SA-STUDENT

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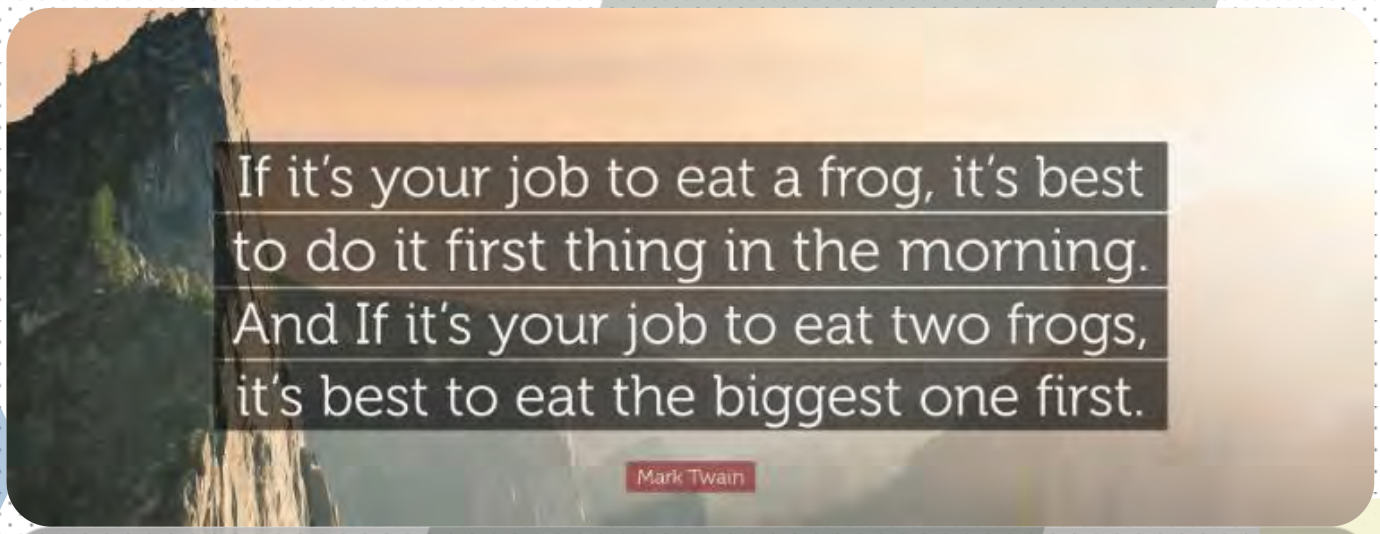


QUESTION 5/*VRAAG 5*

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. (2)

Note/*Aantekening*:
If the word 'work' is omitted, 0/2.
Indien die woord 'arbeid' weggelaat is, 0/2.

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 m·s^{-1} ✓

OPTION 1/*OPSIE 1*

$W_{net} = \Delta K$
$W_w + W_f + W_F = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$mg\sin\theta\Delta x\cos\theta + W_f + W_F = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
✓Any one/*Enige een*

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

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta K + \Delta U$
$W_f + W_F = \Delta K + mg(h_f - h_i)$
$f\Delta x\cos\theta + F\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i$
✓Any one/*Enige een*

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

OPTION 3/*OPSIE 3*

$W_{net} = \Delta K$
$W_w + W_f + W_F = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$-\Delta E_p + W_f + W_F = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
✓Any one/*Enige*

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

OPTION 4/*OPSIE 4*

$W_{net} = \Delta K$
$W_w + W_f + W_F = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ } ✓Any one/*Enige*
$mg\Delta x\cos\theta + W_f + W_F = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$\underline{(20)(9,8)(15,6)\cos 108°}$✓ + $\underline{(13,5)(15,6)\cos 180° + (96,8)(15,6)\cos 0°}$✓ = $\underline{\frac{1}{2}(20)(v_f^2 - 0^2)}$ ✓
$v_f = 5,96\ m\cdot s^{-1}$ ✓

OPTION 5/*OPSIE 5*

$F_{net} = ma$
$F_{net} = F - F_{w//} - f$
$= 96,8 - \underline{(20)(9,8)\sin 18°}$ ✓ – 13,5
$= 22,73\ N$

$W_{net} = \Delta K$
$F_{net}\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ } ✓Any one/*Enige*

$\underline{22,73(15,6)\cos 0°}$✓ = $\underline{\frac{1}{2}(20)(v_f^2 - 0^2)}$ ✓
$v_f = 5,96\ m\cdot s^{-1}$ ✓ (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*. ✓
- Correct substitution into power equation./ ✓
  Korrekte vervanging in drywingvergelyking.
- Correct final answer/*Korrekte finale antwoord*: 288,46 W ✓
  Range: 286,46 W to/*na* 288,73 W

OPTION1/*OPSIE 1*

$P_{ave} = Fv_{ave}$ ✓
$= 96,8\left(\frac{(0) + 5,96}{2}\right)$ ✓
$= 288,46\ W$ ✓

OPTION2/*OPSIE 2*

$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$
$15,6 = \left(\frac{(0) + 5,96}{2}\right)\Delta t$
$\Delta t = 5,23\ s$ (5,24)

OPTION 3/*OPSIE 3*

$v_f^2 = v_i^2 + 2a\Delta x$
$(5,96)^2 = 0^2 + 2a(15,6)$
$a = 1,14\ m\cdot s^{-2}$ (1,13)

$v_f = v_i + a\Delta t$
$\underline{5,96 = 0 + (1,14)\Delta t}$
$\Delta t = 5,23\ s$ (5,27)

$P = \frac{W}{\Delta t}$
$P = \frac{F\Delta x\cos}{\Delta t}$ } ✓Any one/*Enige een*

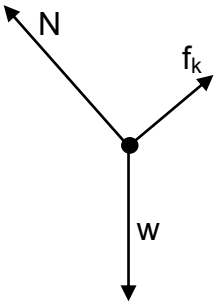
$P = \frac{96,8(15,6)\cos 0}{5,23}$ ✓
$P = 288,73\ W$ ✓

OR/*OF*

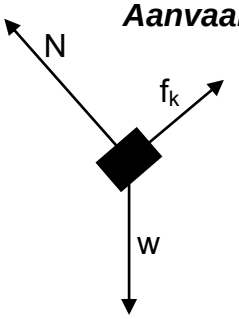
$v_{ave} = \frac{\Delta x}{\Delta t}$
$= \frac{15,6 - 0}{5,23 - 0}$
$= 2,98\ m\cdot s^{-1}$

$P_{ave} = Fv_{ave}$ ✓
$= 96,8(2,98)$ ✓
$= 288,46\ W$ ✓ (3)

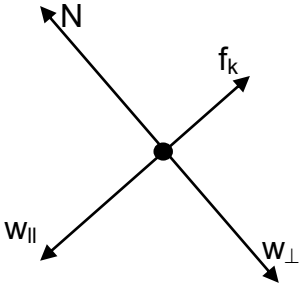
5.4



Accept force diagram/
Aanvaar kragte-diagram:



Accept/Aan*vaar:*



	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*/$F_{Earth\ on\ crate}$/ $F_{Aarde\ op\ krat}$

Notes/*Aantekeninge:*

- Accept correct numerical values for the forces./*Aanvaar korrekte numeriese waardes vir die kragte.*
- 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* $^2/_3$
- If everything correct, but no arrows/*Indien alles korrek, maar geen pyltjies*: Max/*Maks* $^2/_3$

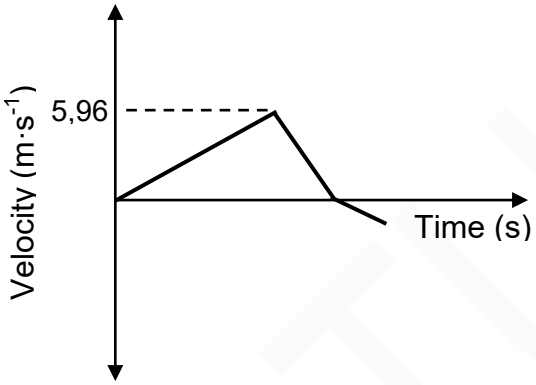
(3)

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

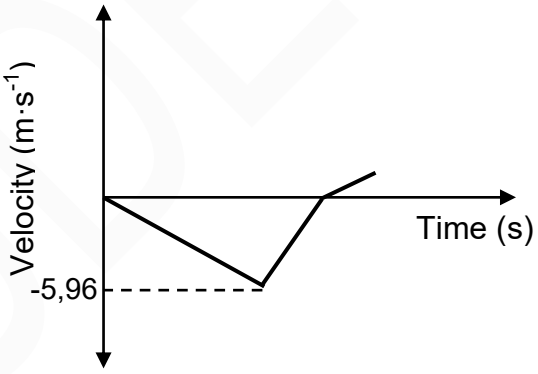
Marking criteria/*Nasienkriteria:*
- First straight line starting at zero with positive gradient, reaching a maximum velocity./*Eerste reguit lyn met 'n positiewe gradiënt begin by nul en bereik maksimum snelheid.* ✓
- Second straight line with negative gradient from maximum velocity to zero./ *Tweede 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)

QUESTION 5/*VRAAG 5*

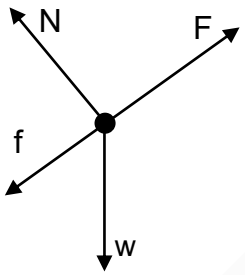
5.1

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.*

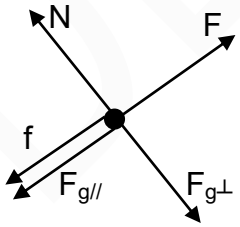
A force is non-conservative if the work done by the force on an object (which is moving between two points) depends on the path taken. ✓✓
'n Krag waarvoor die arbeid wat verrig word deur die krag op 'n voorwerp (wat tussen twee punte beweeg,) afhanklik is van die pad wat gevolg word.
OR/*OF*
A force 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 ommited/ 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 / *gravitasiekrag* / weight / *gewig*
F	F_A /Applied force / T /*Toegepaste krag*/ F_T
f	F_f / f_k / (kinetic) Friction / *(kinetiese) wrywing* / F_w
N	F_N / Normal / *Normaal*

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* $Fg_{\perp}$ *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*

$W_{nc} = \Delta E_k + \Delta E_p$
$W_{nc} = \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i)$ ✓ Any one/Enige een

$= \frac{1}{2}(12)(2,25^2 - 0)$ ✓ + $(12)(9,8)(4,5 - 0)$ ✓
$= 559,58$ J ✓

OPTION 2/*OPSIE 2*

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

$W_{Fg} = F_g\Delta x\cos(90° + \theta)$
$= mg\Delta x(-\sin\theta)$
$= (12)(9,8)\left(\frac{-4,5}{\Delta x}\right)\Delta x$
$= -529,2$ J

$W_{net} = \Delta E$
$= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$= \frac{1}{2}(12)(2,25)^2 - 0^2$ ✓
$= 30,375$ J

$W_{net} = W_{nc} + W_c$ ✓
$30,375 = W_{nc} + (-529,2)$ ✓
$W_{nc} = 559,575$ J ✓ (559,58 J)

