 \\ v_f &= 19,80 \text{ m}\cdot\text{s}^{-1}\end{aligned}$$

(4)

3.2.2

POSITIVE MARKING FROM QUESTION 3.2.1/POSITIEWE NASIEN VANAF VRAAG 3.2.1

OPTION 1/OPSIE 1

Downwards positive/Afwaarts positief

$$\begin{aligned}v_f &= v_i + a\Delta t \\ 19,80 &= 0 + (9,8)\Delta t \\ \Delta t &= 2,02 \text{ s}\end{aligned}$$

Upwards positive/Opwaarts positief

$$\begin{aligned}v_f &= v_i + a\Delta t \\ -19,80 &= 0 + (-9,8)\Delta t \\ \Delta t &= 2,02 \text{ s}\end{aligned}$$

OPTION 2/OPSIE 2

Upwards positive/Opwaarts positief:

$$\begin{aligned}\Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \\ -20 &= 0 + \frac{1}{2}(-9,8)\Delta t^2 \\ \Delta t &= 2,02 \text{ s}\end{aligned}$$

Downwards Positive/Afwaarts positief

$$\begin{aligned}\Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \\ 20 &= 0 + \frac{1}{2}(9,8)\Delta t^2 \\ \Delta t &= 2,02 \text{ s}\end{aligned}$$

OPTION 3/OPSIE 3

Downwards positive/Afwaarts positief:

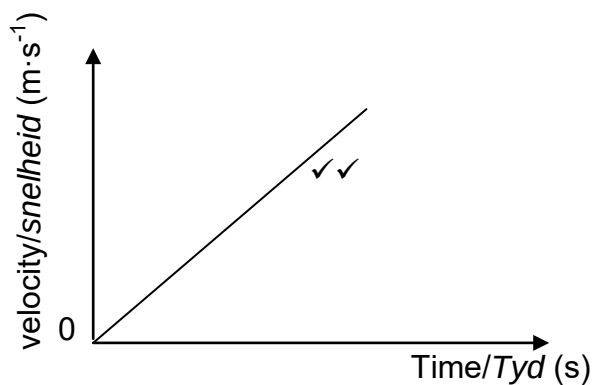
$$\begin{aligned}\Delta y &= \left(\frac{v_i + v_f}{2}\right)\Delta t \\ 20 &= \left(\frac{0 + 19,80}{2}\right)(\Delta t) \\ \Delta t &= 2,02 \text{ s}\end{aligned}$$

Upwards positive/Opwaarts positief:

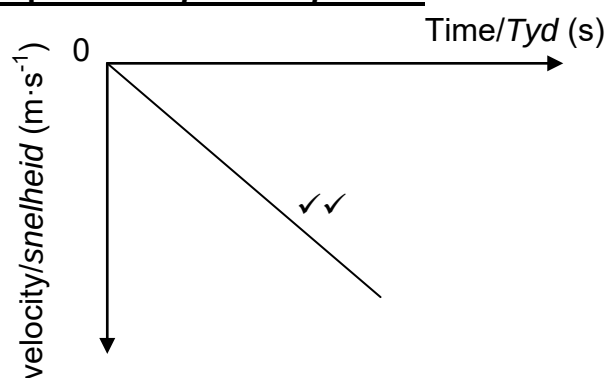
$$\begin{aligned}\Delta y &= \left(\frac{v_i + v_f}{2}\right)\Delta t \\ -20 &= \left(\frac{0 - 19,80}{2}\right)(\Delta t) \\ \Delta t &= 2,02 \text{ s}\end{aligned}$$

(3)

3.3 **Downward positive/Afwaarts positief**



Upward positive/Opwaarts positief



Notes/Aantekeninge

✓✓	Straight line through the origin. Reguitlyn deur die oorsprong

(2)
[11]

QUESTION 4/VRAAG 4

- 4.1 A system on which the resultant/net external force is zero/*n Sisteem waarop die resulterende krag/netto eksternekrag nul is* ✓
A system which excludes external forces /*n Sisteem wat eksterne kragte uitlaat.* (1)

- 4.2.1
- | | |
|--|-----|
| <p><u>OPTION 1/OPSIE 1</u>
 $p = mv$ ✓
 $30\,000 = (1\,500)v$ ✓
 $v = 20\text{ m}\cdot\text{s}^{-1}$ ✓</p> | (3) |
| <p><u>OPTION 2/OPSIE 2</u>
 $\Delta p = mv_f - mv_i$ ✓
 $0 = (1\,500)v_f - 30\,000$ ✓
 $v = 20\text{ m}\cdot\text{s}^{-1}$ ✓</p> | |

- 4.2.2 **POSITIVE MARKING FROM QUESTION 4.2.1/POSITIEWE NASIEN VANAF VRAAG 4.2.1**

<u>OPTION 1/OPSIE 1</u> $\sum p_i = \sum p_f$ $m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$ } ✓ $30\,000 + (900)(-15)$ ✓ = $14\,000 + 900v_B$ ✓ $\therefore v_B = 2,78\text{ m}\cdot\text{s}^{-1}$ ✓ east/oos ✓ (Accept/Aanvaar: to the right/na regs)	1 mark for any/1 punt vir enige	(5)
<u>OPTION 2/OPSIE 2</u> $\Delta p_A = -\Delta p_B$ $p_f - p_i = -(mv_f - mv_i)$ } $14\,000 - 30\,000$ ✓ = $900v_f - 900(-15)$ ✓ $v_f = 2,78\text{ m}\cdot\text{s}^{-1}$ ✓ east/oos ✓ (Accept/Aanvaar: to the right/na regs)	1 mark for any/1 punt vir enige	

- 4.2.3
- | | |
|--|-----|
| <p><u>OPTION 1/OPSIE 1</u>
 Slope/Helling = $\frac{\Delta p}{\Delta t} = F_{\text{net}}$ ✓
 $= \frac{(14\,000 - 30\,000)}{(20,2 - 20,1)}$ ✓
 $= -160\,000$
 $F_{\text{net}} = 160\,000\text{ N}$ ✓</p> | (5) |
| <p><u>OPTION 2/OPSIE 2</u>
 $F_{\text{net}}\Delta t = \Delta p$ ✓
 $F_{\text{net}}(0,1)$ ✓ = $14\,000 - 30\,000$ ✓
 $F_{\text{net}} = -160\,000\text{ N}$
 $F_{\text{net}} = 160\,000\text{ N}$ ✓</p> | |
| <p><u>POSITIVE MARKING FROM QUESTION 4.2.2/POSITIEWE NASIEN VANAF VRAAG 4.2.2</u>
 <u>OPTION 3/OPSIE 3</u>
 $F_{\text{net}}\Delta t = \Delta p$ ✓
 $F_{\text{net}}(0,1)$ ✓ = $900[(2,78) - (-15)]$ ✓
 $F_{\text{net}} = 160\,020\text{ N}$
 $F_A = -F_B$
 $F_{\text{net}} = 160\,020\text{ N}$ ✓</p> | |

OPTION 4/OPSIE 4

$$p = mv$$

$$14\,000 = 1\,500v_f \checkmark$$

$$v_f = 9,33 \text{ m}\cdot\text{s}^{-1}$$

$$F_{\text{net}} = \frac{m(v_f - v_i)}{\Delta t} \checkmark = \frac{1500(9,33 - 20)}{0,1} \checkmark$$

$$= -160\,050$$

$$= 160\,050 \text{ N} \checkmark$$

$$v_f = v_i + a\Delta t$$

$$9,33 = 20 + a(0,1)$$

$$a = -106,7 \text{ m}\cdot\text{s}^{-2}$$

$$F_{\text{net}} = ma \checkmark$$

$$= 1\,500(-106,7) \checkmark$$

$$F_{\text{net}} = -160\,050 \text{ N}$$

$$F_{\text{net}} = 160\,050 \text{ N} \checkmark$$

(4)
[13]**QUESTION 5/VRAAG 5**

$$5.1.1 \quad E_k/K = \frac{1}{2}mv^2 \checkmark$$

$$= \frac{1}{2}(2)(4,95)^2 \checkmark$$

$$= 24,50 \text{ J} \checkmark$$

(3)

5.1.2

POSITIVE MARKING FROM QUESTION 5.1.1/POSITIEWE NASIEN VANAF**5.1.1****OPTION 1/OPSIE 1**

$$E_{\text{mech before}} = E_{\text{mech after}}$$

$$[(E_{\text{mech}})_{\text{bob}} + (E_{\text{mech}})_{\text{block}}]_{\text{before/voor}} = [(E_{\text{mech}})_{\text{Block}} + (E_{\text{mech}})_{\text{bob}}]_{\text{after/na}}$$

$$(mgh + \frac{1}{2}mv^2)_{\text{before/voor}} = (mgh + \frac{1}{2}mv^2)_{\text{after/na}}$$

$$(5)(9,8)h + 0 + 0 \checkmark = 5(9,8)\frac{1}{4}h + 0 + 24,50 \checkmark$$

$$h = 0,67 \text{ m} \checkmark$$

Any one/
Enige een ✓**OPTION 2/OPSIE 2**

$$W_{\text{nc}} = \Delta E_p + \Delta E_k$$

$$0 = \Delta E_p + \Delta E_k$$

$$-\Delta E_p = \Delta E_k$$

$$-[(5)(9,8)(\frac{1}{4}h) - (5)(9,8)h] \checkmark = 24,50 \checkmark$$

$$h = 0,67 \text{ m} \checkmark$$

Any one/
Enige een ✓**OPTION 3/OPSIE 3**

$$\text{Loss } E_p \text{ bob} = \text{Gain in } E_k \text{ of block} \checkmark$$

$$mg(\frac{3}{4}h) = 24,5$$

$$(5)(9,8)(\frac{3}{4}h) \checkmark = 24,5 \checkmark$$

$$h = 0,67 \text{ m} \checkmark$$

(4)

OPTION 4/OPSIE 4**Before/Voor**

$$(mgh + \frac{1}{2}mv^2)_{\text{top/bo}} = (mgh + \frac{1}{2}mv^2)_{\text{bottom/onder}}$$

$$(5)(9,8)h + 0 = (5)(9,8)h_o + \frac{1}{2}(5)v^2$$

$$v_i^2 = 19,6h - 19,6h_o$$

After/Na

$$(mgh + \frac{1}{2}mv^2)_{\text{bottom/onder}} = (mgh + \frac{1}{2}mv^2)_{\text{top/bo}}$$

$$(5)(9,8)h_o + \frac{1}{2}(5)v_f^2 = (5)(9,8)(\frac{1}{4}h) + 0$$

$$v_f^2 = 4,9h - 19,6h_o$$

$$E_{\text{mech/meg before collision/voor botsing}} = E_{\text{mech/meg after collision/na botsing}} \checkmark$$

$$\frac{1}{2}mv_i^2(\text{bob/skietlood}) + 0 = \frac{1}{2}mv_f^2(\text{bob/skietlood}) + \frac{1}{2}mv^2(\text{block/blok})$$

$$\frac{1}{2}(5)(19,6h - 19,6h_o) \checkmark = \frac{1}{2}(5)(4,9h - 19,6h_o) + 24,5 \checkmark$$

$$h = 0,67 \text{ m} \checkmark$$

- 5.2 The net/total work done on an object is equal ✓ to the change in the object's kinetic energy ✓
Die netto/totale arbeid op 'n voorwerp verrig is gelyk aan die verandering in die kinetiese energie van die voorwerp.

OR/OF

The work done on an object by a resultant/net force is equal to the change in the object's kinetic energy.

Die arbeid verrig op 'n voorwerp deur 'n resulterende/netto krag is gelyk aan die voorwerp se verandering in kinetiese energie.

(2)

5.3

OPTION 1/OPSIE 1

$$W_{\text{net}} = \Delta E_K \checkmark$$

$$W_f + mg\Delta y \cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$W_f + (2)(9,8)(0,5)\cos 180^\circ \checkmark = \frac{1}{2}(2)(2^2 - 4,95^2) \checkmark$$

$$W_f = -10,7 \text{ J} \checkmark$$

OPTION 2/OPSIE 2

$$W_{\text{nc}} = \Delta E_K + \Delta U \checkmark$$

$$W_{\text{nc}} = \Delta E_K + \Delta E_P \checkmark$$

$$W_f = \frac{1}{2}(2)(2^2 - 4,95^2) \checkmark + (2)(9,8)(0,5-0) \checkmark$$

$$= -10,7 \text{ J} \checkmark$$

(4)

[13]

QUESTION 6/VRAAG 6

- 6.1.1 It is the (apparent) change in frequency (or pitch) of the sound (detected by a listener) ✓ because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓
Dit is die verandering in frekwensie (of toonhoogte) van die klank (waargeneem deur 'n luisteraar) omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klankvoortplanting het.

OR/OF

An (apparent) change in (observed/detected) frequency (pitch), (wavelength) ✓ as a result of the relative motion between a source and an observer ✓ (listener).

'n Skynbare verandering in (waargenome) frekwensie (toonhoogte), (golflengte) as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/luisteraar.

(2)

- 6.1.2 $v = f\lambda \checkmark$
 $340 = f(0,28) \checkmark$
 $f_s = 1\,214,29 \text{ Hz} \checkmark$

(3)

6.1.3 **POSITIVE MARKING FROM QUESTION 6.1.2/POSITIEWE NASIEN VANAF VRAAG 6.1.2**

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \text{OR/OF} \quad f_L = \frac{v \pm v_L}{v \pm v_s} \times \frac{v}{\lambda_s} \quad \text{OR/OF} \quad f_L = \frac{v}{v - v_s} f_s \quad \text{OR/OF} \quad f_L = \frac{f_s}{1 - \frac{v_s}{v}} \checkmark$$

$$f_L = \left(\frac{340}{340 - 30} \right) 1214,29 \checkmark \quad \text{OR/OF} \quad f_L = \left(\frac{340}{340 - 30} \right) \times \frac{340}{0,28} \quad \text{OR/OF} \quad f_L = \frac{1214,29}{1 - \frac{30}{340}}$$

$$= 1\,331,80 \text{ Hz} \checkmark \quad (1\,331,80 \text{ Hz} - 1\,335,72 \text{ Hz}) \quad (5)$$

6.1.4 Decreases/Verlaag $\checkmark$ (1)

6.2 The spectral lines of the star are/should be shifted towards the lower frequency $\checkmark$ end, which is the red end (red shift) of the spectrum. $\checkmark$

Die spektraallyne van die van die ster is verskuif na die laer frekwensie ent, wat die rooi ent van die spektrum is.

(2)
[13]

QUESTION 7/VRAAG 7

7.1.1 The (magnitude of the) electrostatic force exerted by one (point) charge on another is directly proportional to the product of the charges $\checkmark$ and inversely proportional to the square of the distance between their (centres) them. $\checkmark$

Die (grootte) van die elektrostatische krag wat een (punt) lading op 'n ander uitoefen, is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte.

(2)

7.1.2 F_E /Electrostatic force/Elektrostatische krag $\checkmark$ (1)

7.1.3 The electrostatic force is inversely proportional to the square of the distance between the charges $\checkmark$

Die elektrostatische krag is omgekeerd eweredig aan die kwadraat van die afstand tussen die ladings

OR/OF

The electrostatic force is directly proportional to the inverse of the square of the distance between the charged spheres (charges). $\checkmark$

Die elektrostatische krag is direk eweredig aan omgekeerde van die kwadraat van die afstand tussen die gelaaide sfere (ladings).

OR/OF

$$F \propto \frac{1}{r^2} \checkmark$$

OR/OF

They are inversely proportional to each other /Hulle is omgekeerd eweredig aan mekaar

(1)

7.1.4

OPTION 1/OPSIE 1

$$\text{Slope/Helling} = \frac{\Delta F_E}{\Delta \frac{1}{r^2}} = \frac{(0,027 - 0)}{(5,6 - 0)} \checkmark$$

$$= 4,82 \times 10^{-3} \text{ N} \cdot \text{m}^2 \quad (4,76 \times 10^{-3} - 5 \times 10^{-3})$$

$$\text{Slope/Helling} = F_E r^2 = kQ_1 Q_2 = kQ^2 \checkmark$$

$$4,82 \times 10^{-3} \checkmark = \frac{9 \times 10^9 Q^2}{\checkmark}$$

$$\therefore Q = 7,32 \times 10^{-7} \text{ C} \checkmark$$

OPTION 2/OPSIE 2

Accept any pair of points on the line/Aanvaar enige paar punte op die lyn

$$F = \frac{kQ_1 Q_2}{r^2} \checkmark$$

$$() \checkmark = \frac{(9 \times 10^9) Q^2}{()} \checkmark \checkmark$$

$$Q = 7,32 \times 10^{-7} \text{ C} \checkmark \quad (7,32 \times 10^{-7} - 7,45 \times 10^{-7} \text{ C})$$

Examples/Voorbeelde

$$(0,005) \checkmark = \frac{(9 \times 10^9) Q^2}{(1)} \checkmark \checkmark$$

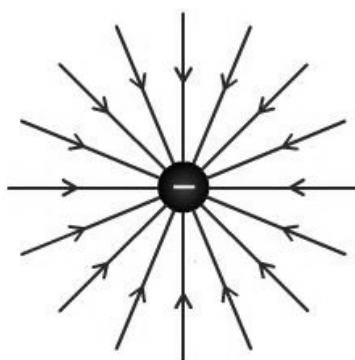
$$Q = 7,45 \times 10^{-7} \text{ C} \checkmark$$

$$(0,027) \checkmark = \frac{(9 \times 10^9) Q^2}{\left(\frac{1}{5,6}\right)} \checkmark \checkmark$$

$$Q = 7,32 \times 10^{-7} \text{ C} \checkmark$$

(6)

7.2.1



Criteria for drawing electric field: <i>Kriteria vir teken van elektriese veld:</i>	Marks/Punte
Direction /Rigting	✓
Field lines radially inward/Veldlyne radiaal inwaarts	✓

7.2.2

$$E = \frac{kQ}{r^2} \checkmark$$

Take right as positive/Neem regs as positief

$$E_{PA} = \frac{(9 \times 10^9)(0,75 \times 10^{-6})}{(0,09)^2} \checkmark$$

$$= 8,33 \times 10^5 \text{ N} \cdot \text{C}^{-1} \text{ to the left/na links}$$

$$E_{PB} = \frac{(9 \times 10^9)(0,8 \times 10^{-6})}{(0,03)^2} \checkmark$$

$$= 8 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ to the left/na links}$$

$$E_{\text{net}} = E_{PA} + E_{PB}$$

$$= [-8,33 \times 10^5 + (-8 \times 10^6)] \checkmark$$

$$= -8,83 \times 10^6$$

$$= 8,83 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark$$

1 mark for the addition of same signs/
1 punt vir optelling van dieselfde tekens

Take left as positive/Neem links as positief

$$E_{PA} = \frac{(9 \times 10^9)(0,75 \times 10^{-6})}{(0,09)^2} \checkmark$$

$$= 8,33 \times 10^5 \text{ N} \cdot \text{C}^{-1} \text{ to the left/na links}$$

$$E_{PB} = \frac{(9 \times 10^9)(0,8 \times 10^{-6})}{(0,03)^2} \checkmark$$

$$= 8 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ to the left/na links}$$

$$E_{\text{net}} = E_{PA} + E_{PB}$$

$$= (8,33 \times 10^5 + 8 \times 10^6) \checkmark$$

$$= 8,83 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark$$

1 mark for the addition of same signs/
1 punt vir optelling van dieselfde tekens

(5)
[17]

QUESTION 8/VRAAG 8

8.1.1 (Maximum) energy provided (work done) by a battery per coulomb/unit charge passing through it ✓✓ / *Energie verskaf (arbeid verrig) deur 'n battery per coulomb/eenheid lading wat daardeur vloei.* (2)

8.1.2 12 (V)✓ (1)

8.1.3 0 (V) / Zero/nul ✓ (1)

8.1.4 $\varepsilon = I(R + r)$
 $\varepsilon = V_{\text{ext}} + V_{\text{int}}$ } ✓
 $12 = 11,7 + Ir$
 $0,3 = I_{\text{tot}}(0,2)$ ✓
 $I_{\text{tot}} = 1,5 \text{ A}$ ✓

OR/OF

$V = IR$ ✓ (Accept/Aanvaar: $V_{\text{"lost"}} = Ir$)

$0,3 = I_{\text{tot}}(0,2)$ ✓

$I_{\text{tot}} = 1,5 \text{ A}$ ✓

(3)

8.1.5 <u>OPTION 1/OPSIE 1</u> $\left. \begin{aligned} \frac{1}{R_{\parallel}} &= \frac{1}{R_1} + \frac{1}{R_2} \\ \frac{1}{R} &= \frac{1}{10} + \frac{1}{15} \end{aligned} \right\} \begin{array}{l} \checkmark \text{ Any one} \\ \text{Enigeen} \end{array}$ $R = 6 \Omega$ ✓	<u>OPTION 2/OPSIE 2</u> $\left. \begin{aligned} R_{\parallel} &= \frac{R_1 R_2}{R_1 + R_2} \\ &= \frac{(10)(15)}{10 + 15} \end{aligned} \right\} \begin{array}{l} \checkmark \text{ Any one} \\ \text{Enigeen} \end{array}$ $= 6 \Omega$ ✓

(2)

8.1.6 **POSITIVE MARKING FROM QUESTIONS 8.1.4 AND 8.1.5/POSITIEWE NASIEN VANAF VRAE 8.1.4 EN 8.1.5**
OPTION 1/OPSIE 1

$V = IR$ ✓
 $11,7 \checkmark = 1,5(6 + R)$ ✓
 $R = 1,8 \Omega$ ✓

OR/OF

$V = IR$ ✓
 $11,7 = 1,5R$ ✓
 $R = 7,8 \Omega$

↓
 $R_R = 7,8 - 6$ ✓
 $= 1,8 \Omega$ ✓

OPTION 2/OPSIE 2

$$\varepsilon = I(R + r) \checkmark$$

$$12 = 1,5(R + 0,2) \checkmark$$

$$R = 7,8 \, \Omega$$



$$R_R = 7,8 - 6 \checkmark$$

$$= 1,8 \, \Omega \checkmark$$

OPTION 3/OPSIE 3

$$V_{||} = IR_{||}$$

$$= (6)(1,5) \checkmark$$

$$= 9 \, V$$

$$V_R = IR \checkmark$$

$$(11,7 - 9) = (1,5)R \checkmark$$

$$R = 1,8 \, \Omega \checkmark$$

(4)

8.2.1

$$P_{\text{ave/gemid}} = Fv_{\text{ave/gemid}} \checkmark = mg(v_{\text{ave/gemid}})$$

$$= (0,35)(9,8)(0,4) \checkmark$$

$$= 1,37 \, W \checkmark$$

OR/OF

$$P = \frac{W_{nc}}{\Delta t} \checkmark = \frac{\Delta E_k + \Delta E_p}{\Delta t} = \frac{0 + (0,35)(9,8)(0,4 - 0)}{1} \checkmark = 1,37 \, W \checkmark$$

OR/OF

$$P = \frac{W}{\Delta t} \checkmark = \frac{E_p}{\Delta t} = \frac{(0,35)(9,8)(0,4)}{1} \checkmark = 1,37 \, W \checkmark$$

(3)

8.2.2

POSITIVE MARKING FROM QUESTION 8.2.1/POSITIEWE NASIEN VANAF VRAAG 8.2.1

OPTION 1/OPSIE 1

$$P = VI$$

$$1,37 = (3)I \checkmark$$

$$I = 0,46 \, A$$

$$\varepsilon = V_{\text{ext}} + V_{\text{int}}$$

$$= V_T + V_X + V_{\text{int}}$$

$$12 = V_T + 3 + (0,2)(0,46) \checkmark$$

$$V_T = 8,91 \, V$$

$$V_T = IR_T$$

$$8,91 = (0,46)R_T \checkmark$$

$$R_T = 19,37 \, \Omega \checkmark$$

✓ Any one
Enigeen

OPTION 2/OPSIE 2

$$P = \frac{V^2}{R}$$

$$1,37 = \frac{3^2}{R} \checkmark$$

$$R = 6,57 \, \Omega$$

$$P = VI$$

$$1,37 = (3)I \checkmark$$

$$I = 0,46 \, A$$

$$\varepsilon = I(R + r)$$

$$12 = 0,46(6,57 + R_T + 0,2) \checkmark$$

$$R_T = 19,38 \, \Omega \checkmark$$

✓ Any one
Enigeen

OPTION 3/OPSIE 3

$$P = VI \checkmark$$

$$1,37 = (3)I \checkmark$$

$$I = 0,46 \text{ A}$$

$$P_{\text{tot}} = P_r + P_{\text{motor}} + P_T$$

$$(12)(0,46) \checkmark = (0,46)^2(0,2) + 1,37 + (0,46)^2 R_T \checkmark$$

$$R_T = 19,41 \Omega \checkmark$$

OR/OF

$$P = VI \checkmark$$

$$1,37 = (3)I \checkmark$$

$$I = 0,46 \text{ A}$$

$$P_{\text{tot}} = P_r + P_{\text{motor}} + P_T$$

$$(12)(0,46) = (0,46)^2(0,2) + 1,37 + P_T \checkmark$$

$$P_T = 4,07 \text{ W}$$

$$P = I^2 R$$

$$4,07 = (0,46)^2 R_T \checkmark$$

$$R_T = 19,49 \Omega \checkmark$$

OPTION 4/OPSIE 4

$$P = VI$$

$$1,37 = (3)I \checkmark$$

$$I = 0,46 \text{ A}$$

✓ Any one
Enig een

$$\varepsilon = I(R + r)$$

$$12 = (0,46)(R + 0,2) \checkmark$$

$$R = 25,87 \Omega$$

$$V = IR$$

$$3 = (0,46)R \checkmark$$

$$R = 6,52 \Omega$$

$$R_T = 25,87 - 6,52 \\ = 19,35 \Omega \checkmark$$

$$P = I^2 R$$

$$1,37 = (0,46)^2 R \checkmark$$

$$R = 6,47 \Omega$$

$$R_T = 25,87 - 6,47 \\ = 19,4 \Omega \checkmark$$

$$P_{\text{motor}} = \frac{V^2}{R}$$

$$1,37 = \frac{3^2}{R} \checkmark$$

$$R = 6,56 \Omega$$

$$R_T = 25,87 - 6,56 \\ = 19,31 \Omega \checkmark$$

(5)
[21]

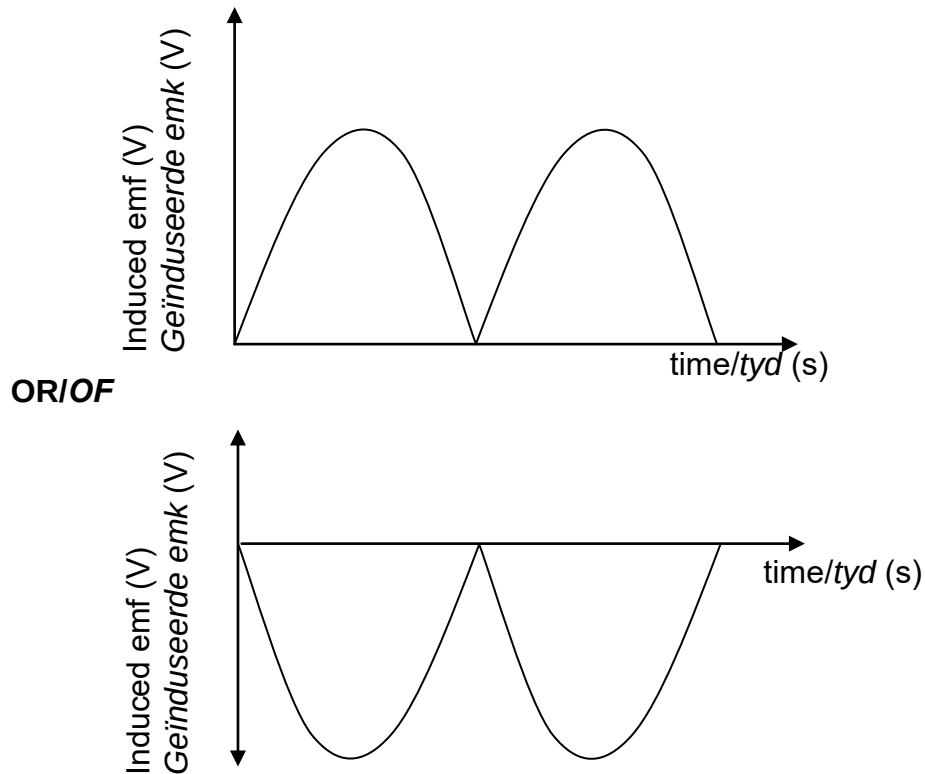
QUESTION 9/VRAAG 9

9.1.1 DC/GS-generator✓

Uses split ring/commutator/*Gebruik spleetring/kommutator*✓

(2)

9.1.2



(2)

9.2.1

OPTION 1/OPSIE 1

$$V_{\text{rms/wgk}} = \frac{V_{\text{max/maks}}}{\sqrt{2}}$$

$$P_{\text{ave/gem}} = V_{\text{rms/wgk}} I_{\text{rms/wgk}} \checkmark$$

$$800 = \frac{340}{\sqrt{2}} (I_{\text{rms/wgk}}) \checkmark$$

$$I_{\text{rms/wgk}} = 3,33 \text{ A} \checkmark$$

OR/OF

$$V_{\text{rms/wgk}} = \frac{V_{\text{max/maks}}}{\sqrt{2}} = \frac{340}{\sqrt{2}} = 240,416$$

$$P_{\text{ave/gem}} = V_{\text{rms/wgk}} I_{\text{rms/wgk}} \checkmark$$

$$800 = I_{\text{rms/wgk}} (240,416) \checkmark$$

$$I_{\text{rms/wgk}} = 3,33 \text{ A} \checkmark$$

OPTION 2/OPSIE 2

$$P_{\text{ave/gem}} = \left(\frac{V_{\text{rms/wgk}}^2}{R} \right) = \frac{(V_{\text{max/maks}}^2)}{(2)(R)}$$

$$800 = \frac{(340)^2}{(\sqrt{2})^2 (R)}$$

$$R = 72,25 \, \Omega$$

$$V_{\text{rms/wgk}} = I_{\text{rms/wgk}} R$$

$$I_{\text{rms/wgk}} = \frac{240,416}{72,25} \checkmark$$

$$= 3,33 \, \text{A} \checkmark$$

$$P_{\text{ave/gem}} = I_{\text{rms/wgk}}^2 R$$

$$800 = I_{\text{rms/wgk}}^2 (72,25) \checkmark$$

$$I_{\text{rms/wgk}} = 3,33 \, \text{A} \checkmark$$

(3)

9.2.2

POSITIVE MARKING FROM QUESTION 9.2.1

POSITIEWE NASIEN VANAF VRAAG 9.2.1

OPTION 1/OPSIE 1

$$P_{\text{ave/gemid}} = V_{\text{rms/wgk}} I_{\text{rms/wgk}} \checkmark$$

for the kettle/vir die ketel:

$$2000 = \frac{340}{\sqrt{2}} (I_{\text{rms/wgk}}) \checkmark$$

$$I_{\text{rms/wgk}} = 8,32 \, \text{A}$$

$$I_{\text{tot}} = (8,32 + 3,33) \checkmark$$

$$= 11,65 \, \text{A} \checkmark$$

OPTION 2/OPSIE 2

$$P_{\text{ave/gemid}} = \left(\frac{V_{\text{rms/wgk}}^2}{R} \right) \checkmark = \frac{(V_{\text{max/maks}}^2)}{(2)(R)}$$

$$800 = \frac{(340)^2}{(\sqrt{2})^2 (R)} \checkmark$$

$$R = 72,25 \, \Omega$$

$$2\,000 = \frac{(340)^2}{(\sqrt{2})^2 (R_{2000})}$$

$$R = 28,9 \, \Omega$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R = \frac{(28,9)(72,25)}{(28,9 + 72,25)} = 20,64 \, \Omega$$

$$V_{\text{rms/wgk}} = I_{\text{rms/wgk}} R$$

$$240,42 = I_{\text{rms/wgk}} (20,64) \checkmark$$

$$I_{\text{rms/wgk}} = 11,65 \, \text{A} \checkmark$$

OPTION 3/OPSIE 3

$$P_{\text{ave/gemid}} = V_{\text{rms/wgk}} I_{\text{rms/wgk}} \checkmark = \frac{V_{\text{max/maks}} I_{\text{max/maks}}}{2}$$

$$2\,800 \checkmark = \frac{(340) I_{\text{max/maks}}}{2} \checkmark$$

$$I_{\text{max/maks}} = 16,47 \text{ A}$$

$$I_{\text{rms}} = \frac{I_{\text{max/maks}}}{\sqrt{2}} = \frac{16,47}{\sqrt{2}}$$

$$I_{\text{rms/wgk}} = 11,65 \text{ A} \checkmark$$

OPTION 4/OPSIE 4

$$P_{\text{ave/gemid}} = V_{\text{rms/wgk}} I_{\text{rms/wgk}} \checkmark$$

$$2\,800 \checkmark = \frac{340}{\sqrt{2}} I_{\text{rms/wgk}} \checkmark$$

$$I_{\text{rms/wgk}} = 11,65 \text{ A} \checkmark$$

OPTION 5/OPSIE 5

$$P_T : P_K$$

$$800 : 2\,000 \checkmark$$

$$1 : 2,5$$

$$I_T : I_K$$

$$3,33 : 8,325 \checkmark$$

$$I_{\text{rms}} = 3,33 + 8,325 \checkmark$$

$$= 11,66 \text{ A} \checkmark$$

(4)
[11]

QUESTION 10/VRAAG 10

- 10.1.1 The minimum frequency (of a photon/light) needed✓ to emit electrons from (the surface of) a metal. (substance) ✓
Die minimum frekwensie (van 'n foton/lig) benodig om elektrone vanaf die (oppervlakte van)'n metaal (stof) vry te stel

OR/OF

- The frequency (of a photon/light) needed✓ to emit electrons from (the surface of) a metal. (substance) with zero kinetic energy✓
Die frekwensie (van 'n foton/lig) benodig om elektrone vanaf die (oppervlakte van)'n metaal (stof) met nul/geen kinetiese energie vry te stel

(2)

10.1.2 Silver/Silwer✓

Threshold/cutoff frequency (of Ag) is higher/Drumpel/afsnryfrekwensie (van Ag) is hoër✓

$$W_o \propto f_o / W_o = hf_o \checkmark$$

OR/OF

To eject electrons with the same kinetic energy from each metal, light of a higher frequency/energy is required for silver. ✓ Since $E = W_o + E_{k(max)}$ (and E_k is constant), the higher the frequency/energy of the photon/light required, the greater is the work function/ W_o .✓

Om elektrone met dieselfde kinetiese energie van elke metal vry te stel, is lig van hoër frekwensie benodig vir silwer. Aangesien $E = W_o + E_{k(maks)}$ (en $E_{k(maks)}$ is konstant) word fotone/lig van hoër frekwensie/energie benodig, dus is arbeidsfunksie hoër

(3)

10.1.3 Planck's constant /Planck se konstante ✓

(1)

10.1.4 Sodium/Natrium✓

(1)

10.2.1 Energy radiated per second by the blue light /Energie per sekonde uitgestraal deur die bloulig = $(\frac{5}{100})(60 \times 10^{-3}) \checkmark = 3 \times 10^{-3} \text{ J} \cdot \text{s}^{-1}$

$$\begin{aligned} E_{\text{photon/foton}} &= \frac{hc}{\lambda} \checkmark \\ &= \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{470 \times 10^{-9}} \checkmark \\ &= 4,232 \times 10^{-19} \text{ J} \end{aligned}$$

$$\begin{aligned} \text{Total number of photons incident per second/Totale aantal fotone wat per sekonde inval} &= \frac{3 \times 10^{-3}}{4,232 \times 10^{-19}} \checkmark \\ &= 7,09 \times 10^{15} \checkmark \end{aligned}$$

(5)

10.2.2 **POSITIVE MARKING FROM QUESTION 10.2.1**
POSITIEWE NASIEN VANAF VRAAG 10.2.1

$$7,09 \times 10^{15} \text{ (electrons per second/elektron per sekonde) } \checkmark$$

OR/OF

Same number as that calculated in Question 10.2.1 above/Dieselfde as die in Vraag 10.2.1 hierbo bereken

(1)

[13]

TOTAL/TOTAAL: 150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

FEBRUARY/MARCH/FEBRUARIE/MAART 2016

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 16 pages.
*Hierdie memorandum bestaan uit 16 bladsye.***

QUESTION 1/VRAAG 1

1.1	B ✓✓	(2)
1.2	D ✓✓	(2)
1.3	B ✓✓	(2)
1.4	D ✓✓	(2)
1.5	A ✓✓	(2)
1.6	C ✓✓	(2)
1.7	B ✓✓	(2)
1.8	B ✓✓	(2)
1.9	C ✓✓	(2)
1.10	A ✓✓	(2)
		[20]

QUESTION 2/VRAAG 2

2.1 For the 5 kg mass/Vir die 5 kg massa:

2.1.1 $T - f = ma$

$T - \mu_k(mg) = ma \checkmark$

$T - (0,4)(5)(9,8) \checkmark = 5a \checkmark \dots\dots\dots(1)$

NOTE/LET WEL:

1 mark for any of the 2 formulae
1 punt vir enige van die 2 formules

For the 20 kg mass/Vir die 20 kg massa

$mg - T = ma$

$20(9,8) - T = 20a \checkmark \dots\dots\dots(2)$

$176,4 = 25a \quad (1) + (2)$

$\therefore a = 7,06 \text{ (7,056) m} \cdot \text{s}^{-2} \checkmark$

(5)

ACCEPT/AANVAAR (4 marks/4 punte)

$F_{\text{net}} = ma$

$Mg - f = (M + m) a \checkmark$

$[20(9,8) - (0,4)(5)(9,8)] \checkmark = 25a \checkmark$

$\therefore a = 7,06 \text{ m} \cdot \text{s}^{-2} \checkmark$

(4)

2.1.2 **POSITIVE MARKING FROM QUESTION 2.1.1**

POSITIEWE NASIEN VANAF VRAAG 2.1.1

OPTION 1/OPSIE 1

$v_f^2 = v_i^2 + 2a\Delta y \checkmark$

$= 0 \checkmark + (2)(7,056)(6) \checkmark$

$v_f = 9,20 \text{ m} \cdot \text{s}^{-1} \checkmark$

POSITIVE MARKING FROM QUESTION 2.1.1

POSITIEWE NASIEN VANAF VRAAG 2.1.1

OPTION 2/OPSIE 2

The 5 kg mass travels as fast as the 20 kg mass

Die 5 kg massa beweeg net so vinnig soos die 20 kg massa

$W_{\text{net}} = \Delta K \checkmark$

$(5)(7,056)(6 \cos 0^\circ) \checkmark = \frac{1}{2}(5)(v_f^2 - 0) \checkmark$

$v_f = 9,20 \text{ m} \cdot \text{s}^{-1} \checkmark$

OPTION 3/OPSIE 3

For the 20 kg mass/Vir die 20 kg massa

$W_{\text{net}} = \Delta K \checkmark$

$Mg - T = Ma$

$(20)(9,8) - T = (20)(7,056) \checkmark$

$T = 54,88 \text{ N}$

$W_{\text{net}} = \Delta K$

$W_T + W_g = \frac{1}{2}m(v_f^2 - v_i^2)$

$(54,88)(6)(\cos 180^\circ) + 20(9,8)(6)(\cos 0^\circ) = \frac{1}{2}(20)(v_f^2 - 0) \checkmark$

$v_f = 9,202 \text{ m} \cdot \text{s}^{-1} \checkmark$

OPTION 4/OPSIE 4

$$W_{nc} = \Delta K + \Delta U \checkmark$$

$$W_{nc} = f_k \Delta x \cos \theta = \mu_k N \Delta x \cos \theta = \Delta U + \Delta K$$

$$(0,4)(5)(9,8)(6) \cos 180^\circ \checkmark = (20)(9,8)(0 - 6) + \frac{1}{2}(25)(v_f^2 - 0) \checkmark$$

$$-117,6 = (20)(9,8)(-6) + \frac{1}{2}(25)(v_f^2 - 0)$$

$$v_f = 9,202 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(4)

2.1.3 6 m ✓

(1)

2.2

2.2.1 Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses ✓ and inversely proportional to the square of the distance between their centres. ✓

Elke liggaam in die heelal trek elke ander liggaam aan met 'n krag wat direk eweredig is aan die produk van hul massas ✓ en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul middelpunte. ✓

(2)

2.2.2

$$F = \frac{Gm_1m_2}{r^2} \checkmark$$

On the mountain/Op die berg

$$F_g = \frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(65)}{(6,38 \times 10^6 + 6 \times 10^3)^2} \checkmark$$

$$= 627,2 \text{ N}$$

On the ground/Op die grond

$$F_g = W = mg$$

$$= (65 \times 9,8) \checkmark$$

$$= 637 \text{ N}$$

$$F_g = \frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(65)}{(6,38 \times 10^6)^2}$$

$$= 636,94 \text{ N}$$

$$\text{Difference/Verskil} = (637 - 627,2) \checkmark$$

$$= 9,8 \text{ N} \checkmark$$

(6)
[18]

QUESTION 3/VRAAG 3

3.1

3.1.1

OPTION 1/OPSIE 1**Upwards positive/Opwaarts positief:**

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$v_f^2 = (-2)^2 + 2(-9,8)(-45) \checkmark$$

$$v_f = 29,76 \text{ m}\cdot\text{s}^{-1} \checkmark$$

Downwards positive/Afwaarts positief:

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$v_f^2 = (2)^2 + 2(9,8)(45) \checkmark$$

$$v_f = 29,76 \text{ m}\cdot\text{s}^{-1} \checkmark (29,77 \text{ m}\cdot\text{s}^{-1})$$

OPTION 2/OPSIE 2**Upwards positive/Opwaarts positief:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

for either equation/vir beide vergelykings

$$-45 = -2\Delta t + \frac{1}{2}(-9,8)\Delta t^2$$

$$-4,9 \Delta t^2 - 2\Delta t + 45 = 0$$

$$4,9 \Delta t^2 + 2\Delta t - 45 = 0 \checkmark$$

$$\Delta t = 2,83$$

$$v_f = v_i + a \Delta t$$

$$v_f = 0 + (-9,8)(2,83)$$

$$v_f = -29,73 \text{ m s}^{-1} \checkmark$$

Downwards positive/Afwaarts positief:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

for either equation/vir beide vergelykings

$$45 = 2\Delta t + \frac{1}{2}(9,8)\Delta t^2$$

$$4,9 \Delta t^2 + 2\Delta t - 45 = 0 \checkmark$$

$$\Delta t = 2,83$$

$$v_f = v_i + a \Delta t$$

$$v_f = 0 + (9,8)(2,83)$$

$$v_f = 29,73 \text{ m s}^{-1} \checkmark$$

OPTION 3/OPSIE 3**Downwards positive/Afwaarts positief:**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

for either equation/vir beide vergelykings

$$45 = 2\Delta t + \frac{1}{2}(9,8)\Delta t^2$$

$$4,9 \Delta t^2 + 2\Delta t - 45 = 0 \checkmark$$

$$\Delta t = 2,83$$

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$45 = \frac{2 + v_f}{2} \cdot 2,83$$

$$v_f = 29,80 \text{ m s}^{-1} \checkmark$$

Upwards positive/Opwaarts positief:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

for either equation/vir beide vergelykings

$$-45 = -2\Delta t + \frac{1}{2}(-9,8)\Delta t^2$$

$$-4,9 \Delta t^2 - 2\Delta t + 45 = 0$$

$$4,9 \Delta t^2 + 2\Delta t - 45 = 0 \checkmark$$

$$\Delta t = 2,83$$

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$-45 = \frac{-2 + v_f}{2} \cdot 2,83 \checkmark$$

$$v_f = -29,80 \text{ m s}^{-1} \checkmark$$

OPTION 4/OPSIE 4

$$E_{\text{mech at top}} = E_{\text{mech at surface of water}}$$

$$\frac{1}{2} m v_i^2 + mgh_i = \frac{1}{2} m v_f^2 + mgh_f \checkmark$$

$$\frac{1}{2} (2)^2 + 9,8(45) = \frac{1}{2} v_f^2 + 0 \checkmark$$

$$v_f = 29,76 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 5/OPSIE 5

$$W_{\text{net}} = \Delta K \checkmark$$

$$F_g \Delta h \cos \theta = \frac{1}{2} m (v_f^2 - v_i^2)$$

$$mg \Delta h \cos \theta = \frac{1}{2} m (v_f^2 - v_i^2)$$

$$9,8(45) \cos 0 = \frac{1}{2} (v_f^2 - 2^2) \checkmark$$

$$v_f = 29,76 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(3)

3.1.2

POSITIVE MARKING FROM 3.1**POSITIEWE NASIEN VANAF 3.1****OPTION 1/OPSIE 1****Upwards positive/Opwaarts positief:**

The balls hit the water at the same instant./Die balle tref die water gelyktydig

$$v_f = v_i + a\Delta t \checkmark$$

Ball/Bal A

$$-29,76 = -2 + (-9,8) \Delta t$$

$$\Delta t = 2,83 \text{ s} \checkmark$$

 $\therefore$ for ball/vir bal B

$$\Delta t_B = 2,83 - 1 = 1,83 \text{ s}$$

 $\therefore$ for ball/vir bal B

$$\Delta t_B = 2,83 - 1 = 1,83 \text{ s} \checkmark$$

POSITIVE MARKING FROM 3.1**POSITIEWE NASIEN VANAF****3.1****OPTION 1/OPSIE 1****Downwards positive/Afwaarts positief**

The balls hit the water at the same instant./Die balle tref die water gelyktydig

$$v_f = v_i + a\Delta t \checkmark$$

Ball/Bal A

$$29,76 = 2 + (9,8) \Delta t$$

$$\Delta t = 2,83 \text{ s} \checkmark$$

 $\therefore$ for ball/vir bal B

$$\Delta t_B = 2,83 - 1 = 1,83 \text{ s}$$

 $\therefore$ for ball/vir bal B

$$\Delta t_B = 2,83 - 1 = 1,83 \text{ s} \checkmark$$

OPTION 2**Upwards positive/Opwaarts positief:**

Ball/Bal A

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$-45 = -2\Delta t + \frac{1}{2}(-9,8)\Delta t^2$$

$$-4,9 \Delta t^2 - 2\Delta t + 45 = 0$$

$$4,9 \Delta t^2 + 2\Delta t - 45 = 0$$

$$\Delta t = 2,83 \checkmark$$

 $\therefore$ for ball/vir bal B

$$\Delta t_B = 2,83 - 1 = 1,83 \text{ s} \checkmark$$

Downwards positive/Afwaarts positief:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$45 = 2\Delta t + \frac{1}{2}(9,8)\Delta t^2$$

$$4,9 \Delta t^2 + 2\Delta t - 45 = 0$$

$$\Delta t = 2,83 \checkmark$$

 $\therefore$ for ball/vir bal B

$$\Delta t_B = 2,83 - 1 = 1,83 \text{ s} \checkmark$$

OPTION 3 Downwards positive/Afwaarts positief: Ball/Bal A $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $45 = \frac{2 + 29,76}{2} \Delta t$ $\Delta t = 2,83 \checkmark$ $\therefore \text{for ball/vir bal B}$ $\Delta t_B = 2,83 - 1 = 1,83 \text{ s} \checkmark$	Upwards positive/Opwaarts positief: Ball/Bal A $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $-45 = \frac{-2 - 29,76}{2} \Delta t$ $\Delta t = 2,83 \checkmark$ $\therefore \text{for ball/vir bal B}$ $\Delta t_B = 2,83 - 1 = 1,83 \text{ s} \checkmark$

(3)

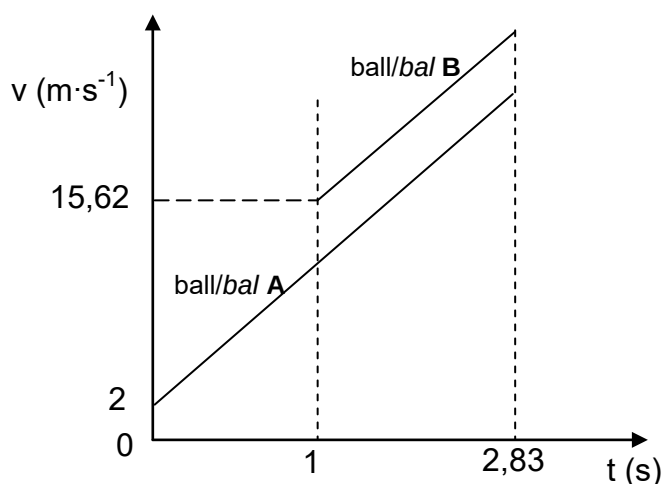
3.1.3

POSITIVE MARKING FROM 3.2/POSITIEWE NASIEN VANAF 3.2 Upwards positive/Opwaarts positief: $\Delta t_B = 1,83 \text{ s} \checkmark$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $-45 \checkmark = v_i (1,83) + \frac{1}{2} (-9,8)(1,83)^2 \checkmark$ $v_i = -15,62 \text{ m} \cdot \text{s}^{-1} \checkmark$	Downwards positive/Afwaarts positief: $\Delta t_B = 1,83 \text{ s} \checkmark$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $45 \checkmark = v_i (1,83) + \frac{1}{2} (9,8)(1,83)^2 \checkmark$ $v_i = 15,62 \text{ m} \cdot \text{s}^{-1} \checkmark$

(5)

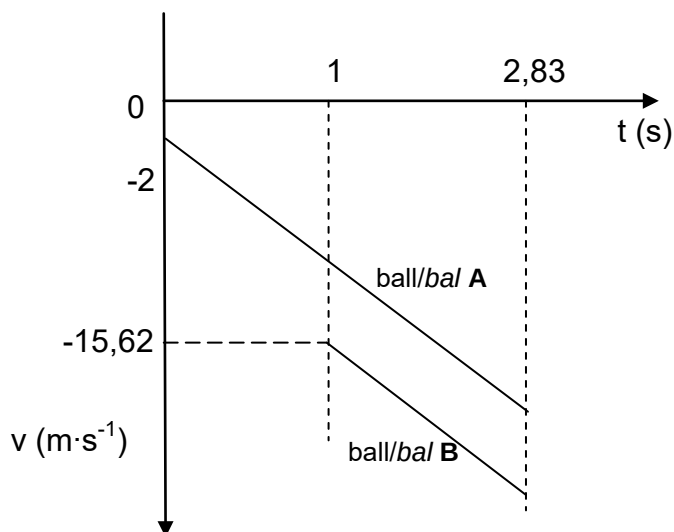
3.2

POSITIVE MARKING FROM 3.1.2; 3.1.3/POSITIEWE NASIEN VANAF 3.1.2; 3.1.3
CONSIDER MOTION DOWNWARD AS POSITIVE/BESKOU BEWEGING AFWAARTS AS POSITIEF



CRITERIA FOR MARKING/KRITERIA VIR NASIEN	
1 mark for each initial velocity shown/1 punt vir elke beginsnelheid aangedui (For/Vir A $2 \text{ m} \cdot \text{s}^{-1}$ for/vir B $15,62 \text{ m} \cdot \text{s}^{-1}$)	✓✓
Time of release of ball/Tyd van vrystelling van bal B $t = 1 \text{ s}$	✓
Time of flight for both balls must be indicated as same on time axis/Vlugtyd van beide balle moet op dieselfde tyd as aangetoon word ($2,83 \text{ s}$)	✓
Shape: Lines must be parallel or nearly so/Vorm: Lyne moet parallel of amper parallel wees	✓

CONSIDER MOTION UPWARD AS POSITIVE/BESKOU OPWAARTSE BEWEGING AS POSITIEF



CRITERIA FOR MARKING/KRITERIA VIR NASIEN	
1 mark for each initial velocity shown/1 punt vir elke beginsnelheid aangedui (For/Vir A $-2 \text{ m}\cdot\text{s}^{-1}$ for/vir B $-15,62 \text{ m}\cdot\text{s}^{-1}$)	✓✓
Time of release of ball/Tyd van vrystelling van bal B $t = 1 \text{ s}$	✓
Time of flight for both balls must be indicated as same on time axis/Vlugtyd van beide balle moet op dieselfde tyd as aangetoon word (2,83 s)	✓
Shape: Lines must be parallel or nearly so/Vorm: Lyne moet parallel of amper parallel wees	✓

(5)
[16]

QUESTION 4/VRAAG 4

- 4.1 The total linear momentum in a closed system ✓ remains constant./is conserved ✓/Die totale lineêre momentum in 'n geslote stelsel ✓ bly konstant/bly behoue. ✓

OR/OF

In a closed/isolated system, the total momentum before a collision is equal to the total momentum after the collision./In 'n geslote/geïsoleerde stelsel is die totale momentum voor 'n botsing gelyk aan die totale momentum na die botsing.

(2)

4.2

- 4.2.1 $\sum p_i = \sum p_f$ ✓
 $m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$
 $(m_1 + m_2) v_i = m_1 v_{1f} + m_2 v_{2f}$
 $0 \checkmark = (0,4) v_{1f} + 0,6 (4) \checkmark$
 $v_{1f} = -6 \text{ m} \cdot \text{s}^{-1}$
 $= 6 \text{ m} \cdot \text{s}^{-1}$ to the left/na links ✓

NOTE: Mark for final answer to be forfeited if direction is not given/
LET WEL: Punt vir finale antwoord word verbeur indien rigting nie gegee word nie.

(4)

4.2.2

<u>OPTION 1/OPSIE 1</u> $\Delta p = F_{\text{net}} \Delta t$ ✓ $[(0,6)(4) - 0] \checkmark = F_{\text{net}} (0,3) \checkmark$ $F_{\text{net}} = 8 \text{ N} \checkmark$ <u>OR/OF</u> $m(v_f - v_i) = F_{\text{net}} \Delta t$ ✓ $0,6(4 - 0) \checkmark = F_{\text{net}} (0,3) \checkmark$ $F_{\text{net}} = 8 \text{ N} \checkmark$	<u>OPTION 2/OPSIE 2</u> $v_f = v_i + a \Delta t$ $4 = 0 + a(0,3)$ $a = 13,33 \text{ m} \cdot \text{s}^{-2}$ $F_{\text{net}} = ma$ $= 0,6(13,33)$ $F_{\text{net}} = 8 \text{ N} \checkmark$
<u>OPTION 3/OPSIE 3</u> $\Delta p = F_{\text{net}} \Delta t$ ✓ $[(0,4)(6) - 0] \checkmark = F_{\text{net}} (0,3) \checkmark$ $F_{\text{net}} = 8 \text{ N} \checkmark$ <u>OR/OF</u> $m(v_f - v_i) = F_{\text{net}} \Delta t$ ✓ $0,4(6 - 0) \checkmark = F_{\text{net}} (0,3) \checkmark$ $F_{\text{net}} = 8 \text{ N} \checkmark$	<u>OPTION 4/OPSIE 4</u> $v_f = v_i + a \Delta t$ $6 = 0 + a(0,3)$ $a = 20 \text{ m} \cdot \text{s}^{-2}$ $F_{\text{net}} = ma$ $= 0,4(20)$ $F_{\text{net}} = 8 \text{ N} \checkmark$

(4)

- 4.3 No/Nee ✓

(1)

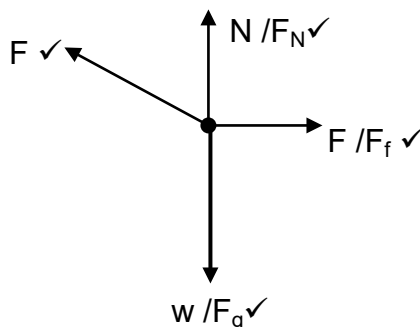
[11]

QUESTION 5/VRAAG 5

5.1 It is a ratio of two forces ✓ (hence units cancel out)./Dit is 'n verhouding van twee kragte ✓ (dus word eenhede uitgekansleer) (1)

5.2 The net work done on an object is equal ✓ to the change in kinetic energy of the object ✓/Die netto arbeid wat op 'n voorwerp verrig word, is gelyk ✓ aan die verandering in kinetiese energie van die voorwerp ✓ (2)

5.3



(4)

5.4 $F \sin 20^\circ + N = mg$ ✓
 $N = mg - F \sin 20^\circ$

$$\begin{aligned} W_{fk} &= f_k \Delta x \cos \theta = \mu_k N \Delta x \cos \theta \checkmark \\ &= \mu_k (mg - F \sin 20^\circ) (3) \cos \theta \\ &= (0,2) [200(9,8) - F \sin 20^\circ] (3) \cos 180^\circ \checkmark \\ &= (-1176 + 0,205 F) \text{ J} \checkmark \end{aligned} \quad (4)$$

5.5 $W_{\text{tot}} = [W_g] + W_f + W_F \checkmark$
 $0 \checkmark = [0] + [-1176 + 0,205 F] + [F (\cos 20^\circ) (3) (\cos 0^\circ)] \checkmark$
 $F = 388,88 \text{ N} \checkmark$

NOTE: Do not penalise if value of W_g is not indicated/

LET WEL: Moenie penaliseer indien die waarde van W_g nie aangedui word nie.

(4)

[15]

QUESTION 6/VRAAG 6

6.1 $v = f\lambda$ ✓
 $= (222 \times 10^3)(1,5 \times 10^{-3})$ ✓
 $= 333 \text{ m.s}^{-1}$ ✓ (3)

6.2
 6.2.1 Towards the bat/Na die vlermuis toe ✓ (1)

6.2.2 **POSITIVE MARKING FROM QUESTION 6.1/POSITIEWE NASIEN VANAF VRAAG 6.1**

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR/OF } f_L = \frac{v}{v - v_s} f_s \quad \checkmark$$

$$230,3 = \frac{333}{333 - v_s} (222) \quad \checkmark$$

$$76689,9 - 230,3 v_s = 73\,926$$

$$v = 12 \text{ m.s}^{-1} \quad \checkmark \quad (\text{towards bat/na die vlermuis toe})$$

Notes/Notas:

- Any other Doppler formula, e.g./Enige ander Doppler-formule, bv.:

$$f_L = \frac{v - v_L}{v - v_s} - \text{Max./Maks. } \frac{3}{4}$$
- Marking rule 1.5: No penalisation if zero substitutions are omitted./Nasienreël 1.5: Geen penalisering indien nulvervangings uitgelaat is nie.

(6)
[10]

QUESTION 7/VRAAG 7

7.1 The magnitude of the charges are equal ✓ / The balls repel each other with the same/identical force or force of equal magnitude ✓ / Die grootte van die ladings is gelyk ✓ / Die balle stoot mekaar af met dieselfde/identiese kragte of krag van dieselfde grootte. ✓ (1)

7.2 The electrostatic force of attraction between two point charges is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between them. ✓ / Die elektrostatische aantrekkingskrag tussen twee puntladings is direk eweredig aan die produk van die ladings ✓ en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. ✓ (2)

7.3
 7.3.1 $T \cos 20^\circ = w$ ✓
 $= mg$
 $= (0,1)(9,8) \quad \checkmark = 0,98 \text{ N}$
 $\therefore T = 1,04 \text{ N} \quad \checkmark$ (3)

7.3.2 **POSITIVE MARKING FROM 7.3/POSITIEWE NASIEN VANAF 7.3**

$$F_{\text{electrostatic/elektrostaties}} = T \sin 20^\circ \checkmark$$

$$\frac{kQ_1 Q_2}{r^2} \checkmark = (1,04) \sin 20^\circ$$

$$\frac{kQ_1 Q_2}{r^2} = 0,356$$

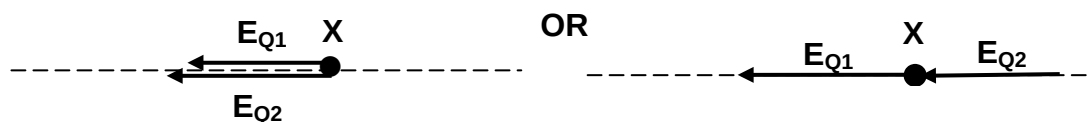
$$\frac{(9 \times 10^9)(250 \times 10^{-9})(250 \times 10^{-9})}{r^2} \checkmark = 0,356 \checkmark$$

$$\therefore r = 0,0397 \text{ m} \checkmark$$

(5)
[11]

QUESTION 8/VRAAG 8

8.1



Vectors E_{Q1} and E_{Q2} in the same direction $\checkmark \checkmark$ / Vektore E_{Q1} en E_{Q2} in dieselfde rigting $\checkmark \checkmark$

Correct drawing of vectors E_{Q1} and E_{Q2} $\checkmark \checkmark$ / Korrekte tekening van vektore E_{Q1} en E_{Q2} $\checkmark \checkmark$

The fields due to the two charges add up because they come from the same direction. Hence the field cannot be zero. / Die velde as gevolg van die twee ladings word bymekaar getel omdat hulle uit dieselfde rigting inwerk. Die veld kan dus nie nul wees nie.