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*

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

$W_{nc} = 559,58$ J ✓

(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*

$W_{nc} = W_F + W_f$
$W_{nc} = F\Delta x\cos 0° + f_1\Delta x\cos 180°$ } ✓ Any one/*Enige een*
$559,58 = F\Delta x\cos 0° + f_1\Delta x\cos 180°$
$559,58$ ✓ $= (F - f_1)\Delta x$ .....(1)

ALONG THE HORIZONTAL/BC/*LANGS DIE HORISONTAAL*

$F - f_2 = ma$
$F - f_2 = 0$ ✓ **OR/*OF*** $F = f_2$
$F - (f_1 + 42)$ ✓ $= 0$
$F - f_1 = 42$.....(2)

Substitute/*Vervang* (2) into/*in* (1):
$559,58 = 42\Delta x$
$\Delta x = 13,32$ m ✓

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 HORISONTAAL*

$F - f_2 = ma$
$F - f_2 = 0$ ✓ **OR/*OF*** $F = f_2$
$F - (f_1 + 42)$ ✓ $= 0$
$F = f_1 + 42$

ALONG THE INCLINE/AB/*TEEN DIE SKUINSVLAK*

$W_{nc} = \Delta E_K + \Delta E_P$
$(F - f_1)\Delta x\cos\theta = [\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2] + [mgh_f - mgh_i]$ } ✓ Any one/*Enige een*
$(f_1 + 42 - f_1)\Delta x\cos 0° = [\frac{1}{2}(12)(2,25)^2 - 0^2] + [(12)(9,8)(4,5) - 0]$ ✓
$\Delta x = 13,32$ m ✓ (13,32 m)

OPTION 3/*OPSIE 3*

ALONG THE HORIZONTAL/BC/*LANGS DIE HORISONTAAL*

$F - f_2 = ma$
$F - f_2 = 0$ ✓

OR/*OF* $F = f_2$

$F - (f_1 + 42)$ ✓$= 0$
$F = f_1 + 42$

ALONG THE INCLINE/AB/*TEEN DIE SKUINSVLAK*

$W_{net} = \Delta E_K$
$(F - f_1 - F_{g//})\Delta x\cos\theta = [\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2]$
} ✓ Any one/ *Enige een*

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

$\Delta x = 13,323214$ m ✓ (13,32 m)

OPTION 4/*OPSIE 4*

$W_{nc} = \Delta E_K + \Delta E_P$
$W_{nc} = [\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2] + [mgh_f - mgh_i]$
} ✓ Any one/ *Enige een*

$(f_1 + 42 - f_1)$✓$\Delta x\cos 0°$ ✓$= 559,575$ ✓
$(42)\Delta x\cos 0° = 559,575$
$\Delta x = 13,323214$ m ✓ (13,32 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 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 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 HORISONTAAL*

$F - f_2 = ma$
$F - f_2 = 0$ ✓

OR/*OF* $F = f_2$

$F - (f_1 + 42)$ ✓$= 0$
$F = f_1 + 42$ .....(1)

ALONG THE INCLINE/AB/*TEEN DIE SKUINSVLAK*

$v_f^2 = v_i^2 + 2a\Delta x$
$2,25^2 = 0 + 2a\Delta x$ ✓
$a = \frac{2,53}{\Delta x}$
$F_{net} = ma$
$F - F_{g//} - f_1 = ma$
$F - mg\sin\theta - f_1 = 12a$ .....
$F - (12)(9,8)\sin\theta - f_1 = 12\left(\frac{2,53}{\Delta x}\right)$ ✓….(2)

Substitute/*Vervang* (2) into/*in* (1):
$42 - (12)(9,8)\left(\frac{4,5}{\Delta x}\right) = 30,38$
$\Delta x = 13,32$ m ✓ (5)

[15]

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*
$W_{net} = F_{net}\ \Delta x\cos\theta$ and/*en* $\theta = 180°/\cos\theta = -1$ (1)

5.3

OPTION 1/*OPSIE 1*

$W_{net} = \Delta K$
$W_w + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$mg\sin\theta\Delta x\cos\theta + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
✓Any one/*Enige een*

$(30\ 000)(9,8)\sin28°\Delta x\cos180°$✓ + $(31\ 000)\Delta x\cos180°$✓
$= \frac{1}{2}(30\ 000)(0^2 - 33^2)$ ✓
$\Delta x = 96,64$ m ✓

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta K + \Delta U$
$W_f = \Delta K + mg(h_f - h_i)$
$f\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i$
✓Any one/*Enige een*

$31\ 000\Delta x\cos180°$✓ = $\frac{1}{2}(30\ 000)(0^2 - 33^2)$ ✓ + $30\ 000(9,8)(\Delta x\sin28° - 0)$ ✓
$\Delta x = 96,64$ m ✓

OPTION 3/*OPSIE 3*

$W_{net} = \Delta K$
$W_w + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$-\Delta E_p + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$-mg(h_f - h_i) + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
✓Any one/*Enige*

$-(30\ 000)(9,8)(\Delta x\sin28° - 0)$✓ + $(31\ 000)\Delta x\cos180°$✓ = $\frac{1}{2}(30\ 000)(0^2 - 33^2)$ ✓
$\Delta x = 96,64$ m ✓

OPTION 4/*OPSIE 4*

$W_{net} = \Delta K$
$W_w + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$mg\Delta x\cos\theta + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓Any one/*Enige*

$(30\ 000)(9,8)\Delta x\cos 118°$✓ + $(31\ 000)\Delta x\cos 180°$✓ = $\frac{1}{2}(30\ 000)(0^2 - 33^2)$ ✓
$\Delta x = 96,64$ m ✓

OPTION 5/*OPSIE 5*

$F_{net} = ma$
$F_{net} = F_{w//} + f$
$= (30\ 000)(9,8)\sin 28° + 31\ 000$✓
$= 169\ 024,64$ N

$W_{net} = \Delta E_k$
$F_{net}\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓Any one/*Enige een*

$169\ 024,64\Delta x \cos 180°$✓ = $\frac{1}{2}(30\ 000)(0^2 - 33^2)$ ✓
$\Delta x = 96\ 64$ m ✓ (5)

5.4 Ascending/*Opgaande* ✓

1. Ascending/*Opgaande*: $F_{net(A)} = F_{w//} + f$
   Descending/*Afgaande*: $F_{net(D)} = F_{w//} - f$ ✓
   $F_{net(A)} > F_{net(D)}$ ✓

OR/*OF*

2. Ascending: $F_{w//}$ and f are both acting in the opposite to direction of displacement.
   Descending: only f is acting in the opposite direction of displacement. ✓
   Net force for ascending greater than net force for descending. ✓

   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. ✓
   Descending: F_{net} acts downwards in the direction of motion. ✓

   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
   Descending: $F_{w(//)}$ acts downwards in the direction of motion ✓
   Net force for ascending greater than net force for descending. ✓

   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 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/*OPSIE1*
$E_{P/mech\ top/meg\ bo} = E_{Q/mech\ ground\ /meg\ grond}$
$(E_p + E_k)_{P/top/bo} = (E_p + E_k)_{Q/bottom/onder}$
$(mgh + ½mv^2)_{P/top/bo} = (mgh + ½mv^2)_{Q/bottom/onder}$ ✓Any one/*Enige een*
$(2)(9,8)(5) + 0 = 0 + ½(2)v_f^2$ ✓
$v_f = 9,90\ m\cdot s^{-1}$ ✓ (9,899)

OPTION 2/*OPSIE2*
$\Delta E_p + \Delta E_K = 0$
$(mgh_f - mgh_i) + ½m(v_f^2 - v_i^2) = 0$ ✓Any one/*Enige een*
$0 - (2)(9,8)(5) + ½(2)(v_f^2 - 0)$ ✓ $= 0$
$v_f = 9,90\ m\cdot s^{-1}$ ✓ (9,899) (3)

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

OPTION 1/*OPSIE 1*
$W_{net} = \Delta E_K$
$W_f = ½mv_f^2 - ½mv_i^2$
$W_N + W_f + W_w = ½mv_f^2 - ½mv_i^2$ ✓Any one/*Enige een*
$f\Delta x\cos\theta = ½m(v_f^2 - v_i^2)$
$f(10)\cos 180°$ ✓$= ½(2)(4^2 - 9,90^2)$ ✓
$f = 8,2\ N$ ✓

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta E_K + \Delta E_p$
$W_f = ½mv_f^2 - ½mv_i^2$
$W_N + W_f = ½mv_f^2 - ½mv_i^2$
$f\Delta x\cos\theta = ½m(v_f^2 - v_i^2) + mg(h_f - h_i)$ ✓Any one/*Enige een*
$f(10)\cos180°$ ✓$= ½(2)(4^2 - 9{,}90^2) + 0$ ✓
$f = 8{,}2$ N ✓ (4)

5.4

LEFT NEGATIVE/*LINKS NEGATIEF*

$F_{net}\Delta t = \Delta p$
$F_{net}\Delta t = mv_f - mv_i$
$F_{net}\Delta t = m(v_f - v_i)$ ✓Any one/*Enige een*
$-14 = 2(v_f - 4)$ ✓
$v_f = -3\ m\cdot s^{-1}$

ACCEPT/*AANVAAR*
Impulse/*Impuls* = mΔv

$\Delta E_K = ½mv_f^2 - ½mv_i^2$ ✓
$= ½(2)[(-3)^2 - 4^2]$ ✓
$= -7$ J ✓

Do not penalise if +3 is substituted.
Moenie penaliseer indien +3 vervang is.

ACCEPT/AANVAAR

$\Delta E_K = ½mv_f^2 - ½mv_i^2$ ✓
$= ½(2)[(0)^2 - (-3)^2]$ ✓
$= -9$ J ✓

Do not penalise if +3 is substituted.
Moenie penaliseer indien +3 vervang is.

RIGHT NEGATIVE/*REGS NEGATIEF*

$F_{net}\Delta t = \Delta p$
$F_{net}\Delta t = mv_f - mv_i$
$F_{net}\Delta t = m(v_f - v_i)$ ✓Any one/*Enige een*
$14 = 2(v_f - (-4))$ ✓
$v_f = 3\ m\cdot s^{-1}$

ACCEPT/*AANVAAR*
Impulse/*Impuls* = mΔv

$\Delta E_K = ½mv_f^2 - ½mv_i^2$ ✓
$= ½(2)[(3)^2 - (-4)^2]$ ✓
$= -7$ J ✓

Do not penalise if +4 is substituted.
Moenie penaliseer indien +4 vervang is.

ACCEPT/*AANVAAR*

$\Delta E_K = ½mv_f^2 - ½mv_i^2$ ✓
$= ½(2)[(0)^2 - (-3)^2]$ ✓
$= -9$ J ✓

Do not penalise if +3 is substituted.
Moenie penaliseer indien +3 vervang is.

(5)
[14]

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*

$P = \frac{W}{\Delta t}$
$= \frac{\Delta mgh}{\Delta t}$ ✓Any one/*Enige een*
$= \frac{(1\ 250)(9,8)(5,8)}{60}$ ✓
$= 1\ 184,17$ W ✓ (1 184,167)

OPTION 2/*OPSIE 2*

$P = \frac{W}{\Delta t}$
$= \frac{F\Delta x\cos\theta}{\Delta t}$ or/*of* $\frac{F\Delta y\cos\theta}{\Delta t}$ ✓Any one/*Enige een*
$= \frac{mg\Delta x\cos 0^\circ}{\Delta t}$
$= \frac{(1250)(9,8)(5,8)\cos 0^\circ}{60}$ ✓
$= 1\ 184,17$ W ✓ (1 184,167)

OPTION 3/*OPSIE 3*

$P = \frac{W}{\Delta t}$
$= \frac{F\Delta x\cos\theta}{\Delta t}$ or/*of* $\frac{F\Delta y\cos\theta}{\Delta t}$ ✓Any one/*Enige een*
$= \frac{mg\Delta x\cos 180^\circ}{\Delta t}$ ✓
$= \frac{(1250)(9,8)(5,8)\cos 180^\circ}{60}$
$= -1\ 184,17$ W (-1 184,167)
Power dissipated by the crane/*Drywing verkwis deur hyskraan* =1 184,17 W✓

OPTION 4/*OPSIE 4*

$P_{ave} = Fv_{ave}$ ✓
$= 1\ 250(9,8)\frac{5,8}{60}$ ✓
$= 1\ 184,17$ W ✓

(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*:
  $W_{net} = \Delta Ek$ / $W_{nc} = \Delta E_k + \Delta E_p$ ✓
- 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:*
  $W_{net} = \Delta Ek$ / $W_{nc} = \Delta E_k + \Delta E_p$ ✓
- 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*:

$\Delta U = mg(h_f - h_i)$
$= \underline{1\,250(9,8)(0 - 5,8)}$ ✓
$= -71\,050$ J

$\Delta K = -\Delta U = 71\,050$ J

Into the wall:/ *In die muur in*

$W_{net} = \Delta K$
$W_{wall/muur} = K_f - K_i$
$F_{wall\ /muur}\ \Delta x\cos\theta = K_f - K_i$
✓Any one/*Enige een*

$\underline{F_{wall/muur}(0,25)\cos180°}$ ✓ $= 0 \underline{- 71\,050}$ ✓
$F_{wall/muur} = 284\,089$ N ✓

OPTION 2/*OPSIE 2*

From R to the wall */ Vanaf R na die muur*

$W_{nc} = \Delta K + \Delta U$
$W_{nc} = (mgh_f - mgh_i) + \frac{1}{2}m(v_f^2 - v_i^2)$
✓Any one/*Enige een*

$\underline{0 = 0 - (1\,250)(9,8)(5,8) + \frac{1}{2}(1\,250)(v_f^2 - 0)}$ ✓
$v_i = 10,66\ m\cdot s^{-1}$ (10,662)

Into the wall / *In die muur in*:

$W_{net} = \Delta K$
$W_{wall/muur} = K_f - K_i$
$F_{wall\ /muur}\ \Delta x\cos\theta = K_f - K_i$

$\underline{F_{wall/muur}(0,25)\cos180°}$ ✓ $= 0\ \underline{- \frac{1}{2}(1\,250)(10,66)^2}$ ✓
$F_{wall/muur} = 284\,089$ 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*:

$W_{nc} = \Delta K + \Delta U$
$W_{nc} = (mgh_f - mgh_i) + \frac{1}{2}m(v_f^2 - v_i^2)$
✓Any one/ *Enige een*

$\underline{0 = (1\,250)(9,8)[h - (5,8+h)] + \frac{1}{2}(1\,250)(v_f^2 - 0)}$ ✓
$v_i = 10,66\ m\cdot s^{-1}$ (10,662)

Into the wall / *In die muur in*:

$W_{net} = \Delta K$
$W_{wall/muur} = K_f - K_i$
$F_{wall/muur}\ \Delta x\cos\theta = K_f - K_i$
✓Any one/*Enige een*

$\underline{F_{wall/muur}(0,25)\cos180°}$ ✓ $= 0 - \underline{\frac{1}{2}(1\,250)(10,66)^2}$ ✓
$F_{wall/muur} = 284\,089$N ✓ (284 195,61 N)

OPTION 4/*OPSIE 4*

From R to the wall / *Vanaf R na die muur*:

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

$W_{nc} = (mgh_f - mgh_i) + ½m(v_f^2 - v_i^2)$

$0 = 0 - (1\ 250)(9,8)(5,8) + ½(1\ 250)(v_f^2 - 0)$ ✓

$v_i = 10,66\ m\cdot s^{-1}$ (10,662)

✓Any one/*Enige een*

Into the wall / *In die muur in*:

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

$W_{wall/muur} = ½m(v_f^2 - v_i^2) + (mgh_f - mgh_i)$

$F_{wall/muur}\Delta x\cos\theta = ½m(v_f^2 - v_i^2) + mgh_f - mgh_i$

$F_{wall/muur}(0,25)\cos 180°$ ✓ $= ½(1\ 250)(0 - 10,66^2)$ ✓ $+ 0$

$F_{wall/muur} = 284\ 089$ N ✓ (284 195,61)

OPTION 5/*OPSIE 5*

From R to the wall/*Vanaf R na die muur*:

$(E_{mech})_{Top/Bo} = (E_{mech})_{Ground/Grond}$

$(E_p + E_k)_{Top} = (E_p + E_k)_{Bottom/Onder}$

$(mgh + ½ mv^2)_{Top/Bo} = (mgh + ½ mv^2)_{Bottom/Onder}$

$(9,8)(5,8) + 0 = 0 + (½)v^2$

$v = 10,662\ m\cdot s^{-1}$

✓Any one/*Enige een*

Into the wall / *In die muur in*:

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

$W_{wall/muur} = ½m(v_f^2 - v_i^2) + (mgh_f - mgh_i)$

$F_{wall/muur}\Delta x\cos\theta = ½m(v_f^2 - v_i^2) + mgh_f - mgh_i$

$F_{wall/muur}\ 0,25\cos 180°$✓ $= ½(1\ 250)(0 - 10,66^2)$ ✓ $+ 0$

$F_{wall/muur} = 284\ 089$ N ✓

OPTION 6/*OPSIE 6*

For the total motion/*Vir die totale beweging*:

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

$W_{wall/muur} = \Delta K + mg(h_f - h_i)$

$F_{wall/muur}\Delta x\cos\theta = \Delta K + mgh_f - mgh_i$

✓Any one/*Enige een*

$F_{wall/muur}\ 0,25\cos 180°$✓ $= 0 + [0 - 1\ 250(9,8)(5,8)]$ ✓✓

$F_{wall/muur} = 284\ 200$ N✓

OPTION 7/*OPSIE 7*

From R to the wall/*Vanaf R na die muur*:

$(E_{mech})_{Top/Bo} = (E_{mech})_{Ground/Grond}$

$(E_p + E_k)_{Top} = (E_p + E_k)_{Bottom/Onder}$

$(mgh + ½ mv^2)_{Top/Bo} = (mgh + ½ mv^2)_{Bottom/Onder}$

✓Any one/*Enige een*

$(9,8)(5,8) + 0 = 0 + (½)v^2$ ✓

$v = 10,662\ m\cdot s^{-1}$

Into the wall / *In die muur in*:

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

$$0,25 = \left(\frac{10,66 + 0}{2}\right)\Delta t$$

$\Delta t = 0,0469$ s

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

$F_{wall/muur}(0,047)$ ✓ $= 1250(0 - 10,66)$ ✓

$F_{wall/muur} = 283\ 510,63$ N ✓

OPTION 8/*OPSIE 8*

From R to the wall/*Vanaf R na die muur*:

$(E_{mech})_{Top/Bo} = (E_{mech})_{Ground/Grond}$
$(E_P + E_K)_{Top} = (E_P + E_K)_{Bottom/Onder}$
$(mgh + ½ mv^2)_{Top/Bo} = (mgh + ½ mv^2)_{Bottom/Onder}$
✓Any one/*Enige een*

$(9,8)(5,8) + 0 = 0 + (½)v^2$ ✓
$v = 10,66 \text{ m·s}^{-1}$

Into the wall / *In die muur in*:
$v_f^2 = v_i^2 + 2a\Delta x$
$0 = (10,66)^2 + (2)a(0,25)$✓
$a = -227,36 \text{ m·s}^{-1}$ (- 227,356)

$F_{wall/muur} = ma$
$F_{wall/muur} = (1\,250)(-227,356)$ ✓
$F_{wall/muur} = -284\,200$ (-284 195)
$F_{wall/muur} = 284\,200$ N ✓ (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)

4.2.2

For ball/*Vir bal* P:
West as negative/*Wes as negatief*
Impulse = Δp
$F_{net}\Delta t = \Delta p$
$\Delta p = m(v_{Pf} - v_{Pi})$ ✓Any one/*Enige een*
$= 0{,}16(-5 - 10)$ ✓
$= -2{,}4$
$\therefore$ 2,4 N·s ✓ (2,4 kg·m·s^{-1})

OR/*OF*

West as positive /*Wes as positief*
Impulse = Δp
$F_{net}\Delta t = \Delta p$
$= m(v_{Pf} - v_{Pi})$ ✓Any one/*Enige een*
$= 0{,}16(5 - (-10))$ ✓
= 2,4 N·s ✓

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
$F_{net}\Delta t = \Delta p$
$= m(v_{Qf} - v_{Qi})$ ✓ Any one/*Enige een*
$= 0{,}2[-3 - (-15)]$ ✓
= 2,4 N·s ✓ (2,4 kg·m·s^{-1})

OR/*OF*

West as positive /*Wes as positief*
Impulse = Δp
$F_{net}\Delta t = \Delta p$
$= m(v_{Qf} - v_{Qi})$ ✓Any one/*Enige een*
$= 0{,}16(3 - (15))$ ✓
= - 2,4 N·s
$\therefore$ 2,4 N·s ✓ (2,4 kg·m·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. ✓✓
'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. ✓✓
'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. ✓✓
'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

$K = \frac{1}{2}mv^2$ / $E_k = \frac{1}{2}mv^2$
$\Delta K = K_f - K_i$
$\Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$= \frac{1}{2}m(v_f^2 - v_i^2)$
$= \frac{1}{2}(200)(2^2 - 4^2)$ ✓Any one /*Enige een*
ΔK = - 1 200 J ✓

(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*

$W_{nc} = \Delta K + \Delta U$
$W_{nc} = ½ mv_f^2 - ½ mv_i^2 + mgh_f - mgh_i$
$= ½ m (v_f^2 - v_i^2) + mg(h_f - h_i)$
} ✓Any one/*Enige een*

$\underline{-3,40 \times 10^3}$ ✓ = $\underline{-1\ 200 + 200(9,8)(h_f - 10)}$ ✓
h = 8,88 m ✓ (8,87765 m)

OPTION 2/*OPSIE 2*

$E_{(mech/meg)A} + W_f = E_{(mech)B}$
$(E_p + E_k)_A + W_f = (E_p + E_k)_B$
$(mgh + ½mv^2)_A + W_f = (mgh + ½mv^2)_B$
} ✓Any one/*Enige een*

$\underline{200(9,8)(10) + ½(200)(4^2) - 3,40 \times 10^3}$ ✓ = $\underline{200(9,8)(h) + ½(200)(2)^2}$ ✓
h = 8,88 m ✓ (8,87755)