(4)

8.2 $E = k \frac{Q}{r^2} \checkmark$

$$E_{-2,5\mu\text{C}} = k \frac{Q}{r^2} = \frac{(9 \times 10^9)(2,5 \times 10^{-6})}{(0,3)^2} \checkmark = 250\,000 \text{ N.C}^{-1} \text{ to the left/na links}$$

$$E_{6\mu\text{C}} = k \frac{Q}{r^2} = \frac{(9 \times 10^9)(6 \times 10^{-6})}{(1,3)^2} \checkmark = 31\,952,66 \text{ N.C}^{-1} \text{ to the left/na links}$$

$$\begin{aligned} E_P &= E_{6\mu\text{C}} + E_{-2,5\mu\text{C}} \checkmark \\ &= 31\,952,66 + 250\,000 \\ &= 281\,952,66 \text{ N.C}^{-1} \checkmark \text{ to the left/na links } \checkmark \end{aligned}$$

(6)
[10]

QUESTION 9/VRAAG 9

9.1

9.1.1 $V = IR$ ✓
 $= (0,2)(4+8)$ ✓
 $= 2,4 \text{ V}$ ✓

(3)

9.1.2 **POSITIVE MARKING FROM QUESTION 9.1.1/POSITIEWE NASIEN VANAF VRAAG 9.1.1**

$V = IR$ $2,4 = I_2(2)$ ✓ $I_{2\Omega} = 1,2 \text{ A}$ ✓ $I_T = I_2 + 0,2 \text{ A}$ ✓ $= 1,4 \text{ A}$ ✓	OR $I_2 = 6 \times 0,2$ ✓ $I_2 = 1,2 \text{ A}$ ✓ $I_T = I_2 + 0,2$ ✓ $= 1,4 \text{ A}$ ✓

(4)

9.1.3 **POSITIVE MARKING FROM QUESTION 9.1.2/POSITIEWE NASIEN VANAF VRAAG 9.1.2**

OPTION 2/OPSIE 2 $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ $\frac{1}{R_p} = \frac{1}{12} + \frac{1}{2}$ $R_p = 1,72 \Omega$ ✓ $\varepsilon = I(R+r)$ ✓ $= 1,4(1,72 + 0,5)$ ✓ $= 3,11 \text{ V}$ ✓	OR/OF $R_p = \frac{R_1 R_2}{R_1 + R_2}$ ✓ $R_p = \frac{(12)(2)}{12 + 2}$ $= 1,71 \Omega$ ✓ $\varepsilon = I(R+r)$ ✓ $= 1,4(1,71 + 0,5)$ ✓ $= 3,09 \text{ V}$ ✓

OPTION 2/OPSIE 2 $V_{\text{int}} = Ir$ ✓ $= (1,4)(0,5)$ $= 0,7 \text{ V}$ ✓ $\varepsilon = V_{\text{ext/eks}} + V_{\text{int}}$ ✓ $= 2,4 + 0,7$ ✓ $= 3,1 \text{ V}$ ✓

(5)

9.2 Removing the 2Ω resistor increases the total resistance of the circuit. ✓ Thus the total current decreases, decreasing the V_{int} (V_{lost}). ✓ Therefore the voltmeter reading increases. ✓ /Wanneer die 2Ω -resistor verwyder word, verhoog dit die totale weerstand van die kring. ✓ Dus verklein die totale stroom, wat die V_{int} (V_{verloor}) verlaag. ✓ Dus verhoog die voltmeterlesing V . ✓

(3)

[15]

QUESTION 10/VRAAG 10

10.1

10.1.1 North pole/Noordpool✓

(1)

10.1.2 Q to P✓

(1)

10.2

10.2.1 **OPTION 1/OPSIE 1**

$$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}} \checkmark$$

$$I_{\text{rms}} = \frac{8}{\sqrt{2}} \checkmark$$

$$= 5,66 \text{ A}$$

$$V_{\text{rms}} = I_{\text{rms}} R \checkmark$$

$$220 = (5,66)R \checkmark$$

$$R = 38,87 \Omega \checkmark$$

(5)

OPTION 2/OPSIE 2

$$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$$

$$220 = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$$

$$V_{\text{max}} = 311,12 \text{ V}$$

$$V_{\text{max}} = I_{\text{max}} R \checkmark$$

$$311,12 = (8)R \checkmark$$

$$R = 38,89 \Omega \checkmark$$

10.2.2 **POSITIVE MARKING FROM QUESTION 10.4.1/POSITIEWE NASIEN VANAF VRAAG 10.4.1**

OPTION 1/OPSIE 1

$$\begin{aligned} P_{\text{average}} &= V_{\text{rms}} I_{\text{rms}} \checkmark \\ &= (220)(5,66) \checkmark \\ &= 1\,245,2 \text{ W} \end{aligned}$$

$$P = \frac{W}{\Delta t} \checkmark$$

$$1245,2 = \frac{W}{7200} \checkmark$$

$$W = 8\,965\,440 \text{ J} \checkmark$$

$$\begin{aligned} P_{\text{average}} &= I_{\text{rms}}^2 R \\ &= (5,66)^2 (38,89) \\ &= 1245,86 \\ E &= Pt \\ &= (1245,86)(7200) \\ &= 8970192 \text{ J} \end{aligned}$$

(5)

OPTION 2/OPSIE 2

$$\begin{aligned} P_{\text{average}} &= I_{\text{rms}}^2 R \checkmark \\ &= (5,66)^2 (38,87) \checkmark \\ &= 1\,245,22 \text{ W} \checkmark \\ 1245,22 &= \frac{W}{7200} \checkmark \\ W &= 8\,965\,584 \text{ J} \checkmark \end{aligned}$$

OPTION 3/OPSIE 3

$$\begin{aligned} P_{\text{average}} &= \frac{V_{\text{rms}}^2}{R} \checkmark \\ P_{\text{average}} &= \frac{220^2}{38,87} \checkmark \\ &= 1245,18 \text{ W} \\ P &= \frac{W}{\Delta t} \checkmark \\ 1245,18 &= \frac{W}{7200} \checkmark \\ W &= 8\,965\,296 \text{ J} \checkmark \end{aligned}$$

$$\begin{aligned} P_{\text{average}} &= \frac{V_{\text{rms}}^2}{R} \\ P_{\text{average}} &= \frac{220^2}{38,89} \\ &= 1244,54 \text{ W} \\ E &= Pt \\ &= (1244,54)(7200) \\ &= 8960688 \text{ J} \end{aligned}$$

OPTION 3/OPSIE 3

$$\begin{aligned} W &= I_{\text{rms}}^2 R \Delta t \\ &= \left(\frac{I_{\text{max}}}{\sqrt{2}} \right)^2 R \Delta t \\ &= \left(\frac{8}{\sqrt{2}} \right)^2 (38,87)(7200) \\ W &= 8\,965\,296 \text{ J} \checkmark \end{aligned}$$

(5)
[12]

QUESTION 11/VRAAG 11

11.1 It is the minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓/Dit is die minimum energie wat 'n elektron in die metaal benodig om elektrone uit die metaaloppervlak vry te stel. ✓ (2)

11.2 Frequency/Intensity ✓/Frekwensie/Intensiteit (1)

11.3 The minimum frequency required to remove an electron from the surface of the metal ✓/Die minimum frekwensie benodig om 'n elektron vanaf die oppervlak van die metaal te verwyder ✓ (2)

11.4 **POSITIVE MARKING FROM QUESTION 11.4/**

POSITIEWE NASIEN VANAF VRAAG 11.4

$$\left. \begin{aligned} E &= W_0 + E_k \\ hf &= hf_0 + E_k \end{aligned} \right\} \text{✓ Any one/Enige een}$$

$$(6,63 \times 10^{-34})(6,50 \times 10^{14}) = (6,63 \times 10^{-34})(5,001 \times 10^{14}) + \frac{1}{2}(9,11 \times 10^{-31})v^2$$

$$\therefore v = 4,67 \times 10^5 \text{ m} \cdot \text{s}^{-1} \text{✓}$$

OR/OF

$$\left. \begin{aligned} E_k &= E_{\text{light}} - W_0 \\ &= hf_{\text{light}} - hf_0 \end{aligned} \right\} \text{✓ Any one/Enige een}$$

$$= (6,63 \times 10^{-34})(6,50 \times 10^{14} - 5,001 \times 10^{14})$$

$$= 9,94 \times 10^{-20} \text{ J}$$

$$E_k = \frac{1}{2}mv^2 \text{✓}$$

$$v = \sqrt{\frac{2E_k}{m}} = \sqrt{\frac{(2)(9,94 \times 10^{-20})}{9,11 \times 10^{-31}}} \text{✓}$$

$$v = 4,67 \times 10^5 \text{ m} \cdot \text{s}^{-1} \text{✓} \quad (5)$$

11.5 The photocurrent is directly proportional to the intensity of the incident light. ✓✓/Die fotostroom is direk eweredig aan die intensiteit van die invallende lig. ✓✓ (2)
[12]

TOTAL/TOTAAL: 150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS SENIORSERTIFIKAAT-EKSAMEN

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

2016

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 18 pages.
*Hierdie memorandum bestaan uit 18 bladsye.***

QUESTION/VRAAG 1

1.1	A✓✓	(2)
1.2	B✓✓	(2)
1.3	D✓✓	(2)
1.4	C✓✓	(2)
1.5	B✓✓	(2)
1.6	B✓✓	(2)
1.7	A✓✓	(2)
1.8	D✓✓	(2)
1.9	C✓✓	(2)
1.10	D✓✓	(2)
		[20]

QUESTION/VRAAG 2

- 2.1 A body will remain in its state of rest or motion at constant velocity ✓ unless a resultant/net force ✓ acts on it.
'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid bly tensy 'n resulterende/netto krag daarop inwerk

OR/OF

Every body continues in its state of rest or of uniform motion in a straight line ✓ unless a resultant/net force ✓ acts on it.
Elke liggaam bly in sy toestand van rus of uniforme beweging in 'n reguitlyn tensy 'n resulterende/netto krag daarop inwerk

(2)

- 2.2 0 (N) ✓ / zero/nul (newton)

NOTE: No penalisation if the unit is omitted

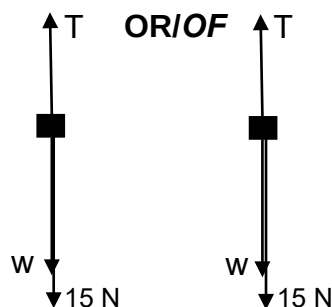
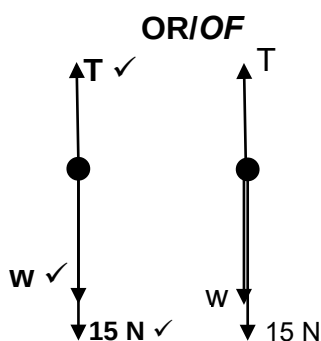
LET WEL: Geen penalisering as eenheid weggelaat is nie

(1)

- 2.3

Accepted labels/Aanvaarde byskrifte	
W	F_g / F_w / weight / mg / gravitational force F_g / F_w / gewig / mg / gravitasiekrag
T	F_T / tension F_s / spanning
15 N	F_a / F_{15N} / F_{applied} / F_t / F_{toegepas} / F

Accept/Aanvaar



(3)

Notes/Aantekeninge

- Mark awarded for label and arrow/Punt toegeken vir byskrif en pyltjie
- Do not penalise for length of arrows since drawing is not to scale./Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie
- Any other additional force(s)/Enige ander addisionele krag(te) Minus 1 (-1) mark/punt
- If force(s) do not make contact with body/Indien krag(te) nie met die voorwerp kontak maak nie: Minus 1 (-1) mark/punt
- Minus 1 mark if all arrows are omitted but correctly labelled / Minus 1 punt indien alle pyltjies weggelaat is maar korrek benoem

2.4

2 kg block/blok

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 F_a + F_g + (-T) &= ma \\
 F_a + mg + (-T) &= ma
 \end{aligned}
 \left. \vphantom{\begin{aligned} F_{\text{net}} &= ma \\ F_a + F_g + (-T) &= ma \\ F_a + mg + (-T) &= ma \end{aligned}} \right\} \checkmark$$

$$[15 + (2)(9,8) - T] \checkmark = (2)(1,2) \checkmark$$

$$T = 32,2 \text{ N}$$

10 kg block/blok

$$\begin{aligned}
 T + (-f_k) &= ma \\
 T - \mu_k N &= ma \\
 T - \mu_k mg &= ma
 \end{aligned}
 \left. \vphantom{\begin{aligned} T + (-f_k) &= ma \\ T - \mu_k N &= ma \\ T - \mu_k mg &= ma \end{aligned}} \right\} \checkmark$$

$$32,2 - (\mu_k)(10)(9,8) \checkmark = (10)(1,2) \checkmark$$

$$\mu_k = 0,21 \checkmark$$

NOTE: LET WEL

If f_k is calculated separately – award one mark. *Indien f_k apart bereken is - ken een punt toe*

Massless string approximation/Systems approach /Massalose toutjie benadering /Sistiem Benadering ($\frac{4}{7}$)

$$\begin{aligned}
 F_{\text{net}} &= ma \checkmark \\
 F_A - f_k + w &= (M + m)a \\
 15 - \mu_k Mg + mg &= (M + m)a \\
 15 - \mu_k(10)(9,8) + (2)(9,8) \checkmark &= (10 + 2)(1,2) \checkmark \\
 \mu_k &= 0,21 \checkmark
 \end{aligned}$$

(7)

2.5

Smaller than / *Kleiner as* ✓

(1)

2.6

Remains the same / *Bly dieselfde* ✓

The coefficient of kinetic friction is independent of the (apparent microscopic) surface areas in contact. ✓

Die kinetiese wrywingskoëffisiënt is onafhanklik van die (waarskynlike mikroskopiese) oppervlakareas waarmee in kontak is

OR/OF

The coefficient of kinetic friction depends only on the type of materials used ✓
Die kinetiese wrywingskoëffisiënt hang slegs af van die tipe materiaal gebruik

(2)

[16]

QUESTION/VRAAG 3

- 3.1 An object upon which the only force✓ acting is the force of gravity.✓
'n Voorwerp waarop die enigste krag wat inwerk, swaartekrag is

ACCEPT/AANVAAR

An object that falls freely ✓ with an acceleration of (g) $9,8 \text{ m}\cdot\text{s}^{-2}$ ✓
 'n Voorwerp wat vryval met 'n versnelling van (g) $9,8 \text{ m}\cdot\text{s}^{-2}$

An object that is launched ✓(or synonyms) with an initial velocity under the influence of the force of gravity.✓

'n Voorwerp wat met 'n beginsnelheid geprojekteer ✓ (of sinonieme) word onder die invloed van die gravitasiekrag ✓

(2)

- ### 3.2.1

<u>OPTION 1/OPSIE 1</u>	
Upward positive <i>Opwaarts positief</i>	Downward positive <i>Afwaarts positief</i>
$v_f = v_i + a\Delta t \checkmark$ $-30 = 30 \checkmark + (-9,8)\Delta t \checkmark$ $\Delta t = 6.12 \text{ s} \checkmark$	$v_f = v_i + a\Delta t \checkmark$ $30 = -30 \checkmark + (9,8)\Delta t \checkmark$ $\Delta t = 6.12 \text{ s} \checkmark$

<u>OPTION 2/OPSIE 2</u>	
Upward positive Opwaarts positief $v_f = v_i + a\Delta t \checkmark$ $0 = 30\checkmark + (-9,8)\Delta t\checkmark$ $\Delta t = 3,06 \text{ s}$ Total time/Totale tyd = $(2)(3,06)$ $= 6,12 \text{ s} \checkmark$	Downward positive Afwaarts positief $v_f = v_i + a\Delta t \checkmark$ $0 = -30\checkmark + (9,8)\Delta t\checkmark$ $\Delta t = 3,06 \text{ s}$ Total time/Totale tyd = $(2)(3,06)$ $= 6,12 \text{ s} \checkmark$

<u>OPTION 3/OPSIE 3</u>	
Upward positive Opwaarts positief	Downward positive Afwaarts positief
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $0 = (30) \Delta t \checkmark + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$ $\Delta t = 6,12 \text{ s} \checkmark$	$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $0 = (-30) \Delta t \checkmark + \frac{1}{2} (9,8) \Delta t^2 \checkmark$ $\Delta t = 6,12 \text{ s} \checkmark$

<u>OPTION 4/OPSIE 4</u>	
Upward positive <i>Opwaarts positief</i> $F_{\text{net}}\Delta t = \Delta p = (mv_f - mv_i)✓$ $mg\Delta t = m(v_f - v_i)$ $9,8\Delta t✓ = (30 - (-30))✓$ $\Delta t = 6,12 \text{ s}✓$	Downward positive <i>Afwaarts positief</i> $F_{\text{net}}\Delta t = \Delta p = (mv_f - mv_i)✓$ $mg\Delta t = m(v_f - v_i)$ $-9,8\Delta t ✓ = (-30 - 30)✓$ $\Delta t = 6,12 \text{ s}✓$

OPTION 5/OPSIE 5	
Upward positive Opwaarts positief From top to bottom/ <i>Van bo na onder</i> $v_f = v_i + a\Delta t$ ✓ $-30 = 0 \checkmark + (-9,8)\Delta t \checkmark$ $\Delta t = 3,06 \text{ s}$ Total time/totale tyd = $2(3,06)$ = $6,12 \text{ s} \checkmark$	Downward positive Afwaarts positief From top to bottom/ <i>Van bo na onder</i> $v_f = v_i + a\Delta t$ ✓ $30 = 0 \checkmark + (9,8)\Delta t \checkmark$ $\Delta t = 3,06 \text{ s}$ Total time/totale tyd = $2(3,06)$ = $6,12 \text{ s} \checkmark$

(4)

3.2.2

POSITIVE MARKING FROM QUESTION 3.2.1 / POSITIEWE NASIEN VANAF VRAAG 3.2.1
OPTION 1/OPSIE 1
Upward positive/Opwaarts positief

$$\left. \begin{aligned} \Delta y &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ \Delta y_{\text{last}} &= \Delta y_{(6,12)} - \Delta y_{(5,12)} \end{aligned} \right\} \checkmark$$

$$= \{30(6,12) + \frac{1}{2}(-9,8)(6,12)^2\} \checkmark - \{30(5,12) + \frac{1}{2}(-9,8)(5,12)^2\} \checkmark$$

$$= -25,076$$

$$\text{Distance/Afstand} = |\Delta y| = 25,08 \text{ m} \checkmark$$

OR/OF
POSITIVE MARKING FROM QUESTIONS 3.2.1
POSITIEWE NASIEN VANAF VRAAG 3.2.1
Downward positive/Afwaarts positief

$$\left. \begin{aligned} \Delta y &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ \Delta y_{\text{last}} &= \Delta y_{(6,12)} - \Delta y_{(5,12)} \end{aligned} \right\} \checkmark$$

$$= \{-30(6,12) + \frac{1}{2}(9,8)(6,12)^2\} \checkmark - \{-30(5,12) + \frac{1}{2}(9,8)(5,12)^2\} \checkmark$$

$$= 25,076$$

$$\text{Distance/Afstand} = |\Delta y| = 25,08 \text{ m} \checkmark$$

OPTION 2/OPSIE 2

Upward positive
Opwaarts positief

$$v_f = v_i + a\Delta t$$

$$= 0 + (-9,8)(2,06) \checkmark$$

$$= -20,188 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$= \frac{(-20,188)(1) + \frac{1}{2}(-9,8)(1)^2}{} \checkmark$$

$$= -25,09 \text{ m}$$

$$\text{Distance / Afstand} = |\Delta y| = 25,09 \text{ m} \checkmark$$

OR/OF

$$\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{-20,188 + (-30)}{2} \right) (1) \checkmark$$

$$= -25,09 \text{ m}$$

$$\text{Distance / Afstand} = |\Delta y| = 25,09 \text{ m} \checkmark$$

OR/OF

$$v_f^2 = v_i^2 + 2a\Delta x \checkmark$$

$$\frac{(-30)^2}{} = \frac{(-20,188)^2 + 2(-9,8)\Delta x}{} \checkmark$$

$$\Delta x = -25,12 \text{ m}$$

$$\text{Distance / Afstand} = |\Delta y| = 25,12 \text{ m} \checkmark$$

Downward positive
Afwaarts positief

$$v_f = v_i + a\Delta t$$

$$= 0 + (9,8)(2,06) \checkmark$$

$$= 20,188 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$= \frac{(20,188)(1) + \frac{1}{2}(9,8)(1)^2}{} \checkmark$$

$$= 25,09 \text{ m}$$

$$\text{Distance / Afstand} = |\Delta y| = 25,09 \text{ m} \checkmark$$

OR/OF

$$\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{20,188 + 30}{2} \right) (1) \checkmark$$

$$= 25,09 \text{ m}$$

$$\text{Distance / Afstand} = |\Delta y| = 25,09 \text{ m} \checkmark$$

OR/OF

$$v_f^2 = v_i^2 + 2a\Delta x \checkmark$$

$$\frac{(30)^2}{} = \frac{(20,188)^2 + 2(9,8)\Delta x}{} \checkmark$$

$$\Delta x = 25,12 \text{ m}$$

$$\text{Distance / Afstand} = |\Delta y| = 25,12 \text{ m} \checkmark$$

OPTION 3/OPSIE 3

$$v_f = v_i + a\Delta t$$

$$= 0 + (-9,8)(2,06) \checkmark$$

$$= -20,188 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{-20,188 + 30}{2} \right) (5,12) \checkmark$$

$$= 25,12 \text{ m}$$

$$\text{Distance / Afstand} = |\Delta y| = 25,12 \text{ m} \checkmark$$

$$v_f = v_i + a\Delta t$$

$$= 0 + (9,8)(2,06) \checkmark$$

$$= 20,188 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t \checkmark$$

$$= \left(\frac{20,188 - 30}{2} \right) (5,12) \checkmark$$

$$= -25,12 \text{ m}$$

$$\text{Distance / Afstand} = |\Delta y| = 25,12 \text{ m} \checkmark$$

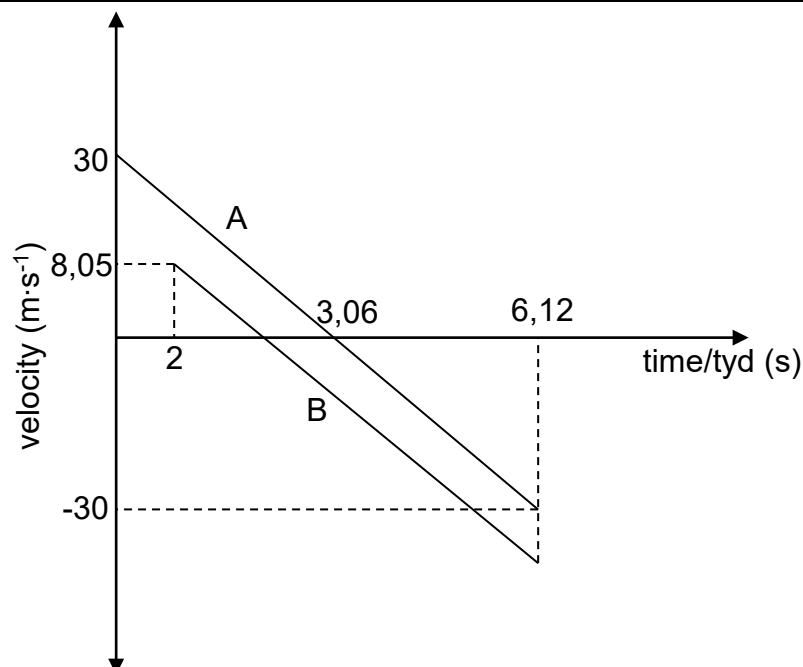
OPTION 4/OPSIE 4 Upward positive Opwaarts positief Distance travelled in the first second = distance travelled in the last second <i>Afstand afgelê in die eerste sekonde = afstand afgelê in laaste sekonde</i> $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $= (30)(1) + \frac{1}{2} (-9,8)(1)^2 \checkmark$ $= 25,1 \text{ m} \checkmark$ Distance /Afstand = $\Delta y = 25,1 \text{ m} \checkmark$	Downward positive Afwaarts positief Distance travelled in the first second = distance travelled in the last second <i>Afstand afgelê in die eerste sekonde = afstand afgelê in laaste sekonde</i> $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $= (-30)(1) + \frac{1}{2} (9,8)(1)^2 \checkmark$ $= -25,1 \text{ m} \checkmark$ Distance /Afstand = $\Delta y = 25,1 \text{ m} \checkmark$	(4)

3.3

POSITIVE MARKING FROM QUESTION 3.2.1 POSITIEWE NASIEN VANAF VRAAG 3.2.1		
Upward positive Opwaarts positief $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $-50 \checkmark = [v_i (4,12)] + [\frac{1}{2} (-9,8)(4,12)^2] \checkmark$ $v_i = 8,05 \text{ m} \cdot \text{s}^{-1}$ speed/spoed = $8,05 \text{ m} \cdot \text{s}^{-1} \checkmark$	Downward positive Afwaarts positief $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $50 \checkmark = \underline{v_i (4,12) + [\frac{1}{2} (9,8)(4,12)^2]} \checkmark$ $v_i = -8,05 \text{ m} \cdot \text{s}^{-1}$ speed/spoed = $8,05 \text{ m} \cdot \text{s}^{-1} \checkmark$	(4)

3.4

POSITIVE MARKING FROM QUESTIONS 3.2.1 AND 3.2.2 POSITIEWE NASIEN VANAF VRAAG 3.2.1 EN 3.2.2 Upward positive/ Opwaarts positief



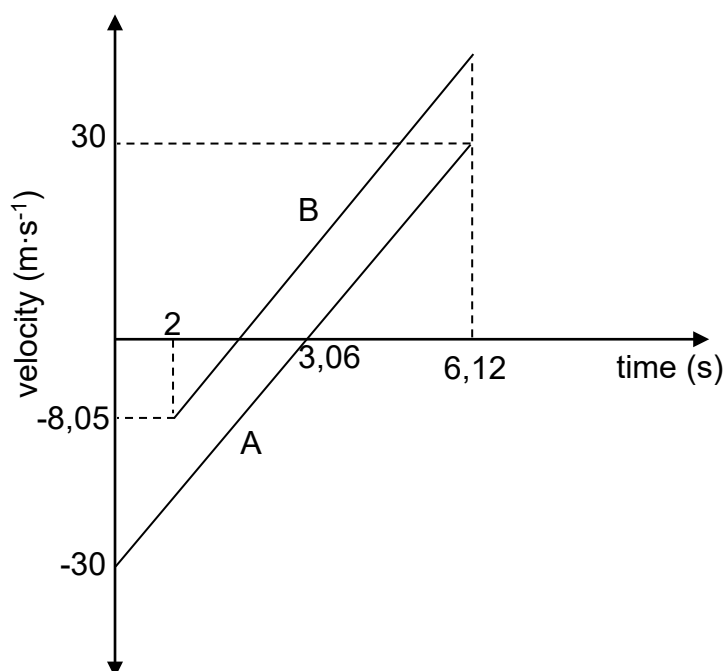
Criteria/Kriteria	Marks/Punte
Correct shape of A <i>Korrekte vorm van A</i>	✓
Correct shape of Graph B parallel to A below A <i>Korrekte vorm van Grafiek parallel met A onder A</i>	✓
Time at which both A and B reach the ground (6,12 s) <i>Tyd wat beide A en B die grond bereik (6,12 s)</i>	✓
Time for A to reach the maximum height (3,06 s) shown <i>Tyd vir A om maksimum hoogte te bereik (3,06 s) aangedui</i>	✓

NOTE/LET WEL

Do not penalise if velocities are not indicated

Moenie penaliseer indien snelhede nie aangedui is nie

3.4

POSITIVE MARKING FROM QUESTIONS 3.2.1 AND 3.2.2**POSITIEWE NASIEN VANAF VRAAG 3.2.1 EN 3.2.2****Downward positive/Afwaarts positief**

Criteria/Kriteria	Marks/Punte
Correct shape of A <i>Korrekte vorm van A</i>	✓
Correct shape of Graph B parallel to A above A <i>Korrekte vorm van Grafiek parallel met A bo A</i>	✓
Time at which both A and B reach the ground (6,12 s) <i>Tyd wat beide A en B die grond bereik (6,12 s)</i>	✓
Time for A to reach the maximum height (3,06 s) shown <i>Tyd vir A om maksimum hoogte te bereik (3,06 s) aangedui</i>	✓

(4)
[18]

QUESTION/VRAAG 4

- 4.1 The total (linear) momentum of an isolated (closed) system ✓ is constant (is conserved) ✓

Die totale (lineêre) momentum van 'n geïsoleerde (geslote) sisteem is konstant (bly behoue)

OR/OF

In an isolated (closed) system, the total (linear) momentum ✓ before collision is equal to the total linear momentum after collision. ✓

In 'n geïsoleerde (geslote) sisteem is die totale (lineêre) momentum ✓ voor botsing gelyk aan die totale (lineêre) momentum van botsing ✓

(2)

- 4.2.1

$$\left. \begin{aligned} \Sigma p_i &= \Sigma p_f \\ m_1 v_{1i} + m_2 v_{2i} &= m_1 v_{1f} + m_2 v_{2f} \\ m_1 v_{1i} + m_2 v_{2i} &= (m_1 + m_2) v_f \\ (5)(4) + (3)(0) &\checkmark = (5 + 3) v_f \checkmark \\ \therefore v &= 2,5 \text{ m} \cdot \text{s}^{-1} \checkmark \end{aligned} \right\}$$

1 mark for any
1 punt vir enige

OR/OF

$$\Delta p_{5\text{kg}} = -\Delta p_{3\text{kg}} \checkmark$$

$$m v_f - m v_i = m v_f - m v_i$$

$$5 v_f - (5)(4) \checkmark = 3 v_f - (3)(0) \checkmark$$

$$v_f = 2,5 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(4)

- 4.2.2

OPTION 1/OPSIE 1

POSITIVE MARKING FROM QUESTION 4.2.1

POSITIEWE NASIEN VANAF VRAAG 4.2.1

$$F_{\text{net}} \Delta t = \Delta p = (p_f - p_i) = (m v_f - m v_i) \checkmark$$

$$F_{\text{net}}(0,3) \checkmark = 8 [(0 - (2,5))] \checkmark$$

$$F_{\text{net}} = -66,67 \text{ N}$$

$$\therefore F_{\text{net}} = 66,67 \text{ N} \checkmark$$

OPTION 2/OPSIE 2

POSITIVE MARKING FROM 4.2.1

POSITIEWE NASIEN VANAF 4.2.1

$$F_{\text{net}} = m a \checkmark$$

$$= \frac{m(v_f - v_i)}{\Delta t}$$

$$= \frac{8(0 - 2,5)}{0,3} \checkmark = -66,67 \text{ N}$$

$$\therefore F_{\text{net}} = 66,67 \text{ N} \checkmark$$

OPTION 3/OPSIE 3

POSITIVE MARKING FROM 4.2.1

POSITIEWE NASIEN VANAF 4.2.1

$$v_f = v_i + a \Delta t$$

$$0 = 2,5 + a(0,3) \checkmark$$

$$a = -8,333 \text{ m} \cdot \text{s}^{-2}$$

$$F_{\text{net}} = m a \checkmark$$

$$= 8 (-8,333) \checkmark$$

$$= -66,67 \text{ N}$$

$$\therefore F_{\text{net}} = 66,67 \text{ N} \checkmark$$

(4)

OPTION 4/OPSIE 4

$$W_{\text{net}} = \Delta E_k$$

$$F_{\text{net}} \Delta x \cos \theta = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$F_{\text{net}} \left(\frac{v_f + v_i}{2} \right) \Delta t \cos 180^\circ = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$F_{\text{net}} \left(\frac{2,5 + 0}{2} \right) (0,3) (-1) \checkmark = \frac{1}{2} (8) (0^2 - 2,5^2) \checkmark$$

$$F_{\text{net}} = 66,67 \text{ N} \checkmark$$

} ✓ Any one/Enige een

[10]

QUESTION/VRAAG 5

- 5.1 The total mechanical energy in an isolated (closed) system ✓ remains constant (is conserved). ✓
Die totale meganiese energie in 'n geslote (geïsoleerde) sisteem ✓ bly konstant (bly behoue) ✓

NOTE/LET WEL

If total or isolated/closed is omitted (max: 1/2)

Indien totale of geslote (geïsoleerde) weggelaat is (maks: 1 2)

(2)

5.2.1

$$W = F \Delta x \cos \theta \checkmark$$

$$= (30) \left(\frac{5}{\sin 30^\circ} \right) \cos \theta \checkmark$$

$$= (30)(10) \cos 180^\circ$$

$$= (30)(10)(-1)$$

$$= -300 \text{ J} \checkmark$$

(3)

5.2.2

OPTION 1/OPSIE 1**POSITIVE MARKING FROM 5.2.1/POSITIEWE NASIEN VANAF 5.2.1**

$$W_{\text{nc}} = \Delta E_P + \Delta E_K$$

$$W_{\text{nc}} = mg(h_f - h_i) + \frac{1}{2} m(v_f^2 - v_i^2) \checkmark$$

$$-300 \checkmark = (20)(9,8)(0 - 5) \checkmark + \frac{1}{2} (20)(v_f^2 - 0) \checkmark$$

$$v = 8,25 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 2/OPSIE 2**POSITIVE MARKING FROM 5.2.1/POSITIEWE NASIEN VANAF 5.2.1**

$$W_{\text{net}} = \Delta E_K$$

$$W_g + W_f = \frac{1}{2} m(v_f^2 - v_i^2) \checkmark$$

$$W_g + (-300) = \frac{1}{2} (20)(v_f^2 - 0) \checkmark$$

$$[(20)(9,8) \sin 30^\circ \frac{5}{0,5} \cos 0] \checkmark + (-300) \checkmark = 10 v_f^2$$

$$v_f = 8,25 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(5)

5.3

$$F = w_{\parallel} + f$$

$$= (100)(9,8)\sin 30^{\circ} + 25 \checkmark$$

$$= 515 \text{ N}$$

$$P_{\text{ave}} = Fv_{\text{ave}} \checkmark$$

$$= (515)(2) \checkmark$$

$$= 1\,030 \text{ W} \checkmark$$

(4)
[14]**QUESTION/VRAAG 6**

6.1 X ✓

(1)

6.2 As ambulance approaches the hospital the waves are compressed✓ or wavelengths are shorter. Since the speed of sound is constant✓ the observed frequency must increase✓. Therefore the hospital must be located on the side of X (from $v = f\lambda$)

Soos die ambulans die hospitaal nader word die golwe saamgepers of golflengtes word korter. Aangesien die spoed van klank konstant is, moet die waargenome frekwensie verhoog. Die hospitaal moet dus aan die kant van X wees (vanaf $v = f\lambda$)

OR/OF

The number of wave fronts per second reaching the observer are more at X✓✓. For the same constant speed, this means that the observed frequency increases ✓ therefore the hospital must be located on the side of X. (from $v = f\lambda$)

Die aantal golf fronte per sekonde wat die waarnemer bereik, is meer by X. Vir dieselfde konstante spoed moet die waargenome frekwensie verhoog, dus is die hospitaal aan die kant van X geleë (vanaf $v = f\lambda$)

(3)

6.3

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR/OF } f_L = \frac{v}{v - v_s} f_s \checkmark$$

$$f_L = \frac{340 \checkmark}{(340 \checkmark - 30)} (400) \checkmark$$

$$f_L = 438,71 \text{ Hz} \checkmark$$

NOTE/LET WEL

If any other value for the speed of sound is used subtract 2 marks. One for substitution and one for answer / *Indien enige ander waarde vir die spoed van klank gebruik word, trek 2 punte af. Een vir vervanging en een vir die antwoord.*

(5)

6.4

$$v = f\lambda \checkmark$$

$$340 = 400\lambda \checkmark$$

$$\lambda = 0,85 \text{ m} \checkmark$$

(3)
[12]

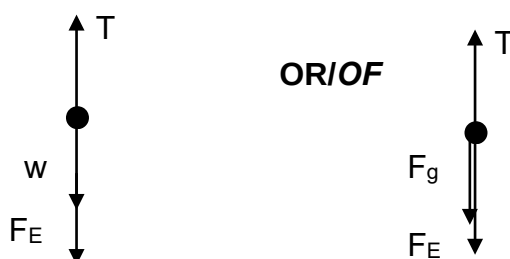
QUESTION/VRAAG 7

7.1

$n = \frac{Q}{e} \checkmark$ $= \frac{-32 \times 10^{-9}}{-1,6 \times 10^{-19}} \checkmark$ $= 2 \times 10^{11} \checkmark \text{ electrons/elektrone}$ NOTE:/LET WEL Answer must be positive (-1 mark) Antwoord moet positief wees (-1 punt)	$n = \frac{Q}{e} \checkmark$ $= \frac{32 \times 10^{-9}}{1,6 \times 10^{-19}} \checkmark$ $= 2 \times 10^{11} \checkmark \text{ electrons/elektrone}$

(3)

7.2



Accepted labels/Aanvaarde byskrifte	
w	F _g /F _w /weight/mg/gravitational force F _g /F _w /gewig/mg/gravitasiekras
T	F _T /tension F _s /spanning
F _E	Felectrostatic/FQ1Q2 /Coulomb force/F FelektrostatieseFQ1Q2 /Coulomb krag/F

(3)

7.3

$F_{\text{net}} = 0$ $mg + F_E = T$ $mg + k \frac{Q_1 Q_2}{r^2} - T = 0$ $(0,007)(9,8) \checkmark + (9 \times 10^9) \frac{(32 \times 10^{-9})(55 \times 10^{-9})}{(0,025)^2} \checkmark = T$ $\therefore T = 9,39(4) \times 10^{-2} \text{ N} \checkmark$ (Accept/Aanvaar: 0,1 N) ACCEPT/AANVAAR F_E = w_{Q2} ✓ (0,007)(9,8) ✓ + (0,007)(9,8) ✓✓ = T T = 0,137 N ✓

(5)
[11]

QUESTION/VRAAG 8

- 8.1 The (electrostatic) force experienced by a unit positive charge (placed at that point). ✓✓

Die (elektrostatiese) krag ondervind per eenheid positiewe lading by daardie punt.

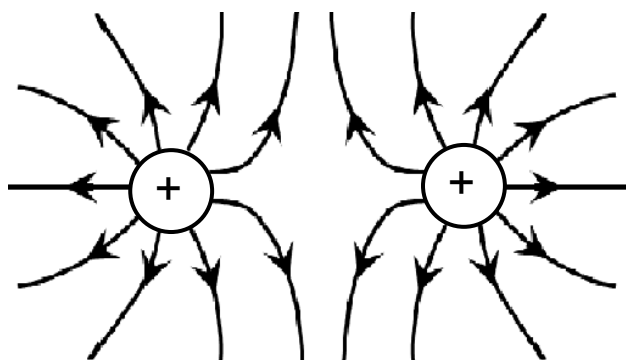
NOTE/LET WEL

If the words "unit positive" is omitted (max 1/2)

Indien die woorde "eenheid positiewe" weggelaat is (maks 1/2)

(2)

8.2



Guideline for allocating marks/Riglyne vir toekenning van punte	
Lines must not cross / Lines must touch the spheres but not enter spheres <i>Lyne moet nie kruis nie/Lyne moet die sfere raak maar nie binnegaan nie</i>	✓
Arrows point outwards <i>Pyle uitwaarts gerig</i>	✓
Correct shape <i>Korrekte vorm</i>	✓

(3)

8.3

$$E = \frac{kQ}{r^2} \checkmark$$

$$E_{Q1x} = \frac{(9 \times 10^9)(30 \times 10^{-6})}{(x)^2} \checkmark$$

$$E_{Q2x} = \frac{(9 \times 10^9)(45 \times 10^{-6})}{(0,15 + x)^2} \checkmark$$

$$E_{\text{net}} = 0$$

$$E_{Q1x} = E_{Q2x}$$

$$\frac{(9 \times 10^9)(30 \times 10^{-6})}{(x)^2} = \frac{(9 \times 10^9)(45 \times 10^{-6})}{(0,15 + x)^2}$$

$$\frac{5,477}{x} = \frac{6,708}{0,15 + x}$$

$$x = 0,67 \text{ m } (0,667 \text{ m}) \checkmark$$

For equating equations
Vir gelykstelling van vergelykings

(5)
[10]

QUESTION/VRAAG 9

9.1.1	OPTION 1/OPSIE 1 $P = \frac{V^2}{R} \checkmark$ $4 = \frac{V^2}{R} = \frac{(12)^2}{R} \checkmark$ $R = 36 \Omega \checkmark$	OPTION 2/OPSIE 2 $P = VI$ $4 = I(12)$ $I = 0,33...A$ $V = IR \checkmark$ $12 = 0,33R \checkmark$ $R = 36,36 \Omega \checkmark$	OPTION 3/OPSIE 3 $P = VI$ $4 = I(12)$ $I = 0,33...A$ $P = I^2 R \checkmark$ $4 = (0,33^2) R \checkmark$ $R = 36,73 \Omega \checkmark$	(3)

9.1.2 Increase/Toeneem $\checkmark$ (1)

9.1.3 No change/Geen verandering nie $\checkmark$
 Same potential difference $\checkmark$ (and resistance)
Dieselfde potensiaalverskil (en weerstand) (2)

9.2.1	$V = IR \checkmark$ $5 = I(6) \checkmark$ $\therefore I = 0,83 A$ $V_{\text{lost}} = Ir$ $1 = (0,83)r \checkmark$ $r = 1,20 \Omega \checkmark$	OR/OF	$\varepsilon = I(R + r)$ $6 = (0,83)(6 + r) \checkmark$ $r = 1,23 \Omega \checkmark$	(4)

9.2.2 Work done $\checkmark$ in moving a unit charge $\checkmark$ through a cell.
Arbeid verrig $\checkmark$ om 'n eenheidslading $\checkmark$ deur 'n sel te beweeg.

ACCEPT/AANVAAR

Energy transferred per unit charge/Energie oorgedra per eenheidslading

Work done in moving in 1 C of charge. / Arbeid verrig deur 1 C lading te beweeg (2)

9.2.3	OPTION 1/OPSIE 1 POSITIVE MARKING FROM 9.2.1/POSITIEWE NASIEN VANAF 9.2.1 $V_{\text{lost}} = Ir$ $1,5 \checkmark = I(1,2) \checkmark$ $I = 1,25 A$ $V_{ } = I_6 R_6$ $4,5 = I_6(6) \checkmark$ $I_6 = 0,75 A$ $V_x = IR_x \checkmark$ $4,5 = (1,25 - 0,75)R_x \checkmark$ $R_x = 9 \Omega \checkmark$	or/of	$V = IR$	

OPTION 2/OPSIE 2**POSITIVE MARKING FROM 9.2.1/POSITIEWE NASIEN VANAF 9.2.1**

$$V_{\text{lost}} = Ir$$

$$1,5\checkmark = I(1,2)$$

$$I = 1,25 \text{ A}$$

$$V_{\parallel} = I_p R_p$$

$$4,5 = (1,25)R_p\checkmark$$

$$R_p = 3,6 \Omega$$

$$\frac{1}{R_{\parallel}} = \frac{1}{R_x} + \frac{1}{R_6} \checkmark$$

$$\frac{1}{R_{\parallel}} = \frac{1}{R_x} + \frac{1}{6} \checkmark$$

$$\therefore R_{\parallel} = \frac{6R_x}{R_x + 6} = 3,6$$

$$R_x = 9 \Omega \checkmark$$

$$R_{\parallel} = \frac{R_x R_6}{R_x + R_6} \checkmark$$

$$3,6 = \frac{(R_x)(6)}{(R_x + 6)} \checkmark$$

$$R_x = 9 \Omega \checkmark$$

(5)
[17]**QUESTION/VRAAG 10**

10.1.1 a to b/a na b ✓

(1)

10.1.2 Fleming's left hand rule /Left hand motor rule✓
Fleming se linkerhandreël / Linkerhand motorreël

ACCEPT/AANVAAR

Right hand rule

Regherhandreël

(1)

10.1.3 Split rings /commutator ✓
Splitringe / kommutator

(1)

10.2.1 Mechanical/Kinetic energy to electrical energy. ✓✓ (2 or/of 0)
Meganiese /kinetiese energie na elektriese energie

(2)

10.2.2 **OPTION 1/OPSIE 1**

$$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$$

$$= \frac{430}{\sqrt{2}} \checkmark$$

$$= 304,06 \text{ V}$$

$$I = \frac{V}{R} \checkmark$$

$$= \frac{304,06}{400} \checkmark$$

$$= 0,76 \text{ A} \checkmark$$

OPTION 2/OPSIE 2

$$V_{\text{max}} = I_{\text{max}} R \checkmark$$

$$430 = I_{\text{max}}(400) \checkmark$$

$$I_{\text{max}} = 1,075$$

$$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}} = \frac{1,075}{\sqrt{2}} \checkmark$$

$$= 0,76 \text{ A} \checkmark$$

(5)

OPTION 3/OPSIE 3	OPTION 4/OPSIE 4
$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $= \frac{430}{\sqrt{2}} \checkmark = 304,06 \text{ V}$ $P_{\text{average}} = \frac{V_{\text{rms}}^2}{R} = \frac{(304,06)^2}{400}$ $= 231,13 \text{ W}$ $P_{\text{ave}} = I_{\text{rms}} V_{\text{rms}} \checkmark$ $231,13 = I_{\text{rms}} (304,06) \checkmark$ $I_{\text{rms}} = 0,76 \text{ A} \checkmark$	$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$ $= \frac{430}{\sqrt{2}} \checkmark = 304,06 \text{ V}$ $P_{\text{average}} = \frac{V_{\text{rms}}^2}{R} = \frac{(304,06)^2}{400}$ $= 231,13 \text{ W}$ $P_{\text{ave}} = I_{\text{rms}}^2 R \checkmark$ $231,13 = I_{\text{rms}}^2 (400) \checkmark$ $I_{\text{rms}} = 0,76 \text{ A} \checkmark$

[10]

QUESTION/VRAAG 11

11.1.1 It tells us that light has a particle nature. ✓

Dit sê vir ons dat lig 'n deeltjie-aard het

(1)

11.1.2 Remain the same. ✓

*Bly dieselfde*

For the same colour/ frequency/wavelength the energy of the photons will be the same ✓. (The brightness causes more electrons to be released, but they will have the same maximum kinetic energy.)

Vir dieselfde kleur / frekwensie/ golflengte is die energie van die fotone dieselfde. (Die helderheid veroorsaak dat meer elektrone vrygestel word, maar hulle sal dieselfde maksimum kinetiese energie hê.)

OR/OF

Intensity only affects the number of ejected photo-electrons and not the maximum kinetic energy or maximum speed of the ejected photo-electrons

Intensiteit beïnvloed slegs die aantal vrygestelde foto-elektrone en nie die maksimum kinetiese energie of maksimum spoed van die foto-elektrone.

OR/OF

Maximum kinetic energy of ejected photo-electrons is independent of intensity of radiation

Maksimum kinetiese energie van vrygestelde foto-elektrone is onafhanklik van die intensiteit van straling.

(2)

11.1.3

$$E = W_0 + E_k$$

$$hf = hf_0 + E_k$$

$$hf = hf_0 + \frac{1}{2} mv^2$$

$$E = W_0 + \frac{1}{2} mv^2$$

✓ Any one/Enige een

$$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{420 \times 10^{-9}} \checkmark = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{\lambda_0} \checkmark + \frac{1}{2} (9,11 \times 10^{-31})(4,76 \times 10^5)^2 \checkmark$$

$$\lambda_0 = 5,37 \times 10^{-7} \text{ m}$$

∴ the metal is sodium / *die metaal is natrium* ✓

(5)

11.2 Q✓ and/en S ✓



Emission spectra occur when excited atoms /electrons drop from higher energy levels to lower energy levels. ✓✓

Emissiespektra ontstaan wanneer opgewekte atome/elektrone vanaf hoër energievlakke na laer energievlakke beweeg.

(Characteristic frequencies are emitted/Kenmerkende frekwensies word vrygestel.)

(4)
[12]

TOTAL/TOTAAL: 150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

NOVEMBER 2015

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 28 pages.
*Hierdie memorandum bestaan uit 28 bladsye.***

QUESTION 1/VRAAG 1

1.1	B✓✓	(2)
1.2	D✓✓	(2)
1.3	C✓✓	(2)
1.4	D✓✓	(2)
1.5	A✓✓	(2)
1.6	A✓✓	(2)
1.7	A✓✓	(2)
1.8	D✓✓	(2)
1.9	C✓✓	(2)
1.10	B✓✓	(2)
		[20]

QUESTION 2/VRAAG 2

- 2.1.1 When body A exerts a force on body B, body B exerts a force of equal magnitude in the opposite direction on body A. ✓✓
Wanneer liggaam A 'n krag uitoefen op liggaam B, oefen liggaam B 'n krag van gelyke grootte in die teenoorgestelde rigting op liggaam A uit.

OR/OF

If body A exerts a force on body B, then body B exerts an equal ✓ and opposite ✓ force on body A

Indien liggaam A 'n krag uitoefen op liggaam B, dan sal liggaam B 'n gelyke maar teenoorgestelde krag op liggaam A uitoefen

(2)

- 2.1.2 For 2,5 kg block/Vir 2,5 kg blok

$$T = mg✓$$

$$\therefore T = (2,5)(9,8)✓$$

$$= 24,5 \text{ N}✓$$

OR/OF

$$F_{\text{net}} = ma$$

$$T - mg = (2,5)(0)✓$$

$$T - (2,5)(9,8)✓ = 0$$

$$T = 24,5 \text{ N}✓$$

OR/OF

$$F_{\text{net}} = ma$$

$$mg - T = (2,5)(0)✓$$

$$(2,5)(9,8) - T✓ = 0$$

$$T = 24,5 \text{ N}✓$$

(3)

- 2.1.3 **POSITIVE MARKING FROM 2.1.2**
POSITIEWE NASIEN VANAF 2.1.2

For mass M/Vir mass M

$$f_s = \mu_s N✓$$

$$\therefore N = \frac{24,5}{0,2}✓ = 122,5 \text{ N}$$

$$N = Mg = 122,5 \text{ N}$$

$$\underline{M(9,8) = 122,5 \text{ N}✓}$$

$$M = 12,5 \text{ kg}✓$$

OR/OF

$$\mu_s N✓ = \mu_s Mg$$

$$24,5✓ = (0,2)✓ \underline{M(9,8)}✓$$

$$M = 12,5 \text{ kg}✓$$

(5)

- 2.1.4 For the 5 kg block/Vir die 5 kg blok:

$$f_k = \mu_k N$$

$$f_k = (0,15)(5)(9,8)✓$$

$$= 7,35 \text{ N}$$

$$F_{\text{net}} = ma \quad \left. \begin{array}{l} T - f_k = ma \end{array} \right\}✓$$

$$\underline{T - 7,35 = 5a}✓$$

For the 2,5 kg block/Vir die 2,5 kg blok

$$w - T = ma$$

$$\underline{(2,5)(9,8) - T = 2,5 a}✓$$

$$17,15 = 7,5 a$$

$$a = 2,29 \text{ m} \cdot \text{s}^{-2}✓$$

(5)

2.2

$$F = G \frac{m_1 m_2}{r^2} \checkmark$$

$$F = \frac{(6,67 \times 10^{-11})(6,5 \times 10^{20})(90)}{(550 \times 10^3)^2} \checkmark$$

$$= 12,90 \text{ N} \checkmark (12,899 \text{ N})$$

(4)

OR/OF

$$g = \frac{Gm}{r^2} \checkmark$$

$$g = \frac{(6,67 \times 10^{-11})(6,5 \times 10^{20})}{(550 \times 10^3)^2} \checkmark$$

$$= 0,143 \dots \text{m} \cdot \text{s}^{-2}$$

$$w = mg$$

$$= (90)(0,143 \dots) \checkmark$$

$$= 12,89 \text{ N} \checkmark (\text{downwards/afwaarts})$$

(4)

[19]

QUESTION 3/VRAAG 3

3.1.	OPTION 1/OPSIE 1 Upwards positive/Opwaarts positief: $v_f = v_i + a\Delta t \checkmark$ $-16 \checkmark = 16 - 9,8(\Delta t) \checkmark$ $\Delta t = 3,27 \text{ s} \checkmark$	Downwards positive/Afwaarts positief: $v_f = v_i + a\Delta t \checkmark$ $16 \checkmark = -16 + 9,8(\Delta t) \checkmark$ $\Delta t = 3,27 \text{ s} \checkmark$	(4)
	OPTION 2/OPSIE 2 Upwards positive/Opwaarts positief: $v_f = v_i + a\Delta t \checkmark$ To the top/By bopunt: $0 \checkmark = 16 - 9,8(\Delta t) \checkmark$ $\Delta t = 1,63 \text{ s}$ Total time/Totale tyd = $1,63 \times 2$ = $3,26(7) \text{ s} \checkmark$	Downwards positive/Afwaarts positief: $v_f = v_i + a\Delta t \checkmark$ To the top/By bopunt: $0 \checkmark = -16 + 9,8(\Delta t) \checkmark$ $\Delta t = 1,63 \text{ s}$ Total time/Totale tyd = $1,63 \times 2$ = $3,26(7) \text{ s} \checkmark$	(4)
3.1	OPTION 3/OPSIE 3 Upwards positive/Opwaarts positief: $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $0 \checkmark = 16\Delta t + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$ $\Delta t(16 - 4,9\Delta t) = 0$ $\Delta t = 0 \text{ or/of } 3,27 \text{ s}$ Time taken/Tyd geneem = $3,27 \text{ s}$ (accept/aanvaar $3,26 \text{ s}$) $\checkmark$	Downwards positive/Afwaarts positief: $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $0 \checkmark = -16\Delta t + \frac{1}{2} (9,8) \Delta t^2 \checkmark$ $\Delta t(-16 + 4,9\Delta t) = 0$ $\Delta t = 0 \text{ or/of } 3,27 \text{ s}$ Time taken/Tyd geneem = $3,27 \text{ s}$ (accept/aanvaar $3,26 \text{ s}$) $\checkmark$	(4)
	OPTION 4/OPSIE 4 Upwards positive/Opwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ At highest point/By hoogste punt $0 = 16^2 + 2(-9,8)\Delta y \checkmark$ $\Delta y = 13,06 \text{ m}$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $13,06 = 16\Delta t - 4,9\Delta t^2 \checkmark$ $\Delta t = 1,62 \text{ or } 1,65$ Total time/Totale tyd = $(1,62/1,65) \times 2$ = $3,24 \text{ s} \checkmark$ or/of $3,3 \text{ s}$	Downwards positive/Afwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ At highest point/By hoogste punt $0 = (-16)^2 + 2(9,8)\Delta y \checkmark$ $\Delta y = 13,06 \text{ m}$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $13,06 = -16\Delta t + 4,9\Delta t^2 \checkmark$ $\Delta t = 1,62 \text{ or } 1,65$ Total time/Totale tyd = $(1,62/1,65) \times 2$ = $3,24 \text{ s} \checkmark$ or/of $3,3 \text{ s}$	(4)

OPTION 5/OPSIE 5 Upwards positive/Opwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ At highest point/By hoogste punt $0 = 16^2 + 2(-9,8)\Delta y \checkmark$ $\Delta y = 13,06 \text{ m}$ $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t \checkmark$ $13,06 = \left(\frac{0 + 16}{2}\right)\Delta t \checkmark$ $\Delta t = 1,63 \text{ s}$ Total time/totale tyd = 3,26 s ✓	Downwards positive/Afwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ At highest point/By hoogste punt $0 = (-16)^2 + 2(9,8)\Delta y \checkmark$ $\Delta y = -13,06 \text{ m}$ $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t \checkmark$ $-13,06 = \left(\frac{0 - 16}{2}\right)\Delta t \checkmark$ $\Delta t = 1,63 \text{ s}$ Total time/totale tyd = 3,26 s ✓

(4)

3.1

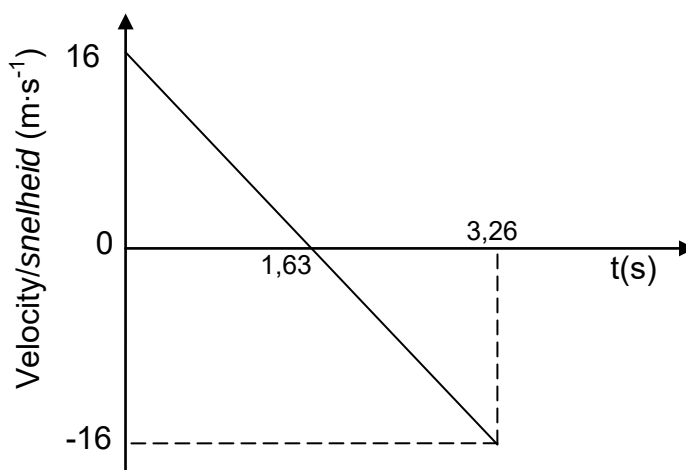
OPTION 6 /OPSIE 6 Upwards positive/Opwaarts positief: $F_{\text{net}} \Delta t = \Delta p \checkmark$ $mg \Delta t = m (v_f - v_i)$ $-9,8\Delta t \checkmark = (0 - 16) \checkmark$ $\Delta t = 1,63 \text{ s}$ Total time/Totale tyd = (1,63)(2) = 3,26 s ✓	Downwards positive/Afwaarts positief: $F_{\text{net}} \Delta t = \Delta p \checkmark$ $mg \Delta t = m (v_f - v_i)$ $9,8\Delta t \checkmark = \{0 - (-16)\} \checkmark$ $\Delta t = 1,63 \text{ s}$ Total time/Totale tyd = (1,63)(2) = 3,26 s ✓

(4)

OPTION 7 /OPSIE 7 Upwards positive/Opwaarts positief: $F_{\text{net}} \Delta t = \Delta p \checkmark$ $mg \Delta t = m (v_f - v_i)$ $-9,8\Delta t \checkmark = [-16 - (+16)] \checkmark$ $\Delta t = 3,26 \text{ s}$ Total time/Totale tyd = 3,26 s ✓	Downwards positive/Afwaarts positief: $F_{\text{net}} \Delta t = \Delta p \checkmark$ $mg \Delta t = m (v_f - v_i)$ $9,8\Delta t \checkmark = [16 - (-16)] \checkmark$ $\Delta t = 3,26 \text{ s}$ Total time/Totale tyd = 3,26 s ✓

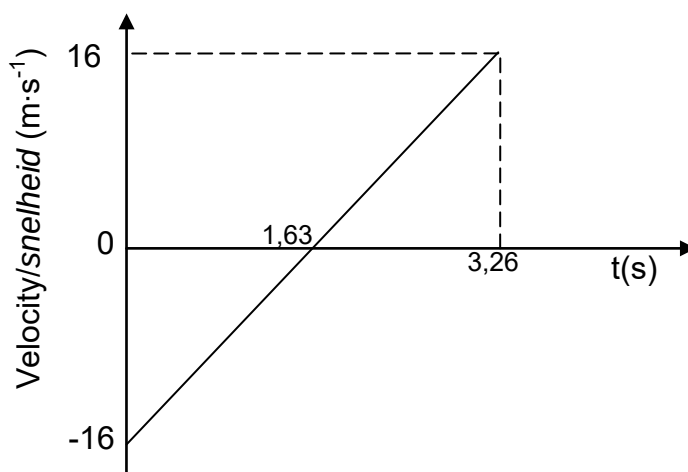
(4)

3.2 **POSITIVE MARKING FROM 3.1./POSITIEWE NASIEN VANAF 3.1**
Upwards positive/Opwaarts positief:



(3)

POSITIVE MARKING FROM 3.2./POSITIEWE NASIEN VANAF 3.2
Downwards positive/Afwaarts positief:



Criteria for graph/Kriteria vir grafiek	Marks/Punte
Correct shape for line extending beyond $t = 1,63$ s. <i>Korrekte vorm vir lyn verleng verby $t = 1,63$ s</i>	✓
Initial velocity correctly indicated as shown. <i>Beginsnelheid korrek aangedui soos getoon.</i>	✓
Time to reach maximum height and time to return to the ground correctly shown. <i>Tyd om maksimum hoogte te bereik en om na die grond terug te keer.</i>	✓

(3)

3.3

OPTION 1 / OPSIE 1

Upwards positive/Opwaarts positief:

Take y_A as height of ball A from the ground. (no penalising)/Neem y_A as hoogte van bal A vanaf die grond. (geen penalisering)

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$y_A - 0 = 16\Delta t + \frac{1}{2}(-9,8)\Delta t^2 \\ = 16\Delta t - 4,9\Delta t^2 \checkmark$$

Take y_B as height of ball B from the ground./Neem y_B as hoogte van bal B vanaf die grond.

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$y_B - 30 = (v_i \Delta t + \frac{1}{2} a \Delta t^2) \\ y_B = 30 - [-9(\Delta t - 1) + \frac{1}{2}(-9,8)(\Delta t - 1)^2] \checkmark \\ = 34,1 + 0,8\Delta t - 4,9 \Delta t^2 \checkmark$$

$$y_A = y_B$$

$$\therefore 16\Delta t - 4,9\Delta t^2 = 34,1 + 0,8\Delta t - 4,9\Delta t^2$$

$$15,2\Delta t = 34,1$$

$$\Delta t = 2,24 \text{ s } \checkmark$$

$$y_A = 16(2,24) - 4,9(2,24)^2 \\ = 11,25 \text{ m } \checkmark$$

(6)

Downwards positive/Afwaarts positief:

Take y_A as height of ball A from the ground.(no penalising)/Neem y_A as hoogte van bal A vanaf die grond. (geen penalisering)

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$y_A - 0 = -16\Delta t + \frac{1}{2}(9,8)\Delta t^2 \\ = -16\Delta t + 4,9\Delta t^2 \checkmark$$

Take y_B as height of ball B from the ground/Neem as hoogte van bal B vanaf die grond..