OPTION 3/*OPSIE 3*

$W_{net} = \Delta K$
$W_f + W_w = ½mv_f^2 - ½mv_i^2$
$W_f - \Delta E_p = ½mv_f^2 - ½mv_i^2$
$W_f - mg(h_f - h_i) = ½m(v_f^2 - v_i^2)$
} ✓Any one/*Enige een*

$\underline{-3,40 \times 10^3 - 200(9,8)(h-10)}$ ✓= -1 200 ✓
h = 8,88 m ✓ (8,87755 m) (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*

$W_{nc} = \Delta K + \Delta U$
$W_{engine} + W_f = ½mv_f^2 - ½ mv_i^2 + mgh_f - mgh_i$
$= ½m(v_f^2 - v_i^2) + mg(h_f - h_i)$
} ✓✓Any one/*Enige een*

$W_{engine} + \underline{(50)(15)(2)\cos 180°}$ ✓✓ = 0 + $\underline{200(9,8)}$✓(22 – 8,88)
W_{engine} = 27 215,20 J

$P_{engine} = \dfrac{W_{engine}}{\Delta t}$ ↓

$= \dfrac{27\ 215,20}{15}$

= 1 814,35 W

OPTION 2/*OPSIE 2*

$W_{net} = \Delta K$
$W_N + W_{engine} + W_w + W_f = 0$
$W_N + W_{engine} - \Delta Ep + W_f = 0$
✓✓Any one/*Enige een*

$0 + W_{engine} - (200)(9,8)$✓$(13,12) + (50)(2)(15)\cos 180°$ ✓✓ $= 0$
$W_{engine} = 27\,215,20$ J

OR/*OF*

$W_{net} = \Delta K$ ✓✓
$W_N + W_{engine} + W_{w||} + W_f = 0$
$W_N + W_{engine} + mg\sin\theta\Delta x\cos 180^o + W_f = 0$
$0 + W_{engine} - (200)(9,8)$✓$\left(\frac{13,12}{\Delta x}\right)\Delta x(-1) + (50)(2)(15)\cos 180°$ ✓✓ $= 0$
$W_{engine} = 27\,215,20$ J

$P_{engine} = \frac{W_{engine}}{\Delta t}$
$= \frac{25\,215,20}{15}$
$= 1\,814,35$ W

OPTION/OPSIE 3: Marking criteria/*Nasienriglyne Opsie 3*

- Appropriate formula/*Geskikte formule* ✓✓
- Substitution of/*Vervanging van* **- 50** ✓✓
- Substitution of/*Vervanging van* (-200)(9,8)(0,4373) or/*of* (-200)(9,8)(0,44)✓
- Appropriate formula/*Geskikte formule*
- Substitution into/*Vervanging in* $P_{ave} = Fv_{ave}$
- Final answer/*Finale antwoord*: 1 814,35 W - 1 824,8 W

OPTION 3/*OPSIE 3*

$F_{net} = ma$
$F_{engine} + F_{friction} + F_{g//} = 0$
✓✓Any one/*Enige een*

$F_{engine} + (-50)$ ✓✓ $+ (-200)(9,8)$✓$(0,4373) = 0$
$F_{engine} = 906,52$ N (906,52 – 912,4)

$P_{ave} = Fv_{ave}$
$P_{ave} = (908,52)(2)$
$= 1\,813,04$ W (1 824,8 W)

$\sin\theta = \frac{h}{\Delta x}$
$= \frac{13,12}{2(15)}$
$= 0,4373$

OR/*OF*

$W = F_{engine}\Delta x\cos\theta$
$= (906,52)(30)\cos 0^o$
$= 27\,195,6$ J (27 372 W)

$P = \frac{W}{\Delta t} = \frac{27195,6}{15} = 1\,813,04$ W ✓ (1 824,8 W)

(5)
[14]

OPTION 3/*OPSIE 3*

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

$= \frac{480 + 80}{2}\ (0,01)$

$= 2,80$ m

$v_f^2 = v_i^2 + 2a\Delta x$
$(80)^2 = (480)^2 + 2a(2,80)$ ✓
$a = -40\ 000\ m{\cdot}s^{-2}$

$F_{net} = ma$ ✓
$= (0,05)(-40\ 000)$ ✓
$= -2\ 000$ N
$F_{net} = 2\ 000$ N ✓ west/*wes* ✓

$W_{net} = \Delta K$ ✓
$F_{net}\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$F_{net}(2,80)\cos0°$ ✓ $= \frac{1}{2}(0,05)(80^2 - 480^2)$ ✓
$F_{net} = -2\ 000$ N
$F_{net} = 2\ 000$ N ✓ west/*wes* ✓

OR/*OF*
$F_{net}(2,80)\cos180°$ ✓ $= \frac{1}{2}(0,05)(80^2 - 480^2)$ ✓
$F_{net} = 2\ 000$ N ✓ west/*wes* ✓

(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**
$E_P = mgh$ ✓ $= \underline{(1,8)(9,8)\ (1,5)}$ ✓ $= 26,46$ J ✓	$W_w = -\Delta E_p$ ✓ $(1,8)(9,8)(h - 0)\cos 180^o = -(E_{pA} - E_{p(ground)})$ $\underline{(1,8)(9,8)(1,5)(-1) = -E_{pA}}$ ✓ $E_p = 26,46$ J✓ **OR/*OF*** $W = F\Delta x\cos\theta$ $= mg\Delta h\cos\theta$ ✓Any one/*Enige een* $= \underline{(1,8)(9,8)\ (1,5)\cos 0^o}$ ✓ $= 26,46$ J✓

(3)

5.5

POSITIVE MARKING FROM QUESTION 5.4 /
POSITIEWE NASIEN VANAF VRAAG 5.4

OPTION 1/*OPSIE 1*

$W_{nc} = \Delta K + \Delta U$
$W_f = \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i)$ ✓Any one/*Enige een*
$= \underline{\frac{1}{2}(1,8)(4^2 - 0,95^2)}$ ✓+ $\underline{(0 - 26,46)}$ ✓
$= -12,87$ J ✓

OPTION 2/*OPSIE 2*

$W_{net} = \Delta K$
$W_f + W_g = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$W_f + mgh = \frac{1}{2}m(v_f^2 - v_i^2)$ ✓Any one/*Enige een*
$W_f + mgh = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$\underline{W_f + 26,46}$ ✓$= \underline{\frac{1}{2}(1,8)[(4)^2 - (0,95)^2]}$ ✓
$W_f = -12,87$ J (- 12,872 J) ✓

OPTION 3/*OPSIE 3*

$E_{(mech/meg)A} = E_{(mech)B} - W_f$
$(E_p + E_k)_A = (E_p + E_k)_B - W_f$ ✓Any one/*Enige een*
$(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_B - W_f$
$\underline{26,46 + \frac{1}{2}(1,8)(0,95^2)}$ ✓ $= 0 + \frac{1}{2}(1,8)(4^2) - W_f$ ✓
$W_f = -12,87$ J ✓

(4)

5.6 $W_{net} = 0$ (J) / zero✓ (1)

[13]

QUESTION 6/*VRAAG 6*

6.1 Doppler effect/*Doppler-effek* ✓ (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/*OF*

P: (records sounds with) shorter period/ shorter time per wave / higher frequency. ✓
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)

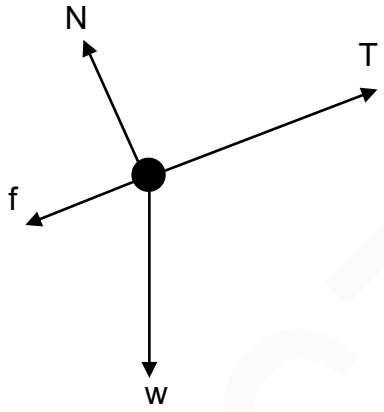
QUESTION 5/*VRAAG 5*

5.1 Tension/*Spanning*✓ (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 in nie geïsoleerd nie omdat daar wrywing/spanning is

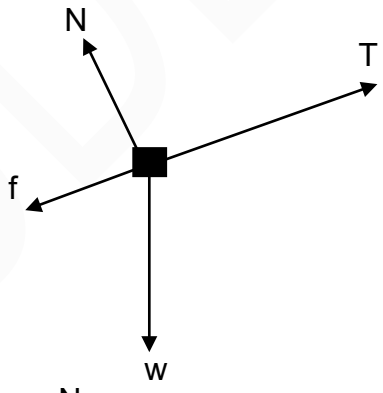
OR/*OF*
The internal energy increases because of friction ✓
Die interne energie neem toe as gevolg van wrywing.
OR
The applied force is non-conservative✓
Die toegepaste krag is nie-konservatief
OR
It is not an isolated system✓ (1)

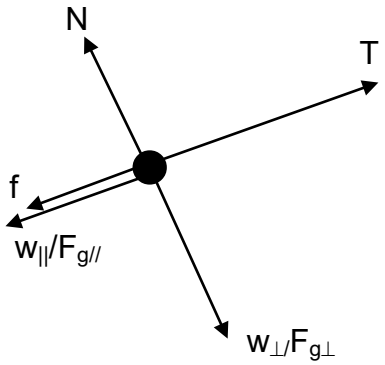
5.3



NOTE: maximum ¾ if friction and tension are not on a straight line
LW: maksimum ¾ indien wrywing en spanning nie in 'n reguitlyn nie.

ACCEPT/*AANVAAR*





NOTE: maximum ¾ if N and $w_{\perp}$ are not on a straight line
LW: maksimum ¾ 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* $^3/_4$
- If force(s) do not make contact with body / *Indien krag(te) nie met die voorwerp kontak maak nie:* Max/*Maks:* $^3/_4$

Deduct 1 mark for an arrow/arrows omitted / *trek 1 punt af indien pyl/pyle weggelaat* (4)

5.4

$W = F\Delta x\cos\theta$✓
$W_f = [178,22(4)\cos 180^o]$ ✓
$= -712,88$ J✓ (3)

5.5

OPTION 1/*OPSIE 1*
POSITIVE MARKING FROM QUESTIONS 5.4 *POSITIEWE NASIEN VANAF VRAE 5.4*

$W_{net} = \Delta E_K$
$W_f + W_g + W_T = \Delta K$
$W_f + mg\sin\theta\Delta x\cos\theta + W_T = \Delta K$

1 mark for any one✓/
1 punt vir enige een

$-712,88 + \underline{(70)(9,8)(\sin 30^o)(4)\cos 180^o}$ ✓$+ \underline{(700 \times 4 \times \cos 0^o)}$✓ $= \underline{½\ 70(v_f^2 - 0)}$✓
$v_f = 4,52\ m\cdot s^{-1}$✓

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:
$W_{gravity/gravitasie} = mg\Delta x\cos\theta$
$= (70)(9,8)(4).(\cos 120^o)$

∴ $-712,88 + \underline{(70)(9,8)(4)\cos 120^o)}$ ✓$+ \underline{(700 \times 4 \times \cos 0^o)}$✓ $= \underline{½\ 70(v_f^2 - 0)}$✓
$v_f = 4,52\ m\cdot s^{-1}$✓