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$y_B - 30 = -(v_i \Delta t + \frac{1}{2} a \Delta t^2) \\ y_B = 30 - [9(\Delta t - 1) + \frac{1}{2}(9,8)(\Delta t - 1)^2] \checkmark \\ = 34,1 + 0,8\Delta t - 4,9 \Delta t^2 \checkmark$$

$$y_A = y_B$$

$$-16\Delta t + 4,9\Delta t^2 = 34,1 + 0,8\Delta t - 4,9\Delta t^2$$

$$15,2\Delta t = 34,1$$

$$\Delta t = 2,24 \text{ s } \checkmark$$

$$\Delta y_A = (-16(2,24) + 4,9(2,24)^2) \\ = 11,25 \text{ m } \checkmark$$

(6)

3.3

OPTION 2/OPSIE 2

Upwards positive/Opwaarts positief:

$$\begin{aligned}\Delta y_A &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark \\ &= 16 \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \\ &= 16 \Delta t - 4,9 \Delta t^2 \checkmark\end{aligned}$$

Distance travelled by ball A = $y_A = 16 \Delta t - 4,9 \Delta t^2$

$$\begin{aligned}\Delta y_B &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ &= -9(\Delta t - 1) + \frac{1}{2} (-9,8)(\Delta t - 1)^2 \checkmark \\ &= 0,8 \Delta t - 4,9 \Delta t^2 + 4,1 \checkmark\end{aligned}$$

Distance travelled by ball B = $y_B = 0,8 \Delta t - 4,9 \Delta t^2 + 4,1$

$$\begin{aligned}y_A + (-y_B) &= 30 \\ 16 \Delta t - 4,9 \Delta t^2 - (0,8 \Delta t - 4,9 \Delta t^2 + 4,1) &= 30 \\ 15,2 \Delta t &= 34,1 \\ \Delta t &= 2,24 \text{ s } \checkmark\end{aligned}$$

$$\begin{aligned}\therefore \Delta y_A &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ y_A &= 16 (2,24) - 4,9 (2,24)^2 \\ &= 11,25 \text{ m } \checkmark\end{aligned}$$

(6)

3.3

Downwards positive/Afwaarts positief:

$$\begin{aligned}y_A &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark \\ &= -16 \Delta t + \frac{1}{2} (9,8) \Delta t^2 \\ &= -16 \Delta t + 4,9 \Delta t^2 \checkmark\end{aligned}$$

$$\begin{aligned}y_B &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ &= 9(\Delta t - 1) + \frac{1}{2} (9,8)(\Delta t - 1)^2 \checkmark \\ &= -0,8 \Delta t + 4,9 \Delta t^2 - 4,1 \checkmark\end{aligned}$$

$$\begin{aligned}(-y_A) + y_B &= 30 \\ -(-16 \Delta t + 4,9 \Delta t^2) - 0,8 \Delta t + 4,9 \Delta t^2 - 4,1 &= 30 \\ 15,2 \Delta t &= 34,1 \\ \Delta t &= 2,24 \text{ s } \checkmark\end{aligned}$$

$$\begin{aligned}\therefore \Delta y_A &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ \Delta y_A &= -16 (2,24) + 4,9 (2,24)^2 \\ &= -11,25 \text{ m}\end{aligned}$$

$\therefore$ Height of ball A/Hoogte van bal A = 11,25 m $\checkmark$

(6)

OPTION 3/OPSIE 3

Upwards positive/Opwaarts positief:

$$v_f = v_i + a\Delta t$$

After 1 s, speed of ball A/Spoed van bal A na 1 s

$$\begin{aligned} v_f &= 16 + (-9,8)(1) \\ &= 6,2 \text{ m}\cdot\text{s}^{-1} \end{aligned}$$

Distance travelled by ball A in 1 s/Afstand deur bal A afgelê in 1 s

$$\begin{aligned} \Delta y_A &= v_i\Delta t + \frac{1}{2} a\Delta t^2 \checkmark \\ &= (16)(1) + \frac{1}{2}(-9,8)1^2 \\ &= 11,1 \text{ m} \end{aligned}$$

For ball A, after 1 s/Vir bal A na 1 s

$$\Delta y_A = 6,2\Delta t - 4,9\Delta t^2 \checkmark$$

For ball/Vir bal B,

$$\begin{aligned} \Delta y_B &= v_i\Delta t + \frac{1}{2} a\Delta t^2 \\ &= -9\Delta t + \frac{1}{2}(-9,8)\Delta t^2 \checkmark \end{aligned}$$

$$\begin{aligned} y_A + (-y_B) &= (30 - 11,1) = 18,9 \\ 6,2\Delta t - 4,9\Delta t^2 - [-9\Delta t + \frac{1}{2}(-9,8)\Delta t^2] &= 18,9 \\ 15,2\Delta t &= 18,9 \\ \Delta t &= 1,24 \text{ s} \checkmark \end{aligned}$$

The balls meet after/Die balle ontmoet na $(1,24 + 1) = 2,24 \text{ s} \checkmark$

$$\begin{aligned} \Delta y_A &= [6,2(1,24) - 4,9(1,24)^2] \\ &= 0,154 \text{ m} \end{aligned}$$

$$\text{Meeting point/Ontmoetingspunt} = (11,1 + 0,154) = 11,25 \text{ m} \checkmark$$

OR/OF

$$\begin{aligned} \Delta y &= (-9)(1,24) + \frac{1}{2}(-9,8)(1,24)^2 \checkmark \\ &= -18,69 \text{ m} \end{aligned}$$

$$\text{Meeting point/Ontmoetingspunt} = (30 - 18,69) = 11,31 \text{ m} \checkmark$$

(6)

Downwards positive/Afwaarts positief:

$$v_f = v_i + a\Delta t$$

After 1 s, speed of ball A/Spoed van bal A na 1 s

$$v_f = -16 + (9,8)(1) \\ = -6,2 \text{ ms}^{-1}$$

Distance travelled by ball A in 1 s/Afstand deur bal A afgelê in 1 s

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark \\ = (-16)(1) + \frac{1}{2}(9,8)(1)^2 \\ = -11,1 \text{ m}$$

For ball A, after 1 s/Vir bal A na 1 s

$$\Delta y_A = -6,2\Delta t + 4,9\Delta t^2 \checkmark$$

For ball/Vir bal B

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ = 9\Delta t + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$-\Delta y_A + \Delta y_B = 18,9$$

$$6,2\Delta t - 4,9\Delta t^2 + [9\Delta t + \frac{1}{2}(9,8)\Delta t^2] = 18,9$$

$$15,2\Delta t = 18,9$$

$$\Delta t = 1,24 \text{ s} \checkmark$$

The balls meet after/Die balle ontmoet na $(1,24 + 1) = 2,24 \text{ s} \checkmark$

$$\Delta y_A = -6,2(1,24) + 4,9(1,24)^2 \\ = -0,154 \text{ m}$$

$$\text{Meeting point/Ontmoetingspunt} = (-11,1 - 0,154) = 11,25 \text{ m} \checkmark$$

OR/OF

$$\Delta y = (9)(1,24) + \frac{1}{2}(9,8)(1,24)^2 \checkmark \\ = 18,69 \text{ m}$$

$$\text{Meeting point/Ontmoetingspunt} = (30 - 18,69) = 11,31 \text{ m} \checkmark$$

(6)
[13]

QUESTION 4/VRAAG 4

4.1

OPTION 1/OPSIE 1

Take motion to the right as positive/*Neem beweging na regs as positief.*

$$\Sigma p_i = \Sigma p_f$$

$$(m_1 + m_2)v_i = m_1 v_{f1} + m_2 v_{f2}$$

$$(m_1 + m_2)v_i = m_1 v_{f1} + m_2 v_{f2}$$

$$(3 + 0,02)(0) \checkmark = (3)(-1,4) + (0,02) v_{f2} \checkmark$$

$$v_{f2} = 210 \text{ m}\cdot\text{s}^{-1} \checkmark$$

Any one/*Enige een*

OR/OF

Take motion to the left as positive/*Neem beweging na links as positief.*

$$\Sigma p_i = \Sigma p_f$$

$$(m_1 + m_2)v_i = m_1 v_{f1} + m_2 v_{f2}$$

$$(m_1 + m_2)v_i = m_1 v_{f1} + m_2 v_{f2}$$

$$(3 + 0,02)(0) \checkmark = (3)(1,4) + (0,02) v_{f2} \checkmark$$

$$v_{f2} = -210 \text{ m}\cdot\text{s}^{-1}$$

$$\text{Speed/} \textit{Spoed} = 210 \text{ m}\cdot\text{s}^{-1} \checkmark$$

Any one/*Enige een*

(4)

OPTION 2/OPSIE 2

Take motion to the right as positive/*Neem beweging na regs as positief.*

$$\Delta p_{\text{bullet}} = -\Delta p_{\text{block}} \checkmark$$

$$m(v_f - v_i) = -m(v_f - v_i)$$

$$(0,02)(v_f - 0) \checkmark = -(3)(-1,4 - 0) \checkmark$$

$$\therefore v_i = 210 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OR/OF

Take motion to the left as positive/*Neem beweging na links as positief*

$$\Delta p_{\text{bullet}} = -\Delta p_{\text{block}} \checkmark$$

$$m(v_f - v_i) = -m(v_f - v_i)$$

$$(0,02)(v_f - 0) \checkmark = -(3)(1,4 - 0) \checkmark$$

$$\therefore v_i = -210 \text{ m}\cdot\text{s}^{-1}$$

$$\text{Speed/} \textit{Spoed} = 210 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(4)

4.2

OPTION 1/OPSIE 1 $v_f^2 = v_i^2 + 2a\Delta x \checkmark$ $0 = 210^2 + 2a(0,4) \checkmark$ $a = -55\,125 \text{ m}\cdot\text{s}^{-2}$ $F_{\text{net}} = ma \checkmark$ $= (0,02)(-55\,125) \checkmark$ $= -1\,102,5 \text{ N}$ Magnitude of force = 1 102,5 N ✓ Grootte van krag = 1 102,5 N	OPTION 2/OPSIE 2 $\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $0,4 = \left(\frac{210 + 0}{2} \right) \Delta t \checkmark$ $\Delta t = 0,004 \text{ s } (0,00381 \text{ s})$ $F_{\text{net}} \Delta t = \Delta p = m \Delta v \checkmark$ $F_{\text{net}} = \frac{(0,02)(0 - 210)}{(0,004)} \checkmark$ $= -1\,050 \text{ N}$ Magnitude of force = 1 050 N ✓ Grootte van krag = 1 050 N (Accept/Aanvaar: 1102,5 N)

(5)

OPTION 3/OPSIE 3 $v_f^2 = v_i^2 + 2a\Delta x \checkmark$ $0 = 210^2 + 2a(0,4) \checkmark$ $a = -55\,125 \text{ m}\cdot\text{s}^{-2}$ $v_f = v_i + a\Delta t$ $0 = 210 - (55\,125)\Delta t$ $\Delta t = 0,004 \text{ s } (0,00381 \text{ s})$ $F_{\text{net}} \Delta t = \Delta p = m \Delta v \checkmark$ $F_{\text{net}} = \frac{(0,02)(0 - 210)}{(0,004)} \checkmark$ $= -1\,050 \text{ N}$ Magnitude of force = 1 050 N ✓ (Accept/Aanvaar: 1 102,5 N) Grootte van krag = 1 050 N

(5)

OPTION 4/OPSIE 4 $W_{\text{net}} = \Delta K$ $F_{\text{net}} \Delta x \cos \theta = \Delta K = \frac{1}{2} m(v_i^2 - v_f^2)$ $F_{\text{net}}(0,4) \checkmark \cos 180^\circ \checkmark = \frac{1}{2} (0,02)(0^2 - 210^2) \checkmark$ $F_{\text{net}} = 1\,102,5 \text{ N} \checkmark$ OR/OF $W_{\text{nc}} = \Delta E_p + \Delta E_k$ $F_{\text{net}} \Delta x \cos \theta = 0 + \frac{1}{2} m(v_i^2 - v_f^2)$ $F_{\text{net}}(0,4) \checkmark \cos 180^\circ \checkmark = \frac{1}{2} (0,02)(0^2 - 210^2) \checkmark$ $F_{\text{net}} = 1\,102,5 \text{ N} \checkmark$	Any one/Enige een Any one/Enige een

(5)

4.3

The same as/equal ✓
Dieselfde as/gelyk

(1)

[10]

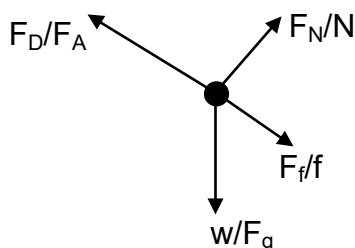
QUESTION 5/VRAAG 5

5.1

OPTION 1/OPSIE 1 $v_{ave} = \frac{800}{75} \checkmark = 10,67 \text{ m} \cdot \text{s}^{-1}$ $P_{ave} = Fv_{ave} \checkmark$ $P_{ave} = (240)(10,67)$ $= 2\,560,8 \text{ W (2,56 kW)} \checkmark$	OPTION 2/OPSIE 2 $v_{ave} = \frac{800}{75} \checkmark = 10,67 \text{ m} \cdot \text{s}^{-1}$ $\therefore \text{Distance covered in 1 s} = 10,67 \text{ m}$ $\therefore W(\text{Work done in 1 s}) = F\Delta x \cos \theta \checkmark$ $= (240)(10,67)(1)$ $= 2\,560,8 \text{ J s}^{-1}$ $\therefore P_{ave} = 2\,560,8 \text{ W (2,56 kW)} \checkmark$
OPTION 3/OPSIE 3 $P = \frac{W}{\Delta t} \checkmark$ $= \frac{F\Delta x \cos \theta}{\Delta t}$ $= \frac{(240)(800) \cos 0^\circ}{75} \checkmark$ $= 2\,560 \text{ W} \checkmark$	OPTION 4/OPSIE 4 $P = \frac{W}{\Delta t} \checkmark$ $= \frac{F\Delta x \cos \theta}{\Delta t}$ $= \frac{(240)(10,67) \cos 0^\circ}{1} \checkmark$ $= 2\,560 \text{ W} \checkmark$

(3)

5.2



Accepted labels/Aanvaarde benoemings	
w	F_g / F_w / weight / mg / gravitational force/2 940 N F_g / F_w / gewig / mg / gravitasiekrak
f	$F_{\text{friction}} / F_f$ / friction /294 N / f_k F_{wrywing} / F_w / wrywing/294 N / f_k
N	F_N / F_{normal} / normal force F_N / F_{normaal} / normaalkrak
F_D	$F_{\text{Applied/toegepas}}$ /350 N/Average driving force $F_{\text{driving/dryfkrak}}$ /350/Gemiddelde aandrywingskrak

(4)

5.3

The net/total work done on an object is equal✓ to the change in the object's kinetic energy ✓
Die netto/totale arbeid verrig op 'n voorwerp is gelyk aan die verandering in die voorwerp se kinetiese energie.

OR/OF

The work done on an object by a resultant/net force is equal✓ to the change in the object's kinetic energy. ✓
Die arbeid verrig op 'n voorwerp deur 'n resulterende krag is gelyk aan die verandering in die voorwerp se kinetiese energie.

(2)

5.4

OPTION 1/OPSIE 1

$$W_{nc} = \Delta U + \Delta K \checkmark$$

$$W_f + W_D = \Delta U + \Delta K$$

$$f\Delta x \cos \theta + W_D = mg(h_f - h_i) + \frac{1}{2} (m)(v_f^2 - v_i^2)$$

$$(f\Delta x \cos \theta + F_D \Delta x \cos \theta = mg(h_f - h_i) + \frac{1}{2} m(v_f^2 - v_i^2)$$

$$(294)(450)(\cos 180^\circ) \checkmark + (350)(450) \cos 0^\circ \checkmark = (300)(9,8)(5 - 0) \checkmark + \frac{1}{2}(300)(v_f^2 - 0) \checkmark$$

$$v_f = 8,37 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(6)

OPTION 2/OPSIE 2

$$W_{net} = \Delta K \checkmark$$

$$W_{net} = W_D + W_g + W_f + W_N$$

$$= (F_D \Delta x \cos \theta) + (mg \sin \alpha) \Delta x \cos \theta + (f \Delta x \cos \theta) + 0$$

$$W_{net} = [350(450)](\cos 0^\circ) \checkmark + (300)(9,8) \frac{5}{450} (450)(\cos 180^\circ) \checkmark +$$

$$294(450)(\cos 180^\circ) \checkmark$$

$$= 157\,500 - 14\,700 - 132\,300$$

$$= 10\,500 \text{ J}$$

$$W_{net} = \Delta K$$

$$10\,500 = \frac{1}{2} (300)(v_f^2 - 0) \checkmark$$

$$v_f = 8,37 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OR/OF

$$\alpha = \sin^{-1} \frac{5}{450}$$

$$= 0,64^\circ$$

(6)

OPTION 3/OPSIE 3

$$W_{net} = W_D + W_g + W_f + W_N$$

$$= (F_D \Delta x \cos \theta) + mg \Delta x \cos \theta + f \Delta x \cos \theta + 0$$

$$W_{net} = (350)(450)(\cos 0^\circ) \checkmark + (300)(9,8)(450) \cos (90 + 0,64) \checkmark + 294(450)(\cos 180^\circ) \checkmark$$

$$= 157\,500 - 14\,777,74 - 13\,2300$$

$$= 10\,430,51 \text{ J}$$

$$W_{net} = \Delta K \checkmark$$

$$10\,430,51 = \frac{1}{2} (300)(v_f^2 - 0) \checkmark$$

$$v_f = 8,34 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OR/OF

$$\alpha = \sin^{-1} \frac{5}{450}$$

$$= 0,64^\circ$$

(6)

OPTION 4/OPSIE 4

$$F_{net} = F_D + (-mgsin \alpha) + (-f)$$

$$= 350 \checkmark + [-(300)(9,8)\sin 0,64^\circ] \checkmark + (-294) \checkmark$$

$$= 23,16 \text{ N}$$

$$W_{net} = F_{net} \Delta x \cos \theta$$

$$= (23,16)(450) \cos 0^\circ$$

$$= 10\,422 \text{ J}$$

$$W_{net} = \Delta K \checkmark$$

$$10\,422 = \frac{1}{2} (300)(v_f^2 - 0) \checkmark$$

$$v_f = 8,34 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OR/OF

$$F_{net} = 350 \checkmark - (300)(9,8)\sin 0,64^\circ \checkmark - 294 \checkmark$$

$$= 350 - 32,84 - 294$$

$$= 23,16 \text{ N}$$

(6)

[15]

QUESTION 6/VRAAG 6

6.1.1 Frequency (of sound detected by the listener (observer))✓
Frekwensie van klank deur luisteraar (waarnemer) waargeneem (1)

6.1.2 The apparent change in frequency or pitch of sound (detected (by a listener) because the sound source and the listener have different velocities relative to the medium of sound propagation.✓✓
Die verandering in frekwensie (of toonhoogte) van die klank deur 'n luisteraar waargeneem omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klankvoortplanting het. (2)

6.1.3 Away/Weg van✓
Detected frequency of source decreases✓
Waargenome frekwensie van bron neem af (2)

6.1.4 **OPTION 1/OPSIE 1**
EXPERIMENT/EKSPERIMENT 2
$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR/OF } f_L = \frac{v}{v + v_s} f_s \checkmark$$

$$874 = \frac{v}{v + 10} (900) \checkmark$$

$$v = 336,15 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (\text{Accept/Aanvaar : } 336,15 \text{ m} \cdot \text{s}^{-1} - 323,33 \text{ m} \cdot \text{s}^{-1}) \quad (5)$$

EXPERIMENT/EKSPERIMENT 3
$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR/OF } f_L = \frac{v}{v + v_s} f_s \checkmark$$

$$850 = \frac{v}{v + 20} (900) \checkmark$$

$$v = 340 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (\text{Accept/Aanvaar : } 313,33 \text{ m} \cdot \text{s}^{-1} - 340 \text{ m} \cdot \text{s}^{-1}) \quad (5)$$

EXPERIMENT 4/EKSPERIMENT 4
$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR/OF } f_L = \frac{v}{v + v_s} f_s \checkmark$$

$$827 = \frac{v}{v + 30} (900) \checkmark$$

$$v = 339,86 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (\text{Accept/Aanvaar : } 339,86 \text{ m} \cdot \text{s}^{-1} - 345 \text{ m} \cdot \text{s}^{-1}) \quad (5)$$

OPTION 2/OPSIE 2

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \text{OR/OF} \quad f_L = \frac{v}{v + v_s} f_s \quad \checkmark$$

Experiment/Eksperiment 2 and/en 3

$$\frac{874(v + 10)}{v} = \frac{850(v + 20)}{v} \quad \checkmark$$

$$874v + 8740 = 850v + 1700$$

✓ both frequencies / beide frekwensies

$$\therefore v = 344,17 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

Experiment/Eksperiment 2 and/en 4

$$\frac{874(v + 10)}{v} = \frac{827(v + 30)}{v} \quad \checkmark$$

$$874v + 8740 = 827v + 24810$$

✓ both frequencies / beide frekwensies

$$\therefore v = 341,91 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

Experiment/Eksperiment 3 and/en 4

$$\frac{850(v + 20)}{v} = \frac{827(v + 30)}{v} \quad \checkmark$$

$$850v + 1700 = 827v + 24810$$

✓ both frequencies / beide frekwensies

$$\therefore v = 339,57 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

(5)

6.2 Away from the Earth/Weg vanaf die aarde ✓

(1)

[11]

QUESTION 7/VRAAG 7

7.1

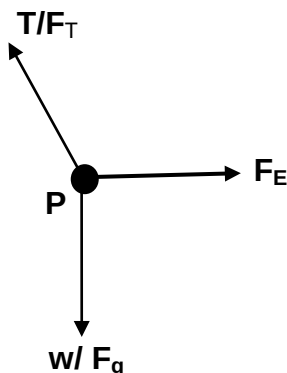
$$n = \frac{Q}{e} \checkmark$$

$$n = \frac{0,5 \times 10^{-6}}{1,6 \times 10^{-19}} \checkmark$$

$$n = 3,13 \times 10^{12} \checkmark \text{ electrons/elektrone}$$

(3)

7.2



Accepted labels/Aanvaarde benoemings	
w	$F_g / F_w / \text{weight} / mg / \text{gravitational force}$ $F_g / F_w / \text{gewig} / mg / \text{gravitasiekrag}$
T	$F_T / \text{tension}$ $F_T / \text{spanning}$
F_E	Electrostatic force/ F_C / Coulombic force/ $F_Q / F_{RP/PR}$ Elektrostiese krag / Coulombkrag / $F_Q / F_{RP/PR}$

(3)

7.3

The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the (magnitudes of the) charges and inversely proportional to the square of the distance (r) between them. $\checkmark\checkmark$

Die grootte van die elektrostatische krag wat deur een puntlading (Q_1) op 'n ander puntlading (Q_2) uitgeoefen word, is direk eweredig aan die produk van die (groottes van die) ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle.

(2)

7.4

OPTION 1/OPSIE 1

$$F_E = k \frac{Q_1 Q_2}{r^2} \checkmark$$

$$T \sin \theta / (T \cos \theta) = F_E$$

$$\therefore T \sin 7^\circ / (T \cos 83^\circ) \checkmark = \frac{(9 \times 10^9)(0,5 \times 10^{-6})(0,9 \times 10^{-6})}{(0,2)^2} \checkmark$$

$$\therefore T = 0,83 \text{ N} \checkmark \quad (\text{Accept/Aanvaar } 0,82 \text{ N})$$

(5)

OPTION 2/OPSIE 2

$$F_E = \frac{kQ_1 Q_2}{r^2} \checkmark$$

$$F_E = \frac{(9 \times 10^9)(0,5 \times 10^{-6})(0,9 \times 10^{-6})}{(0,2)^2} \checkmark$$

$$= 0,101 \text{ N}$$

$$\tan 7^\circ = \frac{T_x}{T_y} = \frac{0,101}{T_y} \checkmark$$

$$T_y = 0,823 \text{ N}$$

$$T = \sqrt{T_x^2 + T_y^2} = \sqrt{(0,101)^2 + (0,823)^2} = 0,83 \text{ N} \checkmark$$

(5)

OPTION 3/OPSIE 3

$$F = \frac{kQ_1 Q_2}{r^2} \checkmark = \frac{(9 \times 10^9)(0,5 \times 10^{-6})(0,9 \times 10^{-6})}{(0,2)^2} \checkmark = 0,101 \text{ N}$$

$$\frac{F_E}{\sin 7^\circ} = \frac{T}{\sin 90^\circ}$$

$$\frac{0,101}{\sin 7^\circ} = \frac{T}{\sin 90^\circ} \checkmark$$

$$T = 0,83 \text{ N} \checkmark$$

(5)

[13]

QUESTION 8/VRAAG 8

8.1 $E_X = E_2 + E_{(-8)} \checkmark$
 $= \frac{kQ_2}{r^2} + \frac{kQ_{-8}}{r^2} \checkmark$ correct equation /korrekte vergelyking
 $= \frac{(9 \times 10^9)(2 \times 10^{-5})}{(0,25)^2} \checkmark + \frac{(9 \times 10^9)(8 \times 10^{-6})}{(0,15)^2} \checkmark$
 $= 2,88 \times 10^6 + 3,2 \times 10^6$
 $= 6,08 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark$ to the east/na oos $\checkmark$

OR/OF

$E = k \frac{Q}{r^2} \checkmark$
 $E_2 = \frac{(9 \times 10^9)(2 \times 10^{-5})}{(0,25)^2} \checkmark$
 $= 2,88 \times 10^6 \text{ NC}^{-1}$ to the east/na oos
 $E_{-8} = \frac{(9 \times 10^9)(8 \times 10^{-6})}{(0,15)^2} \checkmark$
 $= 3,2 \times 10^6 \text{ N} \cdot \text{C}^{-1}$ to the east/na oos

$E_X = E_2 + E_{(-8)}$
 $= (2,88 \times 10^6 + 3,2 \times 10^6) \checkmark$
 $= 6,08 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark$ to the east/na oos $\checkmark$

(6)

8.2

OPTION 1/OPSIE 1

$F_E = QE \checkmark$
 $= (-2 \times 10^{-9})(6,08 \times 10^6) \checkmark$
 $= -12,16 \times 10^{-3} \text{ N}$
 $= 1,22 \times 10^{-2} \text{ N} \checkmark$ to the west/na wes $\checkmark$

(4)

OPTION 2/OPSIE 2

$F_{(-2)Q1} = qE_{(2)} \checkmark$
 $= (2 \times 10^{-9})(2,88 \times 10^6)$
 $= 5,76 \times 10^{-3} \text{ N}$ to the west/na wes

$F_{(-2)Q2} = qE_{(8)} \checkmark$
 $= (2 \times 10^{-9})(3,2 \times 10^6)$
 $= 6,4 \times 10^{-3} \text{ N}$ to the west/na wes

$F_{\text{net}} = 5,76 \times 10^{-3} + 6,4 \times 10^{-3} \checkmark$
 $= 1,22 \times 10^{-2} \text{ N} \checkmark$ to the west/na wes $\checkmark$

(4)

OPTION 3/OPSIE 3

$$F = k \frac{Q_1 Q_2}{r^2} \checkmark$$

$$F_{(-2)2} = \frac{(9 \times 10^9)(2 \times 10^{-9})(2 \times 10^{-5})}{(0,25)^2}$$

$$= 5,76 \times 10^{-3} \text{ N to the west/na wes}$$

$$F_{(-2)(-8)} = \frac{(9 \times 10^9)(2 \times 10^{-9})(8 \times 10^{-6})}{(0,15)^2}$$

$$= 6,4 \times 10^{-3} \text{ N to the west/na wes}$$

$$F_{\text{net}} = (5,76 \times 10^{-3} + 6,4 \times 10^{-3}) \checkmark$$

$$= 1,22 \times 10^{-2} \text{ N } \checkmark \text{ to the west/na wes } \checkmark$$

(4)

8.3 $2,44 \times 10^{-2} \text{ N} \checkmark$

(1)

[11]

QUESTION 9/VRAAG 9

- 9.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature. (provided temperature and all other physical conditions are constant) $\checkmark \checkmark$

Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur (mits temperatuur en alle fisiese toestande konstant bly)

OR/OF

The current in a conductor is directly proportional to the potential difference across the conductor, provided temperature and all other physical conditions are constant $\checkmark \checkmark$

Die stroom in 'n geleier is direk eweredig aan die potensiaalverskil oor 'n geleier by konstante temperatuur mits temperatuur en alle fisiese toestande konstant bly

(2)

9.2

OPTION 1/OPSIE 1

$$V = IR \checkmark$$

$$V_8 = (0,5)(8) \checkmark = 4 \text{ V}$$

$$V_8 = V_{16}$$

$$\therefore V_{16} = 4 \text{ V}$$

$$I_{16} = \frac{V}{R} = \frac{4}{16} = 0,25 \text{ A}$$

$$I_{\text{tot}} = A_1 = (0,5 + 0,25) \checkmark = 0,75 \text{ A} \checkmark$$

OPTION 2/OPSIE 2

$$V = IR \checkmark$$

$$V_8 = (0,5)(8) \checkmark = 4 \text{ V}$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$= \frac{1}{8} + \frac{1}{16} \checkmark$$

$$R = 5,33 \Omega$$

$$I_{\text{tot}} = \frac{4}{5,33}$$

$$A_1 = 0,75 \text{ A} \checkmark$$

(4)

<u>OPTION 3/OPSIE 3</u> $I_1 R_1 = I_2 R_2 \checkmark$ $(0,5)(8) = I_{16}(16) \checkmark$ $I_{16} = \frac{(8)(0,5)}{16} = 0,25 \text{ A}$ $I_{\text{tot}} = A_1 = (0,5 + 0,25) \checkmark = 0,75 \text{ A} \checkmark$	<u>OPTION 4/OPSIE 4</u> $2R_{8\Omega} = R_{16\Omega} \checkmark$ $\therefore I_{R16} = \frac{1}{2} I_{R8} \checkmark$ $\therefore I_{R16} = \frac{1}{2} (0,5) = 0,25 \text{ A}$ $A_1 = (0,5 + 0,25) \checkmark = 0,75 \text{ A} \checkmark$

(4)

9.3

<u>OPTION 1/OPSIE 1</u> $V = IR$ $V_{20\Omega} = (0,75)(20) \checkmark = 15 \text{ V}$ $V_{//\text{tot}} = (15 + 4) \checkmark = 19 \text{ V}$ $V_R = 19 \text{ V}$ $P = VI \checkmark$ $12 = (19)I \checkmark$ $I_R = A_2 = 0,63 \text{ A} \checkmark$

(5)

<u>OPTION 2/OPSIE 2</u> $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{8} + \frac{1}{16} \checkmark$ $R_{//} = 5,33 \Omega$ $R_{//} + R_{20} = (5,33 + 20) \checkmark = 25,33 \Omega$ $V_{//\text{tot}} = I(R_{//} + R_{20})$ $= (0,75)(25,33)$ $= 19 \text{ V}$ $P = VI$ $12 \checkmark = I(19) \checkmark$ $I_R = A_2 = 0,63 \text{ A} \checkmark$	<u>OR/OF</u> $R = \frac{R_1 R_2}{R_1 + R_2} = \frac{8 \times 16}{8 + 16} \checkmark = 5,33 \Omega$
<u>OPTION 3/OPSIE 3</u> $V = IR$ $V_{20\Omega} = (0,75)(20) \checkmark = 15 \text{ V}$ $V_{//\text{tot}} = (15 + 4) \checkmark = 19 \text{ V}$ $V_R = 19 \text{ V}$ $P = \frac{V^2}{R}$ $12 = \frac{(19)^2}{R}$ $R = 30,08 \Omega$ $P = I^2 R \checkmark$ $12 = I^2(30,08) \checkmark$ $I = 0,63 \text{ A} \checkmark$	

(5)

(5)

9.4

<u>OPTION 1/OPSIE 1</u>	<u>OPTION 2/OPSIE 2</u>
$(\varepsilon) = I(R + r) \checkmark$ $= V_{\text{terminal}} + V_{\text{int}}$ $= 19 + (0,75 + 0,63)(1) \checkmark$ $= 20,38 \text{ V} \checkmark$	$V_{\text{int}} = Ir$ $= (0,75 + 0,63)(1) \checkmark$ $= 1,38 \text{ V}$ $\varepsilon = V_{\text{terminal}} + V_{\text{int}} \checkmark$ $= 19 + 1,38$ $= 20,38 \text{ V} \checkmark$

(3)

OPTION 3/OPSIE 3

$$R = \frac{V}{I} = \frac{19}{0,63} = 30,16 \Omega$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{30,16} + \frac{1}{25,33} \therefore R_p = 13,77 \Omega$$

$$I_{\text{tot}} = 0,63 + 0,75 = 1,38 \text{ A}$$

$$\begin{aligned} \varepsilon &= I(R + r) \checkmark \\ &= (1,38)(13,77 + 1) \checkmark \\ &= 20,38 \text{ V} \checkmark \end{aligned}$$

[14]

QUESTION 10/VRAAG10

- 10.1.1 Move the bar magnet very quickly ✓
up and down inside the coil ✓
*Beweeg die staafmagneet baie vinnig
op en af binne in die spoel.* (2)
- 10.1.2 Electromagnetic induction/*Elektromagnetiese induksie* ✓ (1)
- 10.1.3 Commutator/*kommutator* / split rings/*spleetringe* ✓ (1)

10.2.1	<u>OPTION 1/OPSIE 1</u> $P_{\text{average}} = \frac{V_{\text{rms}}^2}{R} \checkmark$ $= \frac{220^2}{40,33} \checkmark$ $= 1\,200,10 \text{ W (J} \cdot \text{s}^{-1}) \checkmark$	$W = \frac{V_{\text{rms}}^2}{R} \Delta t \checkmark$ $= \frac{220^2}{40,33} (1) \checkmark$ $= 1\,200,10 \text{ J} \checkmark$	(4)
	<u>OPTION 2/OPSIE 2</u> $I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \checkmark$ $= \frac{220}{40,33} \checkmark$ $= 5,45 \text{ A}$ $P_{\text{average}} = I_{\text{rms}}^2 R$ $= (5,45^2)(40,33) \checkmark$ $= 1\,197,9 \text{ W OR/OF } 1\,200,10 \text{ W} \checkmark$	$I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \checkmark$ $= \frac{220}{40,33} \checkmark$ $= 5,45 \text{ A}$ $W = I_{\text{rms}}^2 R \Delta t$ $= (5,45^2)(40,33)(1) \checkmark$ $= 1\,197,9 \text{ J OR/OF } 1\,200,10 \text{ J} \checkmark$	(4)
	<u>OPTION 3/OPSIE 3</u> $I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \checkmark$ $= \frac{220}{40,33} \checkmark$ $= 5,45 \text{ A}$ $P_{\text{average}} = V_{\text{rms}} I_{\text{rms}}$ $= (220)(5,45) \checkmark$ $= 1\,199 \text{ W or/of } 1\,200,10 \text{ W} \checkmark$	$I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \checkmark$ $= \frac{220}{40,33} \checkmark$ $= 5,45 \text{ A}$ $W = V_{\text{rms}} I_{\text{rms}} \Delta t$ $= (220)(5,45)(1) \checkmark$ $= 1\,199 \text{ J or/of } 1\,200,10 \text{ J} \checkmark$	(4)

10.2.2

OPTION 1/OPSIE 1

$$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$$

$$220 = \frac{V_{\text{max}}}{\sqrt{2}}$$

$$V_{\text{max}} = 311,13 \text{ V}$$

$$I_{\text{max}} = \frac{V_{\text{max}}}{R} = \frac{311,13}{40,33} \checkmark$$

$$= 7,71 \text{ A} \checkmark$$

OR/OF

$$P_{\text{ave}} = \frac{V_{\text{max}} I_{\text{max}}}{2}$$

$$1200,1 = \frac{(311,13) I_{\text{max}}}{2}$$

$$I_{\text{max}} = 7,71 \text{ A}$$

(3)

OPTION 2/OPSIE 2

$$P_{\text{average}} = V_{\text{rms}} I_{\text{rms}} \checkmark$$

$$1200,1 = (220) I_{\text{rms}} \checkmark$$

$$I_{\text{rms}} = 5,455 \text{ A}$$

$$I_{\text{max}} = \sqrt{2} (5,455)$$

$$= 7,71 \text{ A} \checkmark \quad (7,715 \text{ A})$$

(3)

OPTION 3/OPSIE 3

$$P_{\text{average}} = I_{\text{rms}}^2 R \checkmark$$

$$1200,1 = I_{\text{rms}}^2 (40,33) \checkmark$$

$$I_{\text{rms}} = 5,455 \text{ A}$$

$$I_{\text{max}} = \sqrt{2} I_{\text{rms}}$$

$$= \sqrt{2} (5,455)$$

$$= 7,71 \text{ A} \checkmark$$

(3)

OPTION 4/OPSIE 4

$$V_{\text{rms}} = I_{\text{rms}} R \checkmark$$

$$220 = I_{\text{rms}} (40,33) \checkmark$$

$$I_{\text{rms}} = 5,455 \text{ A}$$

$$I_{\text{max}} = \sqrt{2} I_{\text{rms}}$$

$$= \sqrt{2} (5,455)$$

$$= 7,71 \text{ A} \checkmark$$

(3)

[11]

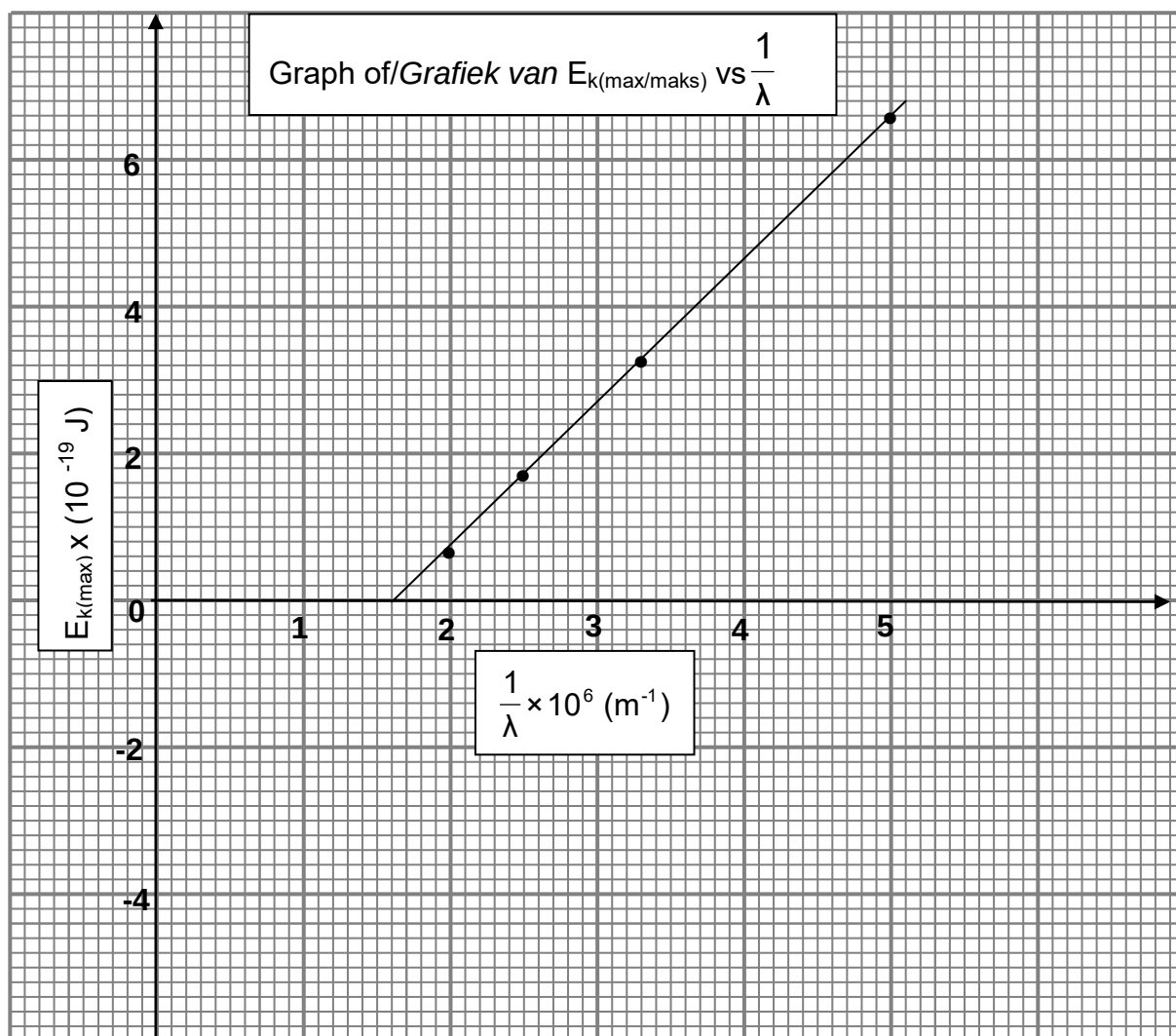
QUESTION 11/VRAAG 11

11.1 It is the process whereby electrons are ejected from a metal surface when light (of suitable frequency) is incident on it. ✓✓

Dit is die proses waartydens elektrone vanaf 'n metaaloppervlak vrygestel word wanneer van geskikte frekwensie daarop inval ✓✓

(2)

11.2



11.3.1

OPTION 1/OPSIE 1

$$\frac{1}{\lambda} = 1,6 \times 10^6 \text{ m}^{-1} \checkmark$$

$$f_o = c \frac{1}{\lambda} \checkmark$$

$$= (3 \times 10^8)(1,6 \times 10^6) \checkmark$$

$$= 4,8 \times 10^{14} \text{ Hz} \checkmark \quad (\text{Accept/Aanvaar } 4,8 \times 10^{14} \text{ Hz to/tot } 5,1 \times 10^{14} \text{ Hz})$$

(4)

OPTION 2/OPSIE 2

By extrapolation: y-intercept = $-W_o$ /Deur ekstrapolasie : y-afsnit = $-W_o$

$$W_o = hf_o \checkmark$$

$$3,2 \times 10^{-19} \checkmark = (6,63 \times 10^{-34})f_o \checkmark$$

$$f_o = 4,8 \times 10^{14} \text{ Hz} \checkmark \quad (\text{Accept/Aanvaar } 4,8 \times 10^{14} \text{ Hz to/tot } 4,83 \times 10^{14} \text{ Hz})$$

(4)

OPTION 3/OPSIE 3 (Points from the graph/ *Punte vanaf grafiek*)

$$E = W_o + E_{k(\text{max})}$$

$$\frac{hc}{\lambda_o} = hf_o + E_{k(\text{max})} \checkmark$$

$$(6,63 \times 10^{-34})(3 \times 10^8)(1,6 \times 10^6) \checkmark = (6,63 \times 10^{-34})f_o + 0 \checkmark$$

$$f_o = 4,8 \times 10^{14} \text{ Hz} \checkmark$$

OR/OF

$$(6,63 \times 10^{-34})(3 \times 10^8)(5 \times 10^6) = (6,63 \times 10^{-34})f_o + 6,6 \times 10^{-19}$$

$$f_o = 4,92 \times 10^{14} \text{ Hz}$$

OR/OF

$$(6,63 \times 10^{-34})(3 \times 10^8)(3,3 \times 10^6) = (6,63 \times 10^{-34})f_o + 3,3 \times 10^{-19}$$

$$f_o = 4,8 \times 10^{14} \text{ Hz}$$

OR/OF

$$(6,63 \times 10^{-34})(3 \times 10^8)(2,5 \times 10^6) = (6,63 \times 10^{-34})f_o + 1,7 \times 10^{-19}$$

$$f_o = 4,94 \times 10^{14} \text{ Hz}$$

OR/OF

$$(6,63 \times 10^{-34})(3 \times 10^8)(2,2 \times 10^6) = (6,63 \times 10^{-34})f_o + 0,7 \times 10^{-19}$$

$$f_o = 5,54 \times 10^{14} \text{ Hz}$$

(4)

11.3.2

<u>OPTION 1/OPSIE 1</u>	<u>OPTION 2/OPSIE 2</u>
$hc = \text{Gradient/ Helling} \checkmark$ $= \frac{\Delta y}{\Delta x}$ $= \frac{6,6 \times 10^{-19}}{(5 - 1,6) \times 10^6} \checkmark$ $= 1,941 \times 10^{-25} \text{ (J}\cdot\text{m)}$ $h = \frac{\text{gradient / helling}}{c}$ $h = \frac{1,941 \times 10^{-25}}{3 \times 10^8} \checkmark$ $= 6,47 \times 10^{-34} \text{ J}\cdot\text{s} \checkmark$	$W_0 = \text{y intercept/afsnit} \checkmark$ $= 3,2 \times 10^{-19} \text{ J}$ Accept /Aanvaar $3,2 \times 10^{-19} \text{ J to/tot } 3,4 \times 10^{-19} \text{ J)}$ $W_0 = hf_0$ $3,2 \times 10^{-19} \checkmark = h(4,8 \times 10^{14}) \checkmark$ $h = 6,66 \times 10^{-34} \text{ J}\cdot\text{s} \checkmark$ Accept /Aanvaar $6,66 \times 10^{-34} \text{ J}\cdot\text{s to/tot } 7,08 \times 10^{-34} \text{ J}\cdot\text{s)}$

(4)

<u>OPTION 3/OPSIE 3</u>	<u>OPTION 4/OPSIE 4</u>
(Points from the graph (Punte vanaf grafiek)) $\frac{hc}{\lambda} = W_0 + K_{\max} = 3,2 \times 10^{-19} \checkmark + 6,6 \times 10^{-19} \checkmark$ $h = \frac{9,8 \times 10^{-19}}{(3 \times 10^8)(5 \times 10^6)} \checkmark = 6,53 \times 10^{-34} \text{ J}\cdot\text{s}$ OR/OF $\frac{hc}{\lambda} = W_0 + K_{\max} = 3,2 \times 10^{-19} \checkmark + 3,3 \times 10^{-19} \checkmark$ $h = \frac{6,5 \times 10^{-19}}{(3 \times 10^8)(3,3 \times 10^6)} \checkmark = 6,57 \times 10^{-34} \text{ J}\cdot\text{s}$ OR/OF $\frac{hc}{\lambda} = W_0 + K_{\max} = 3,2 \times 10^{-19} \checkmark + 1,7 \times 10^{-19}$ $h = \frac{4,7 \times 10^{-19}}{(3 \times 10^8)(2,5 \times 10^6)} \checkmark = 6,27 \times 10^{-34} \text{ J}\cdot\text{s}$ OR/OF $\frac{hc}{\lambda} = W_0 + K_{\max} = 3,2 \times 10^{-19} \checkmark + 0,7 \times 10^{-19} \checkmark$ $h = \frac{3,9 \times 10^{-19}}{(3 \times 10^8)(2 \times 10^6)} \checkmark = 6,5 \times 10^{-34} \text{ J}\cdot\text{s}$	$W_0 = \frac{hc}{\lambda_0} \text{ or / of } W_0 = hc \frac{1}{\lambda_0}$ $3,2 \times 10^{-19} \checkmark = h(3 \times 10^8)(1,6 \times 10^6) \checkmark$ $h = 6,66 \times 10^{-34} \text{ J}\cdot\text{s} \checkmark$

(4)
[13]

TOTAL/TOTAAL:

150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

**FEBRUARY/MARCH 2015
FEBRUARIE/MAART 2015**

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 17 pages.
*Hierdie memorandum bestaan uit 17 bladsye.***

QUESTION 1/VRAAG 1

1.1	A ✓✓	(2)
1.2	C ✓✓	(2)
1.3	D ✓✓	(2)
1.4	B ✓✓	(2)
1.5	D ✓✓	(2)
1.6	A ✓✓	(2)
1.7	A ✓✓	(2)
1.8	C ✓✓	(2)
1.9	A ✓✓	(2)
1.10	B ✓✓	(2)
		[20]

QUESTION 2/VRAAG 2

- 2.1 When one body exerts a force on a second body, the second body exerts a force of equal magnitude in the opposite direction on the first body.
Wanneer een liggaam 'n krag op 'n tweede liggaam uitoefen, oefen die tweede liggaam 'n krag van gelyke grootte in die teenoorgestelde rigting op die eerste liggaam.

OR/OF:

When body A exerts a force on body B, body B will exert a force of equal magnitude but opposite in direction on body A.

Indien liggaam A 'n krag uitoefen op liggaam B, sal B 'n krag van gelyke grootte maar teenoorgesteld in rigting op liggaam A uitoefen.

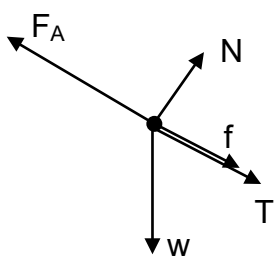
ACCEPT/AANVAAR (for 1 mark only/vir slegs 1 punt)

Action and reaction are equal and opposite.

Aksie en reaksie is gelyk en teenoorgesteld

(2)

2.2



Accept/Aanvaar Force diagram <i>Kragtediagram</i>	Notes/Aantekeninge Do not penalise for length of arrows <i>Moenie vir die lengte van die pyltjies penaliseer nie</i> If w is not shown but $F_{\parallel}$ and $F_{\perp}$ are shown give 1 mark for both. <i>Indien w nie aangetoon is nie maar $F_{\parallel}$ en $F_{\perp}$ is getoon, ken 1 punt toe vir beide.</i>

Accept the following symbols/Aanvaar die volgende simbole.	
N	F_N ; Normal;/Normaal ✓
F_A	40 N ✓
f	F_f, f_k ✓
w	F_G Weight/Gewig; Gravitational force/Gravitasiekrag ✓
T	Tension/Spanning; F_T ; ✓

(5)

2.3.1 **OPTION 1/OPSIE 1**

For the 1 kg block/Vir die 1 kg blok;

$$\begin{aligned} f_k &= \mu_k N \\ &= \mu_k mg \cos \theta \checkmark \\ &= 0,29 (1 \times 9,8 \cos 30^\circ) \checkmark \\ &= 2,46 \text{ N} \checkmark \end{aligned}$$

OPTION 2/OPSIE 2

BY PROPORTION:/DEUR EWEREDIGHEID

The smaller mass = $\frac{1}{4}$ of the larger mass $\checkmark$

Die kleiner massa = $\frac{1}{4}$ die groter massa

$$\begin{aligned} \therefore \text{frictional force/wrywingskrag} &= \frac{1}{4} (10) \checkmark \\ &= 2,5 \text{ N} \checkmark \end{aligned}$$

2.3.2 **POSITIVE MARKING FROM QUESTION 2.2**
POSITIEWE NASIEN VANAF VRAAG 2.2

OPTION 1/OPSIE 1

$$F_{\text{net}} = ma \checkmark$$

For 1 kg block/Vir 1 kg blok

$$\begin{aligned} F_A - \{(T + f_k) + mg \sin \theta\} &= ma \\ 40 - \{T + 2,46 + 1(9,8)(\sin 30^\circ)\} &= (1 \times) a \checkmark \\ 40 - T - 7,36 &= a \\ 32,64 - T &= a \dots \dots (1) \end{aligned}$$

For 4 kg block/Vir 4 kg blok

$$\begin{aligned} T - (mg \sin \theta + f_k) &= 4a \\ T - (4 \times 9,8 \sin 30^\circ + 10) &= 4a \checkmark \\ T - 29,6 &= 4a \dots \dots (2) \end{aligned}$$

From (1) and (2)/Vanaf (1) en (2)

$$\begin{aligned} a &= 0,61 \text{ m} \cdot \text{s}^{-2} \\ T &= 29,6 + (4(0,61)) \checkmark \\ T &= 32,04 \text{ N} \checkmark \end{aligned}$$

OPTION 2/OPSIE 2

Consider the blocks as a single system.

Beskou die blokke as 'n enkele sisteem.

$$\begin{aligned} F_A - [(f_{\text{tot}}) - \{(4+1) g \sin 30^\circ\}] &= (4+1)a \\ 40 - (10 - 2,46) - (5(9,8) \sin 30^\circ) &= 5a \checkmark \\ \therefore a &= 0,61 \text{ m} \cdot \text{s}^{-2} \end{aligned}$$

For 1 kg block/Vir 1 kg blok

$$\begin{aligned} F_{\text{net}} &= ma \checkmark \\ F_A - \{(T + f_k) + mg \sin \theta\} &= ma \\ 40 - \{T + 2,46 + 1(9,8)(\sin 30^\circ)\} &= (1 \times) a \checkmark \\ 40 - T - 7,36 &= a \\ 32,64 - T &= 0,61 \checkmark \\ T &= 32,04 \text{ N} \checkmark \end{aligned}$$

Notes/Aantekeninge

Learners need not show how (1) and (2) were combined
Leerders hoef nie aan te toon hoe (1) en (2) gekombineer is nie.

The first correct substitution for equation (1) should carry 2 marks.

The second substitution must carry 1 mark.

Die eerste korrekte vervanging vir vergelyking (1) moet 2 punte tel.

Die tweede vervanging tel 1 punt.

(3)

OR/OF

For 4 kg block/Vir 4 kg blok

$F_{\text{net}} = ma$

$$T - (mg \sin \theta + f_k) = 4a$$

$$T - (4 \times 9,8 \sin 30^\circ + 10) = 4a \checkmark$$

$$T - 29,6 = 4a$$

$$T = 29,6 + (4)(0,61) \checkmark$$

$$= 32,04 \text{ N} \checkmark$$

(6)
[16]

QUESTION 3/VRAAG 3

3.1 Free fall/Vrye val

ACCEPT/AANVAAR

Vertically accelerated motion/projectile motion.

Vertikale versnelde beweging /projektielbeweging

(1)

3.2.1 Downward motion as positive
Afwaartse beweging as positief

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$30 \checkmark = v_i (1,5) + \frac{1}{2} (9,8)(1,5)^2 \checkmark$$

$$v_i = 12,65 \text{ m} \cdot \text{s}^{-1} \checkmark$$

Upward motion as positive
Opwaartse beweging as positief

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$-30 \checkmark = v_i (1,5) + \frac{1}{2} (-9,8)(1,5)^2 \checkmark$$

$$v_i = 12,65 \text{ m} \cdot \text{s}^{-1} \checkmark$$

Notes / Aantekeninge

Accept/Aanvaar

g or/of a

$$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$s = ut + \frac{1}{2} at^2$$

(4)

3.2.2 **OPTION 1/OPSIE 1**
Positive marking from QUESTION 3.2.1
Positiewe nasien vanaf VRAAG 3.2.1

Downward motion as positive
Afwaartse beweging as positief

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$12,65^2 \checkmark = 0 + 2(9,8) \Delta y \checkmark$$

$$\Delta y = 8,16 \text{ m} \checkmark$$

$$\text{Height/Hoogte } XC = XB + BC$$

$$(30 + 8,16) = 38,16 \text{ m}$$

$$\text{Height is/Hoogte is } 38,16 \text{ m} \checkmark$$

Notes / Aantekeninge

For/Vir XB

Accept/Aanvaar

g or/of a

$$v^2 = u^2 + 2as$$

The height must be written down in order to score the final mark.

Die hoogte moet neergeskryf word om die finale punt te kry.

Upward motion as positive
Opwaartse beweging as positief

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$(-12,65)^2 \checkmark = 0 + 2(-9,8) \Delta y \checkmark$$

$$\Delta y = -8,16 \text{ m} \checkmark$$

Height/Hoogte **XC = XB + BC**

$$(-30) + (-8,16) = -38,16 \text{ m}$$

Height is /Hoogte is 38,16 m) $\checkmark$

(5)

OPTION / OPSIE 2

Positive marking from QUESTION 3.2.1

Positiewe nasien vanaf VRAAG 3.2.1

Downward motion as positive

Afwaartse beweging as positief

$$v_B = v_X + a\Delta t \checkmark$$

$$12,65 = 0 + 9,8\Delta t \checkmark$$

$$\Delta t = 1,29 \text{ s}$$

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$= 0 + \frac{1}{2}(9,8)(1,29)^2 \checkmark$$

$$\Delta y = 8,15 \text{ m}$$

Height/Hoogte **XC = XB + BC**

$$(30 + 8,15) = 38,15 \text{ m} \checkmark$$

Upward motion as positive

Opwaartse beweging as positief

$$v_B = v_X + a\Delta t \checkmark$$

$$-12,65 = 0 + (-)9,8\Delta t \checkmark$$

$$\Delta t = 1,29 \text{ s}$$

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$= 0 + \frac{1}{2}(-9,8)(1,29)^2 \checkmark$$

$$\Delta y = -8,15 \text{ m}$$

Height/Hoogte **XC = XB + BC**

$$(-30) + (-8,15) = 38,15 \text{ m} \checkmark$$

Notes / Aantekeninge

Start with time for XB

Begin met tyd vir XB

Accept/Aanvaar

g or/of a

$$v = u + at$$

$$v^2 = u^2 + 2as$$

$$s = ut + \frac{1}{2}at^2$$

(5)

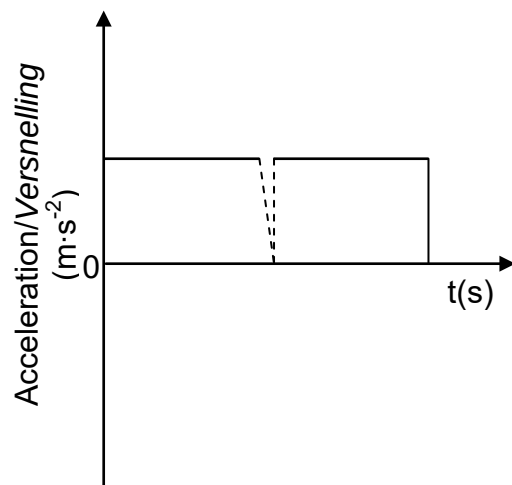
OPTION 3/OPSIE 3 Positive marking from QUESTION 3.2.1 Positiewe nasien vanaf VRAAG 3.2.1 Downward motion as positive Afwaartse beweging as positief $v_C = v_B + a\Delta t \checkmark$ $= 12,65 + 9,8 (1,5) \checkmark$ $= 27,35 \text{ m}\cdot\text{s}^{-1}$ $v_C^2 = v_x^2 + 2a\Delta y \checkmark$ $(27,35)^2 = 0 + 2(9,8) \Delta y \checkmark$ $\therefore \Delta y = 38,16 \text{ m}$ Height is /Hoogte is 38,16 m ✓ Upward motion as positive Opwaartse beweging as positief $v_C = v_B + a\Delta t \checkmark$ $= -12,65 + (-9,8) (1,5) \checkmark$ $= -27,35 \text{ m}\cdot\text{s}^{-1}$ $v_C^2 = v_x^2 + 2a\Delta y \checkmark$ $(-27,35)^2 = 0 + 2(-9,8) \Delta y \checkmark$ $\therefore \Delta y = -38,16 \text{ m}$ Height/Hoogte = 38,16m ✓	Notes / Aantekeninge start with velocity at C Accept/Aanvaar g or/of a $v = u + at$ $v^2 = u^2 + 2as$ The height must be written down in order to score the final mark. Die hoogte moet neergeskryf word om die finale punt te kry.
OPTION 4/OPSIE 4 Positive marking from QUESTION 3.2.1 Positiewe nasien vanaf VRAAG 3.2.1 $\Delta U + \Delta K = 0 \checkmark$ $(mgh + 0) \checkmark = 0 + (\frac{1}{2} m(12,65)^2) \checkmark$ $h = 8,16 \text{ m} \checkmark$ $XC = h + 30$ $= (30 + 8,16)$ $= 38,16 \text{ m} \checkmark$	Notes / Aantekeninge Accept/Aanvaar $mgh_i + \frac{1}{2} mv_i^2 = mgh_f + \frac{1}{2} mv_f^2$ Take point B as the zero position and $XH = h$ Neem punt B is nul posisie en $XH = h$

(5)

(5)

3.3

OPTION 1/OPSIE 1

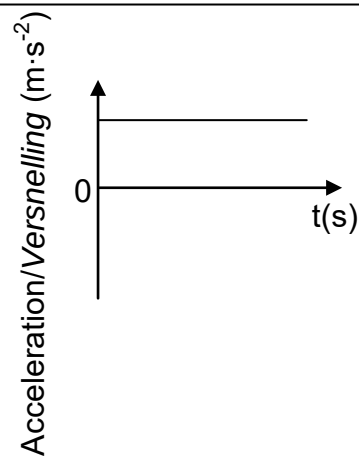


Notes / Aantekeninge

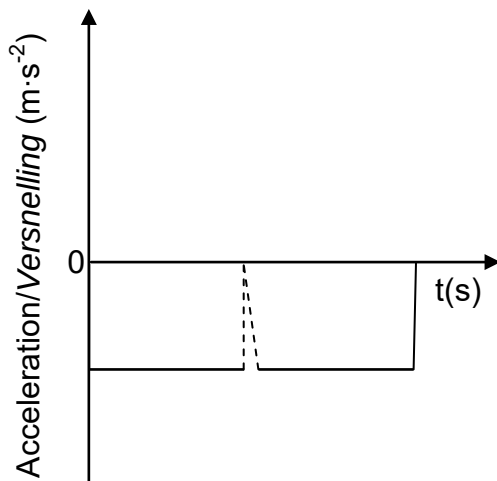
Criteria/Kriteria	Mark/Punt
For each line correctly drawn as shown <i>Vir elke lyn korrek geteken soos getoon</i>	✓✓
Both axes correctly labelled <i>Beide asse korrek benoem</i>	✓

Accept/Aanvaar

Only 2 marks for this answer/Slegs 2 punte vir hierdie antwoord



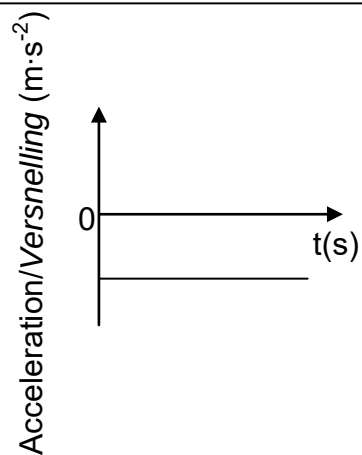
OPTION 2/OPSIE 2



Notes / Aantekeninge

Criteria/Kriteria	Mark/Punt
For each line correctly drawn as shown <i>Vir elke lyn korrek geteken soos getoon</i>	✓✓
Both axes correctly labelled <i>Beide asse korrek benoem</i>	✓

Only 2 marks for this answer/Slegs 2 punte vir hierdie antwoord



(3)
[13]

QUESTION 4/VRAAG 4

4.1	$W_{\text{net}} = \Delta K$ $W_{\text{net}} = \frac{1}{2} (M + m)(v_f^2 - v_i^2)$ $W_{\text{fr}} = f \Delta x \cos \theta \checkmark = \frac{1}{2} (M + m)(v_f^2 - v_i^2)$ $\frac{10 \times 2 \cos 180^\circ \checkmark = \frac{1}{2} (7,02)(0 - v_i^2) \checkmark}{v_{\text{bb}} = 2,39 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (2,387) \text{ m} \cdot \text{s}^{-1}}$	Notes / Aantekeninge 1 mark for either of the formulae indicated 1 punt vir enige van die formule aangedui Accept/Aanvaar $W_{\text{nc}} = \Delta K + \Delta U$ with $\Delta U = 0$	(5)
4.2	The total linear momentum of an (isolated) closed system remains constant. <u>Die totale lineêre momentum in 'n geslote (geïsoleerde) sisteem bly konstant</u> ACCEPT/AANVAAR <u>In an isolated system the total momentum before collision equals the total momentum after collision.</u> <u>In 'n (geïsoleerde) geslote sisteem is die totale momentum voor botsing gelyk aan die totale momentum na botsing.</u>	Notes/Aantekeninge 2 or/of 0	(2)
4.3.	Positive marking from QUESTION 4.1 Positiewe nasien vanaf VRAAG 4.1 $\Sigma p_i = \Sigma p_f \checkmark$ $m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$ $0,02 v_i + (7)(0) = (7,02)(2,39)$ $0,02 v_i \checkmark = 7,02 (2,39) \checkmark$ $v_i = 838,89 \text{ m} \cdot \text{s}^{-1} \checkmark$	Notes / Aantekeninge Accept/Aanvaar $(m_1 + m_2) v_i = m_1 v_{1f} + m_2 v_{2f}$ 837,84 $\text{m} \cdot \text{s}^{-1}$ (for learners working with 2,387 $\text{m} \cdot \text{s}^{-1}$/vir leerders wat met 2,387 $\text{m} \cdot \text{s}^{-1}$ werk)	(4) [11]

QUESTION 5/VRAAG 5

5.1 $\Delta U + \Delta K = 0 \checkmark$
 $(5)(9,8)(5) + 0 \checkmark + (0 + \frac{1}{2}(5v_f^2)) \checkmark = 0$
 $v_f = \sqrt{2 \times 9,8 \times 5}$
 $= 9,90 \text{ m} \cdot \text{s}^{-1} \checkmark (9,899 \text{ m} \cdot \text{s}^{-1})$

Notes / Aantekeninge

Accept/Aanvaar

$$Mgh_i + \frac{1}{2} Mv_i^2 = Mgh_f + \frac{1}{2} Mv_f^2$$

(4)

5.2 No friction/zero resultant force $\checkmark$ so there is no loss in energy. $\checkmark$ /Only conservative forces present./Mechanical energy is conserved
Geen wrywing/nul resulterende krag dus is daar geen verlies in energie nie/
Slegs konserwatiewe kragte is teenwoordig./Meganiiese energie bly behoue

(2)

5.3 A force for which the work done is path dependent. $\checkmark \checkmark$
'n Krag waarvoor arbeid verrig afhanklik van die pad gevolg is

Notes / Aantekeninge

Accept/Aanvaar

A force which does not conserve mechanical energy./'n Krag wat nie meganiiese energie behoue laat bly nie.

(2)

5.4

OPTION 1/OPSIE 1

$$W_{nc} = \Delta U + \Delta K \checkmark$$

$$F \Delta x \cos \theta = \Delta U + \Delta K$$

$$(18 \Delta x \cos 180^\circ) = (5) (9,8) (3 - 0) \checkmark + \frac{1}{2} (5) (0 - 9,90^2) \checkmark$$

$$\Delta x = 5,4458 \text{ m} \checkmark$$

$$\theta = \sin^{-1} \frac{3}{5,4458} \checkmark$$

$$\theta = 33,43^\circ \checkmark$$

OPTION 2/OPSIE 2

$$W_{net} = W_f + W_G \checkmark$$

$$W_{net} = f \Delta x \cos \theta + mg \sin \theta \Delta x \cos \theta$$

$$= [(18) \Delta x \cos 180^\circ] + 5 (9,8) \frac{3}{\Delta x} (\Delta x) \cos 180^\circ \checkmark$$

$$= -18\Delta x - 147$$

$$W_{net} = \Delta K \checkmark$$

$$\Delta K = \frac{1}{2} (5) (0 - 9,90^2) \checkmark$$

$$= -245,025$$

$$-18\Delta x - 147 = -245,025$$

$$\Delta x = 5,4458 \text{ m} \checkmark$$

$$\theta = \sin^{-1} \frac{3}{5,4458} \checkmark$$

$$\theta = 39,43^\circ \checkmark$$

(7)
[15]

QUESTION 6/VRAAG 6

6.1.1 $v = f\lambda$ ✓

$$\lambda = \frac{340}{520}$$

$$= 0,65 \text{ m}$$
 ✓

(2)

6.1.2

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$$
 ✓

$$f_L = \frac{340}{(340 - 15)} (520)$$
 ✓

$$f_L = 544 \text{ Hz}$$

$$v = f\lambda$$

$$\lambda = \frac{340}{544}$$
 ✓

$$= 0,63 \text{ m}$$
 ✓

Notes / Aantekeninge

Accept/Aanvaar

$$f_L = \frac{v}{v - v_s} f_s$$

(6)

6.2 The wavelength in QUESTION 6.1.2 is shorter because the waves are compressed as they approach the observer. ✓ ✓

Die golflengte in VRAAG 6.1.2 is korter omdat die golwe saamgedruk word soos hulle die waarnemer nader.

(2)

6.3 The red shift occurs when the spectrum of a distant star moving away from the earth is shifted toward the red end of the spectrum. ✓ ✓

Rooi verskuiwings vind plaas wanneer die spektrum van 'n vêr afgeleë ster wat vanaf die aarde wegbeweeg na die rooi end van die spektrum skuif.

(2)

[12]

QUESTION 7/VRAAG 7

- 7.1 The net electrostatic force on a charged particle due to the presence of another charged particle is directly proportional to the product of the charges✓ and inversely proportional to the square of the distance between them (their centres) ✓

Die netto elektrostatische krag op 'n gelaaide deeltjies as gevolg van die teenwoordigheid van 'n ander gelaaide deeltjie is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle (hul middelpunte)

OR/OF

The force of attraction or repulsion between two point charges is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between them. ✓

Die aantrekkings- of afstotingskrag tussen twee puntladings is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.

OR/OF

Any two charged particles will exert an electrostatic force on each other where the force is directly proportional to the product of the charges and inversely proportional to the square of the distance between the charged particles. (their centres)

Enige twee gelaaide deeltjies sal 'n elektrostatische krag op mekaar uitoefen waar die krag direk eweredig is aan die produk van die ladings en omgekeerd eweredig is aan die kwadraat van die afstand tussen hulle (tussen hul middelpunte)

(2)

7.2
7.2.1 $F = \frac{KQ_1Q_2}{r^2}$,

$1,44 \times 10^{-1} = \frac{(9 \times 10^9)Q^2}{(0,5)^2}$ ✓

$Q = 2 \times 10^{-6} \text{ C}$ ✓

(4)

7.2.2 Positive marking from QUESTION 7.2.1

Positiewe nasien vanaf VRAAG 7.2.1

$Q = ne$ ✓

$2 \times 10^{-6} = n(1,6 \times 10^{-19})$ ✓

$n = 1,25 \times 10^{13} \text{ electrons/elektrone}$ ✓

(3)

7.3

7.3.1 Left /Links (west/wes) ✓

(1)

7.3.2 Take right as positive/Neem regs as positief

$$E_{\text{net}} = E_A + E_B \checkmark$$

$$(3 \times 10^4) = - \frac{(9 \times 10^9)(2 \times 10^{-6})}{(1,5)^2} + \frac{(9 \times 10^9)Q_{\text{final}}}{(1)^2} \checkmark$$

$$Q_{\text{final}} = 4,22 \times 10^{-6} \text{ C} \checkmark$$

$$Q = ne$$

$$4,22 \times 10^{-6} = n(1,6 \times 10^{-19}) \checkmark$$

$$n_f = 2,64 \times 10^{13} \text{ electrons/elektrone} \checkmark$$

electrons removed/elektrone verwyder

$$= (2,64 \times 10^{13} + 1,25 \times 10^{13}) \checkmark$$

$$= 3,89 \times 10^{13} \text{ electrons/elektrone} \checkmark$$

Notes / Aantekeninge

No. electrons should be removed = $n_f - n_i$
allocate the 1 mark for the subtraction

Aantal elektrone wat verwyder moet word = $n_f - n_i$
Ken 1 punt toe vir aftrekking

(8)

[18]

QUESTION 8/VRAAG 8

8.1.1 Ensure that the wires have:/Maak seker dat die drade

The same length/dieselfde lengte het. ✓

The same thickness/cross-sectional area/dieselfde dikte/deursnit-area/oppervlakte het ✓

(2)

8.1.2 Wire A (Resistor A)/Draad A ✓

$$R = \frac{\Delta V}{\Delta I} \checkmark$$

$$R_A = \frac{4,4}{0,4} \checkmark = 11 \Omega \checkmark$$

$$R_B = \frac{2,2}{0,4} \checkmark = 5,5 \Omega \checkmark$$

$$E = I^2 R \Delta t \checkmark$$

Accept any correct coordinates chosen from the graph
Aanvaar enige korrekte koördinate van die grafiek gekies.

For the same time and current, the heating in A will be higher because its resistance is higher than that of B. ✓

Vir dieselfde tyd en stroom, sal die verwarming in A hoër wees omdat sy weerstand groter is as die van B.

ACCEPT/AANVAAR: $P = I^2 R$

For the same current, the heat produced per unit time in A will be higher because its resistance is higher than that of B. ✓

Vir dieselfde stroom, sal die hitte vrygestel per eenheidstyd in A hoër wees omdat sy weerstand groter is as die van B.

(8)

8.2.1	OPTION 1/OPSIE 1 $I_{5,5\Omega} : I_{11\Omega}$ $2 : 1$ $I_{5,5\Omega} = (0,2)(2) \checkmark \checkmark$ $= 0,4 \text{ A} \checkmark$	OPTION 2/OPSIE 2 $V = IR$ $V_{11\Omega} = 0,2 \times 11$ $= 2,2 \text{ V} \checkmark$ $V_{5,5} = V_{11} = 2,2 \text{ V} \checkmark$ $I_{5,5} = \frac{2,2}{5,5}$ $= 0,4 \text{ A} \checkmark$	(3)

8.2.2	OPTION 1/OPSIE 1 $V = IR$ $I_{\text{tot}} = (0,4 + 0,2) \checkmark$ $= 0,6 \text{ A}$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots \checkmark$ $\frac{1}{R_p} = \frac{1}{11} + \frac{1}{5,5} \checkmark$ $R_p = 3,67 \Omega$ $R_T = R_p + R_A$ $= 3,67 + 11 \checkmark$ $= 14,67 \Omega$ $\mathcal{E} = I(R + r) \checkmark$ $9 = 0,6(14,67 + r) \checkmark$ $r = 0,33 \Omega \checkmark$	Notes / Aantekeninge Accept/Aanvaar $R_p = \frac{R_1 R_2}{R_1 + R_2} \checkmark$ $= \frac{11 \times 5,5}{11 + 5,5} \checkmark$ $= 3,67 \Omega$	(7)

OPTION 2/OPSIE 2 $I_{\text{tot}} = (0,4 + 0,2) \checkmark$ $= 0,6 \text{ A}$ $V_{\text{ext}} = V_{11\Omega} + V_{//} \checkmark$ $= [I_{\text{tot}} (R_{11}) + 2,2]$ $= 0,6 (11) \checkmark + 2,2$ $= 8,8 \text{ V} \checkmark$ $\mathcal{E} = V_{\text{ext}} + I_{\text{tot}}(r) \checkmark$ $9 = 8,8 + 0,6r \checkmark$ $r = 0,33 \Omega \checkmark$

8.2.3	Decrease/Afneem $\checkmark$ The total resistance increases $\checkmark$ / Die totale weerstand neem toe	(2)

[22]

QUESTION 9/VRAAG 9

9.1.1

<u>OPTION 1/OPSIE 1</u> $P_{av} = \frac{V_{rms}^2}{R} \checkmark$ $100 \checkmark = \frac{\left(\frac{340}{\sqrt{2}}\right)^2}{R} \checkmark$ $R = 578 \, \Omega \checkmark$	<u>Notes / Aantekeninge</u> Assume correct formula for V_{rms} and give a mark if the substitution is correct 1 mark <i>Aanvaar die korrekte formule vir V_{wgk} en ken 'n punt toe indien die vervanging korrek is.</i>
<u>OPTION 2/OPSIE 2</u> $V_{rms} = \frac{V_{max}}{\sqrt{2}} = \frac{340}{\sqrt{2}} \checkmark = 240,04$ $P_{ave} = \frac{V_{rms}^2}{R} \checkmark$ $100 \checkmark = \frac{240,04^2}{R} \checkmark$ $R = 578 \, \Omega \checkmark$	

(5)

9.1.2

<u>OPTION 1/OPSIE 1</u> $P_{av} = I_{rms} V_{rms} \checkmark$ $100 = I_{rms} \frac{340}{\sqrt{2}} \checkmark$ $I_{rms} = \frac{100}{\frac{340}{\sqrt{2}}} \checkmark$ $= 0,417 \, A \checkmark$	<u>OPTION 2/OPSIE 2</u> $V_{rms} = I_{rms} R \checkmark$ $\frac{340}{\sqrt{2}} = I_{rms} (578) \checkmark$ $I_{rms} = 0,417 \, A \checkmark$

(3)

9.2

Can be stepped up or down/ can be transmitted with less power loss.
 Kan verhoog of verlaag word/ kan versend word met minder energie verlies.

(1)

[9]

QUESTION 10/VRAAG 10

- 10.1 The minimum energy needed to emit an electron ✓ from (the surface of) a metal. ✓

Die minimum energie benodig om 'n elektron uit die (oppervlak van) 'n metaal vry te stel.

(2)

10.2

$$\left. \begin{aligned} E &= W_0 + \frac{1}{2}mv_{\max}^2 \\ h\frac{c}{\lambda} &= W_0 + \frac{1}{2}mv_{\max}^2 \end{aligned} \right\} \text{Any ONE OF/ENIGE EEN van} \checkmark$$

$$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{(\lambda)} = (3,36 \times 10^{-19}) + 2,32 \times 10^{-19} \checkmark$$

$$\lambda = 3,50 \times 10^{-7} \text{ m} \checkmark$$

(4)

- 10.3 **POSITIVE MARKING FROM QUESTION 10.2**
POSITIEWE NASIEN VANAF VRAAG 10.2

$$\left. \begin{aligned} E &= W_0 + \frac{1}{2}mv_{\max}^2 \\ \text{OR/OF} \\ h\frac{c}{\lambda} &= W_0 + \frac{1}{2}mv_{\max}^2 \end{aligned} \right\} \checkmark \quad \checkmark$$

$$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{(3,50 \times 10^{-7})} = (3,65 \times 10^{-19}) + E_k$$

$$E = 2,03 \times 10^{-19} \text{ J} \checkmark$$

(4)

- 10.4.1 Increasing the intensity does not change the energy/ frequency/wavelength of the incident photons ✓ / The energy of a photon remains unchanged (for the same frequency).

Verhoging van die intensiteit, verander nie die energie/frekwensie/golflengte van die invallende fotone nie / Die energie van die foton bly onveranderd (vir dieselfde frekwensie).

(1)

- 10.4.2 Increases. / *Neem toe* ✓

(1)

- 10.4.3 More photons (packets of energy) strike the surface of the metal per unit time ✓ hence more (photo) electrons ejected per unit time ✓ (leading to increased current).

Meer fotone (energie pakkies) tref die oppervlakte van die metaal per eenheidstyd, gevolglik word meer (foto)elektrone per eenheidstyd vrygestel (wat lei tot 'n verhoogde stroom).

(2)

[14]

TOTAL/TOTAAL: 150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

NOVEMBER 2014

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 20 pages.
*Hierdie memorandum bestaan uit 20 bladsye.***

QUESTION 1/VRAAG 1

- 1.1 A ✓✓ (2)
- 1.2 A ✓✓ (2)
- 1.3 D ✓✓ (2)
- 1.4 C ✓✓ (2)
- 1.5 B ✓✓ (2)
- 1.6 C ✓✓ (Accept/ Aanvaar R) (2)
- 1.7 A ✓✓ (2)
- 1.8 D ✓✓ (2)
- 1.9 A ✓✓ (2)
- 1.10 C ✓✓ (2)
- [20]**

QUESTION 2/VRAAG 2

- 2.1 When a resultant (net) force acts on an object, the object will accelerate in the direction of the force. This acceleration is directly proportional to the force✓ and inversely proportional to the mass of the object.✓

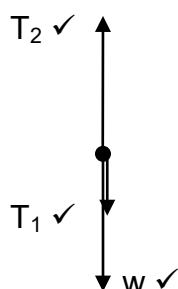
Wanneer 'n resulterende (netto) krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Hierdie versnelling is direk eweredig aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

OR/OF

The net force acting on an object is equal to the rate of change of momentum ✓✓ of the object (in the direction of the force). (2 or 0)

Die netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering in momentum van die voorwerp (in die rigting van die krag).(2 of 0) (2)

2.2



(3)

2.3

OPTION 1/OPSIE 1

$$F_{\text{net}} = ma \checkmark$$

For 5 kg block/Vir 5 kg-blok

$$T_2 + (-mg) + (-T_1) = ma$$

$$250 - (5)(9,8) - T_1 \checkmark = 5a \checkmark$$

$$201 - T_1 = 5a$$

$$T_1 = 201 - 5a \dots\dots(1)$$

For 20 kg block/Vir 20 kg-blok

$$T_1 + (-mg) = ma \dots\dots(2)$$

$$T_1 + [-20(9,8)] \checkmark = 20a$$

$$5 = 25a$$

$$a = 0,2 \text{ m} \cdot \text{s}^{-2} \text{ upwards/opwaarts}$$

$$\therefore T_1 = 201 - 5(0,2) \checkmark$$

$$= 200 \text{ N} \checkmark$$

$$\text{OR/OF } T_1 = 20(9,8) + 20(0,2) \checkmark$$

$$= 200 \text{ N} \checkmark$$

(6)

OPTION 2/OPSIE 2

$$F_{\text{net}} = ma \checkmark$$

For 5 kg block/Vir 5 kg-blok

$$T_2 + (-mg) + (-T_1) = ma$$

$$250 - (5)(9,8) - T_1 \checkmark = 5a \checkmark$$

$$201 - T_1 = 5a$$

$$T_1 = 201 - 5a \dots\dots(1)$$

For 20 kg block/Vir 20 kg-blok ,

$$T_1 + (-mg) = ma \dots\dots(2)$$

$$T_1 + [-20(9,8)] \checkmark = 20a$$

$$(1) \times 4 : 4T_1 = 804 - 20a$$

$$\therefore T_1 - 196 = 804 - 4T_1 \checkmark$$

$$\therefore 5T_1 = 1000$$

$$\therefore T_1 = 200 \text{ N} \checkmark$$

(6)

OPTION 3/OPSIE 3

$$F_{\text{net}} = ma \checkmark$$

For 5 kg block/Vir 5 kg-blok

$$T_2 + (-mg) + (-T_1) = ma$$

$$250 - (5)(9,8) - T_1 \checkmark = 5 a \checkmark$$

$$201 - T_1 = 5 a$$

$$T_1 = 201 - 5a \dots \dots (1)$$

$$\therefore a = \frac{201 - T_1}{5}$$

For 20 kg block/Vir 20 kg-blok ,

$$T_1 + (-mg) = ma \dots \dots (2)$$

$$T_1 + [-(20)(9,8)] \checkmark = 20a$$

$$\therefore T_1 - 196 = 20\left(\frac{201 - T_1}{5}\right) \checkmark$$

$$\therefore T_1 = 200 \text{ N} \checkmark$$

(6)

2.4 Q $\checkmark$

(1)

[12]

QUESTION 3/VRAAG 3

- 3.1 An object moving / Motion under the influence of gravity / weight / gravitational force only (and there are no other forces such as friction). $\checkmark \checkmark$ (2 or/of 0)
(*'n Voorwerp wat / Beweging slegs onder die invloed van swaartekrag / gewig / gravitasiekrag (en daar is geen ander kragte soos wrywing nie).*) (2)

3.2

OPTION 1/OPSIE 1

Upwards positive/Opwaarts positief:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$0 \checkmark = \underline{15 \Delta t + \frac{1}{2} (-9,8) \Delta t^2} \checkmark$$

$$\Delta t = 3,06 \text{ s}$$

It takes/Dit neem 3,06 s $\checkmark$

Downwards positive/Afwaarts positief:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$0 \checkmark = \underline{-15 \Delta t + \frac{1}{2} (9,8) \Delta t^2} \checkmark$$

$$\Delta t = 3,06 \text{ s}$$

It takes/Dit neem 3,06 s $\checkmark$

(4)

OPTION 2/OPSIE 2

Upwards positive/Opwaarts positief:

$$v_f = v_i + a \Delta t \checkmark$$

$$0 \checkmark = \underline{15 + (-9,8) \Delta t} \checkmark$$

$$\Delta t = 1,53 \text{ s}$$

It takes (2)(1,53) = 3,06 s $\checkmark$

Downwards positive/Afwaarts positief:

$$v_f = v_i + a \Delta t \checkmark$$

$$0 \checkmark = \underline{-15 + (9,8) \Delta t} \checkmark$$

$$\Delta t = 1,53 \text{ s}$$

It takes/Dit neem 3,06 s $\checkmark$

(4)

OPTION 3 / OPSIE 3

Upwards positive/Opwaarts positief:

$$v_f = v_i + a \Delta t \checkmark$$

$$-15 \checkmark = \underline{15 + (-9,8) \Delta t} \checkmark$$

$$\Delta t = 3,06 \text{ s} \checkmark$$

Downwards positive/Afwaarts positief:

$$v_f = v_i + a \Delta t \checkmark$$

$$15 \checkmark = \underline{-15 + (9,8) \Delta t} \checkmark$$

$$\Delta t = 3,06 \text{ s} \checkmark$$

(4)

<u>OPTION 4/OPSIE 4</u> Upwards positive/Opwaarts positief: $F_{\text{net}} \Delta t = \Delta p \checkmark$ $mg \Delta t = m (v_f - v_i)$ $\Delta t = \frac{(0 - 15) \checkmark}{-9,8 \checkmark}$ $\Delta t = 1,53 \text{ s}$ It takes/Dit neem (2)(1,53s) = 3,06 s ✓	Downwards positive /Afwaarts positief: $F_{\text{net}} \Delta t = \Delta p \checkmark$ $mg \Delta t = m (v_f - v_i)$ $\Delta t = \frac{0 - (-15) \checkmark}{9,8 \checkmark}$ $\Delta t = 1,53 \text{ s}$ It takes/Dit neem (2)(1,53s) = 3,06 s ✓	(4)
<u>OPTION 5/OPSIE 5</u> Upwards positive/Opwaarts positief: $F_{\text{net}} \Delta t = \Delta p \checkmark$ $mg \Delta t = m (v_f - v_i)$ $\Delta t = \frac{-15 - (15) \checkmark}{-9,8 \checkmark}$ $= 3,06 \text{ s} \checkmark$	Downwards positive/Afwaarts positief: $F_{\text{net}} \Delta t = \Delta p \checkmark$ $mg \Delta t = m (v_f - v_i)$ $\Delta t = \frac{15 - (-15) \checkmark}{9,8 \checkmark}$ $\Delta t = 3,06 \text{ s} \checkmark$	
<u>OPTION 5/OPSIE 6</u> Upwards positive/Opwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ For ball A/Vir bal A $0 = (15)^2 + 2 (-9,8)\Delta y \checkmark$ $\Delta y_A = 11,48 \text{ m}$ $\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t$ $11,48 = \left(\frac{15 + 0}{2} \right) \Delta t \checkmark$ $\Delta t = 1,53 \text{ s}$ It takes/Dit neem (2)(1,53s) = 3,06 s ✓	Downwards positive/Afwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ For ball A/Vir bal A $0 = (-15)^2 + 2 (9,8)\Delta y \checkmark$ $\Delta y_A = -11,48 \text{ m}$ $\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t$ $-11,48 = \left(\frac{-15 + 0}{2} \right) \Delta t \checkmark$ $\Delta t = 1,53 \text{ s}$ It takes/Dit neem (2)(1,53s) = 3,06 s ✓	

3.3

<u>OPTION 1/OPSIE 1</u> Upwards positive/Opwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ ✓ For ball A/Vir bal A $0 = (15)^2 + 2(-9,8)\Delta y$ ✓ $\Delta y_A = 11,48 \text{ m}$ <u>When A is at highest point</u> <u>Wanneer A op hoogste punt is</u> $\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= 0 + \frac{1}{2}(-9,8)(1,53)^2$ ✓ ✓ $\Delta y_B = -11,47 \text{ m}$ $\Delta y_B = 11,47 \text{ m downward/afwaarts}$ Distance/Afstand = $y_A + y_B$ $= 11,47 + 11,48$ ✓ $= 22,95 \text{ m}$ ✓	Downwards positive/Afwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ ✓ For ball A/Vir bal A $0 = (-15)^2 + 2(9,8)\Delta y$ ✓ $\Delta y_A = -11,48 \text{ m}$ <u>When A is at highest point</u> <u>Wanneer A op hoogste punt is</u> $\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= 0 + \frac{1}{2}(9,8)(1,53)^2$ ✓ ✓ $\Delta y_B = 11,47 \text{ m}$ $\Delta y_B = 11,47 \text{ m downward/afwaarts}$ Distance/Afstand = $y_A + y_B$ $= 11,48 + 11,47$ ✓ $= 22,95 \text{ m}$ ✓
<u>OPTION 2/OPSIE 2</u> Upwards positive/Opwaarts positief: <u>At maximum height $v_f = 0$:</u> <u>By maksimum hoogte $v_f = 0$:</u> Ball/Bal A $\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= 15(1,53) + \frac{1}{2}(-9,8)(1,53)^2$ ✓ $= 11,48 \text{ m}$ <u>When A is at highest/point</u> <u>Wanneer A op hoogste punt is</u> $\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= 0 + \frac{1}{2}(-9,8)(1,53)^2$ ✓ ✓ $\Delta y_B = -11,47 \text{ m}$ $\Delta y_B = 11,47 \text{ m downward/afwaarts}$ Distance/Afstand = $y_A + y_B$ $= 11,48 + 11,47$ ✓ $= 22,95 \text{ m}$ ✓	Downwards positive/Afwaarts positief: <u>At maximum height $v_f = 0$:</u> <u>By maksimum hoogte $v_f = 0$:</u> Ball/Bal A $\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= (-15)(1,53) + \frac{1}{2}(9,8)(1,53)^2$ ✓ $= -11,48 \text{ m}$ <u>When A is at highest point</u> <u>Wanneer A by hoogste punt is</u> $\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= 0 + \frac{1}{2}(-9,8)(1,53)^2$ ✓ ✓ $\Delta y_B = -11,47 \text{ m}$ $\Delta y_B = 11,47 \text{ m downward/afwaarts}$ Distance/Afstand = $(y_A + y_B)$ $= 11,48 + 11,47$ ✓ $= 22,95 \text{ m}$ ✓

(7)

OPTION 3/OPSIE 3

Upwards positive/Opwaarts positief:

Ball A/Bal A

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$\Delta y_A = 15(1,53) \checkmark + \frac{1}{2} (-9,8) (1,53)^2 \checkmark$$

$$= 11,48 \text{ m}$$

For ball B/Vir bal B

$$v_f = v_i + a \Delta t$$

$$v_f = 0 + (-9,8)(1,53)$$

$$v_f = 14,99 \text{ m} \cdot \text{s}^{-1}$$

$$v_f^2 = v_i^2 + 2a \Delta x$$

$$14,99^2 \checkmark = 0 + 2(-9,8) \Delta y_B \checkmark$$

$$\Delta y_B = -11,47 \text{ (m)}$$

$$= 11,47 \text{ m downward/afwaarts}$$

$$\text{Distance/Afstand} = (y_A + y_B)$$

$$= 11,48 + 11,47 \checkmark$$

$$= 22,95 \text{ m} \checkmark$$

Downwards positive/Afwaarts positief:

Ball A/Bal A

$$y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$\Delta y_A = -15(1,53) \checkmark + \frac{1}{2} (9,8) (1,53)^2 \checkmark$$

$$= -11,48 \text{ (m)}$$

$$= 11,48 \text{ m upward/opwaarts}$$

For ball B/Vir bal B

$$v_f = v_i + a \Delta t$$

$$v_f = 0 + (9,8)(1,53)$$

$$v_f = 14,99 \text{ m} \cdot \text{s}^{-1}$$

$$v_f^2 = v_i^2 + 2a \Delta x$$

$$14,99^2 \checkmark = 0 + 2(9,8) \Delta y_B \checkmark$$

$$\Delta y_B = 11,47 \text{ (m)}$$

$$\text{Distance/Afstand} = (y_A + y_B)$$

$$= 11,48 + 11,47 \checkmark$$

$$= 22,95 \text{ m} \checkmark$$

(7)

OPTION 4/OPSIE 4

Upwards positive/Opwaarts positief:

Ball A/Bal A

$$\Delta y_A = \frac{v_i + v_f}{2} \Delta t \checkmark = \frac{(15 + 0) \checkmark}{2} (1,53) \checkmark$$

$$= 11,48 \text{ m}$$

For ball B/Vir bal B

$$v_f = v_i + a \Delta t$$

$$= 0 + (-9,8) (1,53)$$

$$= -15 \text{ m} \cdot \text{s}^{-1}$$

$$\Delta y = \frac{v_i + v_f}{2} \Delta t = \frac{(0 - 15) \times 1,53 \checkmark}{2}$$

$$= -11,47 \text{ m}$$

$$= 11,47 \text{ m downward/afwaarts}$$

$$\text{Distance/Afstand} = (y_A + y_B)$$

$$= 11,48 + 11,47 \checkmark$$

$$= 22,95 \text{ m} \checkmark$$

Downwards positive/Afwaarts positief:

Ball A/Bal A

$$\Delta y_A = \frac{v_i + v_f}{2} \Delta t \checkmark = \frac{(-15 + 0) \checkmark}{2} (1,53) \checkmark$$

$$= -11,48 \text{ (m)}$$

$$= 11,48 \text{ m upwards/opwaarts}$$

$$v_f = v_i \Delta t + a \Delta t$$

$$= 0 + (9,8) (1,53)$$

$$= 15 \text{ m} \cdot \text{s}^{-1}$$

$$\Delta y = \frac{v_i + v_f}{2} \Delta t = \frac{(0 + 15) \times 1,53 \checkmark}{2}$$

$$= 11,47 \text{ m}$$

$$\text{Distance/Afstand} = y_A + y_B$$

$$= 11,48 + 11,47 \checkmark$$

$$= 22,95 \text{ m} \checkmark$$

(7)

OPTION 5/OPSIE 5**Upwards positive/Opwaarts positief:**

Ball A/Bal A

$$W_{\text{net}} = \Delta K \checkmark$$

OR/OF

$$\frac{1}{2} m (v_f^2 - v_i^2) = mg(h_f - h_i) \cos \theta$$

$$\frac{1}{2} m (0 - 15^2) \checkmark = m(9,8)h_f \cos 180^\circ \checkmark$$

$$h = 11,48 \text{ m}$$

OR/OF

For Ball B when A is at highest point./
Vir Bal B wanneer A by sy hoogste punt is.

$$v_f = v_i + a\Delta t$$

$$= 0 + (-9,8)(1,53) = -15 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = \frac{v_i + v_f}{2} \Delta t = \frac{(0 - 15) \times 1,53}{2} \checkmark$$

$$= -11,48 \text{ m}$$

$$= 11,48 \text{ m downward/afwaarts}$$

$$\text{Distance/Afstand} = y_A + y_B$$

$$= 11,48 + 11,48 \checkmark$$

$$= 22,96 \text{ m} \checkmark$$

Downwards positive/Afwaarts positief:

Ball A/Bal A

$$W_{\text{net}} = \Delta K \checkmark$$

OR/OF

$$\frac{1}{2} m (v_f^2 - v_i^2) = mg(h_f - h_i) \cos \theta$$

$$\frac{1}{2} m (0 - 15^2) \checkmark = m(9,8)h_f \cos 180^\circ \checkmark$$

$$h = 11,48 \text{ m}$$

OR/OF

For Ball B when A is at highest point./
Vir Bal B wanneer A by sy hoogste punt is.

$$v_f = v_i + a\Delta t$$

$$= 0 + (9,8)(1,53) = 15 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = \frac{v_i + v_f}{2} \Delta t = \frac{(0 + 15)(1,53)}{2} \checkmark$$

$$= 11,48 \text{ m downward/afwaarts}$$

$$\text{Distance/Afstand} = y_A + y_B$$

$$= 11,48 + 11,48 \checkmark$$

$$= 22,96 \text{ m} \checkmark$$

(7)

OPTION 7/OPSIE 7**Upwards positive/Opwaarts positief:**

Ball A

$$\frac{1}{2} m v_i^2 + mgh_i = \frac{1}{2} m v_f^2 + mgh_f \checkmark$$

$$\frac{1}{2} m (15^2) \checkmark + 0 = \frac{1}{2} m (0) + m(9,8)h \checkmark$$

$$h = 11,48 \text{ m}$$

OR/OF

For Ball B when A is at highest point.
Vir Bal B wanneer A by sy hoogste punt is.

$$v_f = v_i + a\Delta t$$

$$= 0 + (-9,8)(1,53)$$

$$= -15 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = \frac{v_i + v_f}{2} \Delta t$$

$$= \frac{(0 - 15)(1,53)}{2} \checkmark$$

$$= -11,48 \text{ m}$$

$$= 11,48 \text{ m downward/afwaarts}$$

$$\text{Distance/Afstand} = y_A + y_B$$

$$= 11,48 + 11,48 \checkmark$$

$$= 22,96 \text{ m} \checkmark$$

Downwards positive/Afwaarts positief:

Ball A

$$\frac{1}{2} m v_i^2 + mgh_i = \frac{1}{2} m v_f^2 + mgh_f \checkmark$$

$$\frac{1}{2} m (15^2) \checkmark + 0 = \frac{1}{2} m (0) + m(9,8)h \checkmark$$

$$h = 11,48 \text{ m}$$

OR/OF

For Ball B when A is at highest point.
Vir Bal B wanneer A by sy hoogste punt is.

$$v_f = v_i + a\Delta t$$

$$= 0 + (9,8)(1,53)$$

$$= 15 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = \frac{v_i + v_f}{2} \Delta t$$

$$= \frac{(0 + 15)(1,53)}{2} \checkmark$$

$$= 11,48 \text{ m downward/afwaarts}$$

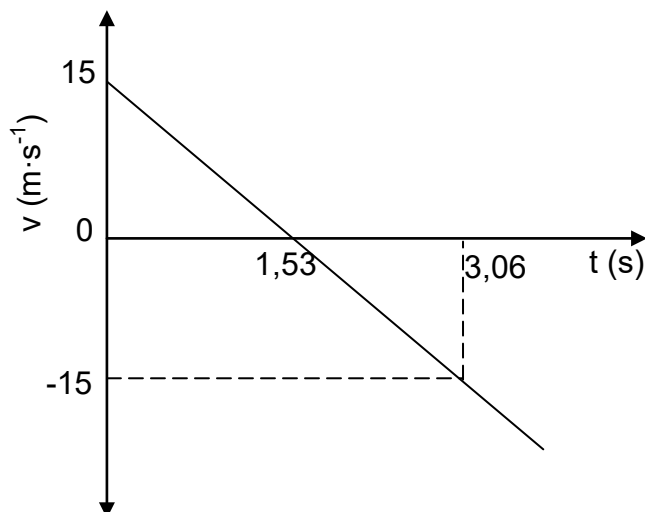
$$\text{Distance/Afstand} = y_A + y_B$$

$$= 11,48 + 11,48 \checkmark$$

$$= 22,96 \text{ m} \checkmark$$

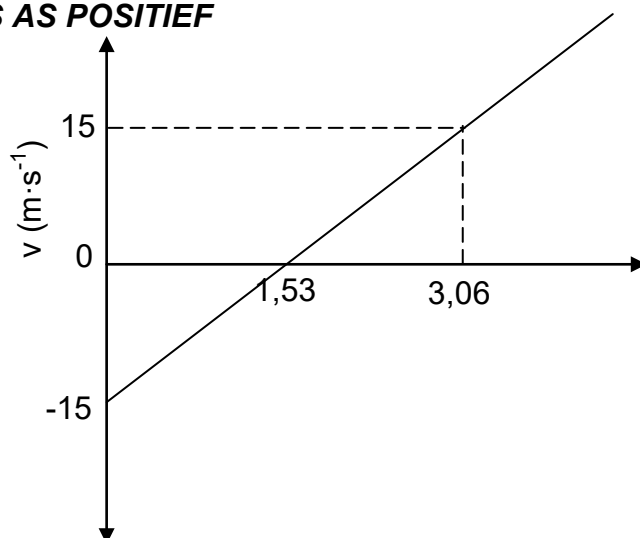
(7)

3.4



(4)
[17]

**CONSIDER MOTION DOWNWARD AS POSITIVE/BESKOU BEWEGING
AFWAARTS AS POSITIEF**



Criteria/Kriteria	Marks/Punte
Graph starts at correct Initial velocity shown./Grafiek begin by korrekte beginsnelheid aangetoon.	✓
Time for maximum height shown (1,53 s)./Tyd vir maksimum hoogte aangetoon.(1,53 s)	✓
Time for return shown (3,06 s) /Tyd om terug te keer (3,06) aangetoon.	✓
Shape/Vorm: Straight line extending beyond 3,06 s/ Reguitlyn wat verby 3,06 s strek.	✓

(4)
[17]

QUESTION 4/VRAAG 4

4.1 $p = mv$ ✓
 $= 50(5)$ ✓
 $= 250 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$ ✓ (downward/afwaarts)

OR/OF

$p = mv$ ✓
 $= 50(-5)$ ✓
 $= -250 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$
 $= 250 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$ ✓ (downward/afwaarts) (3)

4.2 The product of the (net) force and the time interval (during which the force acts)✓✓ (2 or 0)
Die produk van die (netto) krag en die tydinterval (waartydens die krag inwerk) (2 of 0). (2)

4.3 **OPTION 1/OPSIE 1**

$\Delta p = F_{\text{net}} \Delta t$ ✓ $0 - 250 \checkmark = F_{\text{net}}(0,2)$ $F_{\text{net}} = -1\,250 \text{ N}$ $= 1\,250 \text{ N}$ ✓	$\Delta p = F_{\text{net}} \Delta t$ ✓ $250 - 0 \checkmark = F_{\text{net}}(0,2)$ $F_{\text{net}} = 1\,250 \text{ N}$ ✓	$\Delta p = F_{\text{net}} \Delta t$ ✓ $50(0 - (-5)) \checkmark = F_{\text{net}}(0,2)$ $F_{\text{net}} = 1\,250 \text{ N}$ ✓

(3)

OPTION 2/OPSIE 2

$m(v_f - v_i) = F_{\text{net}} \Delta t$ ✓ $50(0 - 5) \checkmark = F_{\text{net}}(0,2)$ $F_{\text{net}} = -1\,250 \text{ N}$ $= 1\,250 \text{ N}$ ✓	$m(v_f - v_i) = F_{\text{net}} \Delta t$ ✓ $50(5 - 0) \checkmark = F_{\text{net}}(0,2)$ $F_{\text{net}} = 1\,250 \text{ N}$ ✓

(3)

OPTION 3/OPSIE 3

$v_f = v_i + a \Delta t$ $0 = 5 + a(0,2)$ ✓ $a = -25 \text{ m} \cdot \text{s}^{-2}$ $F_{\text{net}} = ma$ ✓ $= 50(-25)$ $= -1\,250 \text{ N}$ $= 1\,250 \text{ N}$ ✓	$v_f = v_i + a \Delta t$ $5 = 0 + a(0,2)$ ✓ $a = 25 \text{ m} \cdot \text{s}^{-2}$ $F_{\text{net}} = ma$ ✓ $= 50(25)$ $= 1\,250 \text{ N}$ ✓

(3)

4.4 Greater than/Groter as✓ (1)

4.5 For the same momentum change, ✓
the stopping time (contact time) ✓ will be smaller (less) ✓
∴ the (upward) force exerted (on her) is greater.
Vir dieselfde verandering in momentum,
sal die stilhoutyd (kontaktyd) kleiner wees
∴ die (opwaartse)krag wat (op haar) uitgeoefen word, sal groter wees. (3)
[12]

QUESTION 5/VRAAG 5

5.1.1 In an isolated/closed system, ✓ the total mechanical energy is conserved / remains constant ✓
In 'n geïsoleerde/geslote sisteem bly die totale meganiese energie behoue / bly konstant.

OR/OF

The total mechanical energy of a system is conserved/ remains constant ✓ in the absence of friction.✓

Die totale meganiese energie van 'n sisteem bly behoue/bly konstant in die afwesigheid van wrywing.

OR/OF

The total mechanical energy of a system remains constant ✓ provided the net work done by external non conservative forces is zero.✓

Die totale meganiese energie van 'n sisteem bly konstant, mits die arbeid verrig deur eksterne nie-konserwatiewe kragte, nul is.

OR/OF

In the absence of a non-conservative force, the total mechanical energy is conserved/remains constant

In die afwesigheid van 'n nie-konserwatiewe krag, bly die totale meganiese energie behoue / konstant

OR/OF

In an isolated/closed system, ✓ the sum of kinetic and gravitational potential energy is conserved / remains constant ✓

In 'n geïsoleerde/geslote sisteem bly som van kinetiese en gravitasionele potensiële energie behoue / bly konstant.

5.1.2 No/Nee✓ (1)

5.1.3	<u>OPTION 1/OPSIE 1</u> <table border="1"> <thead> <tr> <th>Along AB/Langs AB</th><th>Along AB/Langs AB</th></tr> </thead> <tbody> <tr> <td> $E_{\text{mechanical at A}} = E_{\text{mechanical at B}}$ $(E_p + E_k)_A = (E_p + E_k)_B$ $(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_B$ $(10)(9,8)(4) + 0 = 0 + \frac{1}{2}(10)v_f^2$ $v_f = 8,85 \text{ m} \cdot \text{s}^{-1}$ </td><td> $W_{\text{net}} = \Delta E_k$ $F_g \Delta h \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2)$ $(10)(9,8)(4) \cos 0^\circ = \frac{1}{2}(10)(v_f^2 - 0)$ $v_f = 8,85 \text{ m} \cdot \text{s}^{-1}$ </td></tr> </tbody> </table>	Along AB/Langs AB	Along AB/Langs AB	$E_{\text{mechanical at A}} = E_{\text{mechanical at B}}$ $(E_p + E_k)_A = (E_p + E_k)_B$ $(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_B$ $(10)(9,8)(4) + 0 = 0 + \frac{1}{2}(10)v_f^2$ $v_f = 8,85 \text{ m} \cdot \text{s}^{-1}$	$W_{\text{net}} = \Delta E_k$ $F_g \Delta h \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2)$ $(10)(9,8)(4) \cos 0^\circ = \frac{1}{2}(10)(v_f^2 - 0)$ $v_f = 8,85 \text{ m} \cdot \text{s}^{-1}$
Along AB/Langs AB	Along AB/Langs AB				
$E_{\text{mechanical at A}} = E_{\text{mechanical at B}}$ $(E_p + E_k)_A = (E_p + E_k)_B$ $(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_B$ $(10)(9,8)(4) + 0 = 0 + \frac{1}{2}(10)v_f^2$ $v_f = 8,85 \text{ m} \cdot \text{s}^{-1}$	$W_{\text{net}} = \Delta E_k$ $F_g \Delta h \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2)$ $(10)(9,8)(4) \cos 0^\circ = \frac{1}{2}(10)(v_f^2 - 0)$ $v_f = 8,85 \text{ m} \cdot \text{s}^{-1}$				

(6)

Along **AB/Langs AB**

$$W_{nc} = \Delta K + \Delta U \checkmark$$

$$0 = \frac{1}{2} (10)(v_f^2 - 0) + 10(9,8)(4 - 0) \checkmark$$

$$v_f = 8,85 \text{ m} \cdot \text{s}^{-1}$$

Substitute $8,85 \text{ m} \cdot \text{s}^{-1}$ in one of the following options

Vervang $8,85 \text{ m} \cdot \text{s}^{-1}$ in een van die volgende opsies

Along **BC/Langs BC**

$$W_{net} = \Delta K \checkmark$$

$$f \Delta x \cos \theta = \Delta K$$

$$\underline{f(8) \cos 180^\circ \checkmark = \frac{1}{2} (10)(0 - 8,85^2) \checkmark}$$

$$f = 48,95 \text{ N} \checkmark$$

Along **BC/Langs BC**

$$W_{nc} = \Delta K + \Delta U \checkmark$$

$$f \Delta x \cos \theta = \Delta K + \Delta U$$

$$\underline{f(8) \cos 180^\circ \checkmark = \frac{1}{2} (10)(0 - 8,85^2) + 0 \checkmark}$$

$$f = 48,95 \text{ N} \checkmark \text{ (Accept/ Aanvaar 49 N)}$$

OPTION 2/OPSIE 2

Along **AC/Langs AC**

$$W_{nc} = \Delta K + \Delta U \checkmark$$

$$f \Delta x \cos \theta = \Delta K + \Delta U$$

$$(f)(8) \checkmark (\cos 180^\circ) \checkmark = (0 - 0) \checkmark + 10 (9,8)(0 - 4) \checkmark$$

$$f = 49 \text{ N} \checkmark$$

(6)

5.2.1

$$f_k = \mu_k N \checkmark$$

$$= \mu_k mg \cos \theta$$

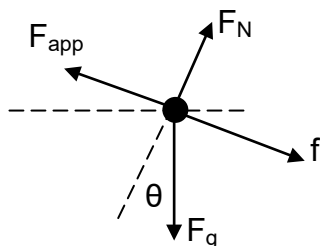
$$= \underline{(0,19)(300)(9,8) \cos 25^\circ \checkmark}$$

$$= 506,26 \text{ N} \checkmark$$

(3)

5.2.2

OPTION 1/OPSIE 1



$$F_{net} = 0$$

$$\underline{F_{app} + (-F_g \sin \theta) + (-f) = 0} \checkmark$$

$$F_{app} - (300)(9,8) \sin 25^\circ \checkmark - 506,26 \checkmark = 0$$

$$F_{app} = 1\,748,76 \text{ N}$$

$$P_{ave} = F v_{ave} \checkmark$$

$$= 1748,76 \times 0,5 \checkmark$$

$$= 874,38 \text{ W} \checkmark$$

(6)

OPTION 2/OPSIE 2

$$W_f + W_{app} + W_N + W_g = 0 \checkmark$$

$$F \Delta x \cos \theta + F_{app} \Delta x \cos \theta + 0 + F_g \Delta x \cos \theta = 0$$

$$(506,26 \Delta x \cos 180^\circ) \checkmark + (F_{app} \Delta x \cos 0) + 300(9,8) \Delta x \cos 115^\circ \checkmark = 0$$

$$F_{app} = 1748,76 \text{ N}$$

$$P_{ave} = F v_{ave} \checkmark$$

$$= (1748,76) (0,5) \checkmark$$

$$= 874,38 \text{ W} \checkmark$$

(6)

OPTION 3/OPSIE 3

$$W_f + W_{app} + W_N + W_g = 0 \checkmark$$

$$F \Delta x \cos \theta + F_{app} \Delta x \cos \theta + 0 + F_g \sin \theta \Delta x \cos \theta = 0$$

$$(506,26 \Delta x \cos 0) \checkmark + (F_{app} \Delta x \cos 0) + 300 (9,8) \sin 25^\circ \Delta x \cos 180^\circ \checkmark = 0$$

$$F_{app} = 1748,76 \text{ N}$$

$$P_{ave} = F v_{ave} \checkmark$$

$$= (1748,76) (0,5) \checkmark$$

$$= 874,38 \text{ W} \checkmark$$

(6)

[18]

QUESTION 6/VRAAG 6

- 6.1.1 An (apparent) change in observed/detected frequency (pitch), (wavelength) ✓ as a result of the relative motion between a source and an observer ✓ (listener).
'n Skynbare verandering in waargenome frekwensie (toonhoogte), (golflengte) as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/luisteraar. (2)

- 6.1.2 Towards/Na✓

Observed/detected frequency is greater than the actual frequency.✓

Waargenome frekwensie is groter as die werklike frekwensie.

(2)

- 6.1.3 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ **OR/OF** $f_L = \frac{v}{v - v_s} f_s \checkmark$

$$(1200) \checkmark = \frac{343}{343 - v_s} \checkmark 1130 \checkmark$$

$$v_s = 20,01 \text{ m} \cdot \text{s}^{-1} \checkmark$$

Accept/Aanvaar: (19,42 – 20,01 m·s⁻¹)

(5)

- 6.2 The star is approaching the earth. ✓

Die ster nader die aarde.

OR/OF

The earth and the star are approaching (moving towards) each other.✓

Die aarde en die ster nader mekaar.

The spectral lines in diagram 2 are shifted towards the blue end/blue shifted.✓

Die spektrumlyne in diagram 2 het verskuif na die blou ent/blou verskuiwing

(2)

[11]

QUESTION 7/VRAAG 7

- 7.1 To ensure that charge does not leak to the ground/insulated. ✓
Om te verseker dat die lading nie na die grond toe lek nie/isoleer. (1)

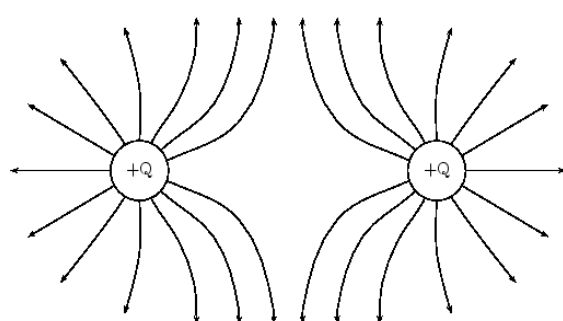
Notes/Aantekeninge

Accept/Aanvaar

In order retain original charge✓/To insulate the charges./ Om oorspronklike lading te behou/ Om lading te isoleer.

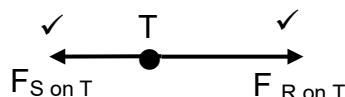
- 7.2 Net charge/Netto lading = $\frac{Q_R + Q_S}{2} = \frac{+8 + (-4)}{2} \checkmark = 2 \mu\text{C} \checkmark$ (2)

7.3



Criteria for sketch:/Kriteria vir skets:	Marks/ Punte
Correct direction of field lines Korrekte rigting van veldlyne	✓
Shape of the electric field Vorm van elektrieseveld	✓
No field line crossing each other / No field lines inside the spheres/ Geen veldlyne wat mekaar kruis nie / Geen veldlyne binne sfeer nie	✓

7.4



(3)

(2)

7.5

OPTION 1/OPSIE 1

$$F = k \frac{Q_1 Q_2}{r^2} \checkmark$$

$$F_{ST} = (9 \times 10^9) \frac{(1 \times 10^{-6})(2 \times 10^{-6})}{(0,2)^2} \checkmark = 0,45 \text{ N} / 4,5 \times 10^{-1} \text{ N left/links}$$

OR/OF

$$F_{TS} = \frac{1}{4} F_{RT} = \frac{1}{4} (1,8) = 0,45 \text{ N}$$

$$F_{RT} = 9 \times 10^9 \times \frac{(2 \times 10^{-6})(1 \times 10^{-6})}{(0,1)^2} \checkmark = 1,8 \text{ N right/regs}$$

OR/OF

$$F_{RT} = 4F_{ST} = 4(0,45) = 1,8 \text{ N right /regs}$$

$$F_{\text{net}} = F_{ST} + F_{RT} = 1,8 + (-0,45) \checkmark \\ = 1,35 \text{ N or towards sphere S / na sfeer or/of right/regs S} \checkmark$$

(6)

OPTION 2/OPSIE 2

$$E_R = \frac{kQ}{r^2} = \frac{(9 \times 10^9)(2 \times 10^{-6})}{(0,1)^2} \checkmark = 1,8 \times 10^6 \text{ N}\cdot\text{C}^{-1} \text{ right/regs}$$

$$E_s = \frac{kQ}{r^2} = \frac{(9 \times 10^9)(2 \times 10^{-6})}{(0,2)^2} \checkmark = 4,5 \times 10^5 \text{ N}\cdot\text{C}^{-1} \text{ left/links}$$

$$E_{\text{net}} = 1,8 \times 10^6 - 4,5 \times 10^5 \checkmark = 1,35 \times 10^6 \text{ N}\cdot\text{C}^{-1} \text{ right/regs}$$

$$F = EQ \checkmark = (1,35 \times 10^6)(1 \times 10^{-6}) \checkmark \\ = \underline{1,35 \text{ N towards sphere S / na sfeer S right/regs}} \checkmark$$

(6)

- 7.6 Force experienced $\checkmark$ per unit positive charge $\checkmark$ placed at that point.
Krag ondervind per eenheid positiewe lading by daardie punt.

(2)

7.7

OPTION 1/OPSIE 1

$$E = \frac{F}{q} \checkmark = \frac{1,35}{1 \times 10^{-6}} \checkmark = 1,35 \times 10^6 \text{ N}\cdot\text{C}^{-1} \checkmark$$

(3)

OPTION 2/OPSIE 2

$$E_R = \frac{kQ}{r^2} \checkmark = \frac{(9 \times 10^9)(2 \times 10^{-6})}{(0,1)^2} \checkmark = 1,8 \times 10^6 \text{ N}\cdot\text{C}^{-1} \text{ right/regs}$$

$$E_s = \frac{kQ}{r^2} = \frac{(9 \times 10^9)(2 \times 10^{-6})}{(0,2)^2} = 4,5 \times 10^5 \text{ N}\cdot\text{C}^{-1} \text{ left/links}$$

$$E_{\text{net}} = 1,8 \times 10^6 - 4,5 \times 10^5 = 1,35 \times 10^6 \text{ N}\cdot\text{C}^{-1} \checkmark$$

(3)

OPTION 3/OPSIE 3

$$E = \frac{F}{q} \checkmark = \frac{1,8}{1 \times 10^{-6}} \checkmark = 1,8 \times 10^6 \text{ N}\cdot\text{C}^{-1}$$

$$E = \frac{F}{q} = \frac{0,45}{1 \times 10^{-6}} = 4,5 \times 10^5 \text{ N}\cdot\text{C}^{-1}$$

$$E_{\text{net}} = 1,8 \times 10^6 - 4,5 \times 10^5 = 1,35 \times 10^6 \text{ N}\cdot\text{C}^{-1} \checkmark$$

(3)

[19]

QUESTION 8/VRAAG 8

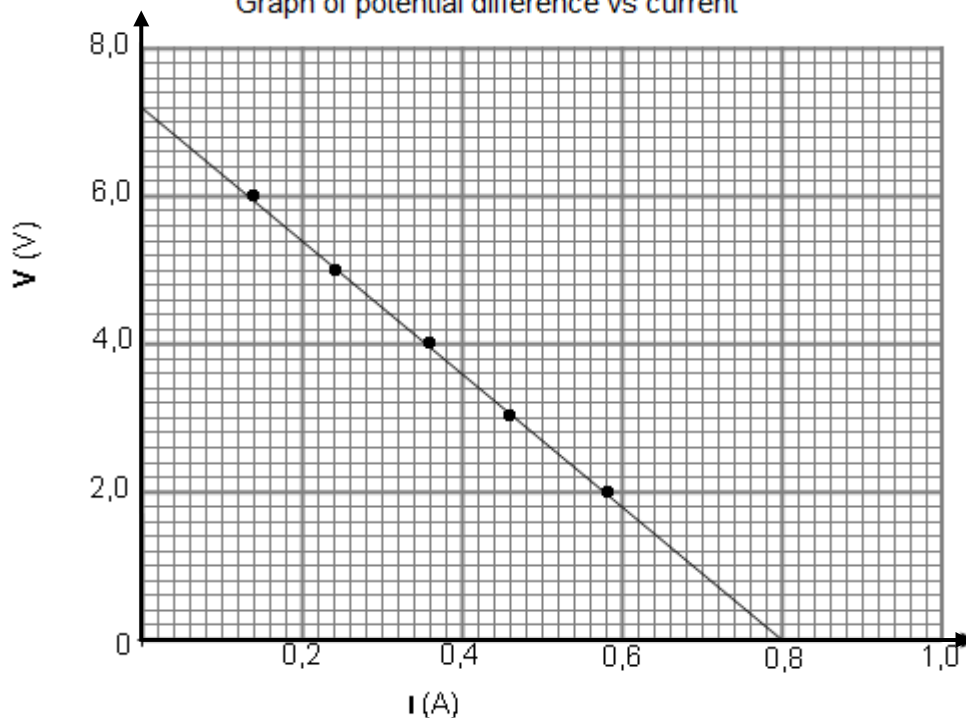
8.1.1 Keep the temperature (of battery) constant.
Hou die temperatuur (van battery) konstant

(1)

8.1.2

Grafiek van potensiaalverskil teenoor stroom

Graph of potential difference vs current



Criteria for drawing line of best fit: <i>Kriteria vir teken van lyn van beste pas:</i>	Marks/ Punte
ALL points correctly plotted (at least 4 points) <i>ALLE punte korrek gestip (ten minste 4 punte)</i>	✓✓
Correct line of best fit if all plotted points are used (at least 3 point) <i>Korrekte lyn van beste pas indien alle punte gebruik word (ten minste 3 punte)</i>	✓

(3)

8.1.3 7,2 V✓

(Accept any readings between 7,0 V and 7,4 V or the value of the y-intercept
Aanvaar enige lesing tussen 7,0 V en 7,4 V of die waarde van die y-afsnit

(1)

8.1.4

$$\begin{aligned}
 \text{Slope/Helling} &= \frac{\Delta V}{\Delta I} \\
 &= \frac{0 - 7,2}{0,8 - 0} = -9 \\
 r &= 9 \, \Omega
 \end{aligned}$$

(3)

8.2.1

OPTION 1/OPSIE 1

$$P = VI \checkmark$$

$$100 = 20(I) \checkmark$$

$$I = 5 \text{ A} \checkmark$$

(3)

OPTION 2/OPSIE 2

$$P = \frac{V^2}{R} \checkmark$$

$$100 = \frac{(20)^2}{R}$$

$$R = 4 \Omega$$

$$V = IR$$

$$20 = I(4) \checkmark$$

$$I = 5 \text{ A} \checkmark$$

(3)

OPTION 3/OPSIE 3

$$P = \frac{V^2}{R} \checkmark$$

$$100 = \frac{(20)^2}{R}$$

$$R = 4 \Omega$$

$$P = I^2 R$$

$$100 = I^2(4) \checkmark$$

$$I = 5 \text{ A} \checkmark$$

8.2.2

OPTION 1/OPSIE 1

$$P = \frac{V^2}{R} \checkmark$$

$$R = \frac{(20)^2}{150} \checkmark$$

$$= 2,67 \Omega \checkmark$$

(3)

OPTION 2/OPSIE 2

$$P = VI \checkmark$$

$$150 = (20)I$$

$$I = 7,5 \text{ A}$$

$$V = IR$$

$$20 = (7,5)R \checkmark$$

$$R = 2,67 \Omega \checkmark$$

OR/OF

$$P = I^2 R$$

$$150 = (7,5)^2 R \checkmark$$

$$R = 2,67 \Omega \checkmark$$

(3)

OPTION 3/OPSIE 3

$$I_X : I_Y$$

$$5 : 7,5$$

$$1 : 1,5$$

$$R_X : R_Y$$

$$1,5 : 1 \checkmark$$

$$4 \checkmark : 2,67 \Omega \checkmark$$

(3)

8.2.3

OPTION 1/OPSIE 1

$$P = VI$$

OR/OF $P = I^2 R$

$$I_{150W} = \frac{150}{20} \checkmark = 7,5 \text{ A}$$

$$I_{150W} = \sqrt{\frac{150}{2,67}} \checkmark = 7,5 \text{ A}$$

$$I_{\text{tot}} = (5 + 7,5) \checkmark$$

$$\mathcal{E} = I(R + r) \checkmark$$

$$24 = 12,5(R + r)$$

$$24 = V_{\text{ext}} + V_{\text{ir}}$$

$$24 = 20 + 12,5(r) \checkmark$$

$$r = 0,32 \Omega \checkmark$$

(5)

OPTION 2/OPSIE 2

$$V = Ir \checkmark$$

$$I_{\text{tot}} = (5 + 7,5) \checkmark$$

$$(24 - 20) \checkmark = 12,5 r \checkmark$$

$$\therefore r = \frac{4}{12,5}$$

$$r = 0,32 \Omega \checkmark$$

(5)

OPTION 3/OPSIE 3

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_{//}} = \frac{1}{4} + \frac{1}{2,67} \quad \text{OR/OF } R_{//} = \frac{(4)(2,67)}{4 + 2,67}$$

$$\therefore R_{//} = 1,6 \Omega$$

$$I_{\text{tot}} = \frac{20}{1,6} = 12,5 \text{ A} \checkmark$$

$$\mathcal{E} = I(R + r) \checkmark$$

$$24 = 12,5(R + r)$$

$$24 = V_{\text{ext}} + V_{\text{ir}}$$

$$24 = 20 + 12,5(r) \checkmark$$

$$r = 0,32 \Omega \checkmark$$

(5)

OPTION 4/OPSIE 4

$$P = VI \checkmark$$

$$250 = (20)I \checkmark$$

$$I = 12,5 \text{ A}$$

$$V = Ir \checkmark$$

$$4 = (12,5)r \checkmark$$

$$r = 0,32 \Omega \checkmark$$

(5)

- 8.2.4 Device Z is a voltmeter $\checkmark$.
Toestel Z is 'n voltmeter

(1)

- 8.2.5 Device Z should be a voltmeter (or a device with very high resistance) because it has a very high resistance $\checkmark$ and will draw very little current. $\checkmark$
The current through X and Y will remain the same hence the device can operate as rated.
Toestel Z moet 'n voltmeter wees (of 'n toestel met 'n baie hoë weerstand) omdat dit 'n baie hoë weerstand het en baie min sal stroom trek
Die stroom deur X en Y sal dieselfde bly, gevolglik kan die toestel werk soos ontwerp.

(2)

[22]

QUESTION 9/VRAAG 9

- 9.1 Electromagnetic induction / *Elektromagnetiese induksie* $\checkmark$

(1)

- 9.2 Rotate the coil faster/Increase the number of coils/ Increase the strength of the magnetic field.
Roteer die spoel vinniger/Verhoog die aantal spoele / Verhoog die sterkte van die magneetveld.

(1)

- 9.3 Slip rings/*Sleepringe* $\checkmark$

(1)

- 9.4.1 It is the value of the voltage in a DC circuit $\checkmark$ that will have the same heating effect as an AC circuit. $\checkmark$
Dit is die waarde van die potensiaalverskil in 'n GS-stroombaan $\checkmark$ *wat dieselfde verhittingseffek het as 'n WS-stroombaan* $\checkmark$

(2)

- 9.4.2
$$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$$

$$= \frac{339,45}{\sqrt{2}} \checkmark$$

$$V_{\text{rms}} = 240,03 \text{ V} \checkmark$$

(3)

[8]

QUESTION 10/VRAAG 10

- 10.1 The minimum frequency (of a photon/light) needed to emit electrons ✓ from (the surface of) a metal. (substance) ✓
 Die minimum frekwensie (van 'n foton/lig) benodig om elektrone vanaf die (oppervlakte van)'n metaal (stof) vry te stel. (2)

10.2 OPTION 1/OPSIE 1

$$E = W_o + E_{k(max)}$$

$$E = W_o + \frac{1}{2}mv_{max}^2$$

$$h\frac{c}{\lambda} = hf_0 + \frac{1}{2}mv_{max}^2$$

$$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{\lambda} = (6,63 \times 10^{-34})(5,548 \times 10^{14}) + \frac{1}{2}(9,11 \times 10^{-31})(5,33 \times 10^5)^2$$

$$\lambda = 4 \times 10^{-7} \text{ m}$$

OPTION 2/OPSIE 2

$$E = W_o + E_{k(max)}$$

$$E = W_o + \frac{1}{2}mv_{max}^2$$

$$hf = hf_0 + \frac{1}{2}mv_{max}^2$$

$$(6,63 \times 10^{-34})f = (6,63 \times 10^{-34})(5,548 \times 10^{14}) + \frac{1}{2}(9,11 \times 10^{-31})(5,33 \times 10^5)^2$$

$$f = 7,5 \times 10^{14} \text{ Hz}$$

$$c = f\lambda$$

$$3 \times 10^8 = (7,5 \times 10^{14})\lambda$$

$$\lambda = 4 \times 10^{-7} \text{ m}$$

- 10.3 Smaller (less) than ✓
 Kleiner (minder) as

- 10.4 The wavelength/frequency/energy of the incident light (photon/hf) is constant ✓.
 Die golflengte/frekwensie/energie van die invallende lig (foton/hf) is konstant

Since the speed is larger, the kinetic energy is larger ✓ the work function/ W_o /threshold frequency smaller. ✓

Aangesien die spoed vergroot, is die kinetiese energie groter, is die arbeidsfunksie / W_o / drumpel frekwensie kleiner

(3)
 [11]

GRAND TOTAL/GROOTTOTAAL: 150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

FEBRUARY/MARCH 2014/FEBRUARIE/MAART 2014

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 20 pages.
*Hierdie memorandum bestaan uit 20 bladsye.***

Learning Outcomes and Assessment Standards Leeruitkomst en Assesseringstandaarde		
LO/LU 1	LO/LU 2	LO/LU 3
AS 12.1.1: Design, plan and conduct a scientific inquiry to collect data systematically with regard to accuracy, reliability and the need to control variables. <i>Ontwerp, beplan en voer 'n wetenskaplike ondersoek uit om data te versamel ten opsigte van akkuraatheid, betroubaarheid en die kontroleer van veranderlikes.</i> AS 12.1.2: Seek patterns and trends, represent them in different forms, explain the trends, use scientific reasoning to draw and evaluate conclusions, and formulate generalisations. <i>Soek patrone en tendense, stel dit in verskillende vorms voor, verduidelik tendense, gebruik wetenskaplike beredenering om gevolgtrekkings te maak en te evalueer, en formuleer veralgemenings.</i> AS 12.1.3: Select and use appropriate problem-solving strategies to solve (unseen) problems. <i>Kies en gebruik geskikte probleemoplossingsstrategieë om (ongesiene) probleme op te los.</i> AS 12.1.4: Communicate and defend scientific arguments with clarity and precision. <i>Kommunikeer en verdedig wetenskaplike argumente duidelik en presies.</i>	AS 12.2.1: Define, discuss and explain prescribed scientific knowledge. <i>Definieer, bespreek en verduidelik voorgeskrewe wetenskaplike kennis.</i> AS 12.2.2: Express and explain prescribed scientific principles, theories, models and laws by indicating the relationship between different facts and concepts in own words. <i>Verduidelik en druk voorgeskrewe wetenskaplike beginsels, teorieë, modelle en wette uit deur die verwantskap tussen verskillende feite konsepte in eie woorde aan te dui.</i> AS 12.2.3: Apply scientific knowledge in everyday life contexts. <i>Pas wetenskaplike kennis in kontekste van die alledaagse lewe toe.</i>	AS 12.3.1: Research, discuss, compare and evaluate scientific and indigenous knowledge systems and knowledge claims by indicating the correlation among them, and explain the acceptance of different claims. <i>Doen navorsing, bespreek, vergelyk en evalueer wetenskaplike en inheemse kennissisteme en kennisaansprake deur die ooreenkoms aan te dui en verduidelik die aanvaarding van verskillende aansprake.</i> AS 12.3.2: Research case studies and present ethical and moral arguments from different perspectives to indicate the impact (pros and cons) of different scientific and technological applications. <i>Vors gevallestudies na en lewer etiese en morele argumente uit verskillende perspektiewe om die impak (voordele en nadele) van verskillende wetenskaplike en tegnologiese toepassings aan te dui.</i> AS 12.3.3: Evaluate the impact of scientific and technological research and indicate the contribution to the management, utilisation and development of resources to ensure sustainability continentally and globally. <i>Evalueer die impak van wetenskaplike en tegnologiese navorsing en dui die bydrae tot bestuur, benutting en ontwikkeling van bronne om volhoubaarheid kontinentaal en globaal te verseker.</i>

GENERAL GUIDELINES/ALGEMENE RIGLYNE

1. CALCULATIONS/BEREKENINGE

- 1.1 **Marks will be awarded for:** correct formula, correct substitution, correct answer with unit.
***Punte sal toegeken word vir:** korrekte formule, korrekte substitusie, korrekte antwoord met eenheid.*
- 1.2 **No marks will be awarded if an incorrect or inappropriate formula is used,** even though there may be relevant symbols and applicable substitutions.
***Geen punte sal toegeken word waar 'n verkeerde of ontoepaslike formule gebruik word nie,** selfs al is daar relevante simbole en relevante substitusies.*
- 1.3 When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.
*Wanneer 'n fout gedurende **substitusie in 'n korrekte formule** begaan word, sal 'n punt vir die korrekte formule en vir korrekte substitusies toegeken word, maar **geen verdere punte** sal toegeken word nie.*
- 1.4 If **no formula** is given, but **all substitutions are correct**, a candidate will **forfeit one mark**.
*Indien **geen formule** gegee is nie, maar **al die substitusies is korrek**, **verloor die kandidaat een punt**.*
- 1.5 **No penalisation if zero substitutions are omitted** in calculations where **correct formula/principle** is given correctly.
***Geen penalisering** indien **nulwaardes nie getoon word nie** in berekeninge waar die **formule/beginsel korrek gegee is nie**.*
- 1.6 Mathematical manipulations and change of subject of appropriate formulae carry no marks, but if a candidate starts off with the correct formula and then changes the subject of the formula incorrectly, marks will be awarded for the formula and the correct substitutions. The mark for the incorrect numerical answer is forfeited.
Wiskundige manipulasies en verandering van die onderwerp van toepaslike formules tel geen punte nie, maar indien 'n kandidaat met die korrekte formule begin en dan die onderwerp van die formule verkeerd verander, sal punte vir die formule en korrekte substitusies toegeken word. Die punt vir die verkeerde numeriese antwoord word verbeur.
- 1.7 Marks are only awarded for a formula if a **calculation has been attempted**, i.e. substitutions have been made or a numerical answer given.
Punte word slegs vir 'n formule toegeken indien 'n poging tot 'n berekening aangewend is, d.w.s. substitusies is gedoen of 'n numeriese antwoord is gegee.
- 1.8 Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.
Punte kan slegs toegeken word vir substitusies wanneer waardes in formule ingestel is en nie vir waardes wat voor 'n berekening gelys is nie.

- 1.9 All calculations, when not specified in the question, must be done to a minimum of two decimal places.
Alle berekenings, wanneer nie in die vraag gespesifiseer word nie, moet tot 'n minimum van twee desimale plekke gedoen word.
- 1.10 If a final answer to a calculation is correct, full marks will not automatically be awarded. Markers will always ensure that the correct/appropriate formula is used and that workings, including substitutions, are correct.
Indien 'n finale antwoord van 'n berekening korrek is, sal volpunte nie outomaties toegeken word nie. Nasieners sal altyd verseker dat die korrekte/toepaslike formule gebruik word en dat bewerkings, insluitende substitusies korrek is.
- 1.11 Questions where a series of calculations have to be made (e.g. a circuit diagram question) do not necessarily always have to follow the same order. FULL MARKS will be awarded provided it is a valid solution to the problem. However, any calculation that will not bring the candidate closer to the answer than the original data, will not count any marks.
Vrae waar 'n reeks berekenings gedoen moet word (bv. 'n stroomdiagramvraag) hoef nie noodwendig dieselfde volgorde te hê nie. VOLPUNTE sal toegeken word op voorwaarde dat dit 'n geldige oplossing vir die probleem is. Enige berekening wat egter nie die kandidaat nader aan die antwoord as die oorspronklike data bring nie, sal geen punte tel nie.

2. UNITS/EENHEDE

- 2.1 Candidates will only be penalised once for the repeated use of an incorrect unit **within a question**.
Kandidate sal slegs een keer gepenaliseer word vir die herhaaldelike gebruik van 'n verkeerde eenheid in 'n vraag.
- 2.2 Units are only required in the final answer to a calculation.
Eenhede word slegs in die finale antwoord op 'n vraag verlang.
- 2.3 Marks are only awarded for an answer, and not for a unit *per se*. Candidates will therefore forfeit the mark allocated for the answer in each of the following situations:
- Correct answer + wrong unit
- Wrong answer + correct unit
- Correct answer + no unit
Punte word slegs vir 'n antwoord en nie vir 'n eenheid per se toegeken nie. Kandidate sal derhalwe die punt vir die antwoord in die volgende gevalle verbeur:
- Korrekte antwoord + verkeerde eenheid
- Verkeerde antwoord + korrekte eenheid
- Korrekte antwoord + geen eenheid
- 2.4 SI units must be used except in certain cases, e.g. $V \cdot m^{-1}$ instead of $N \cdot C^{-1}$, and $cm \cdot s^{-1}$ or $km \cdot h^{-1}$ instead of $m \cdot s^{-1}$ where the question warrants this.
SI-eenhede moet gebruik word, behalwe in sekere gevalle, bv. $V \cdot m^{-1}$ in plaas van $N \cdot C^{-1}$, en $cm \cdot s^{-1}$ of $km \cdot h^{-1}$ in plaas van $m \cdot s^{-1}$ waar die vraag dit regverdig.