$W_{gravity/gravitasie} = -\Delta mgh = -mg(h_f - h_{0)}$
$= mg\Delta y\cos\theta$
$= ((70)(9,8)\ 4(\sin 30^o).\cos 180^o$
$W_{gravity/gravitasie} = mg\sin\theta\Delta x\cos\theta$
$= (70)(9,8)\ (\sin 30^o)(4).\cos 180^o$

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM 5.4 / *POSITIEWE NASIEN VANAF 5.4*
$W_{nc} = \Delta E_K + \Delta E_p$ ✓
$W_T + W_f = \Delta E_K + \Delta E_p$
$(700)(4)\cos 0^o$✓ + (-712,88) = [(70)(9,8) 4(sin 30°). - 0]✓+ $\frac{1}{2}\ 70(v_f^2 - 0)$✓
$v_f = 4{,}52\ m{\cdot}s^{-1}$✓

OPTION 3
$F_{net} = F_T - [mg\sin\theta + f_k]$
$= \underline{700 - [(70 \times 9{,}8 \sin 30^o) + 178{,}22]}$ ✓
$= 178{,}78\ N$
$W_{net} = \Delta E_K$✓
$F_{net} . \Delta x\cos\theta = \Delta E_K$
$\underline{(178{,}78)(4)\cos 0^o}$ ✓=.$\underline{\frac{1}{2}\ 70(v_f^2 - 0)}$✓
$v_f = 4{,}52\ m{\cdot}s^{-1}$✓ (5)

5.5 **WHERE EQUATIONS OF MOTION ARE USED:/ *WAAR BEWEGINGSvERGELYKING GEBRUIK:* MAX/*MAKS*** $\frac{1}{5}$

$F_{net} = ma$
$F_T - [mg\sin\theta + f_k] = ma$
$\underline{700 - [(70 \times 9{,}8 \sin 30^o) + 178{,}22]}$ ✓$= 70a$
$a = 2{,}554\ ms^{-2}$
$v_f^2 = v_i^2 + 2a\Delta x$
$= 0 + 2(2{,}554)(4)$
$v_f = 4{,}52\ m{\cdot}s^{-1}$

5.6 **POSITIVE MARKING FROM 5.4/*POSITIEWE NASIEN VANAF 5.4***

2(-712,88) = -1425,76 J✓

OR/OF
Double the answer (in question 5.4). ✓
Dubbel die antwoord (in vraag 5.4) (1)
[15]

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*

$P = \frac{W}{\Delta t}$ ✓

$= \frac{4{,}8\times10^{6}}{(90)}$ ✓

$= 53\ 333{,}33$ W

$= 5{,}33 \times 10^{4}$ W (53,33 kW) ✓

OPTION 2/*OPSIE 2*

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

$= \left(\frac{0 + 25}{2}\right)(90)$

$= 1\ 125$ m

$W_F = F\Delta x\cos\theta$

$4{,}80 \times 10^{6} = F(1\ 125)\cos0^{o}$

$F = 4\ 266{,}667$ N

$P_{ave} = Fv_{ave}$ ✓

$= (4\ 266{,}667)(12{,}5)$ ✓

$= 53\ 333,33$ W ✓ (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*

$W_{net} = \Delta K$✓
$W_w + W_f + W_F = ½ mv_f^2 - ½ mv_i^2$
$mg\Delta x\cos\theta + W_f + W_F = ½ mv_f^2 - ½ mv_i^2$
$(1\ 500)(9,8)200\cos180^o$✓ + $W_f + 4,8 \times 10^6$ ✓= ½ $(1\ 500)(25^2 - 0)$ ✓
$-2\ 940\ 000 + W_f + 4,8 \times 10^6 = 468\ 750$
$W_f = -1\ 391\ 250$ J
$= -1,39 \times 10^6$ J✓

OR/OF

$W_{net} = \Delta K$✓
$W_w + W_f + W_F = ½ mv_f^2 - ½ mv_i^2$
$-\Delta Ep + W_f + W_F = ½ mv_f^2 - ½ mv_i^2$
$-(1\ 500)(9,8)(200 - 0)$✓ + $W_f + 4,8 \times 10^6$ ✓= ½ $(1\ 500)(25^2 - 0)$ ✓
$-2\ 940\ 000 + W_f + 4,8 \times 10^6 = 468\ 750$
$W_f = -1\ 391\ 250$ J
$= -1,39 \times 10^6$ J ✓ (5)

NOTE/*LET WEL*
0 can be omitted in above substitutions.
0 kan in bogenoemde vervangings weggelaat word.

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta K + \Delta U$
$W_{nc} = ½ mv_f^2 - ½ mv_i^2 + mgh_f - mgh_i$ ✓
$= ½ m (v_f^2 - v_i^2) + mg(h_f - h_i)$
$W_{nc} = ½ mv_f^2 + mgh_f - ½ mv_i^2 - mgh_i$

1 mark for any of these/
1 punt vir enige van hierdie

$W_f + W_F = ½ mv_f^2 - ½ mv_i^2 + mgh_f - mgh_i$
$W_f + 4,8 \times 10^6$ ✓$= [½ (1\ 500)(25)^2 + -0]$ ✓$+[(1\ 500)(9,8)(200) - 0]$✓
$W_f = - 1,39 \times 10^6$ J $(-1,40 \times 10^6$J)✓

OR/*OF*

$W_{nc} = \Delta K + \Delta U$
$W_{nc} = ½ mv_f^2 - ½ mv_i^2 + mgh_f - mgh_i$ ✓
$= ½ m (v_f^2 - v_i^2) + mg(h_f - h_i)$
$W_{nc} = ½ mv_f^2 + mgh_f - ½ mv_i^2 - mgh_i$

1 mark for any of these/
1 punt vir enige van hierdie

$W_f + 4,8 \times 10^6$ ✓$= [½ (1500)(25)^2$ ✓$+ (1500)(9,8)(200)$✓$] - [0 + 0]$
$W_f = - 4,8 \times 10^6 + 3,4 \times 10^6$
$= - 1,39 \times 10^6$ J $(-1,40 \times 10^6$J)✓

(5)

ACCEPT THE FOLLOWING FOR: *IAANVAAR DIE VOLGENDE VIR* : $(3/5)$

POSITIVE MARKING FROM 5.3/*POSITIEWE NASIEN VANAF 5.3*

$v_f = v_i + a\Delta t$
$25 = 0 + a(90)$
$a = 0,277…m \cdot s^{-2}$

$F_{net} = ma$
$=(1\ 500)(0,2777…) = 416,66…$ N

$F + (w_{||}) + (-f_k) = 416,666…$
$4\ 266,6667 – 1\ 500(9,8)\sin\theta - f_k = 416,666…$
$f_k = 1\ 236,6667$ N

$W_f = f_k \Delta x \cos\theta$ ✓
$= (1\ 236,6667)(1\ 125)(\cos 180°)$✓
$= - 1\ 391\ 250$ J ✓

(5)
[13]

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/some van kinetiese en gravitasionele potensiële energie in 'n geslote sisteem bly behoue.
(If key words isolated and total missing -1 mark for each.) (2)

5.2 $E_{MECH\ P} = E_{MECH\ Q}$
$(E_P + E_K)_P = (E_P + E_K)_Q$
$W_{net} = \Delta E_K$
$W_{con} = \Delta E_K$
$\Delta E_K + \Delta E_p = 0$

✓1 mark for any of the three/
1 punt vir enige van die drie

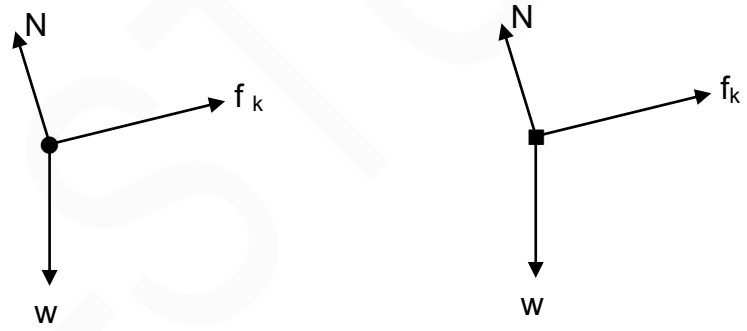
$(mgh + \frac{1}{2}mv^2)_P = (mgh + \frac{1}{2}mv^2)_Q$
$50\ (9,8)(3) + 0$ ✓$= 0 + ½\ (50)v^2$✓

$v = 7,67\ m\cdot s^{-1}$ ✓ $(7,668\ m\cdot s^{-1})$ (4)

5.3

Accepted labels/*Aanvaarde benoemings*		
w	F_g / F_w / weight / mg / gravitational force *F_g/ F_w / gewig / mg / gravitasiekrag*	✓
N	F_N	✓
f_k	F_f/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*

$= 0,08\ (50 \times 9,8)\ \cos 30^o$✓
$= 33,95\ (33, 948)\ N$ ✓ (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*

$W = F_{net}\Delta x \cos\theta$

$W_{net} = W_f + W_w + W_N$
$W_{net} = W_f + (-\Delta E_P) + W_N$
$W_{net} = f_k \Delta x \cos 180^\circ + mg\sin\theta \Delta x \cos 0 + 0$

$W_{net} = \Delta E_K / \Delta K$

✓1 mark for any one/
1 punt vir enige van die drie

$W_{net} = [33,948)(5)(-1)]$ ✓ $+ [(50)(9,8)(5)\sin 30^\circ + 0]$✓
$= 1055, 26$ (1055,259)
$1055,259 = ½ (50)(v_f^2 – 7,668^2)$ ✓
$v_f = 10,05\ m\cdot s^{-1}$✓

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM QUESTION 5.2/*POSITIEWE NASIEN VANAF VRAAG 5.3*

$W_{nc} = \Delta E_p + \Delta E_k$
$f\Delta x\cos\theta = (mgh_f – mgh_i) + (½ mv_f^2 – ½ mv_i^2)$

1 mark for any of the two/
1 punt vir enige van die twee

$\mu mg\Delta x \cos 180^\circ = [0 - (mg\Delta x \sin 30^\circ] + ½ m(v_f^2 – v_i^2)$
$[33,948)(5)(-1)]$ ✓$= [0 - 50(9,8)(5)\sin 30^\circ]$✓ $+ ½ (50)(v_f^2 – 7,668^2)$✓
$v_f = 10,05\ m\cdot s^{-1}$✓

OPTION 3/*OPSIE*
POSITIVE MARKING FROM QUESTION 5.2 AND 5.4/*POSITIEWE NASIEN VANAF VRAAG 5.2 EN 5.4*

$W_{nc} = \Delta E_p + \Delta E_k$
$f\Delta x\cos\theta = (mgh_f – mgh_i) + (½ mv_f^2 – ½ mv_i^2)$

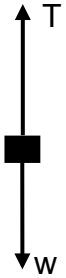
1 mark for any of the two/
1 punt vir enige van die twee

$(33,95)(5)\cos 180$ ✓$= [(50)(9,8)\{0 - 5\sin 30^\circ\}]$✓ $+ ½ (50)(v_f^2 - 7,668^2)$ ✓
$v_f = 10,05\ m\cdot s^{-1}$✓

(5)
[17]

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/ *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* $\frac{1}{2}$
- 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

$W = F\Delta x\cos\theta$
$W_w = mg\Delta x\cos\theta$ ✓

1 mark for any of these/*1 punt vir enige van hierdie*

$= \underline{75(9,8)\ (12)\cos 180^{o}}$✓
$= -\ 8\ 820$ J✓

OR/*OF*
$W_w = -\Delta E_p$ ✓
$= -(mgh - 0)$
$= -(75)(9,8)(12)$ ✓
$= -8\ 820$ J✓

(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*

$W_{net} = \Delta K$
$F_{net}\Delta x\cos\theta = (½ mv_f^2 - ½ mv_i^2)$ ✓

1 mark for any of these
1 punt vir enige van hierdie

$(75)(0,65)(12)$ ✓$\cos 0^o$-✓ = ½(75)(v_f^2 - 0) ✓
v_f = 3,95 m·s^{-1} (3,949 m·s^{-1}) ✓

POSITIVE MARKING FROM 5.2/ *POSITIEWE NASIEN VANAF 5.2*
OPTION 2/OPSIE 2

$W_{net} = \Delta K$
$W_{nc/nk} = \Delta K + \Delta U$ ✓
$W_T + W_g = \Delta K$

1 mark for any of these/*1 punt vir enige van hierdie*

$W_{nc/nk} = (½ mv_f^2 - ½ mv_i^2) + (mgh_f - mgh_i)$
9405 ✓= (½ (75)v_f^2 -0) ✓+ (75)(9,8)(12 -0)✓
v_f = 3,95 m·s^{-1}✓

T – mg = ma
T – 75(9,8) = 75(0,65)✓
T = 783,75 N
W_T = 783,75 (12) $\cos 0^o$✓
= 9405 J
9405 – (8820) = ½ (75)(v_f^2 – 0)✓
v_f = 3,95 m·s^{-1} (3,949 m·s^{-1})✓ (5)

[13]

OPTION 4/*OPSIE 4* $W_{net} = \Delta K/\Delta E_k$ ✓ $F_{net}\Delta x\cos\theta = ma\Delta x\cos\theta = \Delta K/\Delta E_k$ $v_f = v_i + a\Delta t$ $306,666 = 400 + a\,(0,002)$ ✓ $a = -46\ 667\ m\cdot s^{-2}$
$W_{net} = \Delta K/\Delta E_k$ $F_{net}\Delta x\cos\theta = ma\Delta x\cos\theta = \Delta K/\Delta E_k$ $(0,015)(46\ 667)\Delta x\cos180^o$✓ $= ½(0,015)(306,666^2 - 400^2)$✓ $\Delta x = 0,71$ m (0,707) ✓
OR/*OF* $W_{nc} = \Delta E_p + \Delta E_k$ $(0,015)(46\ 667)\Delta x\cos180^o$✓ $= ½(0,015)(306,666^2 - 400^2)$✓ $\Delta x = 0,71$ m (0,707) ✓

(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

$W_w = w\Delta x\cos\theta$✓ $= mg\Delta x\cos\theta$ $= (6)(9,8)(1,6)\cos0^o$✓ $\therefore W = 94,08$ J ✓	$W_w = -\Delta E_P$ ✓ $= -mg(h_f - h_i)$ $= -(6)(9,8)(0 - 1,6)$ ✓ $= 94,08$ J✓

(3)

5.4

OPTION 1/*OPSIE 1*

$W_{net} = \Delta E_K / \Delta K$✓ $= ½m(v_f^{\ 2} - v_i^{\ 2})$
$W_{net} = F_{net}\Delta x\cos\theta$
$W_{net} = W_f + W_g + W_N$
$= \mu_k N\Delta x\cos\theta + W_g + W_N$

$W_{net} = \underline{(0,4)(4)(9,8)(1,6)\cos180^o}$ ✓ + 94,08 + 0
= 68,992 J
$W_{net} = ½m(v_f^{\ 2} - v_i^{\ 2})$
$\underline{68,992}$✓ $= \underline{½(4)(v_f^{\ 2} - 0)} + \underline{½(6)(v_f^2 - 0)}$✓
$v_f = 3,71\ m\cdot s^{-1}$✓

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$f\Delta x\cos\theta = (m_1gh_f - m_1gh_i) + (½m_1v_f^2 - ½m_1v_i^2) + (½m_2v_f^2 - ½m_2v_i^2)$
$\underline{(0,4)(4)(9,8)\ (1,6)\cos 180^o}$ ✓ $= [0 - (6)(9,8)(1,6)]$✓ $+ (½(6)v_f^2 + ½(4)v_f^2 - 0)$✓
$68,992 = 5v_f^2$
$v_f = 3,71\ m\cdot s^{-1}$✓

OPTION 3/*OPSIE 3*

$f_k = \mu_k N = (0,4)(4)(9,8) = 15,68\ N$
$T - f_k = ma$
$w - T = ma$
$T - 15,68 = 4a$ … .(i)
$(6)(9,8) - T = 6a$ ……..(ii)
$\therefore a = 4,312\ m\cdot s^{-2}$
$\therefore T = 32,928\ N$

$F_{net} = ma$
$= (6)(4,312)$
$= 25,872$

$W_{net} = F_{net}\Delta x\cos\theta$
$= (25,872)(1,6)\cos0^o$✓
$= 41,3952\ J$

$W_{net} = \Delta E_k$✓
$41,3952 = ½\ m(v_f^2 - v_i^2$
$\underline{41,3952 = ½\ (6)(v_f^2 - 0)}$✓
$v_f = 3,7146\ m\cdot s^{-1}$✓

Above calculations can be done with 4 kg or 10 kg / *Bostaande berekeninge kan met 4 kg of 10 kg gedoen word*

<u>4 kg block</u>
$W_{net} = \Delta E_K / \Delta K$✓
$W_f + W_T = ½m(v_f^2 - v_i^2)$

$f\Delta x\cos180^o + T\Delta x\cos0^o = ½(4)(v_f^2 - 0)$
$(15,68)(1,6)(-1)$✓ $+ (32,928)(1,6)(1)$✓ $= 2v_f^2$
$v_f = 3,72\ m\cdot s^{-1}$✓

<u>6 kg block</u>
$W_{net} = \Delta E_K / \Delta K$✓
$W_w + W_T = ½m(v_f^2 - v_i^2)$

$mg\Delta x\cos0^o + T\Delta x\cos180^o = ½(6)(v_f^2 - 0)$
$(6)(9,8)(1,6)(1)$✓ $+ (32,928)(1,6)(-1)$✓ $= 3v_f^2$
$v_f = 3,72\ m\cdot s^{-1}$✓

OPTION 4/*OPSIE 4*

$W_{net} = \Delta E_K / \Delta K$ ✓

For the 4 kg mass / *Vir die 4 kg massa*

$T(1,6)\cos 0^o + [(0,4)(9,8)(4)](1,6)\cos 180^o$ ✓ $= ½(4)v^2 - 0)$

For the 6 kg mass/*Vir die 6 kg massa*

$(6)(9,8)(1,6)]\cos 0^o + T(1,6)\cos 180^o$ ✓ $= ½(6)(v^2 - 0)$

Adding the two equations / *Optel van twee vergelykings*

$68,992 = ½ (4)v^2 + ½ (6)v^2$ ✓

$5v^2 = 68,992$

$v = 3,71 \text{ m·s}^{-1}$ ✓

OPTION 5/*OPSIE 5*

$W_{net} = \Delta E_k$ ✓

$F_{net} \Delta x\cos\theta = ½ m(v_f^2 - v_i^2)$

$(F_g - f)\Delta x\cos\theta = ½m(v_f^2 - v_i^2)$

$[(6)(9,8) - (0,4)(4)(9,8)]$ ✓ $(1,6)\cos 0^o$ ✓ $= ½(10)(v_f^2 - 0)$ ✓

$v_f = 3,71 \text{m.s}^{-1}$ ✓ (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

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \checkmark$$

$$170 \overset{\checkmark}{=} \frac{(340 + 0)}{(340 - v_s)} \overset{\checkmark}{\times} f_s \text{ ---------- (1)}$$

$$130 \overset{\checkmark}{=} \frac{(340 - 0)}{340 + v_s} \overset{\checkmark}{\times} f_s \text{ ---------- (2)}$$

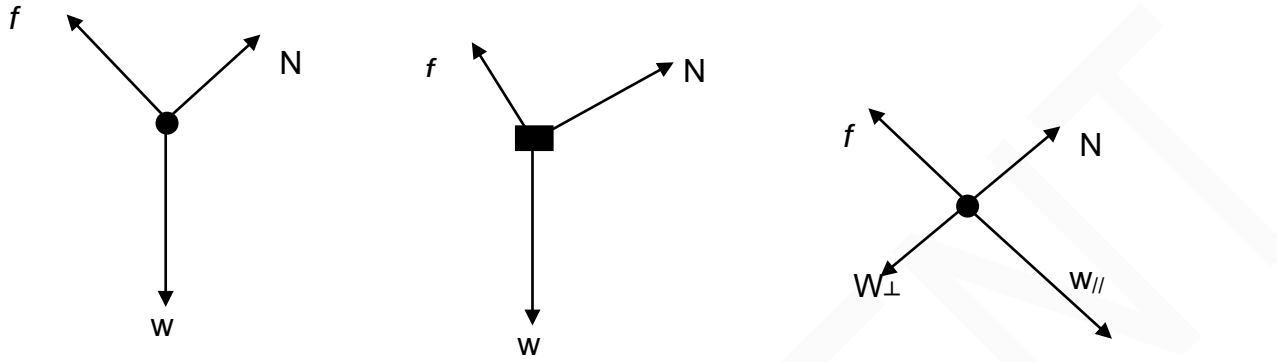
$v_s = 45,33 \text{ m·s}^{-1}$ ✓ $(45,33 - 45,45 \text{ m·s}^{-1})$ (6)

[10]

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:* $^3/_4$
- 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*

$W_{net} = \Delta E_K$
$f\Delta x\cos\theta + F_g\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ } ✓Any one/*Enige een*

$(50)(25\cos 180^o)$✓ + $(60)(9,8)(25\cos 70^o)$ ✓ = $\frac{1}{2}(60)(15^2 - v_i^2)$ ✓
$-1\,250 + 5\,027,696 = 6\,750 - 30v_i^2$
$v_i = 9,95(4)\ m.s^{-1}$✓

OPTION 2/*OPSIE 2*

$W_{net} = \Delta E_K$
$f\Delta x\cos\theta + F_{g||}\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ } ✓Any one/*Enige een*

$(50)(25\cos 180^o)$ ✓+ $(60)(9,8\sin 20^o)(25\cos 0^o)$ ✓ = $\frac{1}{2}(60)(15^2 - v_i^2)$ ✓
$-1\,250 + 5\,027,696 = 6\,750 - 30v_i^2$
$v_i = 9,95(4)\ m.s^{-1}$✓

OPTION 3/*OPSIE 3*

$W_{nc} = \Delta E_K + \Delta E_P$
$f\Delta x\cos\theta = \frac{1}{2}(mv_f^2 - mv_i^2) + (mgh_Q - mgh_P)$
$E_{mechP} + E_{mechQ} + W_{nc} = 0$ } ✓Any one/*Enige een*