3. GENERAL/ALGEMEEN

- 3.1 If one answer or calculation is required, but two given by the candidate, only the first one will be marked, irrespective of which one is correct. If two answers are required, only the first two will be marked, etc.
Indien een antwoord of berekening verlang word, maar twee word deur die kandidaat gegee, sal slegs die eerste een nagesien word, ongeag watter een korrek is. Indien twee antwoorde verlang word, sal slegs die eerste twee nagesien word, ens.
- 3.2 For marking purposes, alternative symbols (s,u,t, etc.) will also be accepted.
Vir nasiendoeleindes sal alternatiewe simbole (s, u, t, ens.) ook aanvaar word.
- 3.3 Separate compound units with a multiplication dot, not a full stop, for example, $m \cdot s^{-1}$.
For marking purposes $m \cdot s^{-1}$ and m/s will also be accepted.
Skei saamgestelde eenhede met 'n vermenigvuldigpunt en nie met 'n punt nie, byvoorbeeld, $m \cdot s^{-1}$. Vir nasiendoeleindes sal $m \cdot s^{-1}$ en m/s ook aanvaar word.

4. POSITIVE MARKING/POSITIEWE NASIEN

Positive marking regarding calculations will be followed in the following cases:
Positiewe nasien met betrekking tot berekenings sal in die volgende gevalle geld:

- 4.1 **Subquestion to subquestion:** When a certain variable is calculated in one subquestion (e.g. 3.1) and needs to be substituted in another (3.2 or 3.3), e.g. if the answer for 3.1 is incorrect and is substituted correctly in 3.2 or 3.3, **full marks** are to be awarded for the subsequent subquestions.
Subvraag na subvraag: *Wanneer 'n sekere veranderlike in een subvraag (bv. 3.1) bereken word en dan in 'n ander vervang moet word (3.2 of 3.3), bv. indien die antwoord vir 3.1 verkeerd is en word korrek in 3.2 of 3.3 vervang, word **volpunte** vir die daaropvolgende subvraag toegeken.*
- 4.2 **A multistep question in a subquestion:** If the candidate has to calculate, for example, current in the first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer will be forfeited.
'n Vraag met veelvuldige stappe in 'n subvraag: *Indien 'n kandidaat byvoorbeeld, die stroom verkeerd bereken in 'n eerste stap as gevolg van 'n substitusiefout, verloor die kandidaat die punt vir die substitusie sowel as die finale antwoord.*

5. **NEGATIVE MARKING/NEGATIEWE NASIEN**

Normally an incorrect answer cannot be correctly motivated if based on a conceptual mistake. If the candidate is therefore required to motivate in QUESTION 3.2 the answer given to QUESTION 3.1, and 3.1 is incorrect, no marks can be awarded for QUESTION 3.2. However, if the answer for e.g. 3.1. is based on a calculation, the motivation for the incorrect answer in 3.2 could be considered.

'n Verkeerde antwoord, indien dit op 'n konsepsuele fout gebaseer is, kan normaalweg nie korrek gemotiveer word nie. Indien 'n kandidaat gevra word om in VRAAG 3.2 die antwoord op VRAAG 3.1 te motiveer en 3.1 is verkeerd, kan geen punte vir VRAAG 3.2 toegeken word nie. Indien die antwoord op bv. 3.1 egter op 'n berekening gebaseer is, kan die motivering vir die verkeerde antwoord in 3.2 oorweeg word.

SECTION A / AFDELING A

QUESTION 1 / VRAAG 1

- 1.1 Mechanical energy / *Meganiese energie* ✓ (1)
1.2 Newton's first law / *Newton se eerste wet* ✓ (1)
1.3 (Electrical) potential energy / *(Elektriese) potensiële energie* ✓ (1)
1.4 Diffraction / *Diffraksie* ✓ (1)
1.5 Work function / *Arbeidsfunksie (Werkfunksie)* ✓ (1)
[5]

QUESTION 2 / VRAAG 2

- 2.1 D ✓✓ (2)
2.2 A ✓✓ (2)
2.3 D ✓✓ (2)
2.4 D ✓✓ (2)
2.5 C ✓✓ (2)
2.6 C ✓✓ (2)
2.7 D ✓✓ (2)
2.8 B ✓✓ (2)
2.9 B ✓✓ (2)
2.10 A ✓✓ (2)
[20]

TOTAL SECTION A / TOTAAL AFDELING A: 25

SECTION B/AFDELING B

QUESTION 3/VRAAG 3

3.1

3.1.1 Upwards / Opwaarts ✓

(1)

3.1.2 Downwards / Afwaarts ✓

(1)

3.2 Q ✓

Weight is the only force acting on the rocket. ✓

Gewig is die enigste krag wat op die vuurpyl inwerk.

(2)

3.3

OPTION 1/OPSIE 1

Upwards positive/Opwaarts positief:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$\therefore -225,6 \checkmark = (112,8) \Delta t \checkmark + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$$

$$\therefore \Delta t = 24,87 \text{ s}$$

Total time/Totale tyd:

$$4 + \checkmark 24,87 = 28,87 \text{ s} \checkmark$$

Downwards positive/Afwaarts positief:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$\therefore 225,6 \checkmark = (-112,8) \Delta t \checkmark + \frac{1}{2} (9,8) \Delta t^2 \checkmark$$

$$\therefore \Delta t = 24,87 \text{ s}$$

Total time/Totale tyd:

$$4 + \checkmark 24,87 = 28,87 \text{ s} \checkmark$$

Notes/Aantekeninge:

Accept/Aanvaar:

g or/of a

$$s = ut + \frac{1}{2} at^2$$

$$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

OPTION 2/OPSIE 2

Upwards positive/Opwaarts positief:

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$\therefore v_f^2 = (112,8)^2 + 2(-9,8)(-225,6) \checkmark$$

$$\therefore v_f = 130,94 \text{ m} \cdot \text{s}^{-1}$$

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \quad \checkmark$$

$$-225,6 \checkmark = \left(\frac{112,8 - 130,94}{2} \right) \Delta t \checkmark$$

$$\therefore \Delta t = 24,87 \text{ s}$$

Total time/Totale tyd :

$$4 + \checkmark 24,87 = 28,87 \text{ s} \checkmark$$

Downwards positive/Afwaarts positief:

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$\therefore v_f^2 = (-112,8)^2 + 2(9,8)(225,6) \checkmark$$

$$\therefore v_f = 130,94 \text{ m} \cdot \text{s}^{-1}$$

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \quad \checkmark$$

Notes/Aantekeninge:

Accept/Aanvaar:

g or/of a

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$v^2 = u^2 + 2as$$

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$s = \left(\frac{u + v}{2} \right) t$$

$$225,6 \checkmark = \left(\frac{-112,8 + 130,94}{2} \right) \Delta t \checkmark$$

$$\therefore \Delta t = 24,87 \text{ s}$$

Total time/Totale tyd:

$$4 + \checkmark 24,87 = 28,87 \text{ s} \checkmark$$

OPTION 3/OPSIE 3

Upwards positive/Opwaarts positief:

Time from point where fuel is used up to maximum height / Tyd vanaf punt waar brandstof opgebruik is tot maksimum hoogte :

$$v_f = v_i + a\Delta t \checkmark$$

$$\therefore 0 = 112,8 + (-9,8)\Delta t \checkmark$$

$$\therefore \Delta t = 11,51 \text{ s}$$

Time from maximum height to ground / Tyd vanaf maksimum hoogte tot die grond:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$= (112,8)(11,51) + \frac{1}{2}(-9,8)(11,51)^2$$

$$\therefore \Delta y = 649,18 \text{ m}$$

Maximum height/Maksimum hoogte:

$$225,6 + 649,18 = 874,78 \text{ m}$$

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$\therefore -874,78 = (0)\Delta t + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$$

$$\therefore \Delta t = 13,36 \text{ s}$$

Total time / Totale tyd:

$$4 + \checkmark 11,51 + 13,36 = 28,87 \text{ s} \checkmark$$

Downwards positive/Afwaarts positief:

Time from point where fuel is used up to maximum height/ Tyd vanaf punt waar brandstof opgebruik is tot maksimum hoogte:

$$v_f = v_i + a\Delta t \checkmark$$

$$\therefore 0 = -112,8 + (9,8)\Delta t \checkmark$$

$$\therefore \Delta t = 11,51 \text{ s}$$

Time from maximum height to ground: Tyd vanaf maksimum hoogte tot die grond:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$= (-112,8)(11,51) + \frac{1}{2}(9,8)(11,51)^2$$

$$\therefore \Delta y = -649,18 \text{ m}$$

Maximum height/ Maksimum hoogte:

$$225,6 + 649,18 = 874,78 \text{ m}$$

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$\therefore 874,78 = (0)\Delta t + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$\therefore \Delta t = 13,36 \text{ s}$$

Total time/Totale tyd

$$4 + \checkmark 11,51 + 13,36 = 28,87 \text{ s} \checkmark$$

Notes/Aantekeninge:

Accept/Aanvaar:

g or/of a

$$v = u + at$$

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$v^2 = u^2 + 2as$$

$$s = ut + \frac{1}{2}at^2$$

$$\Delta x = v_i \Delta t + \frac{1}{2}a\Delta t^2$$

Notes/Aantekeninge:

Accept/Aanvaar:

g or/of a

$$v = u + at$$

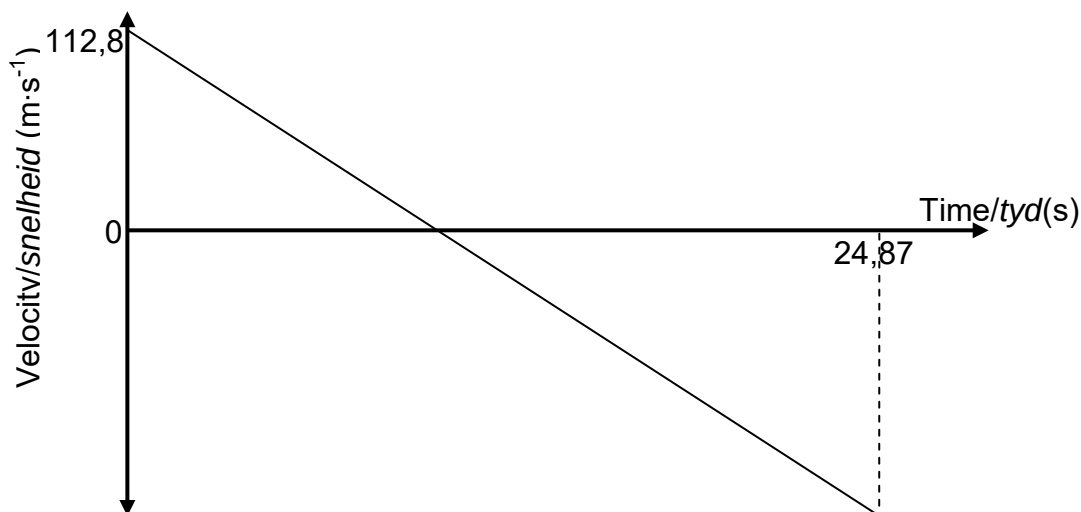
$$v_f^2 = v_i^2 + 2a\Delta x$$

$$v^2 = u^2 + 2as$$

$$s = ut + \frac{1}{2}at^2$$

$$\Delta x = v_i \Delta t + \frac{1}{2}a\Delta t^2$$

3.4 **OPTION 1/OPSIE 1**
Upwards positive/Opwaarts positief:



Criteria for graph/Kriteria vir grafiek:	Marks/ Punte
Graph starts at (0; 112,8)./ Grafiek begin by (0; 112,8).	✓
Graph is a straight line with a gradient. /Grafiek is 'n reguitlyn met 'n gradiënt.	✓
Graph has a negative gradient./Grafiek het 'n negatiewe gradiënt.	✓
POSITIVE MARKING FROM QUESTION 3.3./POSITIEWE NASIEN VANAF VRAAG 3.3. Graph extends below x-axis until t = 24,87 s. Grafiek verleng onder x-as tot t = 24,87s.	✓
Graph extends below the x-axis to a magnitude of the velocity greater than (112,8 m·s ⁻¹). / Tweede deel van grafiek verleng onder die x-as tot 'n grootte van die snelheid groter as (112,8 m·s ⁻¹).	✓

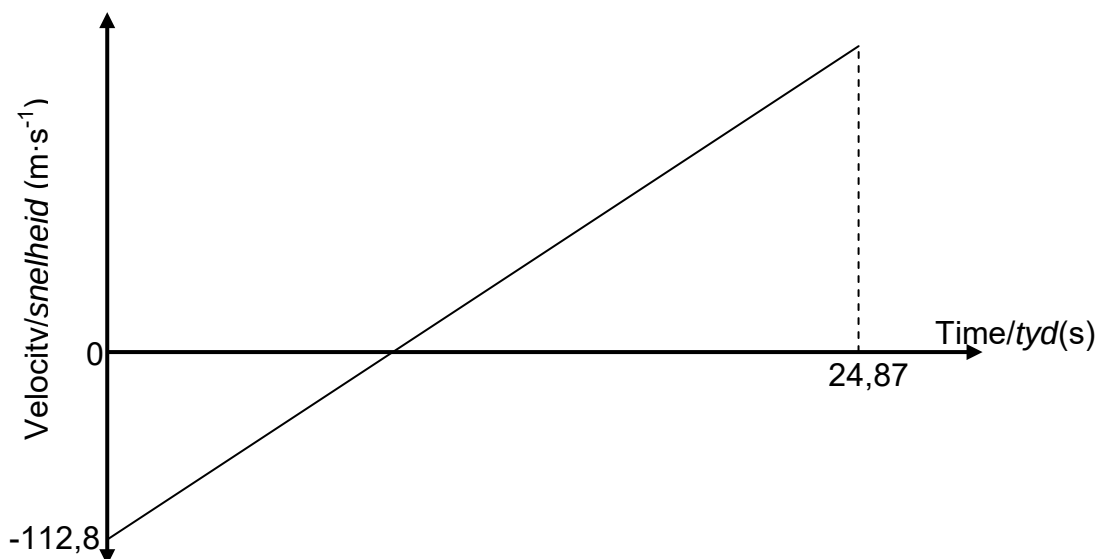
Notes/Aantekeninge:

If wrong labels/Indien verkeerde byskrifte: Max./Maks. $\frac{3}{4}$

OPTION 2/OPSIE 2

If upwards taken as negative: Max $\frac{4}{5}$

Indien opwaarts as negatief geneem: Maks. $\frac{4}{5}$



Criteria for graph/Kriteria vir grafiek:	Marks/ Punte
Graph starts at (0; -112,8). / Grafiek begin by (0; -112,8).	✓
Graph is a straight line with a gradient. / Grafiek is 'n reguitlyn met 'n gradiënt.	✓
Graph has a positive gradient. / Grafiek het 'n positiewe gradiënt.	✓
POSITIVE MARKING FROM QUESTION 3.3./POSITIEWE NASIEN VANAF VRAAG 3.3. Graph extends above x-axis until t = 24,87 s. Grafiek verleng bo x-as tot t = 24,87s.	✓
Graph extends above the x-axis to a magnitude of the velocity greater than ($112,8 \text{ m}\cdot\text{s}^{-1}$). / Tweede deel van grafiek verleng bo die x-as tot 'n grootte van die snelheid groter as ($112,8 \text{ m}\cdot\text{s}^{-1}$).	✓

Notes/Aantekeninge:

If wrong labels/Indien verkeerde byskrifte: Max./Maks. $\frac{3}{4}$

(5)
[15]

QUESTION 4/VRAAG 4

- 4.1 Momentum is the product of the mass and velocity of an object. ✓✓
Momentum is die produk van die massa en snelheid van 'n voorwerp. (2)

4.2 $\Delta p = 0$ ✓
 $F_{\text{net}} = \frac{\Delta p}{\Delta t} = 0$ ✓

OR/OF

$\Delta p = 0$ ✓
 $\Delta v = 0 \therefore a = 0 \therefore F_{\text{net}} = ma$ ✓

OR/OF

Gradient of graph/ *Gradiënt van grafiek* = $\frac{\Delta p}{\Delta t} = F_{\text{net}}$ ✓

Gradient of graph between/ *Gradient van grafiek tussen*:
 $t = 10 \text{ s}$ and/ *en* $20 \text{ s} = 0$ ✓ (2)

4.3	OPTION 1 $F_{\text{net}} \Delta t = \Delta p$ ✓ $= -120 - 50$ ✓ $= -170$ $\therefore F_{\text{net}} \Delta t = 170 \text{ N} \cdot \text{s} / \text{kg} \cdot \text{m} \cdot \text{s}^{-1}$ ✓	OPTION 2 $F_{\text{net}} = \frac{\Delta p}{\Delta t}$ ✓ $= \frac{-120 - 50}{50 - 20}$ $\therefore F_{\text{net}} = -5,67$ $F_{\text{net}} \Delta t = (-5,67)(30)$ ✓ $= -170$ $\therefore F_{\text{net}} \Delta t = 170 \text{ N} \cdot \text{s} / \text{kg} \cdot \text{m} \cdot \text{s}^{-1}$ ✓	(3)

4.4	<u>OPTION 1/ OPSIE 1</u> $\Sigma p_i = \Sigma p_f \checkmark$ $-120 + 70 \checkmark = 50 + p_{Bf} \checkmark$ $\therefore p_{Bf} = -100$ $\therefore p_{Bf} = 100 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark \text{ west / wes } \checkmark$	<u>OPTION 2/ OPSIE 2</u> $\Delta p_A = -\Delta p_B \checkmark$ $50 - (-120) \checkmark = -(p_{Bf} - 70) \checkmark$ $\therefore p_{Bf} = -100$ $\therefore p_{Bf} = 100 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark \text{ west / wes } \checkmark$
	<u>Other formulae/ Ander formules:</u> $m_1 v_{i1} + m_2 v_{i2} = m_1 v_{f1} + m_2 v_{f2}$ or $m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$ or $m_A v_{iA} + m_B v_{iB} = m_A v_{fA} + m_B v_{fB}$ $p_{\text{total before}} = p_{\text{total after}}$ Accept /Aanvaar: $p_{\text{before}} = p_{\text{after}}$ $p_i = p_f$	<u>Notes/Aantekeninge:</u> - If no formula/principle – Max. $\frac{4}{5}$ <i>Indien geen formule/beginsel –</i> Maks. $\frac{4}{5}$ - Mark direction independently. <i>Sien rigting onafhanklik na.</i>

[12]

QUESTION 5/VRAAG 5

- 5.1 The rate at which work is done. / Work done per unit time. ✓✓
Die tempo waarteen arbeid verrig word. / Arbeid verrig per eenheidstyd.

OR/OF

The rate at which energy is transferred. / Energy transferred per unit time.
Die tempo waarteen energie oorgedra word. / Energie oorgedra per eenheidstyd.

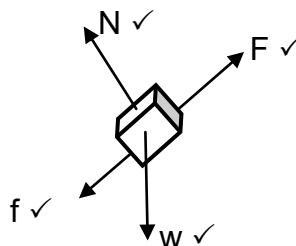
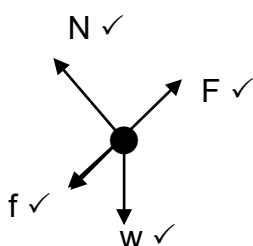
Notes/Aantekeninge:

- No part marking /Geen gedeelte nasien- 2 marks or 0./Twee punte of nul
- Accept/Aanvaar:**
The product of force and average / instantaneous velocity. ✓✓
Die produk van krag en gemiddelde / oombliklike snelheid
- IF/INDIEN:**
The product of force and velocity / *Die produk van krag en snelheid.*
Max/Maks. $\frac{1}{2}$

(2)

5.2

Accept/Aanvaar: Force diagram/kragediagram



Accepted labels/Aanvaarde benoemings	
W	F_g/F_w /force of Earth on truck/weight/12 000 N/mg/gravitational force F_g/F_w /krag van Aarde op vragmotor/gewig/12 000 N/mg/gravitasiekrag
N	F_N /normal F_N /normaal
F	Force of engine / $F_{net}/F_{applied}$ <i>Krag van enjin op vragmotor/$F_{net}/F_{toegepas}$</i>
f	F_f / friction

(4)

5.3

OPTION 1/OPSIE 1

$$W_{net} = \Delta K \checkmark$$

$$W_F + W_f + W_w = K_f - K_i$$

$$W_F - 8,5 \times 10^4 \checkmark + (5\,000)(9,8)(55)\cos 180^\circ \checkmark = 0 \checkmark$$

$$\therefore W_F = 2,78 \times 10^6 \text{ J} \checkmark$$

Notes/Aantekeninge:

Accept/Aanvaar:
 $W_{net} = \Delta E_k$
 $W_{net} = E_{kf} - E_{ki}$

OPTION 2/OPSIE 2

$$W_{net} = \Delta K \checkmark$$

$$W_F + W_f - \Delta E_p = K_f - K_i$$

$$W_F - 8,5 \times 10^4 \checkmark - (5\,000)(9,8)(55) \checkmark = 0 \checkmark$$

$$\therefore W_F = 2,78 \times 10^6 \text{ J} \checkmark$$

Notes/Aantekeninge:

Accept/Aanvaar:
 $W_{net} = \Delta E_k$
 $W_{net} = E_{kf} - E_{ki}$

(5)

POSITIVE MARKING FROM 5.3/POSITIEWE NASIEN VANAF VRAAG 5.3

5.4
$$P = \frac{W}{\Delta t} \checkmark$$
$$= \frac{2,78 \times 10^6}{60} \checkmark$$
$$= 4,63 \times 10^4 \text{ W} \checkmark$$
 (3)

5.5 Smaller than /Kleiner as $\checkmark$
Weight / gravitational force does positive work on the truck. $\checkmark$
Gewig / gravitasiekrag verrig positiewe arbeid op die trek. (2)
[16]

QUESTION 6/VRAAG 6

6.1 Away (from the observer) $\checkmark$

Detected frequency must be less than or equal to 800 Hz. $\checkmark$
If the car moves away from the observer, less waves reaches her per unit time. $\checkmark$

OR/OF
Away (from the observer) $\checkmark$
The apparent wavelength increases. $\checkmark$
For the same speed of sound, the apparent frequency decreases. $\checkmark$ (3)

6.2
$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \checkmark$$
$$800 \checkmark = \frac{340}{340 + v_s} \checkmark (850) \checkmark$$
$$\therefore v_s = 21,25 \text{ m} \cdot \text{s}^{-1} \checkmark$$
 (5)

6.3 **ANY ONE:**
Measurement of foetal heart beat. $\checkmark$
Measurement and monitoring blood flow./ Doppler flow meter (1)
[9]

QUESTION 7/VRAAG 7

7.1 To produce coherent waves. / Act as coherent source. ✓

OR/OF

To produce waves with a constant phase relationship.

Accept: To create an interference pattern./

Aanvaar: Om 'n interferensiepatroon te vorm.

(1)

7.2.1 Increases ✓

(1)

7.2.2 Decreases ✓

(1)

7.2.3 Increases ✓

(1)

7.3 A bright broad central band. ✓

On either side alternating bright and dark bands ✓ (of different widths and intensity).

(2)

7.4 $\sin \theta = \frac{m\lambda}{a}$ ✓

$$\sin 25^\circ = \frac{(4)(450 \times 10^{-9})}{a}$$

$$a = 4,26 \times 10^{-6} \text{ m} \quad \checkmark$$

(5)

7.5 $\lambda_{\text{sound}} > \lambda_{\text{light}}$ ✓

diffraction of sound waves > diffraction light waves ✓

OR

Sound waves have wavelength larger than the opening and therefore are effectively diffracted. ✓

Light waves have wavelength much smaller than the opening and there is virtually no diffraction. ✓

OR

For diffraction to occur, the wavelength must be comparable to the size of the opening. ✓

Since wavelengths of light waves are much smaller than sound waves, ✓
diffraction effects are more visible with sound than with light.

(2)

[13]

QUESTION 8/VRAAG 8

8.1 Coulomb's law / *Coulomb se wet* ✓ (1)

8.2 A: Field lines too dense in relation to C/ Number of field lines differ. /A: *Veldlyne te dig in vergelyking met C/ Aantal veldlyne verskil.* ✓
B: Field lines are crossing each other. /B: *Veldlyne kruis mekaar.* ✓
C: Direction of field lines should be away from C/ C: *Rigting van veldlyne moet weg van C af wees.* ✓ (3)

8.3

OPTION 1/OPSIE 1

$$F_{AC} = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$= \frac{(9 \times 10^9)(100 \times 10^{-6})(100 \times 10^{-6})}{(0,06)^2} \checkmark$$

$$= 2,5 \times 10^4 \text{ N to the right/na regs}$$

$$F_{BC} = \frac{kQ_1Q_2}{r^2}$$

$$= \frac{(9 \times 10^9)(100 \times 10^{-6})(100 \times 10^{-6})}{(0,03)^2} \checkmark$$

$$= 1 \times 10^5 \text{ N to the right/na regs}$$

$$F_{\text{net}} = F_{AC} + F_{BC}$$

$$= 2,5 \times 10^4 + 1 \times 10^5$$

$$= 1,25 \times 10^5 \text{ N } \checkmark \text{ to the right/na regs } \checkmark$$

✓ Any one

OPTION 2/OPSIE 2

$$F_{AC} = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$= \frac{(9 \times 10^9)(100 \times 10^{-6})(100 \times 10^{-6})}{(0,06)^2} \checkmark$$

$$= 2,5 \times 10^4 \text{ N to the right/na regs}$$

$$r_{BC} = \frac{1}{2} r_{AC}$$

$$F_{BC} = 4 F_{AC} \checkmark = 4(2,5 \times 10^4) = 1 \times 10^5 \text{ N to the right}$$

$$F_{\text{net}} = F_{AC} + F_{BC}$$

$$= 2,5 \times 10^4 + 1 \times 10^5$$

$$= 1,25 \times 10^5 \text{ N } \checkmark \text{ to the right/na regs } \checkmark$$

8.4 Net force acting on charge at B = 0 N/
Netto krag wat op lading inwerk by B = 0 N ✓
 $F_{AB} = -F_{CB} \checkmark$

(6)

(2)
[12]

QUESTION 9/VRAAG 9

- 9.1 The amount of energy ✓ given to each coulomb of charge ✓ passing through the battery./Die hoeveelheid energie ✓ oorgedra aan elke coulomb lading ✓ wat deur die battery beweeg.

OR/OF

The maximum ability of a cell to do work./Die maksimum vermoë van 'n sel om arbeid te verrig.

(2)

- 9.2 3 V ✓

(1)

9.3 OPTION 1 / OPSIE 1

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$$

$$= \frac{1}{4} + \frac{1}{1} \checkmark = \frac{5}{4}$$

$$\therefore R_p = 0,8 \, \Omega$$

$$V = IR \checkmark$$

$$2,8 = I(0,8) \checkmark$$

$$I = 3,5 \, A \checkmark$$

OPTION 2 / OPSIE 2

Current through 4 Ω resistor/Stroom deur 4 Ω -weerstand:

$$V = IR \checkmark$$

$$2,8 = I(4) \checkmark$$

$$\therefore I = 0,7 \, A$$

Current through 1 Ω resistor/ Stroom deur 1 Ω -weerstand:

$$V = IR$$

$$2,8 = I(1) \checkmark$$

$$\therefore I = 2,8 \, A$$

Total current through battery/Totale stroom deur battery:

$$I_T = I_1 + I_2$$

$$= 0,7 + 2,8 \checkmark = 3,5 \, A \checkmark$$

(5)

- 9.4 POSITIVE MARKING FROM QUESTION 9.3./POSITIEWE NASIEN VAN VRAAG 9.3.

OPTION 1 / OPSIE 1

$$\text{Emf} = I(R + r) \checkmark$$

$$3 \checkmark = 3,5(0,8 + 2r) \checkmark$$

$$2r = 0,06 \, \Omega \, (0,057 \, \Omega) \checkmark$$

$$\therefore r = 0,03 \, \Omega \checkmark$$

OPTION 2 / OPSIE 2

$$V_{\text{lost}} = 3 - 2,8 \checkmark = 0,2 \, V$$

$$V_{\text{lost}} = Ir_{\text{total}} \checkmark$$

$$0,2 = 3,5r \checkmark$$

$$r_{\text{total}} = 0,057 \, \Omega \checkmark$$

$$\therefore r_{\text{internal}} \text{ of each cell} = 0,03 \, \Omega \checkmark$$

(5)

- 9.5

- 9.5.1 Remains the same/Bly dieselfde ✓

(1)

- 9.5.2 Decreases/Neem af ✓

Total resistance decreases./Totale weerstand verminder. ✓
Current (through battery) increases./Stroom (deur die battery) verhoog ✓
'Lost volts' increases./'Verlore volts' neem toe. ✓

(4)

[18]

QUESTION 10/VRAAG 10

10.1

10.1.1 A: coil / rotor / armature / spoel ✓

B: brushes / borsels ✓

C: commutator / kommutator OR/OF

split-ring (commutator) / (split-ring)kommutator ✓

(3)

10.1.2 **ANY ONE/ENIGE EEN:**

Takes current into the coil./ *Neem stroom in spoel in.* ✓

Maintains contact with the commutator / *Bly in kontak met kommutator.*

(1)

10.1.3 DC motor /GS Motor ✓

(1)

10.1.4 Due to the motor effect / *As gevolg van die motoreffek* ✓✓

OR / OF

There is an interaction between the external magnetic field ✓ and the magnetic field produced by the current in the conductor. ✓

Daar is 'n wisselwerking tussen die eksterne magneetveld en die magneetveld veroorsaak deur die stroom in die geleier.

(2)

10.2

10.2.1 $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$ ✓

$$= \frac{1}{\sqrt{2}} \checkmark$$

$$= 0,707 \text{ V} \checkmark$$

(3)

10.2.2 0,04 s ✓✓

(v doubles ∴ emf doubles ∴ f doubles ∴ period halves)

(v verdubbel ∴ emk verdubbel ∴ f verdubbel ∴ periode halveer)

Notes/Aantekeninge:

IF/INDIEN: 0,04 - Max/Maks. $\frac{1}{2}$

(2)

10.2.3 **POSITIVE MARKING FROM QUESTION 10.2.1.**
POSITIEWE NASIEN VANAF VRAAG 10.2.1.

OPTION 1 / OPSIE 1

$$\begin{aligned}P_{\text{ave}} &= V_{\text{rms}} I_{\text{rms}} \checkmark \\&= \left(\frac{V_{\text{max}}}{\sqrt{2}} \right) \left(\frac{I_{\text{max}}}{\sqrt{2}} \right) \checkmark \quad (1 \text{ mark for formula/1 punt vir formule}) \\&= \left(\frac{1}{\sqrt{2}} \right) \checkmark \left(\frac{2}{\sqrt{2}} \right) \\&= 1 \text{ W } \checkmark\end{aligned}$$

OPTION 2 / OPSIE 2

$$\begin{aligned}P_{\text{ave}} &= V_{\text{rms}} I_{\text{rms}} \checkmark \\&= \left(\frac{1}{\sqrt{2}} \right) \left(\frac{I_{\text{max}}}{\sqrt{2}} \right) \checkmark \\&= \left(\frac{1}{\sqrt{2}} \right) \left(\frac{2}{\sqrt{2}} \right) \checkmark \\&= 1 \text{ W } \checkmark\end{aligned}$$

(4)
[16]

QUESTION 11/VRAAG 11

- 11.1.1 The emission of electrons from the surface of a metal ✓ by light of an appropriate frequency. ✓ / Die vrystelling van elektrone vanaf die oppervlak van 'n metaal/Deur lig van 'n toepaslike frekwensie (2)

- 11.1.2 Total energy transferred per second = $1,8 \times 10^{-9} \text{ J}$
Totale energie oorgedra per sekonde = $1,8 \times 10^{-9} \text{ J}$
Energy of one photon/Energie van een foton:

$$\begin{aligned} E_{\text{photon/foton}} &= hf \\ &= \frac{hc}{\lambda} \quad \checkmark \text{ (any one/enige een)} \\ &= \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{260 \times 10^{-9}} \checkmark \\ &= 7,65 \times 10^{-19} \text{ J} \end{aligned}$$

$$\text{Number of electrons in one second} = \frac{1,8 \times 10^{-9} \checkmark}{7,65 \times 10^{-19} \checkmark} = 2,35 \times 10^9 \checkmark$$

OR/OF

Total energy transferred per second = $1,8 \times 10^{-9} \text{ J}$
Totale energie oorgedra per sekonde = $1,8 \times 10^{-9} \text{ J}$
Energy of one photon/Energie van een foton

$$\begin{aligned} E_{\text{photon/foton}} &= hf \\ &= \frac{hc}{\lambda} \quad \checkmark \text{ any one /enige een} \end{aligned}$$

$$\text{Number of electrons /Aantal elektrone} = \frac{1,8 \times 10^{-9} \checkmark}{hf} = \frac{1,8 \times 10^{-9} \times \lambda}{hc}$$

$$\text{Number of electrons ejected/Aantal elektrone vrygestel} = \frac{1,8 \times 10^{-9} \times 2,6 \times 10^{-7} \checkmark}{6,63 \times 10^{-34} \times 3 \times 10^8 \checkmark}$$

$$\therefore N_e = 2,35 \times 10^9 \text{ (electrons per second)} \checkmark \quad (5)$$

- 11.1.3 **POSITIVE MARKING FROM QUESTION 11.1.2.**
POSITIEWE NASIEN VANAF VRAAG 11.1.2.

$$\begin{aligned} q &= N_e \times e \\ &= (2,35 \times 10^9)(1,6 \times 10^{-19}) \checkmark = 3,76 \times 10^{-10} \text{ C} \end{aligned}$$

$$q = I \Delta t \checkmark$$

$$\therefore I = \frac{q}{\Delta t} = \frac{3,76 \times 10^{-10}}{1} \checkmark$$

$$I = 3,76 \times 10^{-10} \text{ A} \checkmark \quad (4)$$

- 11.2.1 Electrons in excited state fall back to ground state/ lower energy state. ✓
Elektrone in opgewekte toestand val terug na grondtoestand /laer energietoestand
Energy radiated as light. /Energie uitgestraal as lig. ✓ (2)

- 11.2.2 To identify elements. /Om elemente te identifiseer. ✓

Accept / Aanvaar:

To determine the temperature of stars/ Fluorescent lights/ Neon signs./ (1)
Om die temperatuur van sterre te bepaal/ Fluoreserende ligte/ Neontekens [14]

TOTAL SECTION B/TOTAAL AFDELING B: 125
GRAND TOTAL/GROOTTOTAAL: 150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

**EXEMPLAR 2014
MODEL 2014**

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 12 pages.
*Hierdie memorandum bestaan uit 12 bladsye.***

QUESTION 1/VRAAG 1

1.1	B ✓✓	(2)
1.2	A ✓✓	(2)
1.3	A ✓✓	(2)
1.4	D ✓✓	(2)
1.5	C ✓✓	(2)
1.6	D ✓✓	(2)
1.7	A ✓✓	(2)
1.8	B ✓✓	(2)
1.9	C ✓✓	(2)
1.10	C ✓✓	(2)
		[20]

QUESTION 2/VRAAG 2

- 2.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force. This acceleration is directly proportional to the force ✓ and inversely proportional to the mass of the object. ✓

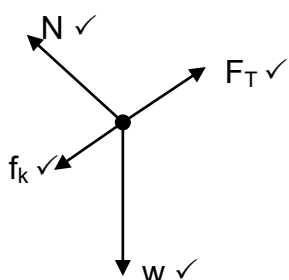
Wanneer 'n resulterende/netto krag op 'n liggaam inwerk, sal die liggaam in die rigting van die krag versnel. Hierdie versnelling is direk eweredig aan die krag en omgekeerd eweredig aan die massa van die liggaam.

(2)

- 2.2 Remains the same / Bly dieselfde ✓

(1)

- 2.3



Accepted labels/Aanvaarde benoemings	
w	F_g / F_w / weight / mg / gravitational force F_g / F_w / gewig / mg / gravitasiekrag
f	$F_{\text{friction}} / F_f$ / friction F_{wrywing} / F_w / wrywing
N	F_N / F_{normal} / normal force F_N / F_{normaal} / normaalkrag
F_T	F_t / T / tension F_t / T / spanning

(4)

- 2.4

- 2.4.1 Up the incline as positive/Teen die skuinste op as positief:

$$F_{\text{net}} = ma$$

$$F_T + f_k + w_{\parallel} = ma$$

$$F_T + \mu_k N + w \sin 30^\circ = ma$$

$$F_T + \mu_k mg \cos 30^\circ + mg \sin 30^\circ = ma$$

$$F_T - (0,2)(6)(9,8) \cos 30^\circ - (6)(9,8) \sin 30^\circ = (6)(4)$$

$$\therefore F_T = 63,58 \text{ N}$$

✓ Any one/Enige een

(5)

- 2.4.2 Up the incline as positive/Teen die skuinste op as positief:

$$F_{\text{net}} = ma$$

$$F + f_{k(6 \text{ kg})} + f_{k(3 \text{ kg})} + w_{\parallel} = ma$$

$$F + \mu_k N_{(6 \text{ kg})} + \mu_k N_{(3 \text{ kg})} + mg \sin 30^\circ = ma$$

$$F - (0,2)(6)(9,8) \cos 30^\circ - (0,1)(3)(9,8) \cos 30^\circ - (9)(9,8) \sin 30^\circ = 0$$

$$\therefore F = 56,83 \text{ N}$$

✓ Any one/Enige een

(6)

- 2.5 Decreases / Afneem ✓

(1)

[19]

QUESTION 3/VRAAG 3

3.1 0,5 m ✓

(1)

3.2 **OPTION 1/OPSIE 1****Upwards positive/Opwaarts positief:**

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = (-2)^2 + 2(-9,8)(-1,8) \checkmark$$

$$v_f = -6,27 \text{ m}\cdot\text{s}^{-1} \checkmark$$

✓ Both equations/Beide vergelykings

$$v_f = v_i + a\Delta t$$

$$-6,27 = -2 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 0,44 \text{ s} \checkmark$$

Downwards positive/Afwaarts positief:

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$v_f^2 = (2)^2 + 2(9,8)(1,89) \checkmark$$

$$v_f = 6,27 \text{ m}\cdot\text{s}^{-1} \checkmark$$

✓ Both equations/Beide vergelykings

$$v_f = v_i + a\Delta t$$

$$6,27 = 2 + (9,8)\Delta t \checkmark$$

$$\Delta t = 0,44 \text{ s} \checkmark$$

OPTION 2/OPSIE 2**Upwards positive/Opwaarts positief:**

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$-1,8 \checkmark = (-2)\Delta t \checkmark + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$$

$$\Delta t = \frac{-2 \pm \sqrt{(2)^2 - 4(4,9)(-1,8)}}{2(4,9)}$$

$$= 0,44 \text{ s} \checkmark$$

Downwards positive/Afwaarts positief:

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$$

$$1,8 \checkmark = (2)\Delta t \checkmark + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$\Delta t = \frac{-2 \pm \sqrt{(-2)^2 - 4(4,9)(-1,8)}}{2(4,9)} = 0,44 \text{ s} \checkmark$$

(5)

3.3 **Upwards positive/Opwaarts positief:**

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0^2 = v_i^2 + 2(-9,8)(0,9) \checkmark$$

$$v_i = 4,2 \text{ m}\cdot\text{s}^{-1} \checkmark \text{ upwards/opwaarts} \checkmark$$

Downwards positive/Afwaarts positief:

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$0^2 = v_i^2 + 2(9,8)(0,9) \checkmark$$

$$v_i = 4,2 \text{ m}\cdot\text{s}^{-1} \checkmark \text{ upwards/opwaarts} \checkmark$$

(4)

3.4 **Upwards positive/Opwaarts positief:**

$$F_{\text{net}}\Delta t = m\Delta v \checkmark$$

$$F_{\text{net}} (0,2) \checkmark = (0,5)[(4,2 - (-6,27))] \checkmark$$

$$F_{\text{net}} = 26,175 \text{ N} \checkmark$$

Downwards positive/Afwaarts positief:

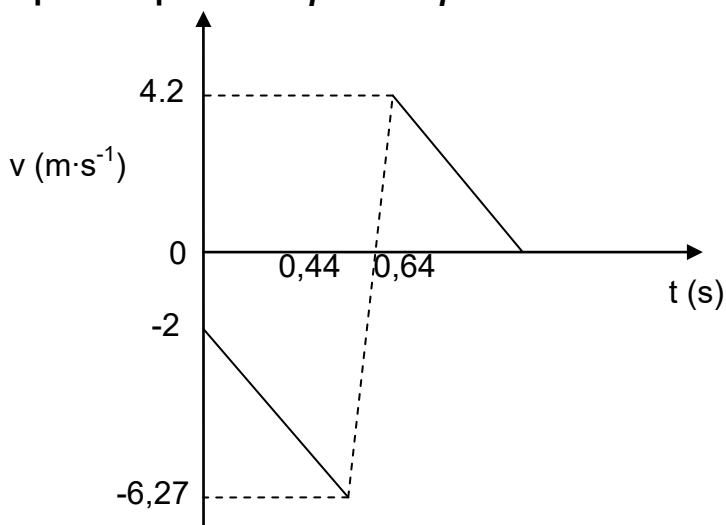
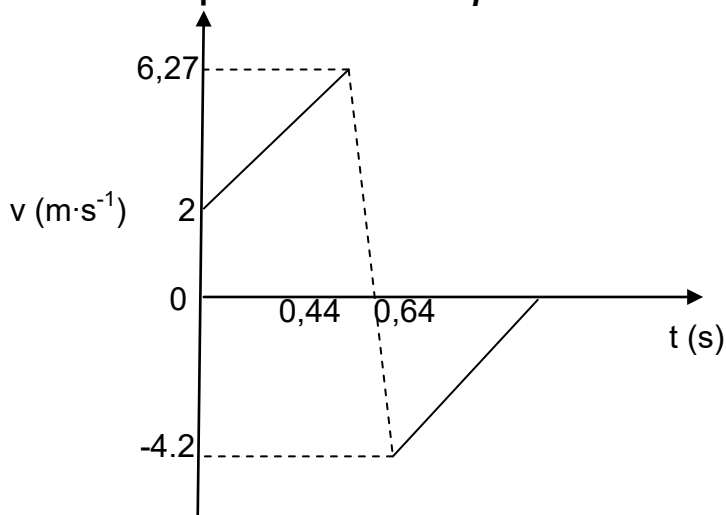
$$F_{\text{net}}\Delta t = m\Delta v \checkmark$$

$$F_{\text{net}} (0,2) \checkmark = (0,5)[(-4,2 - (6,27))] \checkmark$$

$$F_{\text{net}} = -26,175 \text{ N}$$

$$F_{\text{net}} = 26,175 \text{ N} \checkmark$$

(4)

3.5 **Upwards positive/Opwaarts positief:****Downwards positive/Afwaarts positief:**

(3)

Criteria for graph/Kriteria vir grafiek:	Marks/Punte
First part of the graph starts at $v = 2 \text{ m}\cdot\text{s}^{-1}$ at $t = 0 \text{ s}$ and extends until $v = 6,27 \text{ m}\cdot\text{s}^{-1}$ at $t = 0,44 \text{ s}$. <i>Eerste deel van die grafiek begin by $v = 2 \text{ m}\cdot\text{s}^{-1}$ by $t = 0 \text{ s}$ en verleng tot $v = 6,27 \text{ m}\cdot\text{s}^{-1}$ by $t = 0,44 \text{ s}$.</i>	✓
Graph is discontinuous and object changes direction at $0,64 \text{ s}$. <i>Grafiek is nie kontinu nie en voorwerp verander van rigting by $0,64 \text{ s}$.</i>	✓
Second part of graph starts at $v = 4,2 \text{ m}\cdot\text{s}^{-1}$ at $t = 0,64 \text{ s}$ until $v = 0 \text{ m}\cdot\text{s}^{-1}$. <i>Tweede deel van grafiek begin by $v = 4,2 \text{ m}\cdot\text{s}^{-1}$ by $t = 0,64 \text{ s}$ tot $v = 0 \text{ m}\cdot\text{s}^{-1}$.</i>	✓

[17]

QUESTION 4/VRAAG 4

- 4.1 The total linear momentum in a closed system ✓ remains constant. / is conserved. ✓
Die totale lineêre momentum in 'n geslote sisteem bly konstant / bly behoue.

OR/OF

In a closed system ✓ the total linear momentum before collision is equal to the total linear momentum after collision. ✓
In 'n geslote sisteem is die totale lineêre momentum voor botsing gelyk aan die totale lineêre momentum na botsing.

(2)

- 4.2 $\left. \begin{aligned} \sum p_i &= \sum p_f \\ (m_1 + m_2)v_i &= m_1v_{1f} + m_2v_{2f} \end{aligned} \right\}$ ✓ Any one/Enige een
 $(2m + 4m)(0) \checkmark = 2m(2) + 4m(v_{2f}) \checkmark$
 $-4m = 4mv_f$
 $\therefore v_f = -1 \text{ m}\cdot\text{s}^{-1}$
 $\therefore v_f = 1 \text{ m}\cdot\text{s}^{-1}$ ✓ in the opposite direction to that of the boys ✓
in die teenoorgestelde rigting as dié van die seuns

(5)

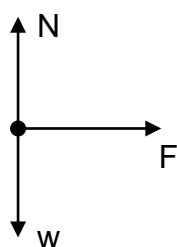
- 4.3 Greater than / Groter as ✓

(1)

[8]

QUESTION 5/VRAAG 55.1 Frictional force / *Wrywingkrag* ✓

(1)

5.2 F_N / Normal force / *Normaalkrag* ✓ F_g / Gravitational force / Weight / *Gravitasiekrag* / *Gewig* ✓ F_{app} / 10 N / Horizontal applied force / *Horisontale toegepaste krag* ✓

Accepted labels/Aanvaarde benoemings	
W	F_g / F_w / weight / mg / gravitational force F_g / F_w / <i>gewig</i> / mg / <i>gravitasiekrag</i>
N	F_N / F_{normal} / normal force F_N / $F_{normaal}$ / <i>normaalkrag</i>
F	F_{app} / applied force / 10 N F_{toeg} / <i>toegepaste krag</i> / 10 N

(3)

5.3 The net work done ✓ on an object is equal to the change in kinetic energy ✓ of the object.*Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp.*

(2)

5.4 $W_{net} = \Delta E_K$ ✓

$$W_F + W_w + W_{FN} = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$(10)(2,5)\cos 0^\circ + 0 + 0 = \frac{1}{2} (3)(v_f^2 - 0^2) \quad \checkmark$$

$$v_f = 4,08 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

(4)

5.5 **OPTION 1/OPSIE 1**

$$W_{nc} = \Delta E_p + \Delta E_k \quad \checkmark$$

$$f\Delta x \cos \theta = (mgh_f - mgh_i) + \left(\frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2 \right)$$

$$(2)(10)\cos 180^\circ = (3)(9,8)h_f - 0 + 0 - \frac{1}{2} (3)(4,08)^2 \quad \checkmark$$

$$\therefore h = 0,17 \text{ m} \quad \checkmark$$

OPTION 2/OPSIE 2

$$W_{net} = \Delta E_K \quad \checkmark$$

$$W_f + W_w = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$(2)(10)\cos 180^\circ + (3)(9,8)h \cos 180^\circ = \frac{1}{2} (3)(0^2 - 4,08^2) \quad \checkmark$$

$$\therefore h = 0,17 \text{ m} \quad \checkmark$$

OPTION 3/OPSIE 3

$$W_{net} = \Delta E_k \quad \checkmark$$

$$mgsin\alpha \Delta x \cos \theta + f\Delta x \cos \theta = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$(3)(9,8)\left(\frac{h}{10}\right)(10)\cos 180^\circ + (2)(10)\cos 180^\circ = \frac{1}{2} (3)(0^2 - 4,08^2) \quad \checkmark$$

$$\therefore h = 0,17 \text{ m} \quad \checkmark$$

(5)

[15]

QUESTION 6/VRAAG 6

6.1 Smaller than / *Kleiner as* ✓ (1)

6.2 Doppler effect / *Doppler-effek* ✓ (1)

6.3 $v = f\lambda$ ✓
 $345 = f(0,55)$ ✓
 $\therefore f = 627,27 \text{ Hz}$

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR/OR } f_L = \frac{v}{v - v_s} f_s \text{ ✓}$$

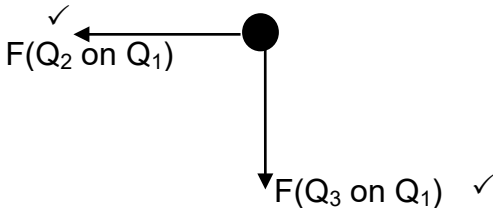
$$= \frac{345}{345 - 33,33} (627,27) \text{ ✓}$$

$$= 694,35 \text{ Hz} \text{ ✓}$$
 (7)

6.4 Decreases / *Verlaag* ✓ (1)
[10]

QUESTION 7/VRAAG 7

7.1 The (magnitude) of the electrostatic force exerted by one charge on another is directly proportional to the (magnitudes of the) charges ✓ and inversely proportional to the square of the distance between their centres. ✓
Die (grootte) van die elektrostatiese krag wat een lading op 'n ander uitoefen, is direk eweredig aan die (groottes van die) ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte. (2)

7.2  (2)

7.3

$$F = k \frac{Q_1 Q_2}{r^2} \checkmark$$

$$F(Q_2 \text{ on } Q_1) = (9 \times 10^9) \frac{(4 \times 10^{-6})(4 \times 10^{-6})}{(3 \times 10^{-3})^2} \checkmark = 1,6 \times 10^4 \text{ N (to left/na links)}$$

$$F(Q_3 \text{ on } Q_1) = (9 \times 10^9) \frac{(4 \times 10^{-6})(4 \times 10^{-6})}{(3 \times 10^{-3})^2} \checkmark = 1,6 \times 10^4 \text{ N}$$

(downwards/afwaarts)

$$\begin{aligned} F_{\text{net}} &= \sqrt{(F_{Q_2 \text{ on } Q_1})^2 + (F_{Q_3 \text{ on } Q_1})^2} \\ &= \sqrt{(1,6 \times 10^4)^2 + (1,6 \times 10^4)^2} \checkmark \\ &= 2,26 \times 10^4 \text{ N} \end{aligned}$$

$$\tan \theta = \left(\frac{F_{Q_3 \text{ on } Q_1}}{F_{Q_2 \text{ on } Q_1}} \right)$$

$$\tan \theta = \left(\frac{1,6 \times 10^4}{1,6 \times 10^4} \right) \checkmark$$

$$\therefore \theta = 45^\circ$$

$$F_{\text{net}} = 2,26 \times 10^3 \text{ N} \checkmark \text{ SW / } 225^\circ \text{ / } 45^\circ \text{ south of west / suid van wes} \checkmark$$

(8)
[12]**QUESTION 8/VRAAG 8**

8.1 The force $\checkmark$ per unit charge $\checkmark$ at that point.
Die krag per eenheidslading by daardie punt.

(2)

8.2

$$\begin{aligned} E &= \frac{kQ}{r^2} \checkmark \\ &= \frac{(9 \times 10^9)(6,5 \times 10^{-12})}{(0,003)^2} \checkmark \\ &= 6,5 \times 10^3 \text{ N} \cdot \text{C}^{-1} \checkmark \end{aligned}$$

(3)

8.3

At point X/By punt X

$$E_Q = 6,5 \times 10^3 \text{ N} \cdot \text{C}^{-1} \text{ west/wes} \checkmark$$

$$\begin{aligned} E_R &= \frac{kQ}{r^2} \\ &= \frac{(9 \times 10^9)(6,5 \times 10^{-12})}{(0,003)^2} \\ &= 6,5 \times 10^3 \text{ N} \cdot \text{C}^{-1} \text{ east/oos} \checkmark \end{aligned}$$

$$\begin{aligned} E_{\text{net}} &= E_Q + E_R \checkmark \\ &= 6,5 \times 10^3 + (-6,5 \times 10^3) \\ &= 0 \text{ N} \cdot \text{C}^{-1} \checkmark \end{aligned}$$

(4)
[9]

QUESTION 9/VRAAG 9

9.1

9.1.1 From graph/*Van grafiek*: $\frac{R}{V}$ ✓**OR/OF**From equation/*Van vergelyking*: $\frac{r}{E}$ (1)

9.1.2 $\frac{1}{E} = 0,65$ ✓

$\therefore E = 1,54 \text{ V}$ ✓ (2)

9.1.3 $\frac{r}{E} = \frac{2-1}{4-1}$ ✓

$\therefore r = 0,51 \Omega$ ✓

(Any set of values from the graph can be used to calculate the gradient./*Enige stel waardes van die grafiek kan gebruik word om die gradiënt te bereken.*) (3)

9.2

9.2.1 $\text{Emf/emk} = I(R + r)$ ✓

$6 = I(9 + 1)$ ✓

$\therefore I = 0,6 \text{ A}$ ✓ (3)

9.2.2 $P = I^2 R$ ✓

$1,8 = (0,6)^2 R_1$ ✓

$R_1 = 5 \Omega$

$R_p = 9 - 5 = 4 \Omega$ ✓

$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{1}{4} = \frac{1}{R_2} + \frac{1}{4R_2}$ ✓

$\therefore R_2 = 5 \Omega$ ✓ (5)

9.3

$W = VI\Delta t$ ✓

$= (240)(9,5)(12)(60)$ ✓

$= 1,64 \times 10^6 \text{ J}$

$\text{Cost/Koste} = \frac{1,64 \times 10^6}{3,6 \times 10^6} \times 1,47$ ✓

$= R0,67 \text{ or/of 67 cents/sent}$ ✓ (4)

[18]

QUESTION 10/VRAAG10

10.1 Increase the speed of rotation. / *Verhoog spoed van rotasie.* ✓

OR/OF

Increase the number of coils. / *Verhoog getal windings/spoele.*

OR/OF

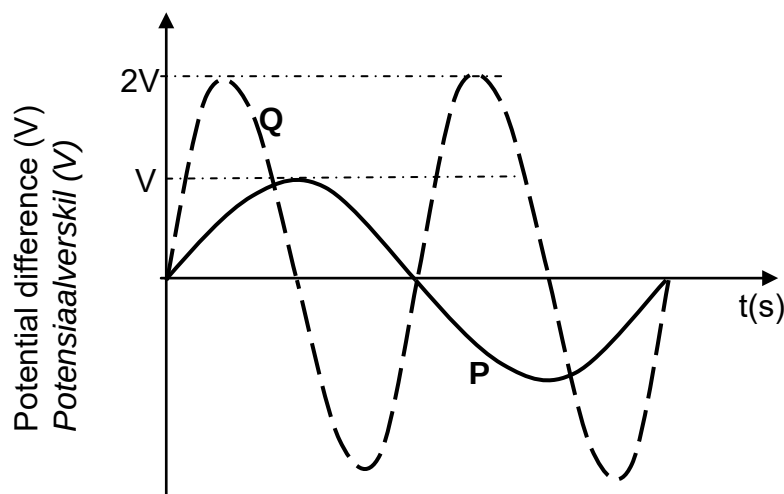
Increase the strength of the magnetic field. / *Verhoog magetiese veldsterkte.* (1)

10.2 Commutators replaced by slip rings. / *Kommutators vervang met sleepringe.* ✓

OR/OF

Slip rings were used. / *Sleepringe is gebruik.* ✓ (1)

10.3



Criteria for graph/Kriteria vir grafiek:	Marks Punte
Correct shape with higher amplitude as shown (accept more than one cycle) <i>Korrekte vorm met hoër amplitude soos aangetoon (aanvaar meer as een siklus)</i>	✓
Correct shape with higher frequency as shown (accept more than one cycle) <i>Korrekte vorm met hoër frekwensie soos aangetoon (aanvaar meer as een siklus)</i>	✓

(2)

10.4

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark = \frac{\left(\frac{V_{\text{max}}}{\sqrt{2}}\right)^2}{R} \checkmark$$

$$120 = \frac{\left(\frac{340}{\sqrt{2}}\right)^2}{R} \checkmark$$

$$R = 481,67 \, \Omega \checkmark$$

(4)
[8]

QUESTION 11/VRAAG 11

11.1 The minimum energy needed to remove an electron ✓
from the surface of a metal. ✓
Die minimum energie benodig om 'n elektron
vanaf die oppervlak van 'n metaal te verwyder. (2)

11.2

11.2.1 $W_0 = hf_0$ ✓
 $= (6,63 \times 10^{-34})(4 \times 10^{14})$ ✓
 $= 2,65 \times 10^{-19} \text{ J}$ ✓ (3)

11.2.2 $E = W_0 + E_k$ } ✓ Any one/Enige een
 $hf = hf_0 + \frac{1}{2}mv^2$ }
 $(6,63 \times 10^{-34})(8 \times 10^{14})$ ✓ $= 2,65 \times 10^{-19}$ ✓ $+ \frac{1}{2}(9,11 \times 10^{-31})v^2$ ✓
 $\therefore v = 7,63 \times 10^5 \text{ m}\cdot\text{s}^{-1}$ ✓ (5)

11.3

11.3.1 Equal to /Gelyk aan ✓
The gradient is Planck's constant./ *Die gradiënt is Planck se konstante.* ✓ (2)

11.3.2 $8 \times 10^{14} \text{ Hz}$ ✓
 f_0 is directly proportional to W_0 . / f_0 is direk eweredig aan W_0 . ✓ (2)
[14]

TOTAL/TOTAAL: 150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

NOVEMBER 2013

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 16 pages.
*Hierdie memorandum bestaan uit 16 bladsye.***

SECTION A

QUESTION 1/VRAAG 1

1.1	Acceleration / <i>Versnelling</i> ✓	(1)
1.2	Wavelength / <i>Golflengte</i> ✓	(1)
1.3	Electric field / <i>Elektriese veld</i> ✓	(1)
1.4	Gamma / γ (rays) / <i>Gamma / γ (strale)</i> ✓	(1)
1.5	Threshold (frequency) / <i>Drumpel(frekwensie)</i> ✓	(1)
		[5]

QUESTION 2/VRAAG 2

2.1	B ✓✓	(2)
2.2	B ✓✓	(2)
2.3	C ✓✓	(2)
2.4	D ✓✓	(2)
2.5	C ✓✓	(2)
2.6	C ✓✓	(2)
2.7	D ✓✓	(2)
2.8	B ✓✓	(2)
2.9	D ✓✓	(2)
2.10	B ✓✓	(2)
		[20]

TOTAL SECTION A/TOTAAL AFDELING A: 25

SECTION B/AFDELING B

QUESTION 3/VRAAG 3

3.1 $15 \text{ m} \cdot \text{s}^{-1} \checkmark$

(1)

3.2 **OPTION 1/OPSIE 1**

 Inelastic $\checkmark$
The speed/velocity at which the ball leaves the floor is less / different than that at which it strikes the floor. OR The speed/velocity of the ball changes during the collision. $\checkmark$

Therefore the kinetic energy changes/is not conserved. $\checkmark$

Onelasties

Die spoed/snelheid waarteen die bal die vloer verlaat is kleiner / verskillend as dit waarteen dit die vloer tref. OF Die spoed / snelheid van die bal verander gedurende die botsing.

Die kinetiese energie verander/bly nie behoue nie.