$(50)(25\cos 180^o)$ ✓= $\frac{1}{2}(60)(15^2 - v_i^2)$ ✓ + $(60)(9,8)(-25\sin 20^o)$ ✓
$-1\,250 = 6\,750 - 30\,v_i^2 - 5\,027,696$
$v_i = 9,95\ m.s^{-1}$✓ (5)

OPTION 4/*OPSIE 4*

$F_{net} = 201,11 - 50$
$= 151,11\ N$

$W_{net} = \Delta E_k$ ✓
$F_{net}\Delta x\cos\theta = \frac{1}{2}(mv_f^2 - mv_i^2)$
$\underline{(151,11)(25)\cos 0^o}$✓ = $\frac{1}{2}(15^2 - v_i^2)$✓
$v_i = 9,95\ m{\cdot}s^{-1}$ ✓

5.4

POSITIVE MARKING FROM QUESTION 5.3
POSITIEWE NASIEN VANAF VRAAG 5.3

OPTION 1/*OPSIE 1*

$P_{ave/gemid} = Fv_{ave/gemid}$ ✓

$= 50$ ✓ $\frac{(9{,}95 + 15)}{2}$ ✓

$= 623{,}75$ W ✓

OPTION 2/*OPSIE 2*

$P = \frac{W}{\Delta t}$

$P_f = \frac{f\,\Delta x\,\cos\theta}{\Delta t}$

✓Any one/*Enige een*

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

$25 = \frac{(9{,}954 + 15)}{2}\Delta t$ ✓

$\Delta t = 2{,}004$ s

$= \frac{[50(25\cos 180^\circ)]}{2{,}004}$ ✓

$= -623{,}75$ W $(-625$ W$)$

$P_{boy/seun} = 623{,}75$ W $(625$ W$)$ ✓

$P_{boy/seun} = \frac{F\Delta x\cos\theta}{\Delta t}$ ✓

$= \frac{[50(25\cos 0^\circ)]}{2{,}004}$ ✓

$= 623{,}75$ W ✓

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 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*

$W = F\Delta x\cos\theta$✓

$W_{gravity/gravitasie} = mg\Delta y\cos\theta$

$= \underline{(1\ 200)(9,8)(55)\cos 180^{o}}$ ✓

$= -\ 646\ 800$ J ($6,47 \times 10^{5}$ J)✓

OPTION 2/*OPSIE 2*

$W = -\ \Delta E_p$✓

$= -(1200)(9,8)(55\ -0)$ ✓

$= -646800$ 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

$W_{counterweight} = mg\Delta y\cos\theta$

$= \underline{(950)(9,8)(55)\cos 0^{o}}$ ✓

$= 512\ 050$ J ($5,12 \times 10^{5}$ 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

$W_{net} = \Delta E_K$

$W_{gravity} + W_{counterweight} + W_{motor} = 0$

$W_{motor} = -(W_{gravity} + W_{counterweight})$

$W_{nc} = \Delta E_K + \Delta E_p$

✓

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✓ $+ 512050$ ✓$+ W_{motor} = 0$

$\therefore W_{motor} = 134\ 750$ J

$P_{ave\ motor} = \frac{W}{\Delta t}$ ✓

$= \frac{134750}{180}$ ✓

$= 748,61$ W✓

OPTION 2/*OPSIE 2*

$F_{net} = 0$
$F_{gcage} + F_{gcount} + F_{motor} = F_{net}$ ✓ 1 mark for any one/*1 punt vir enige een*

-117600✓ $+ 9310$✓ $+ F_{motor} = 0$
$F_{motor} = 2450$ N

$P_{ave} = Fv_{ave}$✓
$= 2450 \frac{55}{180}$✓
$= 748,61$ W

OPTION 3/*OPSIE 3*

$P_{ave} = Fv_{ave}$ ✓✓
$= [1200\ (9,8)$✓ $- 950(9,8)$✓$] \frac{55}{180}$✓
$= 748,61$ W✓

(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 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ **OR/*OF*** $f_L = \frac{v}{v - v_s} f_s$ **OR/*OF*** $f_L = \frac{v}{v + v_s} f_s$ ✓

$2600 = \frac{340}{(340 - v_s)} f_s$ ✓✓✓

$1750 = \frac{340}{(340 + v_s)} f_s$ ✓

$2600(340 - v_s) = 1750(340 + v_s)$
$v_s = 66,44\ m \cdot s^{-1}$ ✓

(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]

OPTION 4/*OPSIE 4*

$p = mv$

$14\ 000 = 1\ 500v_f$ ✓

$v_f = 9{,}33\ m\cdot s^{-1}$

$F_{net} = \frac{m(v_f - v_i)}{\Delta t}$ ✓ $= \frac{1500(9{,}33 - 20)}{0{,}1}$ ✓

$= -160\ 050$

$= 160\ 050\ N$ ✓

$v_f = v_i + a\Delta t$

$9{,}33 = 20 + a(0{,}1)$

$a = -106{,}7\ m\cdot s^{-2}$

$F_{net} = ma$ ✓

$= 1\ 500(-106{,}7)$ ✓

$F_{net} = -160\ 050\ N$

$F_{net} = 160\ 050\ N$ ✓

(4)

[13]

QUESTION 5/*VRAAG 5*

5.1.1 $E_k/K = ½\ mv^2$ ✓

$= ½\ (2)(4{,}95)^2$ ✓

$= 24{,}50\ J$ ✓ (3)

5.1.2

POSITIVE MARKING FROM QUESTION 5.1.1/*POSITIEWE NASIEN VANAF 5.1.1*

OPTION 1/*OPSIE 1*

$E_{mech\ before} = E_{mech\ after}$

$[(E_{mech})_{bob} + (E_{mech})_{block}]_{before/voor} = [(E_{mech})_{Block} + (E_{mech})_{bob}]_{after/na}$ } Any one/ *Enige een*✓

$(mgh + ½\ mv^2)_{before/voor} = (mgh + ½\ mv^2)_{after/na}$

$(5)(9{,}8)h + 0 + 0$ ✓ $= 5(9{,}8)¼h + 0 + 24{,}50$ ✓

$h = 0{,}67\ m$✓

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta E_p + \Delta E_k$ } Any one/ *Enige een*✓

$0 = \Delta E_p + \Delta E_k$

$-\Delta E_p = \Delta E_k$

$-[(5)(9{,}8)(¼h) - (5)(9{,}8)h]$✓ $= 24{,}50$✓

$h = 0{,}67\ m$ ✓

OPTION 3/*OPSIE 3*

Loss Ep bob = Gain in Ek of block ✓

$mg(¾h) = 24{,}5$

$(5)(9{,}8)(¾h)$✓ $= 24{,}5$ ✓

$h = 0{,}67\ m$ ✓

(4)

OPTION 4 /*OPSIE 4*

Before/*Voor*

$(mgh + ½\ mv^2)_{top/bo} = (mgh + ½\ mv^2)_{bottom/onder}$

$(5)(9{,}8)h + 0 = (5)(9{,}8)h_o + ½\ (5)v^2$

$v_i^2 = 19{,}6h - 19{,}6h_o$

After/*Na*

$(mgh + ½\ mv^2)_{bottom/onder} = (mgh + ½\ mv^2)_{top/bo}$

$(5)(9{,}8)h_o + ½(5)v_f^2 = (5)(9{,}8)(¼h) + 0$

$v_f^2 = 4{,}9h - 19{,}6h_o$

$E_{mech/meg}$ before collision/*voor botsing* = $E_{mech/meg}$ after collision/*na botsing*✓

$½\ mv_i^2$(bob/skietlood) $+ 0 = ½\ mv_f^2$(bob/skietlood)$+ ½\ mv^2$(block/blok)

$½\ (5)(19{,}6h - 19{,}6h_o)$ ✓ $= ½\ (5)(4{,}9h - 19{,}6h_o) + 24{,}5$ ✓

$h = 0{,}67\ m$✓

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*

$W_{net} = \Delta E_K$ ✓
$W_f + mg\Delta y\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$
$W_f + (2)(9,8)(0,5)\cos 180^o$ ✓ $= \frac{1}{2}(2)(2^2 - 4,95^2)$ ✓
$W_f = -10,7$ J ✓

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta E_K + \Delta U$
$W_{nc} = \Delta E_K + \Delta E_P$ } ✓
$W_f = \frac{1}{2}(2)(2^2 - 4,95^2)$ ✓ $+ (2)(9,8)(0,5-0)$ ✓
$= -10,7$ J ✓ (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)

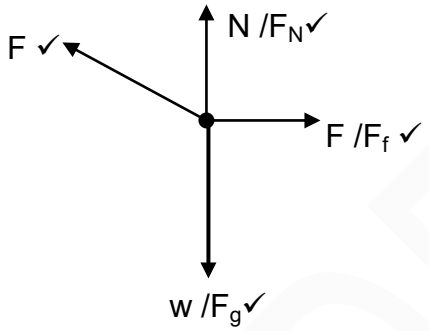
6.1.2 $v = f\lambda$ ✓
$340 = f(0,28)$ ✓
$f_s = 1\,214,29$ Hz ✓ (3)

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 uitgekanseleer)* (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 $F\sin 20^o + N = mg$✓
$N = mg - F\sin 20^o$

$W_{fk} = fk\Delta x \cos\theta = \mu_k N\Delta x \cos\theta$✓
$= \mu_k(mg - F\sin 20)(3)\cos\theta$
$= (0,2)[200(9,8) - F \sin 20](3)\cos 180^o$✓
$= (-1176 + 0,205\ F)$ J✓ (4)

5.5 $W_{tot} = [W_g] + W_f + W_F$ ✓
0 ✓ = [0] +[(-1176 + 0,205 F)] + [F (cos 20) (3) (cos 0)]✓
F = 388,88 N✓
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]

OPTION 4/*OPSIE 4*

$W_{net} = \Delta E_k$
$F_{net}\Delta x\cos\theta = ½\, m(v_f^2 - v_i^2)$
$F_{net}\left(\frac{v_f + v_i}{2}\right)\Delta t \cos 180^o = ½\, m(v_f^2 - v_i^2)$
} ✓ Any one/*Enige een*

$F_{net}\left(\frac{2,5 + 0}{2}\right)(0,3)\,(-1)$✓ $= ½(8)(0^2 - 2,5^5)$✓
$F_{net} = 66,67$ N✓

[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
$W = F\Delta x\cos\theta$✓
$= (30)(\frac{5}{\sin 30^o})\cos\theta$
$= (30)(10)\cos 180^o$
$= (30)(10)(-1)$
} ✓
$= -300$ J✓ (3)

5.2.2
OPTION1/*OPSIE 1*
POSITIVE MARKING FROM 5.2.1/*POSITIEWE NASIEN VANAF 5.2.1*
$W_{nc} = \Delta E_P + \Delta E_K$
$W_{nc} = mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2)$
} ✓
-300 ✓$= \underline{(20)(9,8)(0 - 5)}$ ✓$+ \underline{½\,(20)(v_f^2 - 0)}$ ✓
$v = 8,25$ m·s^{-1}✓

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM 5.2.1/*POSITIEWE NASIEN VANAF 5.2.1*

$W_{net} = \Delta E_K$
$W_g + W_f = \frac{1}{2}m(v_f^2 - v_i^2)$
} ✓
$W_g + (-300) = \underline{½\,(20)(v_f^2 - 0)}$✓
$[(20)(9,8)\sin 30^o \frac{5}{0,5} \cos 0\,]$ ✓ $+ (-300)$ ✓ $= 10v_f^2$
$v_f = 8,25$ m·s^{-1}✓ (5)