 **OPTION 2/OPSIE 2**

Collision is inelastic. $\checkmark$

Botsing is onelasties

$$\begin{aligned}\Delta K &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ &= \frac{1}{2}(0,15)(\underline{15})^2 - \frac{1}{2}(0,15)(\underline{20})^2 \checkmark \\ &= -13,13 \text{ J}\end{aligned}$$

$$K_i \neq K_f / \Delta K \neq 0 \checkmark$$

 **OPTION 3/OPSIE 3**

Collision is inelastic. $\checkmark$

Botsing is onelasties. $\checkmark$

$$\begin{aligned}K_f &= \frac{1}{2}mv_f^2 \\ &= \frac{1}{2}(0,15)(\underline{15})^2 \\ &= 16,88 \text{ J}\end{aligned}$$

$$\begin{aligned}K_i &= \frac{1}{2}mv_i^2 \\ &= \frac{1}{2}(0,15)(\underline{20})^2 \\ &= 30 \text{ J}\end{aligned}$$

$$K_f \neq K_i / \Delta K \neq 0 \checkmark$$

(3)

3.3

OPTION 1/OPSIE 1

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$(20)^2 \checkmark = (10)^2 + 2(9,8)\Delta y \checkmark$$

$$\therefore \Delta y = 15,31 \text{ m} \checkmark$$

OPTION 2/OPSIE 2

$$W_{\text{net}} = \Delta K \checkmark$$

$$F_{\text{net}}\Delta y \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$m(9,8)\Delta y \cos 0^\circ \checkmark = \frac{1}{2}m(20^2 - 10^2) \checkmark$$

$$\Delta y = 15,31 \text{ m} \checkmark$$

OPTION 3/OPSIE 3

$$\left. \begin{aligned}(E_p + E_k)_{\text{top}} &= (E_p + E_k)_{\text{bottom}} \\ (mgh + \frac{1}{2}mv^2)_{\text{top}} &= (mgh + \frac{1}{2}mv^2)_{\text{bottom}}\end{aligned} \right\} \checkmark \text{ any one/enige een}$$

$$m(9,8)h + \frac{1}{2}m(10)^2 \checkmark = m(9,8)(0) + \frac{1}{2}m(20)^2 \checkmark$$

$$h = 15,31 \text{ m} \checkmark$$

OPTION 4/OPSIE 4

$$v_f = v_i + a\Delta t$$

$$20 = 10 + (9,8)(\Delta t) \checkmark$$

$$\therefore \Delta t = 1,02 \text{ s}$$

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$= (10)(1,02) \checkmark + \frac{1}{2}(9,8)(1,02)^2 \checkmark$$

$$\therefore \Delta y = 15,3 \text{ m} \checkmark$$

OPTION 5/OPSIE 5

$$v_f = v_i + a\Delta t$$

$$20 = 10 + (9,8)(\Delta t)$$

$$\therefore \Delta t = 1,02 \text{ s}$$

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$\Delta y = \left(\frac{10 + 20}{2} \right) (1,02) \checkmark$$

$$\therefore \Delta y = 15,3 \text{ m} \checkmark$$

OPTION 6/OPSIE 6

$$v_f = v_i + a\Delta t$$

$$20 = 10 + (9,8)(\Delta t)$$

$$\therefore \Delta t = 1,02 \text{ s}$$

Height = area between graph & t axis
Hoogte = opperv. tussen grafiek & t-as

$$= \frac{1}{2}(\text{sum of sides})h_{\perp}$$

$$= \frac{1}{2}(10 + 20) \checkmark 1,02 \checkmark$$

$$= 15,3 \text{ m} \checkmark$$

$$= 15,3 \text{ m} \checkmark$$

OPTION 7/OPSIE 7

$$v_f = v_i + a\Delta t$$

$$20 = 10 + (9,8)(\Delta t)$$

$$\therefore \Delta t = 1,02 \text{ s}$$

Height = area between graph & t axis
Hoogte = opperv. tussen grafiek & t-as

$$= lb + \frac{1}{2}bh = \frac{1}{2}(10 + 20)1,02$$

$$= (1,02)(10) \checkmark + \frac{1}{2}(1,02)(10) \checkmark$$

$$= 15,3 \text{ m} \checkmark$$

OPTION 8/OPSIE 8

$$F_{\text{net}} = ma$$

$$mg = m \left(\frac{v_f^2 - v_i^2}{2\Delta x} \right) \checkmark$$

$$(0,15)(9,8) \checkmark = (0,15) \left(\frac{20^2 - 10^2}{2\Delta x} \right) \checkmark$$

$$\Delta x = 15,31 \text{ m} \checkmark$$

(4)

3.3.2

$$\left. \begin{aligned} F_{\text{net}}\Delta t &= \Delta p \\ F_{\text{net}}\Delta t &= mv_f - mv_i \\ \Delta p &= mv_f - mv_i \end{aligned} \right\} \checkmark \text{Any one/Enige een}$$

$$= 0,15(-15 - 20) \checkmark$$

$$= -5,25 \text{ N}\cdot\text{s} \text{ (or } -5,25 \text{ kg}\cdot\text{m}\cdot\text{s}^{-1})$$

Magnitude/Grootte = 5,25 N·s or 5,25 kg·m·s⁻¹ ✓

(3)

3.3.3

OPTION 1 / OPSIE 1

Displacement from floor to max. height/ *Verplasing van vloer na maks. hoogte:*

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$(0)^2 = (-15)^2 + 2(9,8)\Delta y \checkmark$$

$$\therefore \Delta y = -11,48 \text{ m}$$

Total displacement / *Totale verplasing*

$$= -11,48 + 15,3 \checkmark$$

$$= 3,82 \text{ m} \checkmark / 3,83 \text{ m}$$

OPTION 2 / OPSIE 2

$$v_f = v_i + a\Delta t$$

$$0 = -15 + (9,8)\Delta t$$

$$\Delta t = 1,53 \text{ s}$$

$$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$= (-15)(1,53) + \frac{1}{2}(9,8)(1,53)^2 \checkmark$$

$$= -11,48 \text{ m}$$

Total displacement / *Totale verplasing*

$$= -11,48 + 15,3 \checkmark$$

$$= 3,82 \text{ m} \checkmark$$

OPTION 3 / OPSIE 3

$$v_f = v_i + a\Delta t$$

$$0 = -15 + (9,8)\Delta t$$

$$\Delta t = 1,53 \text{ s}$$

$$\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t$$

$$= \left(\frac{0 + (-15)}{2} \right) (1,53) \checkmark$$

$$= -11,48 \text{ m}$$

Total displacement / *Totale verplasing*

$$= -11,48 + 15,3 \checkmark$$

$$= 3,82 \text{ m} \checkmark$$

OPTION 4 / OPSIE 4

$$v_f = v_i + a\Delta t$$

$$0 = -15 + (9,8)\Delta t$$

$$\Delta t = 1,53 \text{ s}$$

$$\text{Area} = \frac{1}{2}bh$$

$$= \frac{1}{2}(1,53)(-15) \checkmark$$

$$= -11,48 \text{ m}$$

Total displacement / *Totale verplasing*

$$= -11,48 + 15,3 \checkmark$$

$$= 3,82 \text{ m} \checkmark$$

OPTION 5 / OPSIE 5

$$\left. \begin{aligned} E_{M(\text{initial})} &= E_{M(\text{final})} \\ (E_p + E_k)_{\text{initial}} &= (E_p + E_k)_{\text{final}} \\ (mgh + \frac{1}{2}mv^2)_{\text{initial}} &= (mgh + \frac{1}{2}mv^2)_{\text{final}} \end{aligned} \right\} \checkmark \text{Any one / Enige een}$$

$$(0,15)(9,8)(0) + \frac{1}{2}(0,15)(15)^2 = (0,15)(9,8)h + \frac{1}{2}(0,15)(0)^2 \checkmark$$

$$h = 11,48 \text{ m}$$

Total displacement / Totale verplasing
= 15,31 - 11,48 $\checkmark$ = 3,83 m $\checkmark$

OPTION 6/OPSIE 6

$$W_{\text{net}} = \Delta K \checkmark$$

$$F_{\text{net}} \Delta y \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$m(9,8)\Delta y \cos 180^\circ = \frac{1}{2}m(0^2 - 15^2) \checkmark$$

$$\Delta y = 11,48 \text{ m}$$

Total displacement / Totale verplasing
= 15,31 - 11,48 $\checkmark$
= 3,83 m $\checkmark$

OPTION 7/OPSIE 7

$$F_{\text{net}} = ma$$

$$mg = m \left(\frac{v_f^2 - v_i^2}{2\Delta x} \right) \checkmark$$

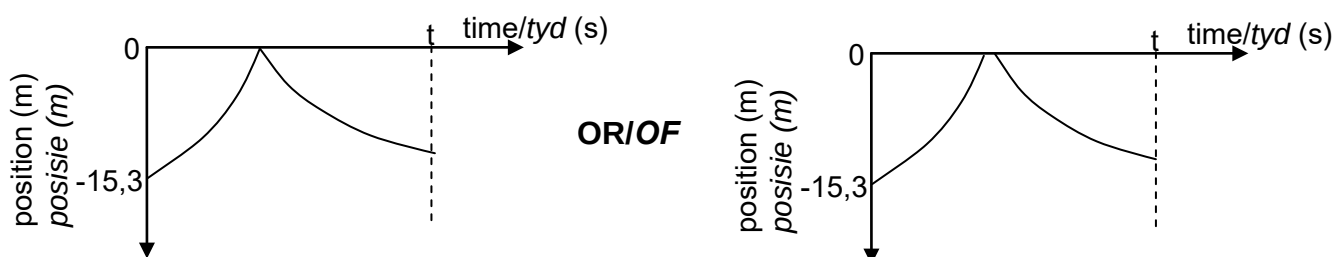
$$(0,15)(9,8) = (0,15) \left(\frac{0^2 - (-15)^2}{2\Delta x} \right) \checkmark$$

$$\Delta x = -11,48 \text{ m}$$

Total displacement / Totale verplasing
= 15,31 - 11,48 $\checkmark$
= 3,83 m $\checkmark$

(4)

3.4



Marking criteria for graph:/Nasienriglyne vir grafiek:

Correct shape as shown for first part./Korrekte vorm soos aangetoon vir eerste deel.	$\checkmark$
Correct shape as shown for the second part up to t / 2,55 s. Korrekte vorm soos aangetoon vir tweede deel t / 2,55 s.	$\checkmark$
Graph starts at -15,3 m at t = 0 s./Grafiek begin by -15,3 m by t = 0 s.	$\checkmark$
Maximum height after bounce at time t / 2,55 s./Maksimum hoogte na bons by tyd t./ 2,55 s.	$\checkmark$
Maximum height after bounce less than 15,3 m./Maksimum hoogte na bons kleiner as 15,3 m.	$\checkmark$

(4)

[19]

QUESTION 4/VRAAG 4

4.1 West / Wes ✓ (1)

4.2 (Newton's) Third Law (of Motion) ✓
 When object A exerts a force on object B,
 object B exerts a force equal in magnitude on object A ✓, but opposite in
 direction. ✓
 (Newton) se Derde (Bewegings)wet
 Wanneer voorwerp A 'n krag op voorwerp B uitoefen,
 oefen voorwerp B 'n krag van gelyke grootte op voorwerp A, maar in die
 teenoorgestelde rigting. (3)

4.3	OPTION 1/ OPSIE 1 East as positive/Oos as positief: $\Sigma p_i = \Sigma p_f$ ✓ $0 \checkmark = (60)v_f + (5)(4) \checkmark$ $\therefore v_f = -0,33 \checkmark$ $\therefore v_f = 0,33 \text{ m}\cdot\text{s}^{-1} \checkmark$	OPTION 2/OPSIE 2 East as positive/Oos as positief: $\Delta p_A = -\Delta p_B \checkmark$ $(60)v_f \checkmark - 0 = -[(5)(4) - 0] \checkmark$ $\therefore v_f = -0,33 \checkmark$ $\therefore v_f = 0,33 \text{ m}\cdot\text{s}^{-1} \checkmark$
	West as positive/Wes as positief: $\Sigma p_i = \Sigma p_f \checkmark$ $0 \checkmark = (60)v_f + (5)(-4) \checkmark$ $\therefore v_f = 0,33 \text{ m}\cdot\text{s}^{-1} \checkmark \checkmark$	West as positive/Wes as positief: $\Delta p_A = -\Delta p_B \checkmark$ $(60)v_f \checkmark - 0 = -[(5)(-4) - 0] \checkmark$ $\therefore v_f = 0,33 \text{ m}\cdot\text{s}^{-1} \checkmark \checkmark$
	OPTION 3/ OPSIE 3 East as positive/Oos as positief $F_{BP} = -F_{PB} \checkmark$ $m_B a_B = -m_P a_P$ $m_B \left(\frac{v_{Bf} - v_{Bi}}{\Delta t} \right) = -m_P \left(\frac{v_{Pf} - v_{Pi}}{\Delta t} \right)$ $(60) \left(\frac{v_{Bf} - 0}{\Delta t} \right) \checkmark = - (5) \left(\frac{4 - 0}{\Delta t} \right) \checkmark$ $v_{Bi} = -0,33 \text{ m}\cdot\text{s}^{-1} \checkmark$ $= 0,33 \text{ m}\cdot\text{s}^{-1} \checkmark$	OPTION 4/ OPSIE 4 West as positive/Wes as positief $F_{BP} = -F_{PB} \checkmark$ $m_B a_B = -m_P a_P$ $m_B \left(\frac{v_{Bf} - v_{Bi}}{\Delta t} \right) = -m_P \left(\frac{v_{Pf} - v_{Pi}}{\Delta t} \right)$ $(60) \left(\frac{v_{Bf} - 0}{\Delta t} \right) \checkmark = - (5) \left(\frac{-4 - 0}{\Delta t} \right) \checkmark$ $v_{Bi} = 0,33 \text{ m}\cdot\text{s}^{-1} \checkmark \checkmark$

4.4
 4.4.1 Increases / Verhoog ✓ (1)

4.4.2 Increases / Verhoog ✓



- Δp package increases, thus Δp boy increases. ✓
 Δp pakkie vermeerder, dus Δp seun vermeerder.
- For the same mass of boy, v will be greater. ✓
Vir dieselfde massa van die seun sal v groter wees.

OR/OF

Increases / Verhoog ✓



From the equation in QUESTION 4.3: $-m_A v_{Af} = m_B v_{Bf}$

Vanaf die vergelyking in VRAAG 4.3: $-m_A v_{Af} = m_B v_{Bf}$

- If mass of package/B doubles/increases, the momentum of the boy / A doubles / increases. ✓
Indien die massa van pakkie / B verdubbel / toeneem, verdubbel / vermeerder die momentum van die seun / A
- For same mass of boy / A, the velocity of boy / A doubles/increases. ✓
Vir dieselfde massa van die seun / A, verdubbel/vermeerder die snelheid van die seun / A.

OR/OF

Increases / Verhoog ✓



$$-m_B v_{Bf} = m_p v_{pf}$$

$$v_B = \frac{-m_p v_{pf}}{m_B} \quad \checkmark \text{ for same } m_B, \text{ if } m_p \text{ doubles, } \checkmark \text{ then } v_B \text{ doubles}$$

(3)
[13]

QUESTION 5/VRAAG 5

- 5.1 The total mechanical energy remains constant / is conserved ✓
in a closed / isolated system / in absence of external forces / non-conservative forces. ✓
Die totale meganiese energie in bly konstant / bly behoue
in 'n geslote / geïsoleerde sisteem / in afwesigheid van eksterne kragte / nie-konserwatiewe kragte.

OR/OF

The sum of the potential and kinetic energy of a system remains constant ✓
in a closed/isolated system. ✓

Die som van die potensiële en kinetiese energie van 'n sisteem bly konstant
in 'n geslote / geïsoleerde sisteem.

OR/OF

When the work done on an object by the non-conservative forces is zero ✓,
the total mechanical energy is conserved. ✓

Wanneer die arbeid deur die nie-konserwatiewe kragte op 'n voorwerp verrig nul is, bly die totale meganiese energie behoue.

(2)

5.2

OPTION 1/OPSIE 1

$$\left. \begin{aligned} E_{\text{mechanical at X}} &= E_{\text{mechanical at Y}} \\ (E_p + E_k)_X &= (E_p + E_k)_Y \\ (mgh + \frac{1}{2}mv^2)_X &= (mgh + \frac{1}{2}mv^2)_Y \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$\underline{5(9,8)(5) + \frac{1}{2}(5)(0^2)} \checkmark = \underline{5(9,8)(1) + \frac{1}{2}(5)v_f^2} \checkmark$$

$$v = 8,85 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 2/OPSIE 2

$$\left. \begin{aligned} E_{\text{mechanical at X}} &= E_{\text{mechanical at Y}} \\ (E_p + E_k)_X &= (E_p + E_k)_Y \\ (mgh + \frac{1}{2}mv^2)_X &= (mgh + \frac{1}{2}mv^2)_Y \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$\underline{5(9,8)(4) + \frac{1}{2}(5)(0^2)} \checkmark = \underline{5(9,8)(0) + \frac{1}{2}(5)v_f^2} \checkmark$$

$$v = 8,85 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(4)

5.3

Weight / gravitational (force) / (force of) gravity $\checkmark$

Gewig / Gravitasie(krag)

Normal force / Normaalkrag $\checkmark$

(2)

5.4

Z to/na Y $\checkmark$

(1)

5.5

OPTION 1/OPSIE 1

$$W_{\text{net}} = \Delta K \checkmark$$

$$W_w + W_f = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$mg\Delta y \cos 0^\circ + f\Delta x \cos 180^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$(5)(9,8)(1)(1) \checkmark + (10)\Delta x(-1) \checkmark = \frac{1}{2}(5)(4^2 - 8,85^2) \checkmark$$

$$\Delta x = 20,48 \text{ m} \checkmark$$

OPTION 2/OPSIE 2

$$W_{\text{net}} = \Delta K \checkmark$$

$$W_w + W_f = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$-\Delta E_p + W_f = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$-(0 - mgh) + f\Delta x \cos 180^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$(5)(9,8)(1) \checkmark + (10)\Delta x(-1) \checkmark = \frac{1}{2}(5)(4^2 - 8,85^2) \checkmark$$

$$\Delta x = 20,48 \text{ m} \checkmark$$

OPTION 3/OPSIE 3

$$W_{\text{net}} = \Delta K \checkmark$$

$$W_w + W_f = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$-\Delta E_p + W_f = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$-(0 - mgh) + f\Delta x \cos 180^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$(5)(9,8)(5) \checkmark + (10)\Delta x(-1) \checkmark = \frac{1}{2}(5)(4^2 - 0^2) \checkmark$$

$$\Delta x = 20,48 \text{ m} \checkmark$$

OPTION 4/OPSIE 4

$$W_{\text{net}} = \Delta K \checkmark$$

$$W_w + W_f = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$mg\Delta x \cos(90^\circ - \theta) + f\Delta x \cos 180^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$mg\Delta x \sin \theta + f\Delta x \cos 180^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$mg\Delta x \left(\frac{1}{\Delta x} \right) + f\Delta x \cos 180^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$(5)(9,8) \checkmark + (10)\Delta x(-1) \checkmark = \frac{1}{2}(5)(4^2 - 8,85^2) \checkmark$$

$$\Delta x = 20,48 \text{ m} \checkmark$$

OPTION 5/OPSIE 5

$$W_{\text{net}} = \Delta K \checkmark$$

$$W_{\text{wll}} + W_f = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$mg\sin\theta\Delta x\cos\theta + f\Delta x\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$mg\left(\frac{1}{\Delta x}\right)\Delta x\cos 0^\circ + f\Delta x\cos 180^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$(5)(9,8) \checkmark + (10)\Delta x(-1) \checkmark = \frac{1}{2}(5)(4^2 - 8,85^2) \checkmark$$

$$\Delta x = 20,48 \text{ m} \checkmark$$

OPTION 6/OPSIE 6

$$W_{\text{net}} = \Delta K \checkmark$$

$$F_{\text{net}}\Delta x\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$(10 - 49\sin\theta)\Delta x\cos 180^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$(10 - 49\left(\frac{1}{\Delta x}\right))\Delta x\cos 180^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$(10\Delta x - 49)(-1)\checkmark = \frac{1}{2}(5)(4^2 - 8,85^2) \checkmark$$

$$\Delta x = 20,48 \text{ m}$$

OPTION 7/OPSIE 7

$$W_{\text{nc}} = \Delta E_p + \Delta E_k \checkmark$$

$$f\Delta x\cos\theta = (mgh_f - mgh_i) + \left(\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2\right)$$

$$(10)\Delta x\cos 180^\circ \checkmark = [0 - (5)(9,8)(1)] \checkmark + \left[\frac{1}{2}(5)(4)^2 - \frac{1}{2}(5)(8,85)^2\right] \checkmark$$

$$\Delta x = 20,48 \text{ m} \checkmark$$

(5)

5.6 Equal to / Gelyk aan $\checkmark$

(1)

[15]

QUESTION 6/VRAAG 6

6.1 Doppler flow meter / Dopplervloeimeter $\checkmark$

(1)

6.2
$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \checkmark$$

$$985 \checkmark = \frac{v}{(v - 10,6)} \checkmark (954,3) \checkmark$$

$$v = 340,1 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(5)

6.3 Decreases / Afneem $\checkmark$

(1)

6.4  For a constant velocity of sound / speed $\checkmark$
if the frequency increases, λ decreases. $\checkmark$
Vir 'n konstante snelheid van klank /spoed,
as die frekwensie toeneem neem λ af.

OR/OF

$$\lambda \propto \frac{1}{f} \text{ or } f \propto \frac{1}{\lambda} \checkmark \text{ at constant velocity/speed / by konstante snelheid/spoed.. } \checkmark$$

(2)

[9]

QUESTION 7/VRAAG 7

- 7.1 The bending of waves around obstacles / corners / through an opening / aperture ✓✓
Die buiging van golwe om versperrings / hoeke / deur 'n opening.

OR/OF

The spreading of waves around the edge of a barrier/through an opening/aperture.

Die uitspreiding van golwe om die kant van 'n versperring/deur 'n opening. (2)

- 7.2 P ✓ (1)

7.3

- 7.3.1 Broadness of the central bright band / diffraction pattern / angle of diffraction / degree of diffraction / $\sin \theta$ / position of the first minimum ✓
Breedte van die sentrale helderband / diffraksiepatroon/hoek van diffraksie / mate van diffraksie / $\sin \theta$ / posisie van die eerste minimum (1)

7.3.2

Criteria for investigative question/Kriteria vir ondersoekende vraag:	
Dependent and independent variables correctly identified. <i>Afhanklike en onafhanklike veranderlikes korrek geïdentifiseer.</i>	✓
Question about the relationship between the independent and dependent variables correctly formulated. <i>Vraag oor die verwantskap tussen die afhanklike en onafhanklike veranderlikes korrek geformuleer.</i>	✓

Example/Voorbeeld:

What is the relationship between the broadness of the central band and the wavelength (of light used)?

Wat is die verwantskap tussen die breedte van die sentrale band en die golflengte (van die lig)? (2)

7.4

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$\sin \theta = \frac{m\lambda}{a}$ ✓ $\sin \theta = \frac{(2)(410 \times 10^{-9})}{5 \times 10^{-6}}$ ✓ $\therefore \theta = 9,44^\circ$ ✓ or $9,21^\circ$	$\sin \theta = \frac{m\lambda}{a}$ ✓ $\sin \theta = \frac{(-2)(410 \times 10^{-9})}{5 \times 10^{-6}}$ ✓ $\therefore \theta = -9,44^\circ$ ✓ or $-9,21^\circ$

(5)

7.5

Light (bright) and dark bands. ✓

Light /dark bands of equal width. ✓

Lig (helder) en donker bande eweredig gespaseer.

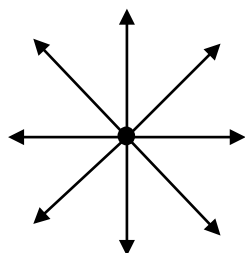
Helder / donker bande van gelyke breedte /wydte.

(2)

[13]

QUESTION 8/VRAAG 8

8.1



Criteria for sketch:/Kriteria vir skets:	
Correct shape - field lines radially around charge. <i>Korrekte vorm – veldlyne radiaal uitwaarts.</i>	✓
Direction of field lines away from charge. <i>Rigting van veldlyne weg van lading af.</i>	✓

(2)

8.2 Non-uniform / Nie-uniform ✓

(1)

8.3

$$E = \frac{kQ}{r^2} \checkmark$$

$$= \frac{(9 \times 10^9)(16 \times 10^{-6})}{(0,12)^2} \checkmark$$

$$= 1 \times 10^7 \text{ N} \cdot \text{C}^{-1} \checkmark \text{ east/oos } \checkmark$$

(5)

8.4 Positive / Positief ✓

(1)

8.5

West: positive	West: negative
$E_A + E_B = E_{\text{net}}$ $-1 \times 10^7 + E_B \checkmark = 1 \times 10^7 \checkmark$ $\therefore E_B = 2 \times 10^7 \text{ N} \cdot \text{C}^{-1}$ $E_B = \frac{kQ_B}{r^2}$ $\therefore 2 \times 10^7 \checkmark = \frac{(9 \times 10^9)Q_B}{(0,23)^2} \checkmark$ $\therefore Q_B = 1,18 \times 10^{-4} \text{ C } \checkmark$	$E_A + E_B = E_{\text{net}}$ $1 \times 10^7 + E_B \checkmark = -1 \times 10^7 \checkmark$ $\therefore E_B = -2 \times 10^7 \text{ N} \cdot \text{C}^{-1}$ $= 2 \times 10^7 \text{ N} \cdot \text{C}^{-1}$ $E_B = \frac{kQ_B}{r^2}$ $\therefore 2 \times 10^7 \checkmark = \frac{(9 \times 10^9)Q_B}{(0,23)^2} \checkmark$ $\therefore Q_B = 1,18 \times 10^{-4} \text{ C } \checkmark$
(5)	(5)

(5)

[14]

QUESTION 9/VRAAG 9

9.1

12 J of energy are transferred to / work done on ✓
each coulomb (of charge) / per C charge ✓ passing through the battery.

12 J energie word oorgedra aan / arbeid word verrig op
elke coulomb (lading) / per C lading wat deur die battery beweeg.

(2)

9.2

<u>OPTION 1/OPSIE 1</u> $P = I^2 R \checkmark$ $5 = I^2(5) \checkmark$ $\therefore I = 1 \text{ A} \checkmark$	
<u>OPTION 2/OPSIE 2</u> $P = \frac{V^2}{R}$ $5 = \frac{V^2}{5} \checkmark$ $V = 5 \text{ V}$ $P = VI$ $5 = (5)I \checkmark$ $I = 1 \text{ A} \checkmark$	<u>OPTION 3/OPSIE 3</u> $P = \frac{V^2}{R}$ $5 = \frac{V^2}{5} \checkmark$ $V = 5 \text{ V}$ $V = IR$ $5 = I(5) \checkmark$ $I = 1 \text{ A} \checkmark$

(3)

9.3

<u>OPTION 1 / OPSIE 1</u> $\text{Emf} = I(R + r) \checkmark$ $12 \checkmark = (1)(R + 1)$ $R = 11 \Omega$ $R_p = 11 - 5 \checkmark = 6 \Omega$	<u>OPTION 2 / OPSIE 2</u> $\text{Emf} = I(R + r) \checkmark$ $12 \checkmark = (1)(R_p + 5 + 1) \checkmark$ $\therefore R_p = 6 \Omega$	<u>OPTION 3/OPSIE 3</u> $V = I R_T \checkmark$ $12 \checkmark = (1)R$ $R_T = 12 \Omega$ $\downarrow$ $R_p = R_T - (5 + 1)$ $= 12 - 6 \checkmark$ $= 6 \Omega$
$\frac{1}{R_p} = \frac{1}{R_{12}} + \frac{1}{R} \therefore \frac{1}{6 \checkmark} = \frac{1}{12 \checkmark} + \frac{1}{4 + R_x \checkmark} \therefore \frac{1}{12} = \frac{1}{4 + R_x} \therefore 12 = 4 + R_x \therefore R_x = 8 \Omega \checkmark$		
<u>OR/OF</u> $R_p = \frac{(4 + R_x)(12)}{4 + R_x + 12} \therefore R_p = \frac{(4 + R_x)(12)}{4 + R_x + 12} \therefore 6 = \frac{(4 + R_x)(12)}{4 + R_x + 12} \therefore R_x = 8 \Omega \checkmark$		
<u>OPTION 4/OPSIE 4</u> $V_{5\Omega} = IR \checkmark$ $= (1)(5)$ $= 5 \text{ V}$ $V_{\text{internal}} = Ir$ $= (1)(1)$ $= 1 \text{ V}$ $V_{\text{parallel}} = 12 \checkmark - (1 + 5) \checkmark$ $= 6 \text{ V}$	$V_{\text{parallel}} = IR$ $6 = I(12) \checkmark$ $\therefore I = 0,5 \text{ A}$ $I_{R_x} = 1 - 0,5$ $= 0,5 \text{ A}$	$V = IR$ $6 \checkmark = (0,5)(4 + R_x) \checkmark$ $\therefore R_x = 8 \Omega \checkmark$

(7)

9.4 No / Nee ✓



Total resistance (R) increases. / Totale weerstand (R) neem toe. ✓

Current (I) decreases / Stroom (I) neem af. ✓

(For a constant R) power ($P = I^2R$) decreases. ✓

(Vir konstante R) drywing ($P = I^2R$) verminder. ✓

(4)
[16]

QUESTION 10/VRAAG 10

10.1

10.1.1 slip rings / *sleepringe* ✓

(1)

10.1.2 brush(es) / *borsel(s)* ✓

(1)

10.2 Maintains electrical contact with the slip rings.
Handhaaf elektriese kontak met die sleepringe.

OR/OF

To take current out/in of the coil.

Om die stroom uit/in die spoel te neem.

(1)

10.3 Mechanical /kinetic energy to electrical energy. ✓

Meganiese / kinetiese energie na elektriese energie.

(1)

10.4 $1\frac{1}{2}$ ✓

(1)

10.5

OPTION 1/ OPSIE 1

$$f = \frac{1}{T} \quad \checkmark$$

$$= \frac{1}{0,02} \quad \checkmark$$

$$= 50 \text{ Hz} \quad \checkmark$$

(3)

OPTION 2/ OPSIE 2

$$f = \frac{\text{number of cycles}}{\text{time}} \quad \checkmark$$

$$= \frac{1,5}{0,03} \text{ or/of } \frac{1}{0,02} \text{ or/of } \frac{0,5}{0,01} \quad \checkmark$$

$$= 50 \text{ Hz} \quad \checkmark$$

(3)

(3)

10.6 Parallel to / *Parallel aan* ✓

(1)

10.7

<u>OPTION 1/ OPSIE 1</u> $P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$ $= \left(\frac{V_{\text{max}}}{\sqrt{2}} \right) \left(\frac{I_{\text{max}}}{\sqrt{2}} \right) \checkmark \quad (1 \text{ mark for both formulae} / 1 \text{ punt vir beide formules})$ $= \left(\frac{311}{\sqrt{2}} \right) \checkmark \left(\frac{21,21}{\sqrt{2}} \right) \checkmark$ $= 3\,298,16 \text{ W} \checkmark \quad (\text{Accept range} / \text{Aanvaar gebied: } 3298,13 - 3299,18 \text{ W})$	
<u>OPTION 2/ OPSIE 2</u> $P_{\text{ave}} = \frac{V_{\text{max}} I_{\text{max}}}{2} \checkmark \checkmark$ $= \frac{(311)(21,21)}{2} \checkmark \checkmark$ $= 3298,16 \text{ W} \checkmark$	<u>OPTION 3 / OPSIE 3</u> $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} = \frac{311}{\sqrt{2}} \checkmark = 219,91 \text{ V}$ $I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}} = \frac{21,21}{\sqrt{2}} \checkmark = 14,998 \text{ A}$ $P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$ $= (219,91)(14,998)$ $= 3\,298,21 \text{ W} \checkmark$
<u>OPTION 4/ OPSIE 4</u> $R = \frac{V_{\text{max}}}{I_{\text{max}}} \checkmark$ $= \frac{311}{21,21}$ $= 14,66 \, \Omega$ $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} = \frac{311}{\sqrt{2}} \checkmark = 219,91 \text{ V}$ $P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark$ $= \frac{(219,91)^2}{14,66} \checkmark$ $= 3\,298,8 \text{ W} \checkmark$	<u>OPTION 6/OPSIE 6</u> $R = \frac{V_{\text{max}}}{I_{\text{max}}} \checkmark$ $= \frac{311}{21,21}$ $= 14,66 \, \Omega$ $I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}} = \frac{21,21}{\sqrt{2}} \checkmark = 14,998 \text{ A}$ $P_{\text{ave}} = I_{\text{rms}}^2 R \checkmark$ $= (14,998)^2 (14,66) \checkmark$ $= 3\,297,62 \text{ W} \checkmark$

(5)
[14]

QUESTION 11/VRAAG 11

11.1

11.1.1 Photo-electric effect / Foto-elektriese effek $\checkmark$

(1)

11.1.2

OPTION 1/OPSIE 1

$$E = W_0 + E_k$$

$$hf = hf_0 + E_k$$

$$\frac{hc}{\lambda} = W_0 + \frac{1}{2}mv^2$$

✓ Any one/Enige een

$$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{200 \times 10^{-9}} \checkmark = 8 \times 10^{-19} \checkmark + \frac{1}{2}(9,11 \times 10^{-31})v^2 \checkmark$$

$$v = 6,53 \times 10^5 \text{ m} \cdot \text{s}^{-1} \checkmark (653454,89 \text{ m} \cdot \text{s}^{-1})$$

OPTION 2 / OPSIE 2

$$c = f\lambda$$

$$3 \times 10^8 = f(200 \times 10^{-9})$$

$$f = 1,5 \times 10^{15} \text{ Hz}$$

$$hf = hf_0 + E_k \checkmark$$

$$(6,63 \times 10^{-34})(1,5 \times 10^{15}) \checkmark = 8 \times 10^{-19} \checkmark + \frac{1}{2}(9,11 \times 10^{-31})v^2 \checkmark$$

$$v = 6,53 \times 10^5 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(5)

11.1.3 Increases / Vermeerder ✓

(1)

11.1.4 Remains the same / Bly dieselfde ✓



Intensity only affects number of photoelectrons emitted per second. ✓

Intensiteit beïnvloed slegs die getal foto-elektrone vrygestel per sekonde.

OR/OF

Remains the same / Bly dieselfde ✓



The kinetic energy of the emitted photoelectrons remains the same.

Die kinetiese energie van die vrygestelde foto-elektrone bly dieselfde.

OR/OF

Remains the same / Bly dieselfde ✓



Only the frequency/wavelength of the incident light affects the maximum kinetic energy.

Slegs the frekwensie/golflengte van die invallende lig beïnvloed die maksimum kinetiese energie.

(2)

11.2 B ✓

Orange light has a higher frequency than red light. ✓

Oranje lig het 'n hoër frekwensie as rooi lig.

OR/OF

Orange light has smaller wavelength than red light.

Oranje lig het 'n kleiner golflengte as rooi lig.

(2)

11.3 Line emission (spectra) / Lyn emissie(spektrum) ✓

(1)

[12]

TOTAL SECTION B/TOTAAL AFDELING B: 125
GRAND TOTAL/GROOTTOTAAL: 150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

FEBRUARY/MARCH/FEBRUARIE/MAART 2013

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 18 pages.
*Hierdie memorandum bestaan uit 18 bladsye.***

SECTION A

QUESTION 1/VRAAG 1

1.1	X-rays/X-strale✓	(1)
1.2	Momentum ✓	(1)
1.3	Huygens (principle)/Huygens (se beginsel)✓	(1)
1.4	ampere/ampère ✓	(1)
1.5	Isolated/closed ✓ Geïsoleerde/geslote	(1) [5]

QUESTION 2/VRAAG 2

2.1	B ✓✓	(2)
2.2	A ✓✓	(2)
2.3	A ✓✓	(2)
2.4	D ✓✓	(2)
2.5	A ✓✓	(2)
2.6	D ✓✓	(2)
2.7	B ✓✓	(2)
2.8	A ✓✓	(2)
2.9	B ✓✓	(2)
2.10	C ✓✓	(2)
- [20]**

TOTAL SECTION A/TOTAAL AFDELING A: 25

SECTION B/AFDELING B

QUESTION 3/VRAAG 3

3.1 50 N ✓ downwards/afwaarts✓

(2)

3.2

3.2.1

<u>OPTION 1/OPSIE 1</u> Downward positive: Afwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $\therefore v_f^2 = 0^2 + 2(9,8)(0,8)$ ✓ $\therefore v_f = 3,96 \text{ m}\cdot\text{s}^{-1}$ ✓ downward /afwaarts✓ Downward negative: Afwaarts negatief: $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $\therefore v_f^2 = 0^2 + 2(-9,8)(-0,8)$ ✓ $\therefore v_f = -3,96 \text{ m}\cdot\text{s}^{-1}$ $\therefore v_f = 3,96 \text{ m}\cdot\text{s}^{-1}$ ✓ downward /afwaarts✓	<u>Notes/Aantekeninge</u> Accept/Aanvaar: g or/of a Accept/Aanvaar: $v_f^2 = v_i^2 + 2a\Delta x$ $v^2 = u^2 + 2as$
<u>OPTION 2/OPSIE 2</u> $(E_p + E_k)_{\text{top/bo}} = (E_p + E_k)_{\text{bottom/onder}}$ ✓ $mgh + 0 = 0 + \frac{1}{2}mv^2$ $(9,8)(0,8) \checkmark = \frac{1}{2}v^2$ $v = 3,96 \text{ m}\cdot\text{s}^{-1}$ ✓ downward/afwaarts✓	<u>Notes/Aantekeninge</u> Accept/Aanvaar: $(U + K)_{\text{top/bo}} = (U + K)_{\text{bottom/onder}}$

(4)

3.2.2

POSITIVE MARKING FROM QUESTION 3.2.1 POSITIEWE NASIEN VAN VRAAG 3.2.1 OPTION 1/OPSIE 1 Downward positive/Afwaarts positief: $F_{\text{net}}\Delta t = \Delta p$ OR $F_{\text{net}}\Delta t = m(v_f - v_i)$ ✓ $(F_{\text{app}} + mg)\Delta t = \Delta p$ $(-50 + (0,2)(9,8))\Delta t = 0,2(-3,43 - 3,96)$ ✓ $\therefore \Delta t = 0,03 \text{ s}$ ✓ ($3 \times 10^{-2} \text{ s}$) Downward negative/Afwaarts negatief: $F_{\text{net}}\Delta t = \Delta p$ OR $F_{\text{net}}\Delta t = m(v_f - v_i)$ ✓ $(F_{\text{app}} + mg)\Delta t = \Delta p$ $(50 - (0,2)(9,8))\Delta t = 0,2[3,43 - (-3,96)]$ ✓ $\therefore \Delta t = 0,03 \text{ s}$ ✓ ($3 \times 10^{-2} \text{ s}$)	Notes/Aantekeninge: Substitution: F_{app} and v_f must have the same sign. Substitusie: F_{app} en v_f moet dieselfde tekens hê.
OPTION 2/OPSIE 2 Downward positive/Afwaarts positief: $F_{\text{net}} = ma$ $F_{\text{app}} + mg = ma$ $(-50 + (0,2)(9,8)) = 0,2a$ ✓ $\therefore a = -240,2 \text{ m}\cdot\text{s}^{-2}$ ✓ both formulae beide formules $v_f = v_i + a \Delta t$ $-3,43 = 3,96 + (-240,2)\Delta t$ ✓ $\therefore \Delta t = 0,03 \text{ s}$ ✓ ($3 \times 10^{-2} \text{ s}$) Downward negative/Afwaarts negatief: $F_{\text{net}} = ma$ $F_{\text{app}} + mg = ma$ $(50 - (0,2)(9,8)) = 0,2a$ ✓ $\therefore a = 240,2 \text{ m}\cdot\text{s}^{-2}$ ✓ both formulae beide formules $v_f = v_i + a \Delta t$ $3,43 = -3,96 + (240,2)\Delta t$ ✓ $\therefore \Delta t = 0,03 \text{ s}$ ✓ ($3 \times 10^{-2} \text{ s}$)	Notes/Aantekeninge Accept/Aanvaar: $v = u + at$ $v_f = v_i + a \Delta t$

(4)

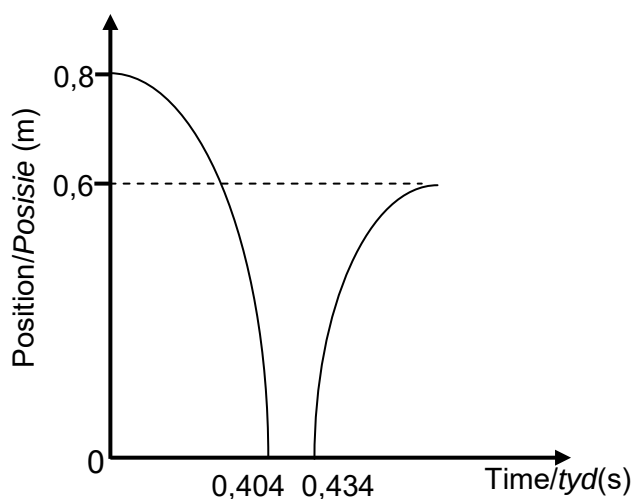
3.3 **POSITIVE MARKING FROM QUESTION 3.2.**
POSITIEWE NASIEN VAN VRAAG 3.2.

OPTION/OPSIE 1

Ground as zero reference and downward negative:

Grond as nulverwysing en afwaarts negatief:

Criteria for graph/Kriteria vir grafiek:	Marks/ Punte
Correct shape (both curves) <i>Korrekte vorm (beide krommes)</i>	✓
Graph starts at $y = 0,8$ m at $t = 0$ s <i>Grafiek begin by $y = 0,8$ m at $t = 0$ s</i>	✓
Second maximum height at $y = 0,6$ m <i>Tweede maksimum by $y = 0,6$ m s</i>	✓
Contact time shown as space on x axis between two curves. <i>Kontaktyd aangetoon as spasie op x-as tussen twee krommes.</i>	✓
Time at which ball leaves the floor shown as $t = 0,434$ s. <i>Tyd wanneer die bal die vloer verlaat getoon as $t = 0,434$ s.</i>	✓

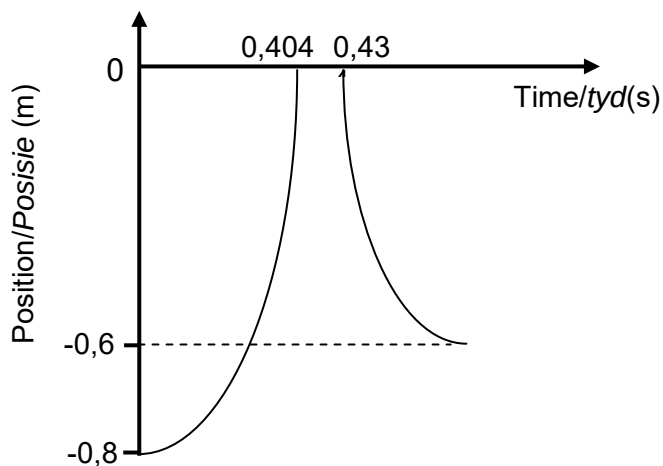


OPTION/OPSIE 2

Ground as zero reference and downward positive:

Grond as nulverwysing en afwaarts positief:

Criteria for graph/Kriteria vir grafiek:	Marks/ Punte
Correct shape (both curves) <i>Korrekte vorm (beide krommes)</i>	✓
Graph starts at $y = -0,8$ m at $t = 0$ s <i>Grafiek begin by $y = -0,8$ m at $t = 0$ s</i>	✓
Second maximum height at $y = -0,6$ m <i>Tweede maksimum by $y = -0,6$ m</i>	✓
Contact time shown as space on x axis between two curves. <i>Kontaktyd aangetoon as spasie op x-as tussen twee krommes.</i>	✓
Time at which ball leaves the floor shown as $t = 0,434$ s. <i>Tyd wanneer die bal die vloer verlaat getoon as $t = 0,434$ s.</i>	✓



(5)
[15]

QUESTION 4/VRAAG 4

- 4.1 The total (linear) momentum remains constant/is conserved ✓
in an isolated/a closed system/the absence of external forces. ✓

*Die totale lineêre momentum bly konstant/behoue ✓
in 'n geïsoleerde sisteem/geslote sisteem/die afwesigheid van eksterne kragte. ✓*

Notes/Aantekeninge:

The mark for 'closed/isolated system' is only awarded if used in conjunction with momentum.

Die punt vir 'geslote/geïsoleerde sisteem' word slegs toegeken indien saam met momentum gebruik.

Accept: The total momentum before a collision equals the total momentum after a collision in a closed system.

Aanvaar: *Die totale momentum voor 'n botsing is gelyk aan die totale momentum na 'n botsing in 'n geslote sisteem.*

(2)

- 4.2 **To the right as positive/Na regs as positief:**

$$\Sigma p_{\text{before/voor}} = \Sigma p_{\text{after/na}} \quad \checkmark$$

$$(0,01)(300) \checkmark + (1,99)(0) = (0,01 + 1,99)v_{f2} \checkmark$$

$$\therefore v_{f2} = 1,5 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

To the right as negative/Na regs as negatief:

$$\Sigma p_{\text{before/voor}} = \Sigma p_{\text{after/na}} \quad \checkmark$$

$$(0,01)(-300) \checkmark + (1,99)(0) = (0,01 + 1,99)v_{f2} \checkmark$$

$$\therefore v_{f2} = -1,5 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_{f2} = 1,5 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

Other formulae/Ander formules:

$$m_1 v_{i1} + m_2 v_{i2} = m_1 v_{f1} + m_2 v_{f2}$$

or/of

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$$

or/of

$$m_1 v_{i1} + m_2 v_{i2} = (m_1 + m_2) v_{f2}$$

Notes/Aantekeninge:

If no formula/principle – Max. $\frac{3}{4}$

Indien geen formule/beginsel – Maks. $\frac{3}{4}$

(4)

- 4.3 Inelastic/Onelasties ✓

Kinetic energy is not conserved./Kinetiese energie bly nie behoue nie. ✓

OR/OF

Inelastic/Onelasties ✓

Objects stick together/Voorwerpe heg aan mekaar. ✓

OR/OF

Inelastic/Onelasties ✓

Structural damage to the block./Strukturele skade aan blok. ✓

OR/OF

Inelastic/Onelasties ✓

There is deformation to the block/bullet./Daar is vervorming van die blok. ✓

OR/OF

Inelastic/Onelasties ✓

Energy converted to other forms such as sound and heat./Energie word omgeskakel na ander vorms soos klank en hitte. ✓

(2)

4.4 **POSITIVE MARKING FROM QUESTION 4.2.**
POSITIEF NASIEN VAN VRAAG 4.2.

Option 1/Opsie 1: $W_{\text{net}} = \Delta K \checkmark$ OR / OF $F_{\text{net}} \Delta x \cos \theta = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$ $(8) \Delta x \cos 180^\circ \checkmark = \frac{1}{2} (2) (0^2 - 1,5^2) \checkmark$ $\therefore \Delta x = 0,28 \text{ m} \checkmark$	Notes/Aantekeninge: Accept/Aanvaar: E_k
Option 2/Opsie 2: $F_{\text{net}} = ma$ $\therefore (-8) = 2a \checkmark$ $\therefore a = -4 \text{ m} \cdot \text{s}^{-2}$ $v_f^2 = v_i^2 + 2a\Delta x$ $0^2 = (1,5)^2 + 2(-4) \Delta x \checkmark$ $\therefore \Delta x = 0,28 \text{ m} \checkmark$	Notes/Aantekeninge: Accept/Aanvaar: $v_f^2 = v_i^2 + 2a\Delta y$ $v^2 = u^2 + 2as$

✓ Both
formulae
Beide
formules

(4)
[12]

QUESTION 5/VRAAG 5

- 5.1 The total mechanical energy remains constant/is conserved ✓
 in an isolated/closed system. ✓
 Die totale meganiese energie bly konstant/bly behoue
 in 'n geïsoleerde/geslote sisteem

OR/OF

The sum of the potential and kinetic energy remains constant ✓
 in an isolated/closed system. ✓
 Die som van die potensiële en kinetiese energies bly konstant
 in 'n geïsoleerde/geslote sisteem

Notes/Aantekeninge:

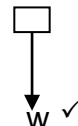
The mark for 'closed/isolated system' is only awarded if used in conjunction with energy.
 Die punt vir 'geslote/geïsoleerde sisteem' word slegs toegeken indien saam met energie gebruik.

(2)

5.2

5.2.1 **Free-body diagram**
Vrye kragtediagram

Accept/Aanvaar: Force diagram/kragtediagram



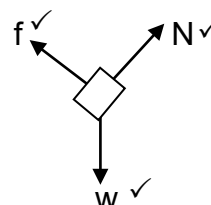
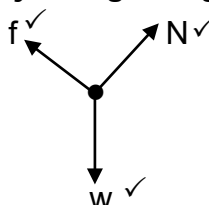
Accepted labels/Aanvaarde benoemings	
w	F_g/F_w /force of Earth on boy/weight/392 N/mg/gravitational force F_g/F_w /krag van Aarde op seun/gewig/392 N/mg/gravitasiekrag

(1)

5.2.2

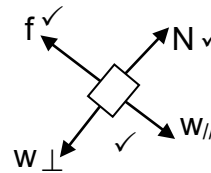
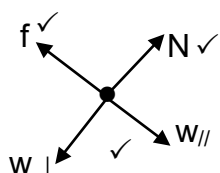
Free-body diagram
Vrye kragtediagram

Accept: Force diagram
Aanvaar: Kragtediagram



OR/OF

OR/OF



Accepted labels/Aanvaarde benoemings	
w	F_g/F_w /force of Earth on girl/weight/215,6 N/mg/gravitational force F_g/F_w /krag van Aarde op meisie/gewig/215,6 N/mg/gravitasiekrag
f	F_{friction}/F_f /friction $F_{\text{wrywing}}/F_f/F_w$ /wrywing
N	F_N/F_{normal} /normal force/force of slide or surface on girl

(3)

5.3

$$K_i + U_i = K_f + U_f \checkmark \quad \text{OR} \quad \frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$$

$$0 + (40)(9,8)(1,5) \checkmark = \frac{1}{2}(40)v_f^2 + 0 \checkmark$$

$$\therefore v_f = 5,42 \text{ m} \cdot \text{s}^{-1} \checkmark$$

Notes/Aantekeninge:
Accept/Aanvaar
 E_p & E_k

(4)

5.4

<u>Option 1/Opsie 1</u> $W_{\text{net}} = \Delta K \checkmark$ $w\Delta x \cos \theta + f\Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $mg\Delta x \cos \theta + f\Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $(22)(9,8)(3)\cos 60^\circ \checkmark + (1,9)(3)\cos 180^\circ \checkmark = \frac{1}{2}(22)(v_f^2 - 0^2) \checkmark$ $\therefore v_f = 5,37 \text{ m}\cdot\text{s}^{-1} \checkmark$	Accept/ Aanvaar: $\Delta y/\Delta x$
<u>Option 2/Opsie 2</u> $W_{\text{net}} = \Delta K \checkmark$ $w\Delta x \cos \theta + f\Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $mgsin \theta x \cos \theta + f\Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $(22)(9,8)\sin 30^\circ(3)\cos 0^\circ \checkmark + (1,9)(3)\cos 180^\circ \checkmark = \frac{1}{2}(22)(v_f^2 - 0^2) \checkmark$ $\therefore v_f = 5,37 \text{ m}\cdot\text{s}^{-1} \checkmark$	Accept/ Aanvaar: $\Delta y/\Delta x$
<u>Option 3/Opsie 3</u> $W_{\text{net}} = \Delta K \checkmark$ $mgh \cos \theta + f\Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $(22)(9,8)(1,5)\cos 0^\circ \checkmark + (1,9)(3)\cos 180^\circ \checkmark = \frac{1}{2}(22)(v_f^2 - 0^2) \checkmark$ $\therefore v_f = 5,37 \text{ m}\cdot\text{s}^{-1} \checkmark$	Accept/ Aanvaar $h/\Delta y/\Delta x$
<u>Option 4/Opsie 4</u> $W_{\text{net}} = \Delta K \checkmark$ $-\Delta U + W_f = \Delta K$ $-(mgh_f - mgh_i) + W_f = \Delta K$ $-(0 - (22)(9,8)(1,5)) \checkmark + (1,9)(3)\cos 180^\circ \checkmark = \frac{1}{2}(22)(v_f^2 - 0^2) \checkmark$ $\therefore v_f = 5,37 \text{ m}\cdot\text{s}^{-1} \checkmark$	Accept/ Aanvaar $h/\Delta y/\Delta x$

(5)

5.5 Equal to/Gelyk aan ✓

(1)
[16]

QUESTION 6/VRAAG 6

- 6.1 The approaching observer (higher f) passes the source at $t = 6$ s and moves away (lower f) from the source. ✓

Die naderende waarnemer (hoër f) beweeg verby die bron by $t = 6$ s en beweeg weg (laer f) van die bron af.

(1)

6.2

6.2.1

OPTION 1/OPSIE 1 Approaching observer: <i>Naderende waarnemer:</i> $f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \text{OR/OF} \quad f_L = \frac{v + v_L}{v} f_s \quad \checkmark$ $\therefore 900 \checkmark = \frac{340 + v_L}{340} \checkmark (850) \checkmark$ $\therefore v_L = 20 \text{ m} \cdot \text{s}^{-1} \checkmark$ OPTION 2 / OPSIE 2 Observer moving away: <i>Waarnemer beweeg weg:</i> $f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \text{OR/OF} \quad f_L = \frac{v - v_L}{v} f_s \quad \checkmark$ $\therefore 800 \checkmark = \frac{340 - v_L}{340} \checkmark (850) \checkmark$ $\therefore v_L = 20 \text{ m} \cdot \text{s}^{-1} \checkmark$	Notes: - Any other Doppler formula, e.g. $f_L = \frac{v - v_L}{v - v_s} - \text{Max. } \frac{3}{4}$ Aantekeninge: <i>Enige ander Dopplerformule, bv.</i> $f_L = \frac{v - v_L}{v - v_s} - \text{Maks. } \frac{3}{4}$

(5)

6.2.2 **POSITIVE MARKING FROM QUESTION 6.2.1**
POSITIEWE NASIEN van VRAAG 6.2.1

Option 1/Opsie 1: $\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$ $= (20)(6) \checkmark + \frac{1}{2}(0) \Delta t$ $\therefore \Delta x = 120 \text{ m} \quad \checkmark$ Option 2/Opsie 2: $\Delta x = v \Delta t \quad \checkmark$ $= (20)(6) \checkmark$ $\therefore \Delta x = 120 \text{ m} \quad \checkmark$	Notes/Aantekeninge Accept/Aanvaar: $s = ut / s = vt$ $s = ut + \frac{1}{2} at^2$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$

(3)
[9]

QUESTION 7/VRAAG 7

7.1 B ✓ (1)

7.2 Constructive ✓ interference ✓
Konstruktiewe interferensie (2)

7.3

7.3.1

$c = f\lambda$ ✓ $3 \times 10^8 = 4,54 \times 10^{14} \lambda$ ✓ $\therefore \lambda = 6,61 \times 10^{-7} \text{ m}$ ✓	Notes/Aantekeninge Accept/Aanvaar $v = f\lambda$

 (3)

7.3.2 **POSITIVE MARKING FROM QUESTION 7.3.1**
POSITIEWE NASIEN VAN VRAAG 7.3.1

OPTION 1/OPSIE 1 $\tan \theta = \frac{\frac{1}{2} \text{ central band}}{\text{screen distance}}$ $\therefore \tan \theta = \frac{\frac{1}{2}(0,2)}{1,5} \checkmark$ $\therefore \theta = 3,81^\circ$ $\sin \theta = \frac{m\lambda}{a} \checkmark$ $\sin 3,81^\circ \checkmark = \frac{(1)(6,61 \times 10^{-7})}{a} \checkmark$ $\therefore a = 9,95 \times 10^{-6} \text{ m} \checkmark$	Notes/Aantekeninge Accept final answer in range: $9,94 \times 10^{-6}$ to $9,95 \times 10^{-6} \text{ m}$ Aanvaar finale antwoorde in die gebied: $9,94 \times 10^{-6}$ to $9,95 \times 10^{-6} \text{ m}$ IF distance is not half of central band: Max $\frac{4}{6}$ INDIEN afstand nie helfte van sentrale band is nie: Maks $\frac{4}{6}$
OPTION 2/OPSIE 2 $\tan \theta = \frac{\frac{1}{2} \text{ central band}}{\text{screen distance}}$ $\therefore \tan \theta = \frac{\frac{1}{2}(0,2)}{1,5} \checkmark$ $\therefore \theta = 3,81^\circ$ $\sin \theta = \frac{m\lambda}{a} \checkmark$ $\sin(-3,81^\circ) \checkmark = \frac{(-1)(6,61 \times 10^{-7})}{a} \checkmark$ $\therefore a = 9,95 \times 10^{-6} \text{ m} \checkmark$	Notes/Aantekeninge Accept final answer in range: $9,94 \times 10^{-6}$ to $9,95 \times 10^{-6} \text{ m}$ Aanvaar finale antwoorde in die gebied: $9,94 \times 10^{-6}$ to $9,95 \times 10^{-6} \text{ m}$ IF distance is not half of central band: Max $\frac{4}{6}$ INDIEN afstand nie helfte van sentrale band is nie: Maks $\frac{4}{6}$

7.4 Decreases/Verminder ✓ (1)
[13]

QUESTION 8/VRAAG 8

- 8.1 Stores (electric) charge/energy. ✓
Stoor (elektriese) lading/energie.

OR/OF

Releases (stored) charge instantly/very fast. ✓
Stel (gestoorde) lading onmiddellik vry/baie vinnig vry. (1)

- 8.2 The brightness of the bulb decreases (gradually) ✓
until it stops glowing/dies.
Die helderheid van die gloeilamp verminder (geleidelik).

OR/OF

The bulb glows dimmer ✓
until it stops glowing/dies.
Die gloeilamp gloei flouer totdat dit ophou gloei/uitbrand. (1)

8.3

- 8.3.1 0 (V) ✓ (1)

- 8.3.2 12 V ✓ (1)

- 8.4 **POSITIVE MARKING FROM QUESTION 8.3.2.**
POSITIEWE NASIEN VAN VRAAG 8.3.2.

- 8.4.1 $E = \frac{V}{d}$ ✓
 $= \frac{12}{5,4 \times 10^{-3}}$ ✓
 $= 2,22 \times 10^3 \text{ V} \cdot \text{m}^{-1}$ ✓ (2 222,22 V·m⁻¹) (3)

- 8.4.2 **POSITIVE MARKING FROM QUESTION 8.4.1.**
POSITIEWE NASIEN VAN VRAAG 8.4.1.

$$E = \frac{F}{q} \quad \checkmark$$
$$\therefore 2,22 \times 10^3 = \frac{F}{1,6 \times 10^{-19}} \quad \checkmark$$
$$\therefore F = 3,56 \times 10^{-16} \text{ N} \quad \checkmark \quad (3)$$

8.5

- 8.5.1 5,4 mm – 3,8 mm = 1,6 mm ✓ (1)

8.5.2 **POSITIVE MARKING FROM QUESTION 8.4.2 & 8.5.1.**
POSITIEWE NASIEN VAN VRAAG 8.4.2 & 8.5.1.

$$\begin{aligned} W &= F\Delta x \cos \theta \checkmark \\ &= (3,56 \times 10^{-16})(1,6 \times 10^{-3}) \checkmark \cos 0^\circ \checkmark \\ &= 5,69 \times 10^{-19} \text{ J } \checkmark \end{aligned}$$

(4)
[15]

QUESTION 9/VRAAG 9

9.1

9.1.1 Potential difference/*Potensiaalverskil* ✓ (1)

9.1.2 Temperature/*Temperatuur* ✓
Resistance/*Weerstand* (1)

9.1.3 Current is directly proportional to potential difference. ✓✓
Stroom is direk eweredig aan potensiaalverskil

OR/OF

The ratio of potential difference to current is constant. ✓✓
Die verhouding van potensiaalverskil tot stroom is konstant.

IF/INDIEN:

Current is proportional to potential difference. ✓
Stroom is eweredig aan potensiaalverskil.

(2)

9.1.4

$$\begin{aligned} \text{Gradient}/m &= \frac{0,18 - 0}{0,5 - 0} \checkmark = 0,36 \\ R &= \frac{1}{0,36} = 2,78 \, \Omega \checkmark \checkmark \end{aligned}$$

Notes/Aantekeninge:

Accept any set of correct values from the graph.
Aanvaar enige stel waardes vanaf die grafiek.

(4)

9.2

9.2.1

$$\begin{aligned} \frac{1}{R_p} &= \frac{1}{R_1} + \frac{1}{R_2} \checkmark \\ &= \frac{1}{6} + \frac{1}{10} \checkmark \\ \therefore R_p &= 3,75 \, \Omega \checkmark \end{aligned}$$

(3)

9.2.2 **POSITIVE MARKING FROM QUESTION 9.2.1.**
POSITIEWE NASIEN VAN VRAAG 9.2.1.

OPTION 2 / OPSIE 2 $V_p = I_{10\Omega} R$ $= 0,6 \times 10 \checkmark$ $= 6 \text{ V}$ $I_p = \frac{V_p}{R_p}$ $= \frac{6}{3,75} \checkmark$ $= 1,6 \text{ A} \checkmark$ $\checkmark$ Any one Enige een	Notes/Aantekeninge Do not penalise for subscripts. <i>Moenie penaliseer indien onderskrifte weggelaat is nie.</i>

OPTION 1/OPSIE 2 $V_{10\Omega} = I_{10\Omega} R$ $= 0,6 \times 10 \checkmark$ $= 6 \text{ V}$ $I_{6\Omega} = \frac{V}{R}$ $= \frac{6}{6} \checkmark$ $= 1 \text{ A}$ $\downarrow$ $I_{\text{tot}} = 1 + 0,6 = 1,6 \text{ A} \checkmark$ $\checkmark$ Any one Enige een	Notes/Aantekeninge Do not penalise for subscripts. <i>Moenie penaliseer indien onderskrifte weggelaat is nie.</i>

(4)

9.2.3 **POSITIVE MARKING FROM QUESTION 9.2.1.**
POSITIEWE NASIEN VAN VRAAG 9.2.1.

$$E = I(R + r) \checkmark$$

$$30 \checkmark = 1,6(3,75 + 5 + 8 + r) \checkmark$$

$$\therefore r = 2 \Omega \checkmark$$

(4)

[19]

QUESTION 10/VRAAG 10

10.1 Q/split ring commutator/commutator ✓
Q/splitringkommutator/kommutator (1)

10.2 Replace Q/split ring commutator with slip rings. ✓
Vervang Q/splitringkommutator met sleepringe. (1)

10.3 AC can be stepped-up at power stations/WS kan by die kragstasie verhoog word ✓
to reduce energy loss during transmission./om energieverlies tydens transmissie te verminder. ✓ (2)

10.4
10.4.1

$$I_{\text{rms/wgk}} = \frac{I_{\text{max/maks}}}{\sqrt{2}} \checkmark$$

$$= \frac{0,35}{\sqrt{2}} \checkmark$$

$$\therefore I_{\text{rms/wgk}} = 0,25 \text{ A} \checkmark$$

Notes/Aantekeninge

If subscripts omitted: no mark for formula

Indien onderskifte weggelaat is: geen punt vir formule

(3)

10.4.2

OPTION 1/OPSIE 1

$$P_{\text{ave/gemid}} = \frac{V_{\text{rms/wgk}}^2}{R} \checkmark$$

$$60 = \frac{240^2}{R} \checkmark$$

$$\therefore R = 960 \Omega \checkmark$$

OPTION 2/OPSIE 2

$$P_{\text{ave/gemid}} = I_{\text{rms/wgk}}^2 R \checkmark$$

$$60 = (0,25)^2 R \checkmark$$

$$\therefore R = 960 \Omega \checkmark$$

OPTION 3/OPSIE 3

$$R = \frac{V_{\text{rms/wgk}}}{I_{\text{rms/wgk}}} \checkmark$$

$$= \frac{240}{0,25} \checkmark$$

$$= 960 \Omega \checkmark$$

Notes/Aantekeninge

Do not penalise if subscripts are omitted.
Moenie penaliseer indien onderskifte weggelaat is nie

Notes/Aantekeninge

Accept/Aanvaar:

$$R = \frac{V}{I} \text{ as formula/formule}$$

(3)
[10]

QUESTION 11/VRAAG 11

11.1 Quantum/packet of energy/Kwantum/pakkie energie ✓
found in light/In lig gevind ✓

(2)

11.2

11.2.1

OPTION 1/OPSIE 1

$$E = \frac{hc}{\lambda} \checkmark$$

$$6,9 \times 10^{-19} \checkmark = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{\lambda} \checkmark$$

$$\therefore \lambda = 2,9 \times 10^{-7} \text{ m } \checkmark$$

OPTION 2 / OPSIE 2

$$E = hf$$

$$6,9 \times 10^{-19} \checkmark = 6,63 \times 10^{-34} f \checkmark$$

$$\therefore f = 1,04 \times 10^{15} \text{ Hz}$$

$$c = f\lambda$$

$$\frac{3 \times 10^8}{1,04 \times 10^{15}} = \lambda \checkmark$$

$$\therefore \lambda = 2,88 \times 10^{-7} \text{ m } \checkmark$$

✓ Both
formulae
Beide
formules

Notes/Aantekeninge

Accept/Aanvaar: $v = f\lambda$

(5)

11.2.2 $E = W_o + E_k \checkmark$

$$6,9 \times 10^{-19} = 6,4 \times 10^{-19} + E_k \checkmark$$

$$\therefore E_k = 5 \times 10^{-20} \text{ J } \checkmark$$

(3)

11.3

11.3.1 Increases/Vermeerder ✓

- More photons (packets of energy) strike the surface of the metal per unit time./Meer fotone (pakkies energie) tref die oppervlakte van die metaal per eenheid tyd. ✓
- More (photo)electrons ejected per unit time./Meer (foto)elektrone vrygestel per eenheid tyd. ✓

(3)

11.3.2 Increases/Vermeerder ✓

- (Photo)electrons are emitted with higher kinetic energy/move faster./ (Foto)elektrone word vrygestel met hoër kinetiese energie/beweeg vinniger. ✓
- Increase in rate of flow of charge./Same number of charges pass a point in a shorter time./Toename in tempo van vloei van lading/dieselfde aantal lading beweeg verby 'n punt in 'n korter tyd. ✓

(3)

[16]

TOTAL SECTION B/TOTAAL AFDELING B:

125

GRAND TOTAL/GROOTTOTAAL:

150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

NOVEMBER 2012

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 12 pages.
*Hierdie memorandum bestaan uit 12 bladsye.***

SECTION A

QUESTION 1/VRAAG 1

1.1	Frequency/ <i>Frekwensie</i> ✓	(1)
1.2	Capacitor/ <i>Kapasitor</i> ✓	(1)
1.3	Split ring commutator ✓ <i>Splitringkommutator</i>	(1)
1.4	Photons/ <i>Fotone</i> ✓	(1)
1.5	<u>Relative velocity/Relatiewe snelheid</u> ✓	(1)
		[5]

QUESTION 2/VRAAG 2

2.1	D ✓✓	(2)
2.2	C ✓✓	(2)
2.3	D ✓✓	(2)
2.4	D ✓✓	(2)
2.5	A ✓✓	(2)
2.6	A ✓✓	(2)
2.7	D ✓✓	(2)
2.8	C ✓✓	(2)
2.9	C ✓✓	(2)
2.10	A ✓✓	(2)
		[20]

TOTAL SECTION A/TOTAAL AFDELING A: 25

SECTION B/AFDELING B

QUESTION 3/VRAAG 3

3.1 Downward/afwaarts ✓ (1)

3.2

3.2.1 Upwards positive/Opwaarts positief:

$$\begin{aligned}v_f &= v_i + a\Delta t \checkmark \\&= 8 \checkmark + (-9,8)(4) \checkmark \\&= -31,2 \text{ m}\cdot\text{s}^{-1} \\ \therefore v_f &= 31,2 \text{ m}\cdot\text{s}^{-1} \checkmark\end{aligned}$$

Downwards positive/Afwaarts positief:

$$\begin{aligned}v_f &= v_i + a\Delta t \checkmark \\&= -8 \checkmark + (9,8)(4) \checkmark \\ \therefore v_f &= 31,2 \text{ m}\cdot\text{s}^{-1} \checkmark\end{aligned}$$

(4)

3.2.2

OPTION 1/OPSIE 1

Upwards positive/Opwaarts positief:

$$\begin{aligned}\Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark \\&= (8)(4) \checkmark + \frac{1}{2}(-9,8)(4)^2 \checkmark \\&= -46,4 \text{ m}\end{aligned}$$

Height of balcony/Hoogte van balkon:

$$60 - 46,4 \checkmark = 13,6 \text{ m} \checkmark$$

Downwards positive/Afwaarts positief:

$$\begin{aligned}\Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark \\&= (-8)(4) \checkmark + \frac{1}{2}(9,8)(4)^2 \checkmark \\&= 46,4 \text{ m}\end{aligned}$$

Height of balcony/Hoogte van balkon:

$$60 - 46,4 \checkmark = 13,6 \text{ m} \checkmark$$

OPTION 2/OPSIE 2

Upwards positive/Opwaarts positief:

$$\begin{aligned}\Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark \\&= (27,13) \checkmark (6) \checkmark + \frac{1}{2}(-9,8)(6)^2 \checkmark \\&= -13,62 \text{ m}\end{aligned}$$

Height of balcony/Hoogte van balkon:

$$= 13,62 \text{ m} \checkmark$$

Downwards positive/Afwaarts positief:

$$\begin{aligned}\Delta y &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark \\&= (-27,13) \checkmark (6) \checkmark + \frac{1}{2}(9,8)(6)^2 \checkmark \\&= 13,62 \text{ m}\end{aligned}$$

Height of balcony/Hoogte van balkon:

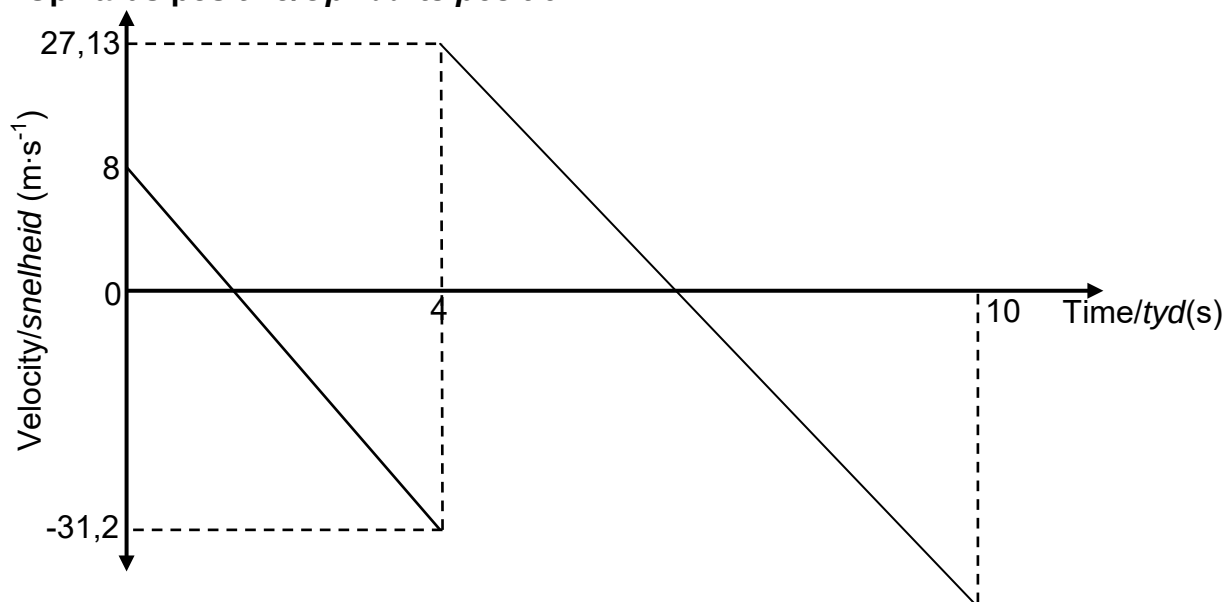
$$= 13,62 \text{ m} \checkmark$$

(5)

3.3

OPTION 1/OPSIE 1

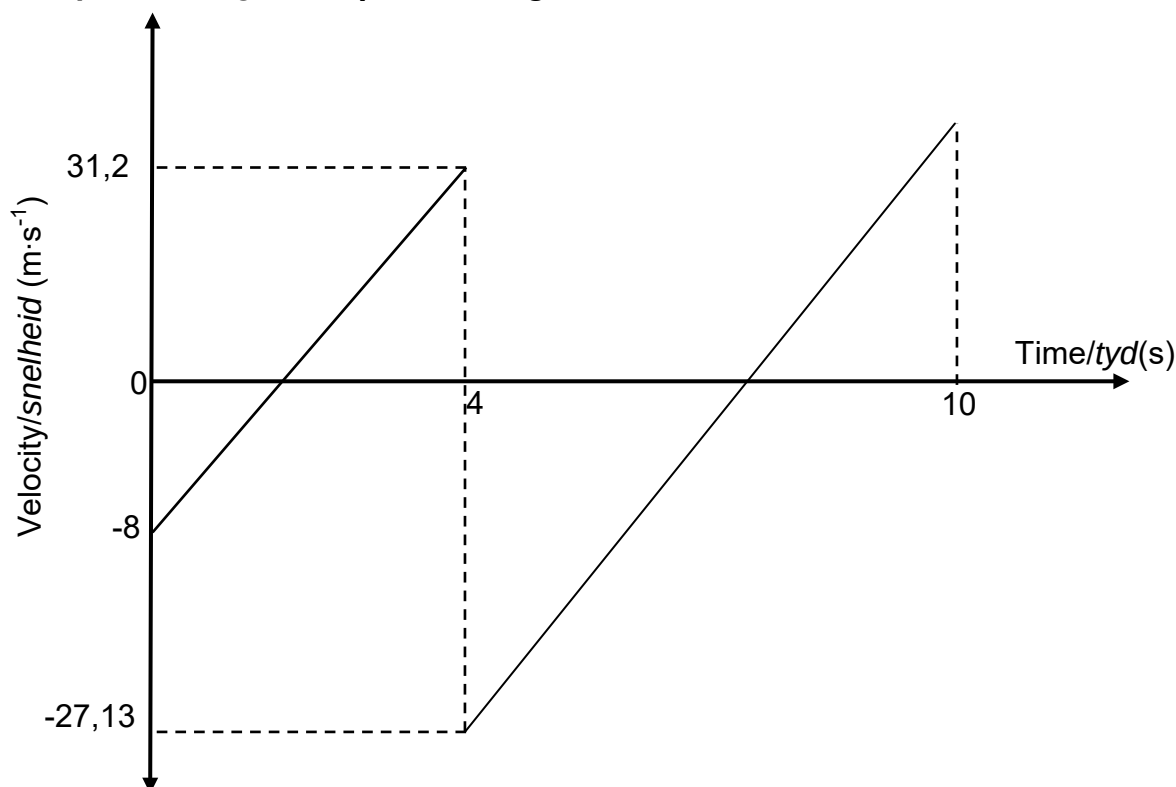
Upwards positive/Opwaarts positief:



Criteria for graph/Kriteria vir grafiek:	Marks/ Punte
Shape has two parallel lines with a gradient. <i>Vorm het twee ewewydige lyne met gradient.</i>	✓
First part of graph starts at $v = 8 \text{ m}\cdot\text{s}^{-1}$ at $t = 0 \text{ s}$ <i>Eerste deel van grafiek begin by $v = 8 \text{ m}\cdot\text{s}^{-1}$ by $t = 0 \text{ s}$.</i>	✓
Positive marking from QUESTION 3.2.1: Positiewe nasien vanaf VRAAG 3.2.1: First part of the graph extends below the x axis until $v = -31,2 \text{ m}\cdot\text{s}^{-1}$ at $t = 4 \text{ s}$. <i>Eerste deel van die grafiek verleng onder x-as tot $v = -31,2 \text{ m}\cdot\text{s}^{-1}$ by $t = 4 \text{ s}$.</i>	✓
Graph is discontinuous and object changes direction at 4 s. <i>Grafiek is nie kontinu nie en voorwerp verander van rigting by 4 s.</i>	✓
Second part of graph starts at $v = 27,13 \text{ m}\cdot\text{s}^{-1}$ at $t = 4 \text{ s}$. <i>Tweede deel van grafiek begin by $v = 27,13 \text{ m}\cdot\text{s}^{-1}$ by $t = 4 \text{ s}$.</i>	✓
Second part of graph extends below the x axis until $t = 10 \text{ s}$. <i>Tweede deel van grafiek verleng onder x-as tot $t = 10 \text{ s}$.</i>	✓

OPTION 2/OPSIE 2

Upwards negative/Opwaarts negatief:



Criteria for graph/Kriteria vir grafiek:	Marks Punte
Correct shape as shown (two parallel lines). <i>Korrekte vorm soos aangetoon (twee ewewydige lyne).</i>	✓
First part of graph starts at $v = -8 \text{ m}\cdot\text{s}^{-1}$ at $t = 0 \text{ s}$ <i>Eerste deel van grafiek begin by $v = -8 \text{ m}\cdot\text{s}^{-1}$ by $t = 0 \text{ s}$</i>	✓
Positive marking from QUESTION 3.2.1. Positiewe nasien vanaf VRAAG 3.2.1. First part of the graph extends above the x axis until $v = 31,2 \text{ m}\cdot\text{s}^{-1}$ at $t = 4 \text{ s}$. <i>Eerste deel van die grafiek verleng bokant x-as tot $v = 31,2 \text{ m}\cdot\text{s}^{-1}$ by $t = 4 \text{ s}$.</i>	✓
Graph is discontinuous and object changes direction at 4 s. <i>Grafiek is nie kontinu en voorwerp verander van rigting by 4 s.</i>	✓
Second part of graph starts at $v = -27,13 \text{ m}\cdot\text{s}^{-1}$ at $t = 4 \text{ s}$. <i>Tweede deel van grafiek begin by $v = -27,13 \text{ m}\cdot\text{s}^{-1}$ by $t = 4 \text{ s}$.</i>	✓
Second part of graph extends above the x axis until $t = 10 \text{ s}$. <i>Tweede deel van grafiek verleng bokant x-as tot $t = 10 \text{ s}$.</i>	✓

(6)
[16]

QUESTION 4/VRAAG 4

4.1 $40 \text{ m} \cdot \text{s}^{-1}$ ✓ east/oos ✓ (2)

4.2 The total (linear) momentum remains constant/is conserved ✓
in an isolated/a closed system/the absence of external forces/ if the impulse of external forces is zero. ✓

*Die totale (liniêre) momentum bly konstant/behoue ✓
in 'n geïsoleerde sisteem/geslote sisteem/ die afwesigheid van eksterne kragte./ indien die impuls van eksterne kragte nul is. ✓* (2)

4.3 **East positive/Oos positief:**

$$\Sigma p_i = \Sigma p_f \checkmark$$

$$m(20) \checkmark + 2m(-20) \checkmark = (m + 2m)v_f \checkmark$$

$$\therefore v_f = -6,67 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_f = 6,67 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ west /wes } \checkmark$$

East negative/Oos negatief:

$$\Sigma p_i = \Sigma p_f \checkmark$$

$$m(-20) \checkmark + 2m(+20) \checkmark = (m + 2m)v_f \checkmark$$

$$\therefore v_f = 6,67 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ west /wes } \checkmark$$

(6)

4.4

4.4.1 F ✓
Newton's Third Law of motion/*Newton se Derde Bewegingswet* ✓ (2)

4.4.2 $-\frac{1}{2} a$ / $\frac{1}{2} a$ ✓
(Same/*Dieselfe* F_{net}), $a \propto \frac{1}{m}$ ✓ (2)

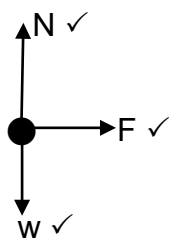
4.4.3 Car driver ✓
(Car - driver system) have greater acceleration. ✓
(Car - driver system) have greater change in velocity /greater Δv . ✓

*Motorbestuurder ✓
(Motor -bestuurder sisteem) het groter versnelling. ✓
(Motor -bestuurder sisteem) het groter verandering in snelheid / groter Δv . ✓* (3)

[17]

QUESTION 5/VRAAG 5

5.1



(3)

- 5.2 The net (total) work (done on an object) is equal to ✓
the change in kinetic energy (of the object.) ✓
Die netto (totale) arbeid verrig (op 'n voorwerp) is gelyk aan ✓
die verandering in kinetiese energie (van die voorwerp). ✓

(2)

5.3

5.3.1 $W_{\text{net}} = \Delta E_k / \Delta K$ ✓ **OR/OF** $F_{\text{net}} \Delta x \cos \theta = \frac{1}{2} m (v_f^2 - v_i^2)$
 $F_{\text{net}} (1,02) \cos 180^\circ = \frac{1}{2} (1\,200) (0 - 20^2)$ ✓
 $F_{\text{net}} = 235\,294,12 \text{ N}$ ✓ $(2,35 \times 10^5 \text{ N})$

(4)

5.3.2

OPTION 1 / OPSIE 1	OPTION 2 / OPSIE 2
$F_{\text{net}} \Delta t = m \Delta v$ ✓ $\therefore (-235\,294,12) \Delta t = (1\,200) (0 - 20)$ ✓ $\therefore \Delta t = 0,1 \text{ s}$ ✓ $(0,102 \text{ s})$	$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$ ✓ $1,02 = \left(\frac{20 + 0}{2} \right) \Delta t$ ✓ $\Delta t = 0,1 \text{ s}$ ✓

(4)

[13]

QUESTION 6/VRAAG 6

- 6.1 Frequency/Frekwensie ✓

(1)

- 6.2 There is relative motion between the bird and the bird watcher. ✓
Daar is relatiewe beweging tussen die voël en die voëlkyker nie. ✓

(1)

- 6.3 0,2 m ✓

(1)

6.4

6.4.1 $v = f \lambda$ ✓
 $340 = f(0,2)$ ✓
 $\therefore f = 1\,700 \text{ Hz}$ ✓

(3)

6.4.2

$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ **OR/OF** $f_L = \frac{v}{v - v_s} f_s$ ✓
 $\therefore 1\,700 = \frac{340}{340 - v_s} (1\,650)$ ✓
 $\therefore v_s = 10 \text{ m} \cdot \text{s}^{-1}$ ✓

(5)

[11]

QUESTION 7/VRAAG 7

7.1 Double slit/Dubbelspleet ✓ (1)

7.2 (Alternate) dark and bright/blue bands. ✓
Bright / blue bands of equal broadness (width). ✓
(Afwissellende) donker en helder/blou bande. ✓
Helder / blou bande van gelyke breedte. ✓ (2)

7.3

7.3.1 $\tan \theta = \frac{\frac{1}{2} \text{ central band}}{\text{screen distance}} / \frac{\frac{1}{2} \text{ sentraleband}}{\text{skermafstand}}$
 $\therefore \tan \theta = \frac{\frac{1}{2}(0,22)}{1,4}$ ✓
 $\therefore \theta = 4,49^\circ$ ✓ (3)

7.3.2

<u>OPTION 1/OPSIE 1:</u>	<u>OPTION 2/OPSIE 2:</u>
$\sin \theta = \frac{m\lambda}{a}$ ✓	$\sin \theta = \frac{m\lambda}{a}$ ✓
$\sin 4,49^\circ = \frac{(1)(470 \times 10^{-9})}{a}$ ✓	$\sin (-4,49^\circ) = \frac{(-1)(470 \times 10^{-9})}{a}$ ✓
$\therefore a = 6 \times 10^{-6} \text{ m} \checkmark (6\,003,67 \text{ nm})$	$\therefore a = 6 \times 10^{-6} \text{ m} \checkmark (6\,003,67 \text{ nm})$

(5)

7.4 $\lambda_{\text{red light}} > \lambda_{\text{blue light}}$ ✓
(Degree of) diffraction/ $\sin \theta / \theta \propto \text{wavelength } (\lambda)$ ✓
 $\lambda_{\text{rooilig}} > \lambda_{\text{bloulig}}$ ✓
Diffraksie $\propto \text{golflengte } (\lambda)$ ✓ (2)

[13]

QUESTION 8/VRAAG 8

8.1 $R = \frac{V}{I} \checkmark$
 $1\,000 = \frac{12}{I} \checkmark$
 $\therefore I = 0,01\text{ A} \checkmark$ (3)

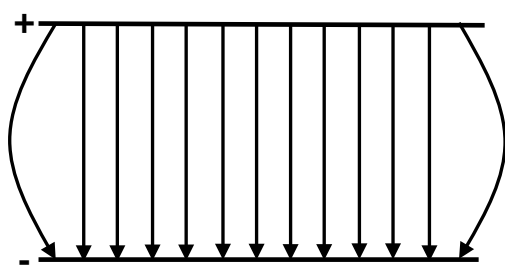
8.2 $12\text{ V} \checkmark$ (1)

8.3 $C = \frac{Q}{V} \checkmark$
 $120 \times 10^{-6} = \frac{Q}{12} \checkmark$
 $\therefore Q = 1,44 \times 10^{-3}\text{ C} \checkmark$ (3)

8.4
 8.4.1 Decreases/*Verminder* $\checkmark$ (1)

8.4.2 Increases/*Vermeerder* $\checkmark$ (1)

8.5
 8.5.1



Criteria for sketch:/ <i>Kriteria vir skets:</i>	Marks/ <i>Punte</i>
Parallel lines equally spaced. <i>Parallele lyne eweredig gespaseer.</i>	$\checkmark$
Direction from positive plate towards negative plate. (Polarity of plates must be indicated) <i>Rigting vanaf positiewe plaat na negatiewe plaat. (Polariteit van plate moet aangedui word)</i>	$\checkmark$
Field curved at the ends of the plates. <i>Veld gekrom aan einde van die plate.</i>	$\checkmark$

(3)

8.5.2
 $E = \frac{V}{d} \checkmark$
 $= \frac{12}{12 \times 10^{-3}} \checkmark$
 $\therefore E = 1\,000\text{ V}\cdot\text{m}^{-1} \checkmark$ (3)

[15]

QUESTION 9/VRAAG 9

9.1

9.1.1
$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$$
$$= \frac{1}{60} + \frac{1}{60} \checkmark$$
$$\therefore R_p = 30 \, \Omega \checkmark$$

(3)

9.1.2

<u>OPTION 1 / OPSIE 1</u> $R_{\text{ext}} = 30 + 25 = 55 \, \Omega \checkmark$ $\text{Emf/emk} = I(R + r) \checkmark$ $\therefore 12 \checkmark = I(55 + 1,5) \checkmark$ $\therefore I = 0,21 \, \text{A} \checkmark$	<u>OPTION 2 / OPSIE 2:</u> $R_{\text{tot}} = (30 + 25) \checkmark + 1,5 = 56,5 \, \Omega$ $V = IR \checkmark$ $12 \checkmark = I(56,5) \checkmark$ $\therefore I = 0,21 \, \text{A} \checkmark$

(5)

9.1.3

<u>OPTION 1/OPSIE 1</u> $V = IR \checkmark$ $= (0,21)(30) \checkmark$ $= 6,3 \, \text{V} \checkmark$	<u>OPTION 2/OPSIE 2</u> $V = IR \checkmark$ $= (0,105)(60) \checkmark$ $= 6,3 \, \text{V} \checkmark$

(3)

9.2

9.2.1 $1,5 \, \text{V} \checkmark$

(1)

9.2.2

$$\text{gradient/m} = \frac{\Delta V}{\Delta I}$$

$$= \frac{0,65 - 1,5 \checkmark}{1,0 - 0 \checkmark}$$

$$= -0,85 \, \Omega \checkmark$$

(3)

9.2.3

Internal resistance $\checkmark \checkmark$
Interne weerstand

(2)

9.2.4

Decreases/*Verminder* $\checkmark$

When I increases/*Wanneer I toeneem*:

"Lost volts"/Ir increases./"Verlore volts"/Ir neem toe. $\checkmark$

$V_{\text{ext}} = \text{emf} - Ir$ decreases. $\checkmark$ / $V_{\text{ext}} = \text{emk} - Ir$ neem af.

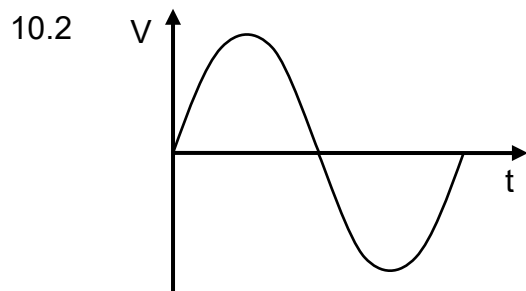
(3)

[20]

QUESTION 10/VRAAG 10

10.1 AC /WS ✓

(1)



Criteria for graph/Kriteria vir grafiek:	Marks Punte
Correct shape as shown; accept more than one cycle. <i>Korrekte vorm soos aangetoon; aanvaar meer as een siklus.</i>	✓✓
If no/wrong labels: minus 1 mark <i>Indien geen/verkeerde byskifte: minus 1 punt</i>	

(2)

10.3

OPTION 1/OPSIE 1	OPTION 2 / OPSIE 2
$V_{rms/wgk} = \frac{V_{max/maks}}{\sqrt{2}} \checkmark$ $= \frac{30 \times 10^3}{\sqrt{2}} \checkmark$ $= 2,12 \times 10^4 \text{ V}$ $P_{ave} = V_{rms}I_{rms}/P_{gem.} = V_{wgk}I_{wgk} \checkmark$ $4,45 \times 10^9 \checkmark = (2,12 \times 10^4)I_{rms/wgk}$ $\therefore I_{rms/wgk} = 2,10 \times 10^5 \text{ A} \checkmark$	$P_{ave} = V_{rms}I_{rms}/P_{gem.} = V_{wgk}I_{wgk}$ $P_{ave/gem.} = \frac{V_{max}I_{rms}}{\sqrt{2}} / \frac{V_{maks}I_{wgk}}{\sqrt{2}} \checkmark \checkmark$ $4,45 \times 10^9 \checkmark = \frac{(30 \times 10^3)I_{rms/wgk}}{\sqrt{2}} \checkmark$ $\therefore I_{rms/wgk} = 2,10 \times 10^5 \text{ A} \checkmark$

(5)

10.4 Less loss in (electrical) energy (as heat). ✓

Minder verlies aan (elektriese) energie (as hitte). ✓

(1)

[9]

QUESTION 11/VRAAG 11

11.1

11.1.1 Kinetic energy /Kinetiese energie (E_k) ✓ (1)

11.1.2 Frequency /Frekwensie ✓ (f) (1)

11.1.3 (Type of) metal ✓
(Soort) metaal ✓ (1)

11.2 The minimum frequency needed to emit electrons ✓
from (the surface of) a metal. ✓
Die minimum frekwensie benodig om elektrone vry te stel
vanaf (die oppervlak van) 'n metaal. (2)

11.3 9×10^{14} Hz ✓ (1)

11.4

$E = W_0 + E_k$ } ✓ Any one /Enige een
 $hf = hf_0 + E_k$ }
 $(6,63 \times 10^{-34})(14 \times 10^{14}) \checkmark = (6,63 \times 10^{-34})(9 \times 10^{14}) \checkmark + E_k$
 $\therefore E_k = 3,32 \times 10^{-19} \text{ J } \checkmark (3,31 \times 10^{-19} \text{ J})$ (4)

11.5 Remains the same /Bly dieselfde ✓ (1)
[11]

TOTAL SECTION B/TOTAAL AFDELING B: 125
GRAND TOTAL/GROOTTOTAAL: 150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

FEBRUARY/MARCH/FEBRUARIE/MAART 2012

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 15 pages.
*Hierdie memorandum bestaan uit 15 bladsye.***

Learning Outcomes and Assessment Standards Leeruitkomst en Assesseringstandaarde		
LO/LU 1	LO/LU 2	LO/LU 3
AS 12.1.1: Design, plan and conduct a scientific inquiry to collect data systematically with regard to accuracy, reliability and the need to control variables. <i>Ontwerp, beplan en voer 'n wetenskaplike ondersoek uit om data te versamel ten opsigte van akkuraatheid, betroubaarheid en die kontroleer van veranderlikes.</i> AS 12.1.2: Seek patterns and trends, represent them in different forms, explain the trends, use scientific reasoning to draw and evaluate conclusions, and formulate generalisations. <i>Soek patrone en tendense, stel dit in verskillende vorms voor, verduidelik tendense, gebruik wetenskaplike beredenering om gevolgtrekkings te maak en te evalueer, en formuleer veralgemenings.</i> AS 12.1.3: Select and use appropriate problem-solving strategies to solve (unseen) problems. <i>Kies en gebruik geskikte probleemoplossingstrategieë om (ongesiene) probleme op te los.</i> AS 12.1.4: Communicate and defend scientific arguments with clarity and precision. <i>Kommunikeer en verdedig wetenskaplike argumente duidelik en presies.</i>	AS 12.2.1: Define, discuss and explain prescribed scientific knowledge. <i>Definieer, bespreek en verduidelik voorgeskrewe wetenskaplike kennis.</i> AS 12.2.2: Express and explain prescribed scientific principles, theories, models and laws by indicating the relationship between different facts and concepts in own words. <i>Verduidelik en druk voorgeskrewe wetenskaplike beginsels, teorieë, modelle en wette uit deur die verwantskap tussen verskillende feite en konsepte in eie woorde aan te dui.</i> AS 12.2.3: Apply scientific knowledge in everyday life contexts. <i>Pas wetenskaplike kennis in kontekste van die alledaagse lewe toe.</i>	AS 12.3.1: Research, discuss, compare and evaluate scientific and indigenous knowledge systems and knowledge claims by indicating the correlation among them, and explain the acceptance of different claims. <i>Doen navorsing, bespreek, vergelyk en evalueer wetenskaplike en inheemse kennissisteme en kennisaansprake deur die ooreenkoms aan te dui en verduidelik die aanvaarding van verskillende aansprake.</i> AS 12.3.2: Research case studies and present ethical and moral arguments from different perspectives to indicate the impact (pros and cons) of different scientific and technological applications. <i>Vors gevallestudies na en lewer etiese en morele argumente uit verskillende perspektiewe om die impak (voordele en nadele) van verskillende wetenskaplike en tegnologiese toepassings aan te dui.</i> AS 12.3.3: Evaluate the impact of scientific and technological research and indicate the contribution to the management, utilisation and development of resources to ensure sustainability continentally and globally. <i>Evalueer die impak van wetenskaplike en tegnologiese navorsing en dui die bydrae tot bestuur, benutting en ontwikkeling van bronne om volhoubaarheid kontinentaal en globaal te verseker.</i>

SECTION A / AFDELING A

QUESTION 1 / VRAAG 1

1.1	Kinetic energy/ <i>Kinetiese energie</i> ✓	(1)
1.2	Interference/ <i>Interferensie</i> ✓	(1)
1.3	Ohm ✓	(1)
1.4	Electromagnetic induction/ <i>Elektromagnetiese induksie</i> ✓ OR/OF Faraday's law/ <i>Faraday se wet</i>	(1)
1.5	(Line) emission (spectrum) ✓ <i>(Lyn)emissie(spektrum)</i>	(1) [5]

QUESTION 2 / VRAAG 2

2.1	B ✓✓	(2)
2.2	B ✓✓	(2)
2.3	C ✓✓	(2)
2.4	B ✓✓	(2)
2.5	C ✓✓	(2)
2.6	A ✓✓	(2)
2.7	D ✓✓	(2)
2.8	D ✓✓	(2)
2.9	C ✓✓	(2)
2.10	A ✓✓	(2)
- [20]**

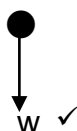
TOTAL SECTION A / TOTAAL AFDELING A: 25

SECTION B/AFDELING B

QUESTION 3/VRAAG 3

3.1

Accepted Labels/Aanvaarde benoemings	
w	F_g / F_w / force of Earth on stone/weight/mg/gravitational force F_g / F_w / krag van Aarde op klip/gewig/mg/gravitasiekrag



(1)

3.2.1

Option 1/Opsie 1: Upward positive/Opwaarts positief: $v_f = v_i + a \Delta t$ ✓ $0 = 10 + (-9,8) \Delta t$ ✓ $\therefore \Delta t = 1,02 \text{ s}$ ✓	
Option 2/Opsie 2: Upward positive/Opwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ $0^2 = 10^2 + 2(-9,8) \Delta y$ ✓ $\therefore y = 5,1 \text{ m}$ $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$ $5,1 = \left(\frac{10 + 0}{2} \right) \Delta t$ ✓ $\therefore \Delta t = 1,02 \text{ s}$ ✓	
✓ Both formulae/Beide formules	
Upward negative/Opwaarts negatief: $v_f = v_i + a \Delta t$ ✓ $0 = -10 + 9,8 \Delta t$ ✓ $\therefore \Delta t = 1,02 \text{ s}$ ✓	
Upward negative/Opwaarts negatief: $v_f^2 = v_i^2 + 2a\Delta y$ $0^2 = (-10)^2 + 2(9,8) \Delta y$ ✓ $\therefore y = -5,1 \text{ m}$ $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$ $-5,1 = \left(\frac{-10 + 0}{2} \right) \Delta t$ ✓ $\therefore \Delta t = 1,02 \text{ s}$ ✓	
✓ Both formulae/Beide formules	

(4)

3.2.2

POSITIVE MARKING FROM QUESTION 3.2.1 TO QUESTION 3.2.2 POSITIEWE NASIEN VAN VRAAG 3.2.1 NA VRAAG 3.2.2

Option 1/Opsie 1: Upward positive/Opwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0^2 = 10^2 + 2(-9,8) \Delta y$ ✓ $\therefore \Delta y = 5,1 \text{ m}$ Height/Hoogte = $\underline{50} + \checkmark 5,1$ = $55,1 \text{ m}$ ✓	
Upward negative/Opwaarts negatief: $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0^2 = (-10)^2 + 2(9,8) \Delta y$ ✓ $\therefore \Delta y = -5,1 \text{ m}$ Height/Hoogte = $50 + \checkmark 5,1$ = $55,1 \text{ m}$ ✓	

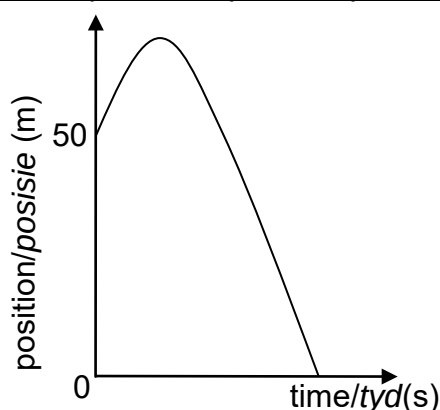
Option 2/Opsie 2: Upward positive/Opwaarts positief: $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $\Delta y = \left(\frac{10 + 0}{2} \right) 1,02 \checkmark$ $\therefore = 5,1 \text{ m}$ Height = 50 + $\checkmark$ 5,1 = 55,1 m $\checkmark$ Upward negative/Opwaarts negatief: $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $\Delta y = \left(\frac{-10 + 0}{2} \right) 1,02 \checkmark$ $\therefore \therefore \Delta y = -5,1 \text{ m}$ Height/Hoogte = 50 + $\checkmark$ 5,1 = 55,1 m $\checkmark$	Option 3/Opsie 3: Consider downward motion/ Beskou afwaartse beweging: $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $\Delta y = \left(\frac{-10 + 0}{2} \right) 1,02 \checkmark$ $\therefore = -5,1 \text{ m}$ Height = 50 + $\checkmark$ 5,1 = 55,1 m $\checkmark$ Upward negative/Opwaarts negatief: $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $\Delta y = \left(\frac{-10 + 0}{2} \right) 1,02 \checkmark$ $\therefore = -5,1 \text{ m}$ Height/Hoogte = 50 + $\checkmark$ 5,1 = 55,1 m $\checkmark$

(4)

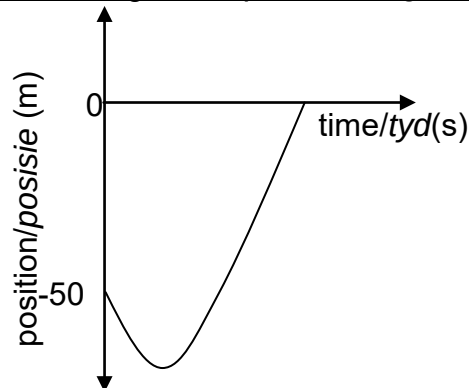
3.3

Criteria for graph/Kriteria vir grafiek	Marks/Punte
Correct shape/Korrekte vorm	$\checkmark$
Final position lower than initial position.	$\checkmark$
Graph ends on x axis./Grafiek eindig op x-as.	$\checkmark$

Upward positive/Opwaarts positief



Upward negative/Opwaarts negatief



3.4

Option 1/Opsie 1

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$1,5 \checkmark = v_i(0,1) + \frac{1}{2}(9,8)(0,1)^2 \checkmark$$

$$\therefore v_i = 14,51 \text{ m}\cdot\text{s}^{-1}$$

From maximum height/*Van maksimum hoogte:*

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$14,51^2 \checkmark = (0)^2 + 2(9,8)\Delta y \checkmark$$

$$\therefore \Delta y = 10,74 \text{ m}$$

$$\text{Height/Hoogte} = 55,1 - 10,74 \\ = 44,36 \text{ m} \checkmark$$

Option 2/Opsie 2

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$1,5 \checkmark = v_i(0,1) + \frac{1}{2}(9,8)(0,1)^2 \checkmark$$

$$\therefore v_i = 14,51 \text{ m}\cdot\text{s}^{-1}$$

Downwards from top of tower to top of window:*/Afwarts van bopunt van toring tot bopunt van venster*

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$14,51^2 \checkmark = (10)^2 + 2(9,8)\Delta y \checkmark$$

$$\therefore \Delta y = 5,64 \text{ m}$$

$$\text{Height/Hoogte} = 50 - 5,64 \\ = 44,36 \text{ m} \checkmark$$

Option 3/Opsie 3

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$1,5 \checkmark = v_i(0,1) + \frac{1}{2}(9,8)(0,1)^2 \checkmark$$

$$\therefore v_i = 14,51 \text{ m}\cdot\text{s}^{-1}$$

From original point of projection:*/Van oorspronklike punt van projeksie*

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$14,51^2 \checkmark = (-10)^2 + 2(9,8)\Delta y \checkmark$$

$$\therefore \Delta y = 5,64 \text{ m}$$

$$\text{Height/Hoogte} = 50 - 5,64 \\ = 44,36 \text{ m} \checkmark$$

Option 4/Opsie 4

$$\bar{v} = \frac{\Delta y}{\Delta t} = \frac{1,5}{0,1} = 15 \text{ m}\cdot\text{s}^{-1}$$

$$\bar{v} = \frac{v_i + v_f}{2} = 15$$

$$\therefore v_i + v_f = 30 \text{ m}\cdot\text{s}^{-1}$$

$$\therefore v_f = 30 - v_i$$

$$v_f = v_i + a \Delta t \checkmark$$

$$30 - v_i \checkmark = v_i + 9,8(0,1) \checkmark$$

$$\therefore v_i = 14,51 \text{ m}\cdot\text{s}^{-1}$$

$$v_f^2 = v_i^2 + 2a\Delta y \checkmark$$

$$14,51^2 \checkmark = (0)^2 + 2(9,8)\Delta y \checkmark$$

$$\therefore \Delta y = 10,74 \text{ m}$$

$$\text{Height/Hoogte} = 55,1 - 10,74 \\ = 44,36 \text{ m} \checkmark$$

(7)
[19]

QUESTION 4/VRAAG 4

- 4.1 Impulse is the product of the (net/average) force and the time during which the force acts. ✓✓
Impuls is die produk van die (netto/gemiddelde) krag en die tyd waartydens die krag inwerk. ✓✓

OR/OF

Impulse is the change in momentum. ✓✓
Impuls is gelyk aan verandering in momentum. ✓✓

(2)

4.2

Option 1/Opsie 1: Upward positive:/Opwaarts positief $F_{\text{net}}\Delta t = \Delta p \checkmark$ $= m(v_f - v_i)$ $= 0,15(3,62 - (-6,2)) \checkmark$ $= 1,473 \text{ N}\cdot\text{s} / \text{kg}\cdot\text{m}\cdot\text{s}^{-1} \checkmark$ upward/opwaarts	Option 2/Opsie 2: Upward negative:/Opwaarts negatief $F_{\text{net}}\Delta t = \Delta p \checkmark$ $= m(v_f - v_i)$ $= 0,15[(-3,62 - (6,2))] \checkmark$ $= -1,473 \text{ N}\cdot\text{s} / \text{kg}\cdot\text{m}\cdot\text{s}^{-1} \checkmark$ $F_{\text{net}}\Delta t = 1,473 \text{ N}\cdot\text{s} / \text{kg}\cdot\text{m}\cdot\text{s}^{-1} \checkmark$ upward/opwaarts
Option 3/Opsie 3: Upward positive: /Opwaarts positief $F_{\text{net}}\Delta t = \Delta p \checkmark$ $= mv_f - mv_i$ $= (0,15)(3,62) - (0,15)(-6,2) \checkmark$ $= 1,473 \text{ N}\cdot\text{s} / \text{kg}\cdot\text{m}\cdot\text{s}^{-1} \checkmark$ upward/opwaarts	Option 4/Opsie 4: Upward negative: /Opwaarts negatief $F_{\text{net}}\Delta t = \Delta p \checkmark$ $= mv_f - mv_i$ $= (0,15)(-3,62) - (0,15)(6,2) \checkmark$ $= -1,473 \text{ N}\cdot\text{s} / \text{kg}\cdot\text{m}\cdot\text{s}^{-1} \checkmark$ $F_{\text{net}}\Delta t = 1,473 \text{ N}\cdot\text{s} / \text{kg}\cdot\text{m}\cdot\text{s}^{-1} \checkmark$ upward/opwaarts

(3)

- 4.3 $(U + K)_{\text{top/bo}} = (U + K)_{\text{bottom/onder}} \checkmark$
 $mgh_f + \frac{1}{2}mv_f^2 = mgh_i + \frac{1}{2}mv_i^2$
 $(0,15)(9,8)h + 0 \checkmark = 0 + \frac{1}{2}(0,15)(6,2)^2 \checkmark$
 $\therefore h = 1,96 \text{ m} \checkmark$

$$\frac{1,96}{3} = 0,65 \text{ m}$$

Yes/Meets requirements ✓

Ja/Voldoen aan vereistes. ✓

K(bottom/onder) = U(top/bo)

$$\text{Max.: } \frac{0}{4}$$

Other formulae/Ander formules:

$$E_{\text{mech(A)}} = E_{\text{mech(B)}} / E_{\text{mech(i)}} = E_{\text{mech(f)}}$$

$$E_{\text{mech(top)}} = E_{\text{mech(bottom)}}$$

$$(E_p + E_k)_A = (E_p + E_k)_B$$

$$(E_p + E_k)_{\text{bottom}} = (E_p + E_k)_{\text{top}}$$

$$E_p + E_k)_i = (E_p + E_k)_f$$

$$(U + K)_i = (U + K)_f$$

$$(U + K)_A = (U + K)_B$$

$$mgh_B + \frac{1}{2}mv_i^2 = mgh_B + \frac{1}{2}mv_f^2$$

(5)

[10]

QUESTION 5/VRAAG 5

- 5.1 The energy of an object due to its position ✓
above the surface of the earth. ✓

*Die energie van 'n voorwerp as gevolg sy posisie ✓
bokant die oppervlak van die aarde. ✓*

(2)

- 5.2

Option 1/Opsie 1:

$$W_{\text{net}} = \Delta K \checkmark$$

$$mg\Delta y \cos\theta + W_f = \frac{1}{2}m v_f^2 - \frac{1}{2}m v_i^2$$

$$(2)(9,8)(2)\cos 0^\circ \checkmark + W_f \checkmark = \frac{1}{2}(2)(5)^2 \checkmark - 0 \checkmark$$

$$\therefore W_f = -14,2 \text{ J} \checkmark$$

Option 2/Opsie 2:

$$W_{\text{net}} = \Delta K \checkmark$$

$$-\Delta U + W_f = \frac{1}{2}m v_f^2 - \frac{1}{2}m v_i^2$$

$$mgh + W_f = \frac{1}{2}m v_f^2 - \frac{1}{2}m v_i^2$$

$$(2)(9,8)(2) \checkmark + W_f \checkmark = \frac{1}{2}(2)(5)^2 \checkmark - 0 \checkmark$$

$$\therefore W_f = -14,2 \text{ J} \checkmark$$

(6)

- 5.3 No/Nee ✓
Friction is present/Wrywing is aanwesig. ✓

(2)

- 5.4.1 $\Sigma p_{\text{before}} = \Sigma p_{\text{after}} \checkmark$
 $(2)(5) + (9)(0) \checkmark = 2v_{f2} + (9)(1) \checkmark$
 $\therefore v_{f2} = 0,5 \text{ m} \cdot \text{s}^{-1} \checkmark$

Notes/Aantekeninge:

Other formulae/Ander formules:

$$m_1 v_{i1} + m_2 v_{i2} = m_1 v_{f1} + m_2 v_{f2}$$

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$$

(4)

- 5.4.2 $K(\text{total after/total na}) = \frac{1}{2}m_1 v_f^2 + \frac{1}{2}m_2 v_f^2 \checkmark$
 $= \frac{1}{2}(2)(0,5)^2 \checkmark + \frac{1}{2}(9)(1)^2 \checkmark$
 $= 4,75 \text{ J} \checkmark$

$$K(\text{total before}) \neq K(\text{total after}) \checkmark$$

$\therefore$ inelastic

$$K(\text{totaal na}) \neq K(\text{totaal voor}) \checkmark$$

$\therefore$ onelasties

(5)

[19]

QUESTION 6/VRAAG 6

6.1
$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR } f_L = \frac{v}{v - v_s} f_s \checkmark$$
$$\therefore 1\,050 \checkmark = \frac{340 + 0}{340 - v_s} (980) \checkmark$$
$$\therefore v_s = 22,67 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (4)$$

- 6.2 Waves in front of the moving source are compressed.
The observed wavelength decreases. $\checkmark$
For the same speed of sound, $\checkmark$ a higher frequency will be observed.
- Golwe voor die bewegende bron word saamgepers.*
Die waargenome golflengte verminder. $\checkmark$
Vir dieselfde spoed van klank $\checkmark$ sal 'n hoër frekwensie waargeneem word. $\checkmark$ (2)

- 6.3 Any ONE/Enige EEN:
- Determine whether arteries are clogged/narrowed $\checkmark$
so that precautions can be taken in advance/to prevent heart attack
/stroke. $\checkmark$
Bepaal of are verstop/vernou is, $\checkmark \checkmark$
sodat voorsorg getref kan word/om hartaanvalle/beroerte te voorkom. $\checkmark$
 - Determine heartbeat of foetus
to assure that child is alive/does not have a heart defect.
Bepaal die hartklop van 'n fetus
om seker te maak of baba leef/geen hartdefekte het nie. $\checkmark$ (2)
- [8]

QUESTION 7/VRAAG 7

7.1

Criteria for investigative question/Kriteria vir ondersoekende vraag:	Mark/Punt
The <u>dependent</u> and <u>independent</u> variables are stated. <i>Die <u>afhanklike</u> en <u>onafhanklike</u> veranderlikes is genoem.</i>	✓
Asks a question about the relationship between dependent and independent variables. <i>Vra 'n vraag oor die verwantskap tussen die <u>afhanklike</u> en <u>onafhanklike</u> veranderlikes.</i>	✓

Dependent variable:

Afhanklike veranderlike:

Broadness of central (bright) band/degree of diffraction
Breedte van sentrale (helder) band/mate van diffraksie

Independent variable:

Onafhanklike veranderlike:

Wavelength (of light)/Golflengte (van lig)

Example/Voorbeeld:

How will the width of the central band change/differ when the wavelength (of the light) changes/is increased/is decreased?

Hoe sal die breedte van die sentrale helder band verander wanneer die golflengte (van die lig) toeneem/afneem?

(2)

7.2

Slit width/Spleetwydte ✓

Distance between slit and screen/Afstand tussen spleet en skerm. ✓

(2)

7.3

$$\tan \theta = \frac{0,033}{0,45} \checkmark \therefore \theta = 4,19(4)^\circ$$

$$\sin \theta = \frac{m\lambda}{a} \checkmark$$

$$\sin 4,19^\circ \checkmark = \frac{(1)\lambda}{5,6 \times 10^{-7}} \checkmark$$

$$\therefore \lambda = 4,1 \times 10^{-8} \text{ m } \checkmark$$

(5)

7.4

Greater than/Groter as ✓

Red light has a longer wavelength (and is diffracted more.) ✓

Rooilig het 'n langer golflengte (en word meer diffrakteer.)

OR/OF

Diffraction/Diffraksie $\propto \lambda$ ✓

(2)

[11]

QUESTION 8/VRAAG 8

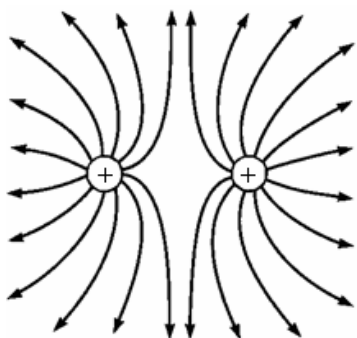
- 8.1 The (electrostatic) force experienced at a point ✓
per unit charge at that point. ✓
Die (elektrostatiese) krag ondervind by 'n punt ✓
per eenheidslading by daardie punt. ✓

OR/OF

The (electrostatic) force experienced ✓
by a charge placed at that point divided by the charge itself. ✓
Die (elektrostatiese) krag ondervind ✓
deur 'n lading geplaas by daardie punt gedeel deur die lading self. ✓

(2)

8.2



Criteria for sketch/Kriteria vir skets	Marks/Punte
Correct shape as shown. <i>Korrekte vorm soos getoon</i>	✓
Direction from positive to negative. <i>Rigting van positief na negatief.</i>	✓
Field lines start on spheres and do not cross. <i>Veldlyne begin op elke sfeer en kruis nie.</i>	✓

(3)

8.3

$$E_P = \frac{kQ}{r^2} \checkmark$$

$$= \frac{(9 \times 10^9)(5 \times 10^{-9})}{(30 \times 10^{-3})^2} \checkmark$$

$$= 5 \times 10^4 \text{ N} \cdot \text{C}^{-1} \text{ to the right/na regs}$$

$$E_Q = \frac{kQ}{r^2}$$

$$= \frac{(9 \times 10^9)(5 \times 10^{-9})}{(10 \times 10^{-3})^2} \checkmark$$

$$= 4,5 \times 10^5 \text{ N} \cdot \text{C}^{-1} \text{ to the right/na regs}$$

$$E_{\text{net}} = 5 \times 10^4 + 4,5 \times 10^5$$

$$= 5 \times 10^5 \text{ N} \cdot \text{C}^{-1} \text{ to the right/na regs} \checkmark$$

(6)

8.4

**POSITIVE MARKING FROM QUESTION 8.3 TO QUESTION 8.4/
POSITIEWE NASIEN VAN VRAAG 8.3 NA VRAAG 8.4**

$$E = \frac{F}{q} \checkmark$$

$$5 \times 10^5 = \frac{F}{1,6 \times 10^{-19}} \checkmark$$

$$F = 8 \times 10^{-14} \text{ N} \checkmark$$

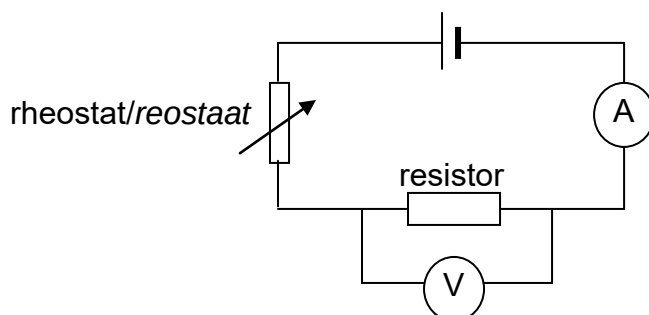
(3)

[14]

QUESTION 9/VRAAG 9

9.1

9.1.1



Criteria for circuit diagram/Kriteria vir stroombaandiagram	Mark/Punt
Battery connected to the resistor as shown – correct symbols used. <i>Battery aan resistor geskakel soos getoon – korrekte simbole is gebruik.</i>	✓
Rheostat connected in series with resistor – correct symbols used. <i>Reostaat in serie geskakel met resistor – korrekte simbole is gebruik.</i>	✓
Ammeter connected in series so that it measures the current through resistor – correct symbols used. <i>Ammeter in serie geskakel sodat dit die stroom deur die resistor meet – korrekte simbole is gebruik.</i>	✓
Voltmeter connected in parallel across resistor – correct symbols used. <i>Voltmeter in parallel geskakel oor resistor – korrekte simbole is gebruik.</i>	✓

(4)

9.1.2 Temperature/Temperatuur ✓

(1)

9.1.3 B ✓

The ratio $\frac{V}{I}$ is greater than that of A. ✓✓

B ✓

Die verhouding $\frac{V}{I}$ is groter as die van A. ✓✓

OR/OF

B ✓

The ratio $\frac{I}{V}$ is smaller than that of A. ✓✓

B ✓

Die verhouding $\frac{I}{V}$ is kleiner as die van A. ✓✓

(3)

9.2

$$9.2.1 \quad \frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} \checkmark = \frac{1}{4} + \frac{1}{16} \checkmark$$

$$\therefore R = 3,2 \, \Omega$$

$$R_{\text{effective/effektief}} = 3,2 \, \Omega + 2 \, \Omega + 0,8 \, \Omega \checkmark \\ = 6 \, \Omega \checkmark$$

(4)

9.2.2

Option 1/Opsie 1:

$$V = IR \checkmark$$

$$12 = I(6) \checkmark$$

$$I = 2 \, \text{A} \checkmark$$

Option 2/Opsie 2:

$$\text{emf} = I(R + r) \checkmark$$

$$12 = I(5,2 + 0,8) \checkmark$$

$$I = 2 \, \text{A} \checkmark$$

(3)

9.2.3

Option 1/Opsie 1:

$$V_{\text{parallel}} = IR \checkmark$$

$$= (2)(3,2) \checkmark$$

$$= 6,4 \, \text{V}$$

$$V_{8\Omega} = \frac{6,4}{2} \checkmark = 3,2 \, \text{V} \checkmark$$

Option 2/Opsie 2:

$$V_p = \frac{R_p}{R} \times V \checkmark$$

$$= \frac{3,2}{6} \checkmark \times 12 \checkmark = 6,4 \, \text{V}$$

$$\therefore V_{8\Omega} = 3,2 \, \text{V} \checkmark$$

Option 3/Opsie 3:

$$I_{8\Omega} = \frac{4}{20} (2) \checkmark$$

$$= 0,4 \, \text{A}$$

$$V_{8\Omega} = IR \checkmark$$

$$= (0,4)(8) \checkmark$$

$$= 3,2 \, \text{V} \checkmark$$

Option 4/Opsie 4:

$$\text{emf} = I(R + r) \checkmark$$

$$12 = IR_{2\Omega} + V_p + Ir$$

$$12 = (2)(2) + V_p + (2)(0,8) \checkmark$$

$$V_p = 6,4 \, \text{V}$$

$$V_{8\Omega} = \frac{6,4}{2} \checkmark = 3,2 \, \text{V} \checkmark$$

(4)

[19]

QUESTION 10/VRAAG 10

10.1

10.1.1

- (a) Reverses the direction of the current in the coil each half cycle. ✓
Keer die stroomrigting in die spoel elke halwe siklus. ✓

OR/OF

Maintains constant direction of rotation of the coil.

Onderhou die konstante rigting van rotasie van die spoel.

(1)

10.1.1 Makes electrical contact (with the commutator). ✓

- (b) *Maak elektriese kontak (met kommutator). ✓*

OR/OF

Allows split-ring commutator to rotate freely.

Laat splitringkommutator toe om vry te roteer.

OR/OF

Allows charges to flow/current in and out of the coil.

Laat vloei van lading/stroom in en uit spoel toe.

(1)

10.1.2 B to/na A ✓

(1)

10.1.3 Maximum/Maksimum ✓

(1)

10.1.4 Any ONE/Enige EEN:

- Increase the current in the coil. ✓
Verhoog die stroom in die spoel. ✓
- Increase the magnitude of the magnetic field./Use a stronger magnet.
Vergroot die grootte van die magneetveld./Gebruik 'n sterker magneet.
- Increase the number of turns in the coil.
Verhoog die aantal windinge in die spoel.
- Use a soft iron core as the core of the coil.
Gebruik 'n sagte ysterkern in die spoel.

(1)

10.2

10.2.1 Any ONE/Enige EEN:

- Can be transmitted over long distances without major energy loss. ✓
Kan oor groot afstande oorgedra word sonder groot energieverlies. ✓
- The potential difference can be increased or decreased.
Die potensiaalverskil kan verhoog of verlaag word.

(1)

10.2.2

(a) $V_{\text{rms/wgk}} = \frac{V_{\text{max/maks}}}{\sqrt{2}}$ ✓

$$230 = \frac{V_{\text{max/maks}}}{\sqrt{2}} \quad \checkmark$$

$$V_{\text{max/maks}} = 325,27 \text{ V} \quad \checkmark$$

(3)

10.2.2

(b) $P_{\text{ave}} = V_{\text{rms/wgk}} I_{\text{rms/wgk}} \checkmark$

$2\,000 = (230) I_{\text{rms/wgk}} \checkmark$

$I_{\text{rms/wgk}} = 8,70 \text{ A} \checkmark (8,696 \text{ A})$

(3)
[12]

QUESTION 11/VRAAG 11

11.1 Photoelectric effect/*Foto-elektriese effek* $\checkmark$

(1)

11.2

11.2.1 $E = hf \checkmark$

$= (6,63 \times 10^{-34})(6,16 \times 10^{14}) \checkmark$

$= 4,08 \times 10^{-19} \text{ J} \checkmark$

(3)

11.2.2 $E = W_0 + K \checkmark$

$4,08 \times 10^{-19} \checkmark = (6,63 \times 10^{-34})f_0 \checkmark + 5,6 \times 10^{-20} \checkmark$

$f_0 = 5,31 \times 10^{14} \text{ Hz} \checkmark$

(5)

11.3

11.3.1 Increases $\checkmark$

More photoelectrons emitted per second $\checkmark$

Vermeerder $\checkmark$

Meer foto-elektrone vrygestel per sekonde $\checkmark$

(2)

11.3.2 Remains the same $\checkmark$

Intensity does not affect energy. $\checkmark$

Bly dieselfde $\checkmark$

Intensiteit het geen effek op energie nie. $\checkmark$

OR/OF

Remains the same $\checkmark$

The frequency of light remains the same. $\checkmark$

Bly dieselfde $\checkmark$

Die frekwensie van die lig bly dieselfde. $\checkmark$

(2)

[13]

TOTAL SECTION B/TOTAAL AFDELING B:

125

GRAND TOTAL/GROOTTOTAAL:

150



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

NOVEMBER 2011

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 13 pages.
*Hierdie memorandum bestaan uit 13 bladsye.***

SECTION A

QUESTION 1 / VRAAG 1

- 1.1 Power ✓
Drywing / Arbeidstempo ✓ (1)
- 1.2 Coherent / Koherent ✓ (1)
- 1.3 Dielectric / Diëlektrikum ✓ (1)
- 1.4 Alternating (current) / AC / ac ✓
Wissel(stroom) / WS / ws ✓ (1)
- 1.5 $\text{N} \cdot \text{C}^{-1} / \text{V} \cdot \text{m}^{-1}$ / newton per coulomb / volt per meter ✓ (1)
- [5]

QUESTION 2 / VRAAG 2

- 2.1 C ✓✓ (2)
- 2.2 D ✓✓ (2)
- 2.3 D ✓✓ (2)
- 2.4 C ✓✓ (2)
- 2.5 B ✓✓ (2)
- 2.6 A ✓✓ (2)
- 2.7 C ✓✓ (2)
- 2.8 C ✓✓ (2)
- 2.9 D ✓✓ (2)
- 2.10 B ✓✓ (2)
- [20]

TOTAL SECTION A / TOTAAL AFDELING A: 25

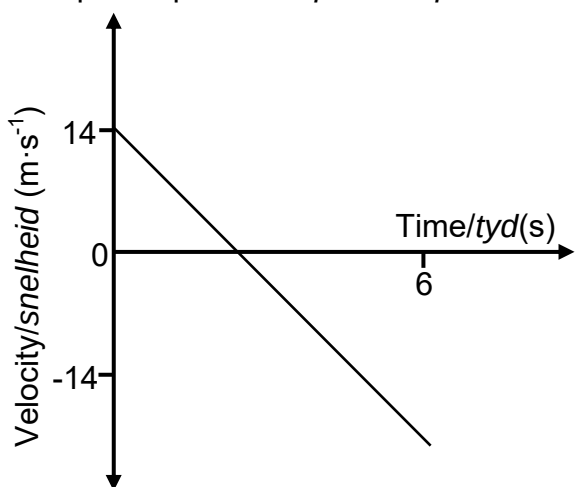
SECTION B / AFDELING B

QUESTION 3 / VRAAG 3

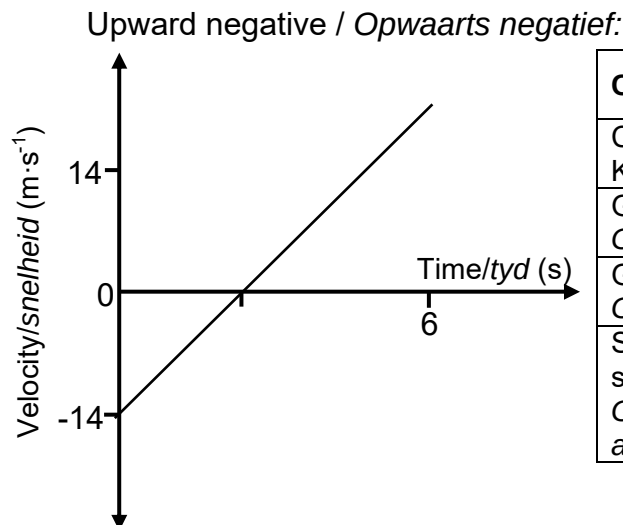
- 3.1 The initial velocity / speed of the camera is the same ✓
(as that of the balloon).
Die beginsnelheid / spoed van die kamera is dieselfde ✓ (as dié van die ballon). (1)

- 3.2 **Downward positive:**
Afwaarts positief:
 $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
 $\therefore 92,4 \checkmark = v_i(6) + \frac{1}{2}(9,8)(6)^2$ ✓
 $\therefore v_i = -14 \text{ m} \cdot \text{s}^{-1}$
 $\therefore v_i = 14 \text{ m} \cdot \text{s}^{-1}$ ✓
- Downward negative:**
Afwaarts negatief:
 $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
 $\therefore -92,4 \checkmark = v_i(6) + \frac{1}{2}(-9,8)(6)^2$ ✓
 $\therefore v_i = 14 \text{ m} \cdot \text{s}^{-1}$ ✓ (4)

- 3.3 Upward positive/Opwaarts positief:



Criteria for graph/Kriteria vir grafiek:	Marks/Punte
Correct shape as shown.(straight line with gradient) Korrekte vorm soos getoon.(reguitlyn met gradient)	✓
Graph starts at $v = 14 \text{ m} \cdot \text{s}^{-1}$ / v_i at $t = 0 \text{ s}$. Grafiek begin by $v = 14 \text{ m} \cdot \text{s}^{-1}$ / v_i by $t = 0 \text{ s}$.	✓
Graph extends below t axis until $t = 6 \text{ s}$. Grafiek verleng onder t -as tot $t = 6 \text{ s}$.	✓
Section of graph below t axis longer than section above t axis. Gedeelte van grafiek onderkant t -as langer as gedeelte bokant t -as.	✓



Criteria for graph/Kriteria vir grafiek:	Marks/Punte
Correct shape as shown. Korrekte vorm soos getoon.	✓
Graph starts at $v / v_i = -14 \text{ m} \cdot \text{s}^{-1}$ at $t = 0 \text{ s}$. Grafiek begin by $v/v_i = -14 \text{ m} \cdot \text{s}^{-1}$ by $t = 0 \text{ s}$.	✓
Graph extends above t axis until $t = 6 \text{ s}$. Grafiek verleng bokant t -as tot $t = 6 \text{ s}$.	✓
Section of graph above t axis longer than section below t axis. Gedeelte van grafiek bokant t -as langer as gedeelte onderkant t -as.	✓

(4)

3.4

Option 1 / Opsie 1:

$$\Delta x = v \Delta t \checkmark$$

$$\therefore 10 \checkmark = (2) \Delta t \checkmark$$

$$\therefore \Delta t = 5 \text{ s} \checkmark$$

Yes/ Will catch the camera, time is less than

6 s. ✓

Ja / Sal die kamera vang, tyd is kleiner as 6 s. ✓

Option 2/Opsie 2:

$$\Delta x = v \Delta t \checkmark$$

$$= (2) \checkmark (6) \checkmark$$

$$= 12 \text{ m} \checkmark$$

Yes / Will catch the camera, distance covered is greater than 10 m. ✓

Ja / Sal die kamera vang, afstand afgelê is groter as 10 m. ✓

Option 3 / Opsie 3:

$$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$\therefore 10 \checkmark = (2) \Delta t \checkmark + \frac{1}{2} (0) \Delta t$$

$$\therefore \Delta t = 5 \text{ s} \checkmark$$

Yes/ will catch the camera, time is less than 6 s ✓.

Ja / Sal die kamera vang, tyd is kleiner as 6 s. ✓

Option 4 / Opsie 4:

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark \therefore 10 \checkmark = \left(\frac{2+2}{2} \right) \Delta t \checkmark \therefore \Delta t = 5 \text{ s} \checkmark$$

Yes / Will catch the camera, time is less than 6 s. ✓

Ja / Sal die kamera vang, tyd is kleiner as 6 s. ✓

Option 5 / Opsie 5:

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark = \left(\frac{2+2}{2} \right) \checkmark 6 \checkmark = 12 \text{ m} \checkmark$$

Yes / Will catch the camera, distance covered is greater than 10 m. ✓

Ja / Sal die kamera vang, afstand afgelê is groter as 10 m. ✓

(5)

[14]

QUESTION 4 / VRAAG 4

4.1 $30 \text{ m}\cdot\text{s}^{-1}$ ✓ east / oos ✓

Notes / Aantekeninge:

$$v_{TP} = v_{TG} - v_{PG} = 40 - 10 = 30$$

$$\therefore v_{TP} = 30 \text{ m}\cdot\text{s}^{-1} \text{ east/oos}$$

OR/OF

$$v_{TP} = v_{TG} + v_{GP} = 40 + (-10) = 30$$

$$\therefore v_{TP} = 30 \text{ m}\cdot\text{s}^{-1} \text{ east/oos}$$

(2)

4.2 $70 \text{ m}\cdot\text{s}^{-1}$ ✓ east / oos ✓

Notes / Aantekeninge:

Solution 1 / Oplossing 1:

$$v_{BT} = v_{BP} - v_{TP}$$

$$= 100 - 30 = 70$$

$$\therefore v_{BT} = 70 \text{ m}\cdot\text{s}^{-1} \text{ east / oos}$$

Solution 2 / Oplossing 2

$$v_{BT} = v_{BP} + v_{PT}$$

$$= 100 + (-30) = 70$$

$$\therefore v_{BT} = 70 \text{ m}\cdot\text{s}^{-1} \text{ east/oos}$$

OR / OF

$$v_{BT} = v_{BP} + v_{PG} + v_{GT}$$

$$= 100 + 10 + (-40)$$

$$= 70$$

$$\therefore v_{BT} = 70 \text{ m}\cdot\text{s}^{-1} \text{ east / oos}$$

Solution 3 / Oplossing 3

$$v_{BT} = v_{BP} + v_{PG} + v_{GT}$$

$$= 100 + 10 + (-40)$$

$$= 70$$

$$\therefore v_{BT} = 70 \text{ m}\cdot\text{s}^{-1} \text{ east / oos}$$

Solution 4 / Oplossing 4

$$v_{BG} = v_{BP} + v_{PG}$$

$$= 100 + 10 = 110$$

$$\therefore v_{BG} = 110 \text{ m}\cdot\text{s}^{-1}$$

$$v_{BT} = v_{BG} + v_{GT}$$

$$= 110 + (-40) = 70$$

$$\therefore v_{BT} = 70 \text{ m}\cdot\text{s}^{-1} \text{ east / oos}$$

(2)

4.3 The total (linear) momentum remains constant/is conserved / does not change. ✓
in an isolated/a closed system/the absence of external forces. ✓

*Die totale (liniêre) momentum bly konstant / behoue / verander nie ✓
in 'n geïsoleerde sisteem / geslote sisteem / die afwesigheid van eksterne kragte. ✓*

(2)

4.4

Option 1 / Opsie 1:

To the right as positive / Na regs as positief:

$$\Sigma p_{\text{before/voor}} = \Sigma p_{\text{after/na}} \checkmark$$

$$(1\,000)(40) \checkmark + (5\,000)(-20) \checkmark = (1\,000 + 5\,000)v_f \checkmark$$

$$\therefore v_f = -10 \text{ m}\cdot\text{s}^{-1} \checkmark$$

$$\therefore v_f = 10 \text{ m}\cdot\text{s}^{-1} \text{ left / na links } \checkmark \text{ OR / OF west / wes}$$

Option 2 / Opsie 2:

To the right as positive / Na regs as positief:

$$\Delta p_{\text{car}} = -\Delta p_{\text{truck}} \checkmark$$

$$m(v_f - v_i) = -m(v_f - v_i)$$

$$(1\,000)(v_f - (40)) \checkmark = -(5\,000)(v_f \checkmark - (-20)) \checkmark$$

$$6\,000v_f = -60\,000$$

$$\therefore v_f = -10 \text{ m}\cdot\text{s}^{-1} \checkmark$$

$$\therefore v_f = 10 \text{ m}\cdot\text{s}^{-1} \text{ left / na links } \checkmark \text{ OR/OF west / wes}$$

(6)

4.5

Option 1 / Opsie 1:

Force on car / Krag op motor:

To the right as positive / Na regs as positief:

$$F_{\text{net}}\Delta t = \Delta p \checkmark = mv_f - mv_i$$

$$F_{\text{net}}(0,5) \checkmark = 1\,000(-10 - 40) \checkmark$$

$$\therefore F_{\text{net}} = -1 \times 10^5 \text{ N } \checkmark \text{ OR/OF}$$

$$\therefore F_{\text{net}} = 1 \times 10^5 \text{ N } (100\,000 \text{ N})$$

$$\therefore F_{\text{net}} > 85\,000 \text{ N}$$

Yes, collision is fatal. / Ja, botsing is fataal. $\checkmark$

Force on car / Krag op motor:

To the left as positive / Na links as positief:

$$F_{\text{net}}\Delta t = \Delta p \checkmark = mv_f - mv_i$$

$$F_{\text{net}}(0,5) \checkmark = 1\,000(10 - (-40)) \checkmark$$

$$\therefore F_{\text{net}} = 1 \times 10^5 \text{ N } \checkmark (100\,000 \text{ N})$$

$$\therefore F_{\text{net}} > 85\,000 \text{ N}$$

Yes, collision is fatal. / Ja, botsing is fataal. $\checkmark$ **Option 2 / Opsie 2:**

Force on truck / Krag op vragmotor:

To the right as positive / Na regs as positief:

$$F_{\text{net}}\Delta t = \Delta p \checkmark = mv_f - mv_i$$

$$F_{\text{net}}(0,5) \checkmark = 5\,000(-10 - (-20)) \checkmark$$

$$\therefore F_{\text{net}} = 1 \times 10^5 \text{ N } \checkmark (100\,000 \text{ N})$$

$$\therefore F_{\text{net}} > 85\,000 \text{ N}$$

Yes, collision is fatal. / Ja, botsing is fataal. $\checkmark$

Force on truck / Krag op vragmotor:

To the left as positive / Na links as positief:

$$F_{\text{net}}\Delta t = \Delta p \checkmark = mv_f - mv_i$$

$$F_{\text{net}}(0,5) \checkmark = 5\,000(10 - 20) \checkmark$$

$$\therefore F_{\text{net}} = -1 \times 10^5 \text{ N } \checkmark$$

$$\therefore F_{\text{net}} = 1 \times 10^5 \text{ N } (100\,000 \text{ N})$$

$$\therefore F_{\text{net}} > 85\,000 \text{ N}$$

Yes, collision is fatal / Ja, botsing is fataal. $\checkmark$ **Option 3 / Opsie 3:**

Force on car / Krag op motor:

To the right as positive / Na regs as positief:

$$v_f = v_i + a \Delta t$$

$$\therefore -10 = 40 + a(0,5) \checkmark$$

$$\therefore a = -100$$

$$F_{\text{net}} = ma = (1\,000)(-100) \checkmark$$

$$\therefore F_{\text{net}} = -1 \times 10^5 \text{ N } \checkmark (-100\,000 \text{ N})$$

$$\therefore F_{\text{net}} = 1 \times 10^5 \text{ N } (100\,000 \text{ N})$$

$$\therefore F_{\text{net}} > 85\,000 \text{ N}$$

Yes, collision is fatal. / Ja, botsing is fataal. $\checkmark$

$\checkmark$ Both
formulae/
Beide
formules

Force on car / Krag op motor:

To the left as positive / Na links as positief:

$$v_f = v_i + a \Delta t$$

$$\therefore 10 = -40 + a(0,5) \checkmark$$

$$\therefore a = 100$$

$$F_{\text{net}} = ma = (1\,000)(100) \checkmark$$

$$\therefore F_{\text{net}} = 1 \times 10^5 \text{ N } \checkmark (100\,000 \text{ N})$$

$$\therefore F_{\text{net}} > 85\,000 \text{ N}$$

Yes, collision is fatal. / Ja, botsing is fataal. $\checkmark$

$\checkmark$ Both
formulae/
Beide
formules

Option 4 / Opsie 4: Force on truck / Krag op vrugmotor: To the right as positive / Na regs as positief: $v_f = v_i + a \Delta t$ $\therefore -10 = -20 + a(0,5) \checkmark$ $\therefore a = 20$ $F_{\text{net}} = ma = (5\,000)(20) \checkmark$ $\therefore F_{\text{net}} = 1 \times 10^5 \text{ N} \checkmark (100\,000 \text{ N})$ $\therefore F_{\text{net}} > 85\,000 \text{ N}$ Yes, collision is fatal. / Ja, botsing is fataal. $\checkmark$	Force on truck / Krag op vrugmotor: To the left as positive / Na links as positief: $v_f = v_i + a \Delta t$ $\therefore 10 = 20 + a(0,5) \checkmark$ $\therefore a = -20$ $F_{\text{net}} = ma = (5\,000)(-20) \checkmark$ $\therefore F_{\text{net}} = -1 \times 10^5 \text{ N} \checkmark (-100\,000 \text{ N})$ $\therefore F_{\text{net}} = 1 \times 10^5 \text{ N} (100\,000 \text{ N})$ $\therefore F_{\text{net}} > 85\,000 \text{ N}$ Yes, collision is fatal. / Ja, botsing is fataal. $\checkmark$

(5)
[17]

QUESTION 5 / VRAAG 5

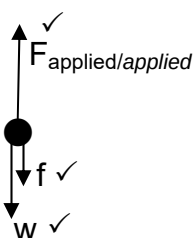
- 5.1 The net (total) work (done on an object) $\checkmark$
 is equal to the change in kinetic energy (of the object.) $\checkmark$
 Die netto (totale) arbeid (verrig op 'n voorwerp) $\checkmark$
 is gelyk aan die verandering in kinetiese energie (van die voorwerp) $\checkmark$

OR / OF

The work done (on an object) by a net (resultant) force $\checkmark$
 is equal to the change in (the object's) kinetic energy. $\checkmark$
 Die arbeid verrig (op 'n voorwerp) deur 'n netto (resulterende) krag $\checkmark$
 is gelyk aan die verandering in kinetiese energie (van die voorwerp.) $\checkmark$

(2)

5.2



(3)

- 5.3 Gravitational force/weight (of soldier) $\checkmark$
 Gravitatiekrag/gewig (van soldaat)

(1)

- 5.4 $W_{\text{net}} = \Delta K \checkmark$

$$F \Delta y \cos \theta + F_w \Delta y \cos \theta + W_f = \Delta K$$

$$(960)(20) \cos 0^\circ \checkmark + (80)(9,8)(20) \cos 180^\circ \checkmark + W_f = 0 \checkmark$$

$$19\,200 - 15\,680 + W_f = 0$$

$$W_f = -3\,520 \text{ J} \checkmark$$

(5)
[11]

QUESTION 6 / VRAAG 6

6.1 Doppler effect / Doppler-effek ✓ (1)

6.2
$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \checkmark$$

$$\therefore f_L = \frac{340 \pm 0}{340 - 20} \checkmark (458) \checkmark$$

$$\therefore f_L = 486,63 \text{ Hz} \checkmark$$
 (4)

6.3 Decreases/Verlaag ✓ (1)

6.4 Equal to/Gelyk aan ✓

Velocity of train driver relative to the whistle is zero. ✓
Snelheid van treindrywer relatief tot fluitjie is nul.

OR / OF

Train driver has same velocity as whistle.
Treindrywer het dieselfde snelheid as die fluitjie.

OR / OF

There is no relative motion between source and observer.
Daar is geen relatiewe beweging tussen bron en waarnemer.

(2)
[8]

QUESTION 7 / VRAAG 7

7.1 Light of a single wavelength **OR** single frequency. ✓✓
Lig van 'n enkele golflengte **OF** enkele frekwensie. ✓✓ (2)

7.2

Criteria for investigative question: <i>Kriteria vir ondersoekende vraag:</i>	Mark/ Punt
The <u>dependent</u> and <u>independent</u> variables are stated. <i>Die afhanklike en onafhanklike veranderlikes is genoem.</i>	✓
Asks a question about the relationship between <u>dependent</u> and <u>independent</u> variables. <i>Vra 'n vraag oor die verwantskap tussen die afhanklike en onafhanklike veranderlikes.</i>	✓

Examples/Voorbeelde:

- How will the broadness / width of the central band change / differ when slit width changes / is increased / is decreased?

Hoe sal die breedte / wydte van die sentrale helderband verander / verskil wanneer die spleetwydte verander / toeneem / afneem?

- What is the relationship between the broadness of the central bright band and slit width?

Wat is die verwantskap tussen die breedte van die sentrale helderband en spleetwydte?

(2)

- 7.3 Wavelength (of light) / Frekwensie (of lig) / Colour of light/ Light source ✓
Distance between slit and screen. ✓

Golflengte (van lig) / Frekwensie (van lig) / Kleur van lig / Ligbron ✓
Afstand tussen spleet en skerm. ✓

(2)

- 7.4 Increases / Vermeerder ✓
Diffraction is inversely proportional to slit width. ✓
Diffraksie is omgekeerd eweredig aan spleetwydte. ✓

OR/OF

Increases / Vermeerder ✓

Diffraction / *Diffraksie* OR/OF $\sin \theta \propto \frac{1}{a}$ ✓

(2)

- 7.5 **Option 1 / Opsie 1:**

$$\sin \theta = \frac{m\lambda}{a} \checkmark$$

$$\sin \theta = \frac{(2)(4 \times 10^{-7})}{2,2 \times 10^{-6}} \checkmark$$

$$\therefore \theta = 21,32^\circ \checkmark$$

Option 2 / Opsie 2:

$$\sin \theta = \frac{m\lambda}{a} \checkmark$$

$$\sin \theta = \frac{(-2)(4 \times 10^{-7})}{2,2 \times 10^{-6}} \checkmark$$

$$\therefore \theta = -21,32^\circ \checkmark$$

(5)

[13]

QUESTION 8 / VRAAG 8

- 8.1 T to/na P ✓

(1)

8.2 $Q = \frac{3 \times 10^{-9} + (-6 \times 10^{-9})}{2} \checkmark = -1,5 \times 10^{-9} \text{ C}$

$$\begin{aligned} \Delta Q_P &= Q_P(\text{final}) - Q_P(\text{initial}) \\ &= -1,5 \times 10^{-9} - 3 \times 10^{-9} \checkmark \\ &= -4,5 \times 10^{-9} \text{ C} \checkmark \end{aligned}$$

OR / OF

$$\begin{aligned} \Delta Q_T &= Q_T(\text{final}) - Q_T(\text{initial}) \\ &= -1,5 \times 10^{-9} - (-6 \times 10^{-9}) \checkmark \\ &= 4,5 \times 10^{-9} \text{ C} \checkmark \end{aligned}$$

(3)

8.3 Number of electrons / *Getal elektrone* = $\frac{-4,5 \times 10^{-9}}{-1,6 \times 10^{-19}} \checkmark$
 $= 2,81 \times 10^{10} \checkmark$

(2)

8.4

Option 1 / Opsie 1

$$F_{TR} = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$= \frac{(9 \times 10^9)(1,5 \times 10^{-9})(3 \times 10^{-9})}{1^2} \checkmark$$

$$= 4,05 \times 10^{-8} \text{ N to the left/towards P}$$

na links/na P toe

$$F_{PR} = \frac{kQ_1Q_2}{r^2}$$

$$= \frac{(9 \times 10^9)(1,5 \times 10^{-9})(3 \times 10^{-9})}{0,5^2} \checkmark$$

$$= 1,62 \times 10^{-7} \text{ N to the right/towards T}$$

na regs/na T toe

To the right / towards T as positive: / Na regs / na T toe as positief

$$F_{\text{net}} = 1,62 \times 10^{-7} - 4,05 \times 10^{-8}$$

$$= 1,22 \times 10^{-7} \text{ N } (1,215 \times 10^{-7} \text{ N})$$

$$= 1,22 \times 10^{-7} \text{ N } \checkmark \text{ to the right / towards T / na regs / na T toe } \checkmark$$

✓ Any one
Enige een

(6)
[12]

QUESTION 9 / VRAAG 9

9.1 Current / I / stroom ✓

(1)

9.2

9.2.1 (4,0 ✓ ; 0,64) ✓

(2)

9.2.2 Temperature was not kept constant. ✓✓
Temperatuur is nie konstant gehou nie. ✓✓

(2)

9.3 Gradient/m = $\frac{\Delta y}{\Delta x} = \frac{0,64 - 0}{4 - 0} \checkmark = 0,16$

$$R = \frac{1}{0,16} = 6,25 \Omega \checkmark \checkmark$$

(4)
[9]

QUESTION 10 / VRAAG 10

10.1 12 V ✓

(1)

10.2.1

Option 1 / Opsie 1: $I = \frac{V}{R} \checkmark = \frac{9,6}{2,4} \checkmark = 4 \text{ A}$	Option 2 / Opsie 2: $\text{emf} = IR + Ir \checkmark$ $12 = I(2,4) + 2,4 \checkmark \therefore I = 4 \text{ A} \checkmark$

(3)

10.2.2	Option 1 / Opsie 1: $\text{emf/emk} = IR + Ir \checkmark$ $12 = 9,6 + 4r \checkmark$ $\therefore r = 0,6 \Omega \checkmark$ Option 3 / Opsie 3: $\text{emf/emk} = I(R + r) \checkmark$ $12 = 4(2,4 + r) \checkmark \therefore r = 0,6 \Omega \checkmark$	Option 2 / Opsie 2: $V_{\text{lost/verlore}} = Ir \checkmark$ $2,4 = 4r \checkmark$ $\therefore r = 0,6 \Omega \checkmark$

(3)

10.3

Option 1 / Opsie 1: $\text{emf/emk} = I(R + r) \checkmark$ $12 = 6(R + 0,6) \checkmark$ $R_{\text{ext/eks}} = 1,4 \Omega$ $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$ $\frac{1}{1,4} = \frac{1}{2,4} + \frac{1}{R} \checkmark$ $\therefore R = 3,36 \Omega$ Each tail lamp/Elke agterlig: $\therefore R = 1,68 \Omega \checkmark$	Option 2 / Opsie 2: $\text{Emf} = V_{\text{terminal}} + Ir \checkmark$ $12 = V_{\text{terminal}} + 6(0,6) \checkmark$ $\therefore V_{\text{terminal}} = 8,4 \text{ V}$ $I_{2,4 \Omega} = \frac{V}{R} = \frac{8,4}{2,4} = 3,5 \text{ A}$ $I_{\text{tail lamps/agterligte}} = 6 - 3,5 = 2,5 \text{ A}$ $R_{\text{tail lamps/agterligte}} = \frac{V}{I} \checkmark = \frac{8,4}{2,5} \checkmark = 3,36 \Omega$ $R_{\text{tail lamp/agterlig}} = 1,68 \Omega \checkmark$
Option 3 / Opsie 3: $V = IR \checkmark$ $12 = (6)R \checkmark$ $R_{\text{ext}} = 2 \Omega$ $\therefore R_{\text{parallel}} = 2 - 0,6 = 1,4 \Omega$ $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$ $\frac{1}{1,4} = \frac{1}{2,4} + \frac{1}{R} \checkmark$ $\therefore R = 3,36 \Omega$ Each tail lamp/Elke agterlig: $R = 1,68 \Omega \checkmark$	Option 4 / Opsie 4: For parallel combination: $I_1 + I_2 = 6 \text{ A}$ Vir parallelle kombinasie: $I_1 + I_2 = 6 \text{ A}$ $\therefore \frac{V}{2,4} + \frac{V}{R_{\text{taillamps}}} \checkmark = 6 \checkmark$ $8,4 \checkmark \left(\frac{1}{2,4} + \frac{1}{R_{\text{taillamps}}} \right) \checkmark = 6$ $\therefore R_{\text{tail lamps/agterligte}} = 3,36$ $R_{\text{tail lamp/agterligte}} = 1,68 \Omega \checkmark$

(5)

- 10.4 Increases / Vermeerder $\checkmark$
Resistance increases, current decreases $\checkmark$
Ir (lost volts) decreases $\checkmark$
Vermeerder $\checkmark$
Weerstand verhoog, stroom verlaag $\checkmark$
Ir (verlore volts) verminder / neem af. $\checkmark$

(3)
[15]

QUESTION 11 / VRAAG 11

- 11.1.1 Electrical (energy) to mechanical / kinetic (energy) ✓
Elektriese (energie) na meganiese / kinetiese (energie) ✓ (1)
- 11.1.2 Mechanical / kinetic (energy) to electrical (energy) ✓
Meganiese / kinetiese (energie) na elektriese (energie) ✓ (1)
- 11.1.3 Motor effect / Motor-effek ✓ (1)
- 11.1.4 Electromagnetic induction ✓
Elektromagnetiese induksie ✓ (1)
- 11.2 BC / conductor is parallel ✓ to the magnetic field. ✓
BC / geleier is parallel ✓ aan die magneetveld. ✓

OR / OF

Open switch ✓, no current. ✓
Oop skakelaar ✓, geen stroom. ✓

(2)

11.3

Option 1 / Opsie 1:

$$\begin{aligned} P_{\text{ave}} &= V_{\text{rms}} I_{\text{rms}} \checkmark \\ &= \frac{V_{\text{max}}}{\sqrt{2}} \checkmark \cdot \frac{I_{\text{max}}}{\sqrt{2}} \checkmark \\ &= \frac{(311)(21)}{2} \checkmark \checkmark \\ &= 3\,265,5 \text{ W} \checkmark \end{aligned}$$

OR / OF

$$\begin{aligned} P_{\text{max}} &= V_{\text{max}} I_{\text{max}} \checkmark \\ &= (311) \checkmark (21) \checkmark \\ &= 6531 \text{ W} \\ \therefore P_{\text{ave}} &= \frac{P_{\text{max}}}{2} \checkmark \checkmark = \frac{6531}{2} \\ &= 3\,265,5 \text{ W} \checkmark \end{aligned}$$

Option 2 / Opsie 2:

$$\begin{aligned} V_{\text{rms}} &= \frac{V_{\text{max}}}{\sqrt{2}} \checkmark \\ &= \frac{311}{\sqrt{2}} \checkmark \\ &= 219,91 \text{ V} \\ I_{\text{rms}} &= \frac{I_{\text{max}}}{\sqrt{2}} \checkmark \\ &= \frac{21}{\sqrt{2}} \checkmark \\ &= 14,85 \text{ A} \\ P_{\text{ave}} &= V_{\text{rms}} I_{\text{rms}} \checkmark \\ &= (219,91)(14,85) \\ &= 3\,265,66 \text{ W} \checkmark \end{aligned}$$

Option 3 / Opsie 3

$$\begin{aligned} R &= \frac{V}{I} \checkmark = \frac{311}{21} \checkmark = 14,81 \, \Omega \\ I_{\text{rms}} &= \frac{I_{\text{max}}}{\sqrt{2}} \checkmark \\ &= \frac{21}{\sqrt{2}} \checkmark \\ &= 14,85 \text{ A} \\ P_{\text{ave}} &= I_{\text{rms}}^2 R \checkmark \\ &= (14,85)^2 (14,81) \\ &= 3\,265,83 \text{ W} \checkmark \end{aligned}$$

Option 4 / Opsie 4

$$\begin{aligned} R &= \frac{V}{I} \checkmark = \frac{311}{21} \checkmark = 14,81 \, \Omega \\ V_{\text{rms}} &= \frac{V_{\text{max}}}{\sqrt{2}} \checkmark \\ &= \frac{311}{\sqrt{2}} \checkmark \\ &= 219,91 \text{ V} \\ P_{\text{ave}} &= \frac{V_{\text{rms}}^2}{R} \checkmark \\ &= \frac{219,91^2}{14,81} \\ &= 3\,265,83 \text{ W} \checkmark \end{aligned}$$

(6)

[12]

QUESTION 12 / VRAAG 12

12.1 Photo-electric effect / Foto-elektriese effek ✓ (1)

12.2 Work function / Werkfunksie / Arbeidsfunksie ✓ (1)

12.3 $c = f\lambda$ ✓
 $3 \times 10^8 \text{ ✓} = f(330 \times 10^{-9}) \text{ ✓}$
 $\therefore f = 9,09 \times 10^{14} \text{ Hz ✓}$

OR/OF

$$E = \frac{hc}{\lambda} = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{330 \times 10^{-9}} \text{ ✓} = 6,03 \times 10^{-19} \text{ J}$$

$$E = hf$$

$$6,03 \times 10^{-19} = (6,63 \times 10^{-34})f \text{ ✓}$$

$$\therefore f = 9,09 \times 10^{14} \text{ Hz ✓}$$

✓ for both equations
vir beide vergelykings

(4)

12.4

Option 1 / Opsie 1:

$$\left. \begin{aligned} E &= W_o + K \\ \frac{hc}{\lambda} &= W_o + K \end{aligned} \right\} \text{ ✓ Any one / Enige een}$$

$$\therefore \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{330 \times 10^{-9}} \text{ ✓} = 3,5 \times 10^{-19} + K \text{ ✓}$$

$$\therefore K = 2,53 \times 10^{-19} \text{ J ✓}$$

Option 2 / Opsie 2:

$$\left. \begin{aligned} E &= W_o + K \\ hf &= W_o + K \end{aligned} \right\} \text{ ✓ Any one / Enige een}$$

$$\therefore (6,63 \times 10^{-34})(9,09 \times 10^{14}) \text{ ✓} = 3,5 \times 10^{-19} + K \text{ ✓}$$

$$\therefore K = 2,53 \times 10^{-19} \text{ J ✓}$$

(4)

12.5

12.5.1 Remains the same / Bly dieselfde ✓ (1)

12.5.2 Increases / Vermeerder ✓ (1)

12.6

12.6.1 Ultraviolet radiation / Ultraviolet-straling ✓ (1)

12.6.2 High energy / high frequency ✓
Hoë energie / hoë frekwensie (1)

[14]

TOTAL SECTION B/TOTAAL AFDELING B: 125
GRAND TOTAL/GROOTTOTAAL: 150



education

Department:
Education
REPUBLIC OF SOUTH AFRICA

**NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

NOVEMBER/NOVEMBER 2009(1)

MEMORANDUM

PUNTE: 150

**This memorandum consists of 21 pages.
*Hierdie memorandum bestaan uit 21 bladsye.***

Learning Outcomes and Assessment Standards Leeruitkomst en Assesseringstandaarde		
LO1/LU1	LO2/LU2	LO3/LU3
AS12.1.1: Design, plan and conduct a scientific inquiry to collect data systematically with regard to accuracy, reliability and the need to control variables. <i>Ontwerp, beplan en voer 'n wetenskaplike ondersoek uit om data te versamel ten opsigte van akkuraatheid, betroubaarheid en die kontroleer van veranderlikes.</i> AS12.1.2: Seek patterns and trends, represent them in different forms, explain the trends, use scientific reasoning to draw and evaluate conclusions, and formulate generalisations. <i>Soek patrone en tendense, stel dit in verskillende vorms voor, verduidelik die tendense, gebruik wetenskaplike beredenering om gevolgtrekkings te maak en te evalueer, en formuleer veralgemenings.</i> AS12.1.3: Select and use appropriate problem-solving strategies to solve (unseen) problems. <i>Kies en gebruik geskikte probleemoplossingstrategieë om (ongesiene) probleme op te los.</i> AS12.1.4: Communicate and defend scientific arguments with clarity and precision. <i>Kommunikeer en verdedig wetenskaplike argumente duidelik en presies.</i>	AS12.2.1: Define, discuss and explain prescribed scientific knowledge. <i>Definieer, bespreek en verduidelik voorgeskrewe wetenskaplike kennis.</i> AS12.2.2 Express and explain prescribed scientific principles, theories, models and laws by indicating the relationship between different facts and concepts in the candidate's own words. <i>Verduidelik en druk voorgeskrewe wetenskaplike beginsels, teorieë, modelle en wette uit deur die verwantskap tussen verskillende feite en konsepte in die kandidaat se eie woorde aan te dui.</i> AS12.2.3: Apply scientific knowledge in everyday-life contexts. <i>Pas wetenskaplike kennis in kontekste van die alledaagse lewe toe.</i>	AS12.3.1 Research, discuss, compare and evaluate scientific and indigenous knowledge systems and knowledge claims by indicating the correlation among them, and explain the acceptance of different claims. <i>Doen navorsing, bespreek, vergelyk en evalueer wetenskaplike en inheemse kennissisteme en kennis aansprake deur die ooreenkoms tussen hulle aan te dui, en verduidelik die aanvaarding van verskillende aansprake.</i> AS12.3.2: Research case studies and present ethical and moral arguments from different perspectives to indicate the impact (pros and cons) of different scientific and technological applications. <i>Vors gevallestudies na en bied etiese en morele argumente aan uit verskillende perspektiewe om die impak (voordele en nadele) van verskillende wetenskaplike en tegnologiese toepassings aan te dui.</i> AS12.3.3: Evaluate the impact of scientific and technological research and indicate the contribution to the management, utilisation and development of resources to ensure sustainability continentally and globally. <i>Evalueer die impak van wetenskaplike en tegnologiese navorsing en dui die bydrae tot bestuur, benutting en ontwikkeling van bronne aan om volhoubaarheid kontinentaal en globaal te verseker.</i>

SECTION A/AFDELING A

QUESTION 1/VRAAG 1

1.1	(gravitational) <u>potential</u> (energy) ✓ (gravitasionele) <u>potensiële</u> (energie)	[12.2.1]	(1)
1.2	watt / W ✓	[12.2.1]	(1)
1.3	Coherent / coherence ✓ <i>Koherent</i>	[12.2.1]	(1)
1.4	gamma rays /-strale ✓ OR/OF γ rays / γ -strale	[12.2.1]	(1)
1.5	Photons / fotone ✓ OR/OF Quanta / kwanta	[12.2.1]	(1) [5]

QUESTION 2/VRAAG 2

2.1	... is $9,8 \text{ m} \cdot \text{s}^{-2}$ at its maximum height. ✓✓ ... is $9,8 \text{ m} \cdot \text{s}^{-2}$ by sy maksimum hoogte. OR/OF ... the velocity is zero at its maximum height./... <i>die snelheid is nul by sy maksimum hoogte.</i>	[12.2.1]	(2)
2.2	... the magnitude of the MOMENTUM of the bullet is equal (opposite in direction) to the magnitude of the momentum of the gun. ✓✓ ... <i>die grootte van die MOMENTUM van die koeël is gelyk (teenoorgestel in rigting) aan die grootte van die momentum van die geweer.</i> OR/OF ...the MOMENTUM of the bullet is opposite in direction to the momentum of the gun ... <i>die MOMENTUM van die koeël is teenoorgestel in rigting aan die momentum van die geweer</i> OR/OF ... the MOMENTUM of the bullet is equal to, but opposite in direction to the momentum of the gun. ... <i>die MOMENTUM van die koeël is gelyk aan, maar teenoorgestel in rigting aan die momentum van die geweer.</i>		

OR/OF

.... the **CHANGE in MOMENTUM (impulse)** of the bullet is equal in magnitude (opposite in direction) to the change in momentum of the gun.

... die *verandering in MOMENTUM* van die koeël is gelyk in grootte (teenoorgesteld in rigting) aan die verandering in momentum van die geweer.

OR/OF

.... the **CHANGE in MOMENTUM (impulse)** of the bullet is equal to, but opposite in direction to the change in momentum of the gun.

... die **VERANDERING in MOMENTUM (impuls)** van die koeël is gelyk aan, maar teenoorgesteld in rigting aan die verandering in momentum van die geweer.

OR/OF

... the **magnitude of the FORCE** that the bullet exerts on the gun is **equal** (opposite in direction) to the force that the gun exerts on the bullet.

... die **grootte van die KRAG** wat die koeël op die geweer uitoefen is **gelyk** (teenoorgesteld in rigting) aan die krag wat die geweer op die koeël uitoefen.

OR/OF

... the **FORCE** that the bullet exerts on the gun is **equal to, but opposite in direction** to the force that the gun exerts on the bullet.

... die **KRAG** wat die koeël op die geweer uitoefen is **gelyk aan, maar teenoorgesteld in rigting**, aan die krag wat die geweer op die koeël uitoefen.

[12.2.3] (2)

- 2.3 ... result of diffraction / interference ✓✓
... gevolg van diffraksie / interferensie

OR/OF

... by a triangular prism ...

... deur 'n driehoekige prisma ...

[12.2.3] (2)

- 2.4 ... different potential differences ... ✓✓
... verskillende potensiaalverskille ...

OR/OF

Identical resistors ...

Identiese resistors ...

OR/OF

Identical resistors ...connected in parallel

Identiese resistors ...in parallel geskakel

OR/OF

Non-identical resistors in parallel different current

Nie identiese resistors ... in parallel ... verskillende stroom

[12.2.2] (2)

- 2.5 A line absorption spectrum ... ✓✓
'n Lynabsorpsiespektrum ...

OR/OF

... when electrons move from higher to lower energy levels.

... *wanneer elektrone van hoër na laer energievlakke beweeg.*

[12.2.1] (2)
[10]

QUESTION 3/VRAAG 3

- 3.1 C ✓✓ [12.1.2] (2)
3.2 A ✓✓ [12.2.3] (2)
3.3 B ✓✓ [12.1.2] (2)
3.4 C ✓✓ [12.2.3] (2)
3.5 A ✓✓ [12.2.1] (2)
[10]

TOTAL SECTION A/TOTAAL AFDELING A: 25

SECTION B / AFDELING B

QUESTION 4 / VRAAG 4

4.1

Option 1/Opsie 1

Statements not correct (or no) / *Stellings nie reg nie (of nee)* ✓

The bricks will experience the same (gravitational) acceleration / free fall ✓ and thus reach the ground at the same time. ✓

Die bakstene ondervind dieselfde (gravitasie) versnelling / vryval ✓ en *bereik dus die grond gelyktydig.* ✓

Option 2/Opsie 2

Pete is correct or Alex is wrong / *Pete is reg of Alex is verkeerd* ✓

The smaller brick experiences less air resistance, thus larger acceleration ✓ and reaches the ground first. ✓

Die kleiner baksteen ondervind minder lugweerstand, dus groter versnelling ✓ en *tref die grond eerste.* ✓

Option 3/Opsie 3

Alex is correct or Pete is wrong / *Alex is reg of Pete is verkeerd* ✓

In the presence of air resistance, the larger brick, with larger mass, experiences a larger net force downwards, thus largest acceleration ✓ and reaches the ground first ✓

In die aanwesigheid van lugweerstand, ondervind die groter baksteen met groter massa 'n groter netto afwaartse krag, dus grootste versnelling ✓ en *tref die grond eerste.* ✓

Option 4/Opsie 4

Both are correct / *Beide is reg* ✓

Pete correct: The smaller brick experiences less air resistance, thus larger acceleration and reaches the ground first. ✓

Die kleiner baksteen ondervind minder lugweerstand, dus groter versnelling en tref die grond eerste ✓

Alex correct: In the presence of air resistance, the larger brick, with larger mass, experiences a larger net force downwards, thus largest acceleration and reaches the ground first ✓

In die aanwesigheid van lugweerstand, ondervind die groter baksteen met groter massa, 'n groter netto afwaartse krag, dus grootste versnelling en tref grond eerste. ✓

[12.2.3] (3)

4.2.1 Any two / Enige twee:

- Ensure that both bricks are dropped from same height
Maak seker dat beide bakstene vanaf dieselfde hoogte laat val word
- Ensure that both bricks are dropped at the same time
Maak seker dat beide bakstene gelyktydig laat val word

OR/OF

Ensure that the stopwatch starts at instant that each brick is released and stopped at the instant that each brick reaches the ground

Maak seker dat die stophorlosie begin die oomblik as elk van die bakstene gelos word, en gestop word die oomblik as elke baksteen die grond bereik

- Repeat the experiment several times and use the average of the results
Herhaal die eksperiment verskeie kere en gebruik die gemiddelde van die resultate
- Make sure that $v_i = 0$ for both bricks
Maak seker dat $v_i = 0$ vir beide bakstene
- Make sure that there is no strong wind
Maak seker dat daar geen sterk wind is nie
- Use bricks made of the same material / of same density
Gebruik bakstene gemaak van dieselfde materiaal / met dieselfde digtheid

[12.1.1] (2)

- 4.2.2 External force(s) may be present e.g. friction/air resistance / strong wind blowing
Eksterne krag(te) kan teenwoordig wees bv. wrywing / lugweerstand / sterk wind wat waai

[12.1.1] (1)

4.3

Option 1/Opsie 1:

Downward direction positive / Afwaartse rigting positief:

A:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$8 \checkmark = (0) \Delta t + \frac{1}{2} (9,8) \Delta t^2 \checkmark$$

$$\therefore \Delta t = 1,28 \text{ s}$$

B:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$8 \checkmark = v_{iB}(1,28 - 0,6) \checkmark + \frac{1}{2} (9,8)(1,28 - 0,6)^2 \checkmark$$

$$\therefore v_{iB} = 8,43 \text{ m} \cdot \text{s}^{-1} \checkmark (8,43 \text{ to/tot } 8,48 \text{ m} \cdot \text{s}^{-1})$$

Downward motion negative / Afwaartse beweging negatief:

A:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$-8 \checkmark = (0) \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \checkmark \therefore \Delta t = 1,28 \text{ s}$$

B:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-8 \checkmark = v_{iB}(1,28 - 0,6) \checkmark + \frac{1}{2} (-9,8)(1,28 - 0,6)^2 \checkmark$$

$$\therefore v_{iB} = -8,43 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_{iB} = 8,43 \text{ m} \cdot \text{s}^{-1} \checkmark (8,43 \text{ to/tot } 8,48 \text{ m} \cdot \text{s}^{-1})$$

Option 2/Opsie 2:

Downward direction positive / Afwaartse rigting positief:

A:

$$v_f^2 = v_i^2 + 2a \Delta y \checkmark = 0^2 + 2(9,8)(8) \checkmark \therefore v_f = 12,52 \text{ m} \cdot \text{s}^{-1}$$

$$v_f = v_i + a \Delta t \checkmark$$

$$\therefore 12,52 = 0 + (9,8) \Delta t \checkmark \therefore \Delta t = 1,28 \text{ s}$$

B:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$8 \checkmark = v_{iB}(1,28 - 0,6) \checkmark + \frac{1}{2} (9,8)(1,28 - 0,6)^2 \checkmark$$

$$\therefore v_{iB} = 8,43 \text{ m} \cdot \text{s}^{-1} \checkmark (8,43 \text{ to/tot } 8,48 \text{ m} \cdot \text{s}^{-1})$$

Downward direction negative / Afwaartse rigting negatief:

A:

$$v_f^2 = v_i^2 + 2a \Delta y \checkmark = 0^2 + 2(-9,8)(-8) \checkmark \therefore v_f = -12,52 \text{ m} \cdot \text{s}^{-1}$$

$$v_f = v_i + a \Delta t \checkmark$$

$$\therefore -12,52 = 0 + (-9,8) \Delta t \checkmark \therefore \Delta t = 1,28 \text{ s}$$

B:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-8 \checkmark = v_{iB}(1,28 - 0,6) \checkmark + \frac{1}{2} (-9,8)(1,28 - 0,6)^2 \checkmark$$

$$\therefore v_{iB} = -8,43 \text{ m} \cdot \text{s}^{-1}$$

$$\therefore v_{iB} = 8,43 \text{ m} \cdot \text{s}^{-1} \checkmark (8,43 \text{ to/tot } 8,48 \text{ m} \cdot \text{s}^{-1})$$

Option 3/Opsie 3:

Downward direction positive / Afwaartse rigting positief:

A:

$$v_f^2 = v_i^2 + 2a \Delta y \quad \checkmark = 0^2 + 2(9,8)(8) \quad \checkmark \therefore v_f = 12,52 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t \quad \checkmark \therefore 8 = \frac{(0 + 12,52)}{2} \Delta t \quad \checkmark \therefore \Delta t = 1,28 \text{ s}$$

B:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$8 \quad \checkmark = v_{iB}(1,28 - 0,6) \quad \checkmark + \frac{1}{2}(9,8)(1,28 - 0,6)^2 \quad \checkmark$$

$$\therefore v_{iB} = 8,43 \text{ m}\cdot\text{s}^{-1} \quad \checkmark (8,43 \text{ to/tot } 8,48 \text{ m}\cdot\text{s}^{-1})$$

Downward direction negative / Afwaartse rigting negatief:

A:

$$v_f^2 = v_i^2 + 2a \Delta y \quad \checkmark = 0^2 + 2(-9,8)(-8) \quad \checkmark \therefore v_f = -12,52 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t \quad \checkmark \therefore 8 = \frac{(0 - 12,52)}{2} \Delta t \quad \checkmark \therefore \Delta t = 1,28 \text{ s}$$

B:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$8 \quad \checkmark = v_{iB}(1,28 - 0,6) \quad \checkmark + \frac{1}{2}(-9,8)(1,28 - 0,6)^2 \quad \checkmark$$

$$\therefore v_{iB} = -8,43 \text{ m}\cdot\text{s}^{-1}$$

$$\therefore v_{iB} = 8,43 \text{ m}\cdot\text{s}^{-1} \quad \checkmark (8,43 \text{ to/tot } 8,48 \text{ m}\cdot\text{s}^{-1})$$

Option 4/Opsie 4:

A:

$$W_{\text{net}} = \Delta K$$

$$mgh = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$m(9,8)(8) = \frac{1}{2}mv_f^2 - 0 \quad \checkmark$$

$$\therefore v_f = 12,52 \text{ m}\cdot\text{s}^{-1}$$

A:

$$(U + K)_i = (U + K)_f$$

$$mgh + 0 = 0 + \frac{1}{2}mv_f^2$$

$$m(9,8)(8) + 0 = 0 + \frac{1}{2}mv_f^2 \quad \checkmark$$

$$\therefore v_f = 12,52 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a \Delta t \quad \checkmark \therefore 12,52 = 0 + (9,8) \Delta t$$

$$\therefore \Delta t = 1,28 \text{ s}$$

B:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$8 \quad \checkmark = v_{iB}(1,28 - 0,6) \quad \checkmark + \frac{1}{2}(9,8)(1,28 - 0,6)^2 \quad \checkmark$$

$$\therefore v_{iB} = 8,43 \text{ m}\cdot\text{s}^{-1} \quad \checkmark (8,43 \text{ to/tot } 8,48 \text{ m}\cdot\text{s}^{-1})$$

[12.1.3]

(7)
[13]

QUESTION 5/VRAAG 5

5.1

Option 1/Opsie 1:

Direction of motion as positive / Rigting van beweging as positief:

$$F_{\text{net}} = ma \checkmark$$

$$-30 = (3)a \checkmark$$

$$\therefore a = -10 \text{ m}\cdot\text{s}^{-2}$$

$$v_f^2 = v_i^2 + 2a \Delta x \checkmark$$

$$= (7)^2 \checkmark + 2(-10)(2) \checkmark$$

$$\therefore v_f = 3 \text{ m}\cdot\text{s}^{-1}$$

Option 2/Opsie 2:

$$W_{\text{net}} = \Delta K \checkmark \text{ or/of } \Delta E_k$$

$$F \Delta x \cos \theta \checkmark = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$(30)(2)\cos 180^\circ \checkmark = \frac{1}{2}(3)v_f^2 \checkmark - \frac{1}{2}(3)(7)^2 \checkmark$$

$$-60 = 1,5v_f^2 - 73,5 \therefore v_f = 3 \text{ m}\cdot\text{s}^{-1}$$

Option 3/Opsie 3:

$$W_{\text{appl}} = \Delta U + \Delta K - W_f$$

Max./Maks.: $\frac{4}{5}$

$$0 = 0 + \left(\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2\right) - F \Delta x \cos \theta \checkmark$$

$$0 = 0 + \frac{1}{2}(3)v_f^2 \checkmark - \frac{1}{2}(3)(7)^2 \checkmark - (30)(2)\cos 180^\circ \checkmark$$

$$0 = 1,5v_f^2 - 73,5 + 60 \therefore v_f = 3 \text{ m}\cdot\text{s}^{-1}$$

$$W_{\text{appl}} = \Delta U + \Delta K + W_f \quad 0/5$$

Option 4 / Opsie 4:

$$(U + K)_i + W_f = (U + K)_f$$

Max./Maks.: $\frac{4}{5}$

$$(0 + \frac{1}{2}mv_i^2) + F \Delta x \cos \theta \checkmark = 0 + \frac{1}{2}mv_f^2$$

$$0 + \frac{1}{2}(3)(7)^2 \checkmark + (30)(2)\cos 180^\circ \checkmark = 0 + \frac{1}{2}(3)v_f^2 \checkmark$$

$$73,5 - 60 = 1,5v_f^2 \therefore v_f = 3 \text{ m}\cdot\text{s}^{-1}$$

$$(U + K)_i - W_f = (U + K)_f \quad 0/5$$

Option 5 / Opsie 5:

$$(U + K)_i = (U + K)_f - W_f$$

Max./Maks.: $\frac{4}{5}$

$$(0 + \frac{1}{2}mv_i^2) = 0 + \frac{1}{2}mv_f^2 - F \Delta x \cos \theta \checkmark$$

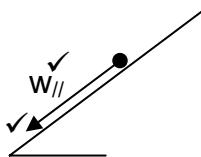
$$0 + \frac{1}{2}(3)(7)^2 \checkmark = 0 + \frac{1}{2}(3)v_f^2 \checkmark - (30)(2)\cos 180^\circ \checkmark$$

$$73,5 = 1,5v_f^2 + 60 \therefore v_f = 3 \text{ m}\cdot\text{s}^{-1}$$

$$(U + K)_i = (U + K)_f + W_f \quad 0/5$$

[12.1.3] (5)

5.2



Any one of the following labels / Enige een van volgende benoemings:

- w_{parallel} or/of $w_{//}$
- $F_{g(\text{parallel})}$ or/of $F_{g//}$
- $mg\sin 20^\circ$
- Component of weight parallel to incline / komponent van gewig parallel aan skuinste

Checklist / kontrolelys

Free-body diagram / vrye kragtediagram

Direction of force indicated as parallel to and down incline (not needed to show incline)

Rigting van krag getoon as parallel aan en afwaarts teen skuinste (skuinste hoef nie getoon te word nie)

Correct label / korrekte benoeming

✓

✓

[12.1.2] (2)

5.3

Option 1/Opsie 1:

$$(U + K)_i = (U + K)_f \checkmark$$

$$0 + \frac{1}{2}mv_i^2 = mgh + 0$$

$$0 + \frac{1}{2}(3)(3)^2 \checkmark = (3)(9,8)h + 0 \checkmark$$

$$\therefore h = 0,46 \text{ m}$$

$$\sin 20^\circ = \frac{h}{d} \checkmark = \frac{0,46}{d} \therefore d = 1,34 \text{ m} \checkmark$$

As single step/As een stap:

$$(U + K)_i = (U + K)_f \checkmark$$

$$0 + \frac{1}{2}(3)(3)^2 \checkmark = (3)(9,8)h + 0 \checkmark$$

$$\frac{1}{2}(3)(3)^2 = (3)(9,8)(d\sin 20^\circ) \checkmark$$

$$\therefore d = 1,34 \text{ m} \checkmark$$

Option 2/Opsie 2:

$$W_{\text{net}} = \Delta K \checkmark \text{ (or/of } \Delta E_k)$$

$$F_{g//} \Delta x \cos \theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$(3)(9,8)\sin 20^\circ \checkmark (d)\cos 180^\circ \checkmark = 0 - \frac{1}{2}(3)(3)^2 \checkmark$$

$$-10,06d = -13,5 \therefore d = 1,34 \text{ m} \checkmark$$

Option 3/Opsie 3:

$$W_{\text{net}} = \Delta K \checkmark \text{ (or/of } \Delta E_k)$$

$$W_{\text{gravity}} = K_f - K_i$$

$$mgh\cos 180^\circ \checkmark = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$(3)(9,8)h(-1) \checkmark = 0 - \frac{1}{2}(3)(3)^2 \checkmark \therefore h = 0,46 \text{ m}$$

$$\sin 20^\circ = \frac{h}{d} \checkmark = \frac{0,46}{d} \therefore d = 1,34 \text{ m} \checkmark$$

Option 4 / Opsie 4:

Direction of motion as positive / Rigting van beweging as positief:

$$F_{\text{net}} = ma \checkmark$$

$$mg \sin 20^\circ = ma$$

$$-(3)(9,8) \sin 20^\circ = 3a \checkmark \therefore a = -3,35 \text{ m} \cdot \text{s}^{-2}$$

$$v_f^2 = v_i^2 + 2a \Delta x \checkmark$$

$$0^2 = (3)^2 + 2(-3,35)(d) \checkmark$$

$$\therefore d = 1,34 \text{ m} \checkmark$$

[12.1.3] (5)
[12]

QUESTION 6 / VRAAG 6

6.1

$$m_m v_{im} + m_b v_{bi} = (m_m + m_b) v_f \checkmark$$

$$(87)v_{im} + 0 = (87 + 22)(2,4) \checkmark$$

$$v_{im} = 3,01 \text{ m} \cdot \text{s}^{-1} \checkmark$$

[12.2.3] (4)

6.2

Option 1/Opsie 1:

$$\begin{aligned} K(\text{before/voor}) &= \frac{1}{2}mv^2 \checkmark \\ &= \frac{1}{2}(87)(3,01)^2 + 0 \checkmark \\ &= 394,11 \text{ J} \checkmark \\ &= (391,5 \text{ if } 3 \text{ m} \cdot \text{s}^{-1}) \end{aligned}$$

$$\begin{aligned} K(\text{after/na}) &= \frac{1}{2}mv^2 \\ &= \frac{1}{2}(109)(2,4)^2 \checkmark \\ &= 313,92 \text{ J} \checkmark \end{aligned}$$

Collision is inelastic / No $\checkmark$
Botsing is nie-elasties / Nee

Option 2/Opsie 2:

$$\begin{aligned} \Delta K &= K(\text{after/na}) - K(\text{before/voor}) \\ &= \frac{1}{2}mv^2(\text{after/na}) - \frac{1}{2}mv^2(\text{before/voor}) \checkmark \\ &= \frac{1}{2}(109)(2,4)^2 \checkmark - (\frac{1}{2}(87)(3,01)^2 + 0) \checkmark \\ &= 313,92 - 394,11 \\ &= -80,19 \text{ J} \checkmark \checkmark \end{aligned}$$

Collision is inelastic / No $\checkmark$
Botsing is nie-elasties / Nee

[12.2.3] (6)

6.3

Option 1 / Opsie 1:

$$W_{\text{net}} = \Delta E_k \checkmark$$

$$F_{\text{net}} \Delta x \cos \theta \checkmark = \frac{1}{2} m (v_f^2 - v_i^2)$$

$$F_{\text{net}}(2)(-1) \checkmark = \frac{1}{2}(87 + 22)(0^2 - 2,4^2) \checkmark$$

$$\therefore F_{\text{net}} = 156,96 \text{ N} \checkmark$$

lf/indien – 156,96 N: minus 1

Option 2 / Opsie 2:

$$v_f^2 = v_i^2 + 2a\Delta x \checkmark$$

$$0^2 = 2,4^2 + 2a(2) \checkmark \therefore a = -1,44 \text{ m}\cdot\text{s}^{-2}$$

$$F_{\text{net}} = ma \checkmark = (87 + 22)(-1,44) \checkmark = -156,96 \text{ N}$$

$$\therefore F_{\text{net}} = 156,96 \text{ N} \checkmark$$

Option 3 / Opsie 3:

$$\Delta x = \left(\frac{v_f + v_i}{2} \right) \Delta t \checkmark \therefore 2 = \left(\frac{0 + 2,4}{2} \right) \Delta t \checkmark \therefore \Delta t = 1,67 \text{ s}$$

$$F_{\text{net}} \Delta t = \Delta p = mv_f - mv_i \checkmark$$

$$F_{\text{net}}(1,67) = (87 + 22)(0 - 2,4) \checkmark$$

$$\therefore F_{\text{net}} = -156,65 \text{ N} \therefore F_{\text{net}} = 156,65 \text{ N} \checkmark$$

Option 4 / Opsie 4:

$$\Delta x = \left(\frac{v_f + v_i}{2} \right) \Delta t \checkmark \therefore 2 = \left(\frac{0 + 2,4}{2} \right) \Delta t \checkmark \therefore \Delta t = 1,67 \text{ s}$$

$$v_f = v_i + a\Delta t \therefore 0 = 2,4 + a(1,67) \therefore a = -1,44 \text{ m}\cdot\text{s}^{-2}$$

$$F_{\text{net}} = ma \checkmark = (87 + 22)(-1,44) \checkmark = -156,96 \text{ N}$$

$$\therefore F_{\text{net}} = 156,96 \text{ N} \checkmark$$

[12.2.3]

(5)
[15]

QUESTION 7/VRAAG 7

- 7.1 Towards the person / Na die persoon toe ✓ [12.1.2] (1)
- 7.2 When the source moves towards a stationary observer
waves in front of the source is compressed ✓
resulting in a shorter wavelength ✓, resulting in a higher frequency
(speed of sound constant)
- Wanneer die bron 'n stilstaande waarnemer nader,
word golwe voor die bron saamgepers ✓
wat 'n korter golflengte tot gevolg het ✓ wat 'n hoër frekwensie tot
gevolg het (spoed van klank konstant)* [12.2.2] (2)
- 7.3 Formulae accepted / Formules aanvaar:
- $$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \checkmark$$
- $$\therefore 450 \checkmark = \left(\frac{340}{340 \pm 20} \right) f_s$$
- $$\therefore f_s = 423,53 \text{ Hz} \quad \checkmark$$
- [12.2.3] (4)
[7]

QUESTION 8/VRAAG 8

- 8.1 A (chemical) substance that (selectively) absorb light of certain
frequencies / colours and (selectively) transmits / reflects
others. ✓✓
- 'n (Chemiese) stof wat (selektief) lig van sekere frekwensies / kleure
absorbeer en ander (selektief) deurlaat / weerkaats.* [12.2.1] (2)
- 8.2 The manufacturing of pigments made all colours affordable for all
people. / Vervaardiging van pigmente het alle kleure vir alle mense
bekostigbaar gemaak. ✓
- At the same time people, e.g. the Mexicans, could have lost their jobs
and only income. / Terselfdertyd het mense, bv. die Meksikane, hulle
werk en enigste inkomste verloor. ✓* [12.3.1] (2)
- 8.3 Subtractive / Subtraktief ✓ [12.2.1] (1)
- 8.4 A: magenta + yellow / geel ✓
B: magenta + cyan / siaan ✓ [12.2.3] (2)

8.5 **Option 1/Opsie 1:**

Yellow light / Geel lig ✓

Cyan paint reflects blue and green light ✓

(Yellow light contains green light and red light)

Only green light (in yellow light) will be reflected ✓ and it appears green

Siaanverf weerkaats blou en groen lig ✓

(Geel lig bevat groen en rooi lig)

Slegs groen lig (in geel lig) sal weerkaats word ✓ en dit kom groen voor

Option 2/Opsie 2:

Green light / Groen lig ✓

Cyan paint reflects blue and green light ✓

When green light shines onto it, only green light will be reflected ✓ and it appears green

Siaanverf weerkaats blou en groen lig ✓

Wanneer groen lig daarop skyn, word slegs groen lig weerkaats ✓ en dit kom groen voor.

[12.2.3] (3)
[10]

QUESTION 9 / VRAAG 9

9.1 Diffraction / Diffraksie ✓

[12.1.2] (1)

9.2.1 Each point on a wave front acts as a source of (spherical) secondary wave fronts / wavelets (that propagates in the forward direction). ✓✓

Elke punt op 'n golffront dien as 'n bron van (sferiese)

sekondêre golffronte / golfies (wat in 'n voorwaartse rigting voortplant). [12.2.1] (2)

9.2.2 Dark bands form where **wave fronts / wavelets** interfere destructively. ✓

Red/bright bands form where **wave fronts / wavelets** interfere constructively. ✓

Donker bande vorm waar **golffronte / golwe** destruktiewe interferensie ondergaan. ✓

Rooi/helder bande vorm waar **golffronte / golwe** konstruktiewe interferensie ondergaan. ✓

[12.1.4] (2)

- 9.2.3 Diffraction is inversely proportional to the slit width / Diffraksie $\propto \frac{1}{a}$ ✓✓
 Diffraksie is omgekeerd eweredig aan die spleetwydte /
 Diffraksie $\propto \frac{1}{a}$ ✓✓

OR/OF

The degree of diffraction / Angle at which minima occurs
 increases with decreasing slit width

Mate van diffraksie / Hoek waar minima voorkom
 neem toe met afname in spleetwydte

[12.1.4] (2)

- 9.2.4 White light consists of different colours with different wavelengths ✓
 Amount of diffraction differs for different colours / different
 wavelengths. ✓

Wit lig bestaan uit verskillende kleure met verskillende golflengtes. ✓
 Mate van diffraksie verskil vir verskillende kleure / golflengtes. ✓

[12.1.4] (2)
[9]

QUESTION 10 / VRAAG 10

- 10.1 $F = \frac{kQ_1Q_2}{r^2}$ ✓
 $F = \frac{(9 \times 10^9)(4 \times 10^{-6})(6 \times 10^{-6})}{(0,4)^2}$ ✓
 $F = 1,35 \text{ N}$ ✓

OR/OF

$$F = \frac{kQ_1Q_2}{r^2} \quad \checkmark$$

$$F = \frac{(9 \times 10^9)(4 \times 10^{-6})(-6 \times 10^{-6})}{(0,4)^2} \quad \checkmark$$

$$F = -1,35 \text{ N}$$

Magnitude of / Grootte van $F = 1,35 \text{ N}$ ✓

[12.2.3] (4)

- 10.2 four / vier (4) ✓

[12.2.2] (1)

10.3

$$E(6 \mu\text{C}) = \frac{kQ}{r^2} \checkmark$$

$$= \frac{(9 \times 10^9)(6 \times 10^{-6})}{(0,2)^2} \checkmark$$

$$= 1,35 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ to the left / na links}$$

$$E(4 \mu\text{C}) = \frac{kQ}{r^2}$$

$$= \frac{(9 \times 10^9)(4 \times 10^{-6})}{(0,6)^2} \checkmark$$

$$= 1 \times 10^5 \text{ N} \cdot \text{C}^{-1} \text{ (to the right / na regs)}$$

To the right as positive / Na regs as positief:

$$E_{\text{net/netto}} = -1,35 \times 10^6 + 1 \times 10^5 = -1,25 \times 10^6 \text{ N} \cdot \text{C}^{-1}$$

$$E_{\text{net/netto}} = 1,25 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ to the left / na links} \checkmark$$

OR/OF

$$E_{\text{net}} = \frac{kQ}{r^2} \checkmark = 9 \times 10^9 \left(\frac{-6 \times 10^{-6}}{(0,2)^2} + \frac{(4 \times 10^{-6})}{(0,6)^2} \right) \checkmark$$

$$= -1,35 \times 10^6 + 1 \times 10^5 = -1,25 \times 10^6$$

$E_{\text{net/netto}} = 1,25 \times 10^6 \text{ N} \cdot \text{C}^{-1}$ in the direction of the field of the $6 \mu\text{C}$ charge / in die rigting van veld van die $6 \mu\text{C}$ lading $\checkmark$

[12.1.3] (6)

10.4

$$\text{New charge / Nuwe lading} = \frac{(+4 \times 10^{-6}) + (-6 \times 10^{-6})}{2} \checkmark$$

$$= -1 \times 10^{-6} \text{ C or/of } -1 \mu\text{C}$$

$$U = \frac{kQ_1 Q_2}{r} \checkmark$$

$$= \frac{(9 \times 10^9)(-1 \times 10^{-6})(-1 \times 10^{-6})}{(0,4)} \checkmark$$

$$\therefore U = 2,25 \times 10^{-2} \text{ J} \checkmark (0,02 \text{ J})$$

[12.1.3] (5)
[16]

QUESTION 11 / VRAAG 11

11.1 9 V $\checkmark$

Potential difference measured when:

switch is open / no current flows / circuit is open / no work done is in external circuit $\checkmark$

Potensiaalverskil gemeet wanneer:

die skakelaar oop is / geen stroom vloei nie / stroombaan oop is / geen arbeid verrig word in die eksterne stroombaan nie

[12.2.2] (2)

11.2

Option 1 / Opsie 1:

$$\begin{aligned} \text{Emf} &= IR + Ir \checkmark \\ 9 \checkmark &= 3(3R) \checkmark + 3(0,3) \checkmark \\ \therefore R = R_1 &= \frac{9-0,9}{9} = 0,9 \, \Omega \checkmark \end{aligned}$$

Option 2 / Opsie 2:

$$\begin{aligned} \text{Emf} &= IR + Ir \checkmark \\ 9 \checkmark &= V_{\text{ext}} + (3)(0,3) \checkmark \therefore V_{\text{ext}} = 8,1 \, \text{V} \\ V_{\text{ext}} &= I(R_1 + R_2) \\ 8,1 &= 3(3R) \checkmark \therefore R_1 = 0,9 \, \Omega \checkmark \end{aligned}$$

Option 3 / Opsie 3:

$$\begin{aligned} \text{emf} &= IR + Ir \checkmark \\ 9 \checkmark &= V_{\text{ext}} + (3)(0,3) \checkmark \therefore V_{\text{ext}} = 8,1 \, \text{V} \\ \therefore V_1 &= \frac{8,1}{3} = 2,7 \, \text{V} \quad (R_1 + R_2 = 3R) \\ R_1 &= \frac{V_1}{I} = \frac{2,7}{3 \checkmark} = 0,9 \, \Omega \checkmark \end{aligned}$$

Option 4 / Opsie 4:

$$\begin{aligned} R_t &= \frac{V}{I} \checkmark = \frac{9}{3} \checkmark = 3 \, \Omega \\ R_2 + R_1 &= (3 - 0,3) \checkmark = 2,7 \, \Omega = 3R \\ \therefore R_1 = R &= \frac{2,7}{3 \checkmark} = 0,9 \, \Omega \checkmark \end{aligned}$$

Option 5 / Opsie 5:

$$\begin{aligned} V_{\text{int}} &= Ir \checkmark = (3)(0,3) \checkmark = 0,9 \, \text{V} \\ V_{\text{ext}} &= 9 \checkmark - 0,9 = 8,1 \, \text{V} \\ V_1 &= IR_1 \therefore V_1 = 3R \\ V_{R_2} &= IR_2 \therefore V_{R_2} = 3(2R) = 6R \\ V_1 + V_{R_2} &= 3R + 6R = 9R \\ \therefore 8,1 &= 9R \checkmark \therefore R = 0,9 \, \Omega \checkmark \end{aligned}$$

[12.1.3] (5)

11.3.1 Decreases / Verminder ✓

[12.2.2] (1)

11.3.2 Increases / Vermeerder ✓

Resistance decreases / Weerstand verminder ✓

Current increases / Stroom vermeerder ✓

Ir increases / Ir vermeerder

OR/OF

Increases / Vermeerder ✓

Current passes through wire QN / wire QN shorts the parallel combination of resistors R_2 and R_3 ✓

All the current passes through R_1 and also through battery, thus Ir increases ✓

Die stroom gaan deur draad QN / draad QN veroorsaak 'n kortsluiting van die parallelle kombinasie resistors R_2 en R_3

Al die stroom gaan deur R_1 en deur die battery, dus verhoog Ir

[12.2.2] (3)

[11]

QUESTION 12/VRAAG 12

$$12.1.1 \quad I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \checkmark = \frac{36}{12} \checkmark = 3 \text{ A} \checkmark$$

OR/OF

$$V_{4\Omega} + V_{8\Omega} = 36 \text{ V and/en } V_{4\Omega} : V_{8\Omega} = 1:2$$

$$\therefore V_{4\Omega} = 12 \text{ V}$$

$$I_{4\Omega} = \frac{V}{R} \checkmark = \frac{12}{4} \checkmark = 3 \text{ A} \checkmark$$

[12.2..3] (3)

$$12.1.2 \quad I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}} \checkmark$$

$$\therefore 3 = \frac{I_{\text{max}}}{\sqrt{2}} \checkmark \therefore I_{\text{max}} = 4,24 \text{ A} \checkmark$$

[12.2.3] (3)

$$12.1.3 \quad P_{\text{ave}} = I_{\text{rms}}^2 R \checkmark = (3)^2(4) \checkmark = 36 \text{ W} \checkmark$$

OR/OF

$$V_{\text{rms}} (\text{speaker/luidspreker 1}) = I_{\text{rms}} R = (3)(4) = 12 \text{ V}$$

$$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark = (12)(3) \checkmark = 36 \text{ W} \checkmark$$

OR/OF

$$V_{\text{rms}} (\text{speaker/luidspreker 1}) = I_{\text{rms}} R = (3)(4) = 12 \text{ V}$$

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R} \checkmark = \frac{12^2}{4} \checkmark = 36 \text{ W} \checkmark$$

[12.2.3] (3)

$$12.2 \quad P_{4\Omega} = \frac{1}{2} P_8 \text{ or } P_{8\Omega} = 2 P_{4\Omega} \text{ or /of}$$

Smaller / *Kleiner* $\checkmark (P_{4\Omega} < P_{8\Omega})$ or/of $P_{8\Omega} > P_{4\Omega}$

$$P_{\text{ave}} = I_{\text{rms}}^2 R, \text{ but since}$$

I_{rms} is constant / omdat I_{wgk} konstant is $\checkmark$

$$P \propto R \checkmark$$

OR/OF

$$P_{4\Omega} = \frac{1}{2} P_8 \text{ or } P_{8\Omega} = 2 P_{4\Omega} \text{ or /of}$$

Smaller / *Kleiner* $\checkmark$

$$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}}, \text{ since}$$

I_{rms} is constant / omdat I_{wgk} konstant is $\checkmark$

$$P_{\text{ave}} \propto V \checkmark$$

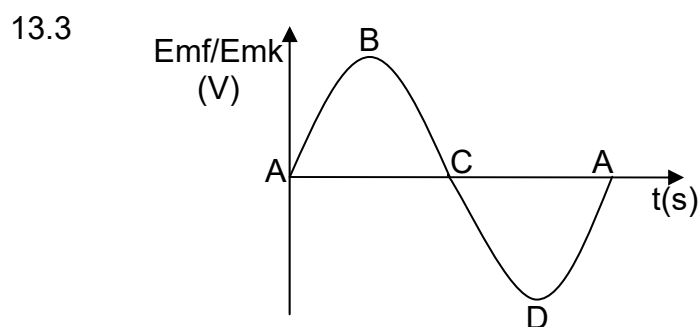
[12.2.2] (3)

[12]

QUESTION 13 / VRAAG 13

13.1 Electromagnetic induction / Faraday's law ✓
Elektromagnetiese induksie / Faraday se wet [12.2.1] (1)

13.2 Provides a (sliding) contact (between coil and conducting wires) ✓/
Ensures free rotation
Verskaf 'n (glyende) kontak (tussen die spoel en die geleidende drade)/ Verseker dat spoel vrylik roteer [12.2.1] (1)



Checklist / Kontrolelys	
Criteria for graph / Kriteria vir grafiek	Marks/ Punte
Correct shape with full cycle (ignore if more than one cycle shown / Korrekte vorm met volle siklus (ignoreer indien meer as een siklus getoon word)	✓✓
Points A, B, C and D correctly indicated/Punte A, B, C en D korrek aangedui,	✓

[12.1.2] (3)

13.4 Increase the speed at which the coil rotates ✓
Verhoog die spoed waarteen die spoel roteer [12.2.3] (1)

13.5 (Splitring) commutator ✓
(Splitring)kommutator [12.2.3] (1)
[7]

QUESTION 14/VRAAG 14

14.1 Photoelectric effect / Foto-elektriese effek ✓ [12.2.1] (1)

14.2 The minimum energy of light needed to emit (photo)electrons from a metal ✓✓
Die minimum energie benodig deur lig om (foto-)elektrone uit 'n metaal vry te stel [12.2.1] (2)

14.3

Option 1 / Opsie 1:

$$E/hf = \frac{hc}{\lambda} \checkmark = \frac{(6,63 \times 10^{-34}) (3 \times 10^8)}{555 \times 10^{-9}} \checkmark = 3,58 \times 10^{-19} \text{ J}$$

$$hf = W_0 + \frac{1}{2}mv^2 \checkmark \therefore 3,58 \times 10^{-19} = W_0 + 0 \checkmark$$

$$\therefore W_0 = 3,58 \times 10^{-19} \text{ J} \checkmark$$

Option 2 / Opsie 2:

$$hf = W_0 + \frac{1}{2}mv^2 \checkmark$$

$$\frac{hc}{\lambda} \checkmark = W_0 + \frac{1}{2}mv^2$$

$$\frac{(6,63 \times 10^{-34}) (3 \times 10^8)}{555 \times 10^{-9}} \checkmark = W_0 + 0 \checkmark$$

$$\therefore W_0 = 3,58 \times 10^{-19} \text{ J} \checkmark$$

Option 3 / Opsie 3:

$$f = \frac{c}{\lambda} = \frac{3 \times 10^8}{555 \times 10^{-9}} \checkmark = 5,41 \times 10^{14} \text{ Hz}$$

$$E = hf = (6,63 \times 10^{-34}) (5,41 \times 10^{14}) \checkmark = 3,59 \times 10^{-19} \text{ J}$$

$$hf = W_0 + \frac{1}{2}mv^2 \checkmark \therefore 3,59 \times 10^{-19} = W_0 + 0 \checkmark$$

$$\therefore W_0 = 3,59 \times 10^{-19} \text{ J} \checkmark$$

Option 4 / Opsie 4:

$$W_0 = hf_0 \checkmark \checkmark = \frac{(6,63 \times 10^{-34}) (3 \times 10^8)}{555 \times 10^{-9}} \checkmark = 3,58 \times 10^{-19} \text{ J} \checkmark$$

[12.1.3] (6)

14.4 Increases / Vermeerder $\checkmark$

With light of higher intensity more photons strikes the metal surface per second / Met lig van hoër intensiteit tref meer fotone die metaaloppervlak per sekonde $\checkmark$

Thus more (photo)electrons are emitted per second, $\checkmark$ resulting in a bigger current. / Dus word meer (foto-)elektrone per sekonde vrygestel wat 'n hoër stroom tot gevolg het.

[12.2.2] (3)

14.5 Decreases / Verminder $\checkmark$

[12.2.2] (1)

[13]

TOTAL SECTION B / TOTAAL AFDELING B: 125
GRAND TOTAL / GROOTTOTAAL: 150