5.3

$F = w_{//} + f$
$= (100)(9,8)\sin 30^o + 25$ ✓
$= 515$ N

$P_{ave} = Fv_{ave}$ ✓
$= (515)(2)$✓
$= 1\ 030$ W✓

(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 golffronte 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

$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ **OR/*OF*** $f_L = \frac{v}{v - v_s} f_s$ ✓
$f_L = \frac{340\ ✓}{(340 \mp 30)} (400)$ ✓
$f_L = 438,71$ Hz✓

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

$v = f\lambda$✓
$340 = 400\lambda$✓
$\lambda = 0,85$ m✓

(3)
[12]

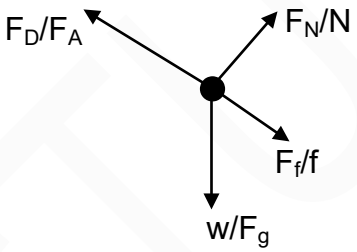
QUESTION 5/*VRAAG 5*

5.1

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$v_{ave} = \frac{800}{75}$ ✓= 10,67m·s^{-1} $P_{ave} = Fv_{ave}$✓ P_{ave} = (240)(10,67) =2 560,8 W (2,56 kW) ✓	$v_{ave} = \frac{800}{75}$ ✓ = 10,67m·s^{-1} ∴Distance covered in 1s = 10,67m· ∴W(Work done in 1 s) = FΔxcosθ✓ = (240)(10,67)(1) = 2 560,8 J s^{-1} ∴ P_{ave} = 2 560,8 W (2,56 kW)✓
OPTION 3/*OPSIE 3*	**OPTION 4/*OPSIE 4***
$P = \frac{W}{\Delta t}$ ✓ $= \frac{F\Delta x\cos\theta}{\Delta t}$ $= \frac{(240)(800)\cos 0°}{75}$ ✓ = 2 560 W✓	$P = \frac{W}{\Delta t}$ ✓ $= \frac{F\Delta x\cos\theta}{\Delta t}$ $= \frac{(240)(10{,}67)\cos 0°}{1}$ ✓ = 2 560 W✓

(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 / gravitasiekrag*
f	$F_{friction}$ / 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 / $F_{normaal}$ / *normaalkrag*
F_D	$F_{Applied/toegepas}$/350 N/Average driving force $F_{driving/dryfkrag}$/350/*Gemiddelde aandrywingskrag*

(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 geyk 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*

$W_{nc} = \Delta U + \Delta K$✓
$W_f + W_D = \Delta U + \Delta K$
$f\Delta x\cos\theta + W_D = mg(h_f - h_i) + ½(m)(v_f^2 - v_i^2)$
$(f\Delta x\cos\theta + F_D\Delta x\cos\theta = mg(h_f - h_i) + ½ m(v_f^2 - v_i^2)$
$(294)(450)(\cos180^o)$✓ + $(350)(450)\cos0^o$✓ = $(300)(9,8)(5 - 0)$✓ + ½$(300)(v_f^2 - 0)$✓
$v_f = 8,37\ m\cdot s^{-1}$✓ (6)

OPTION 2/*OPSIE 2*

$W_{net} = \Delta K$✓
$W_{net} = W_D + W_g + W_f + W_N$
$= (F_D\Delta x\cos\theta) + (mg\sin\alpha)\Delta x\cos\theta) + (f\Delta x\cos\theta) + 0$

$W_{net} = [350(450)](\cos0)$✓ + $(300)(9,8)\ \frac{5}{450}(450)(\cos180)$✓ +
$294(450)(\cos180^o)$✓
$= 157\ 500 - 14\ 700 - 132\ 300$
$= 10\ 500$ J

$W_{net} = \Delta K$
$10\ 500 = \underline{½\ (300)(v_f^2 - 0)}$ ✓
$v_f = 8,37\ m\cdot s^{-1}$ ✓

OR/*OF*
$\alpha = \sin^{-1}\frac{5}{450}$
$= 0,64^o$

(6)

OPTION 3/*OPSIE 3*

$W_{net} = W_D + W_g + W_f + W_N$
$= (F_D\Delta x\cos\theta) + mg\Delta x\cos\theta) + f\Delta x\cos\theta + 0$
$W_{net} = (350)(450)(\cos0^o)$✓ + $(300)(9,8)(450)\cos(90 + 0,64)$ ✓ + $294(450)(\cos180^o)$✓
$= 157\ 500 - 14\ 777,74 - 13\ 2300$
$= 10\ 430,51$ J

$W_{net} = \Delta K$ ✓
$10\ 430,51 = \underline{½\ (300)(v_f^2 - 0)}$✓
$v_f = 8,34\ m\cdot s^{-1}$ ✓

OR/*OF*
$\alpha = \sin^{-1}\frac{5}{450}$
$= 0,64^o$

(6)

OPTION 4/*OPSIE 4*

$F_{net} = F_D + (-mg\sin\alpha) + (-f)$
$= 350$ ✓ + [$-(300)(9,8)\sin0,64^o$]✓ + (-294)✓
$= 23,16$ N

$W_{net} = F_{net}\ \Delta x\cos\theta$
$= (23,16)(450)\cos0^o$
$= 10\ 422$ J

$W_{net} = \Delta K$ ✓
$10\ 422 = \underline{½\ (300)(v_f^2 - 0)}$✓
$v_f = 8,34\ m\cdot s^{-1}$ ✓

OR/*OF*
$F_{net} = 350$ ✓ - $(300)(9,8)\sin0,64^o$✓ - 294✓
$= 350 - 32,84 - 294$
$= 23,16$ N

(6)

[15]

QUESTION 5/*VRAAG 5*

5.1 $\Delta U + \Delta K = 0$✓
$(5)(9,8)(5) + 0$✓ $+ (0 + ½ (5v_f^2)$✓ $= 0$
$v_f = \sqrt{2 \times 9,8 \times 5}$
$= 9,90\ m \cdot s^{-1}$✓ $(9,899\ m \cdot s^{-1})$

Notes / *Aantekeninge*
Accept/*Aanvaar*
$Mgh_i + ½ Mv_i^2 = Mgh_f + ½ Mv_f^2$

(4)

5.2 No friction/zero resultant force ✓so there is no loss in energy.✓/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./Meganiese energie bly behoue (2)

5.3 A force for which the work done is path dependent.✓✓
'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 meganiese energie behoue laat bly nie.*

(2)

5.4

OPTION 1/*OPSIE 1*
$W_{nc} = \Delta U + \Delta K$ ✓
$F\ \Delta x \cos\theta = \Delta U + \Delta K$
$(18\ \Delta x \cos 180$✓$) = (5)\ (9,8)\ (3 - 0)$✓ $+ ½\ (5)\ (0 - 9,90^2)$✓
$\Delta x = 5,4458 m$✓
$\theta = \sin^{-1} \frac{3}{5,4458}$✓
$\theta = 33,43^o$✓

OPTION 2/*OPSIE 2*
$W_{net} = W_f + W_G$✓
$W_{net} = f\ \Delta x \cos\theta + mg\sin\theta \Delta x \cos\theta$
$= [(18\ ) \Delta x \cos 180^o) + 5\ (9,8) \frac{3}{\Delta x} (\Delta x) \cos 180^o]$✓
$= -18\Delta x - 147$
$W_{net} = \Delta K$✓
$\Delta K = ½\ (5)\ (0 - 9,90^2)$✓
$= -245,025$
$-18\Delta x - 147 = -245,025$
$\Delta x = 5,4458\ m$✓
$\theta = \sin^{-1} \frac{3}{5,4458}$✓
$\theta = 39,43^o$✓

(7)
[15]

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

OPTION 1/*OPSIE 1*	
Along **AB**/*Langs* **AB** $E_{mechanical\ at\ A} = E_{mechanical\ at\ B}$ $(E_p + E_k)_A = (E_p + E_k)_B$ ✓ $(mgh + ½ mv^2)_A = (mgh + ½ mv^2)_B$ $(10)(9,8)(4) + 0 = 0 + ½ (10) v_f^2$ ✓ $v_f = 8,85\ m·s^{-1}$	Along **AB**/*Langs* **AB** $W_{net} = \Delta E_k$ ✓ $F_g \Delta h \cos\theta = ½ m(v_f^2 - v_i^2)$ $(10)(9,8)(4)\cos 0^o = ½ (10)(v_f^2 - 0)$ ✓ $v_f = 8,85\ m·s^{-1}$

(6)

Along **AB**/*Langs* **AB**

$W_{nc} = \Delta K + \Delta U$ ✓
$0 = ½ (10)(v_f^2 - 0) + 10(9,8)(4 - 0)$ ✓
$v_f = 8,85 \text{ m·s}^{-1}$

Substitute 8,85 m·s^{-1} in one of the following options
Vervang 8,85 m·s^{-1} in een van die volgende opsies

Along **BC**/*Langs* **BC**	Along **BC**/*Langs* **BC**
$W_{net} = \Delta K$✓ $f\Delta x \cos\theta = \Delta K$ $f(8)\cos 180^o$ ✓$= ½ (10)(0 - 8,85^2)$ ✓ $f = 48,95$ N✓	$W_{nc} = \Delta K + \Delta U$ ✓ $f\ \Delta x\cos\theta = \Delta K + \Delta U$ $f(8)\cos 180$ ✓$= ½ (10)(0 - 8,85^2) + 0$✓ $f = 48,95$ N✓ (Accept/ *Aanvaar* 49 N)

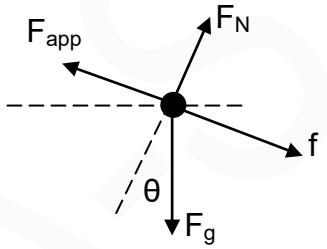
OPTION 2/*OPSIE 2*
Along **AC**/*Langs* **AC**

$W_{nc} = \Delta K + \Delta U$✓
$f\Delta x\cos\theta = \Delta K + \Delta U$
$(f)(8)$✓$(\cos 180^o)$✓ $= (0 - 0)$ ✓ $+ 10\ (9,8)(0 - 4)$ ✓
$f = 49$ N ✓ (6)

5.2.1 $f_k = \mu_k N$✓
$= \mu_k mg\cos\theta$
$= (0,19)(300)(9,8)\cos 25^o$✓
$= 506,26$ N✓ (3)

5.2.2

OPTION 1/*OPSIE 1*



$F_{net} = 0$ ✓
$F_{app} + (-F_g\sin\theta) + (-f) = 0$ ✓
$F_{app} - (300)(9,8)\sin 25^o$✓ $- 506,26$✓ $= 0$
$F_{app} = 1\ 748,76$ N

$P_{ave} = Fv_{ave}$ ✓
$= 1748,76 \times 0,5$✓
$= 874,38$ W ✓ (6)

OPTION 2/*OPSIE 2*

$W_f + W_{app} + W_N + W_g = 0$ ✓
$F\Delta x\cos\theta + F_{app}\Delta x\cos\theta + 0 + F_g\Delta x\cos\theta = 0$
$(506,26\Delta x\cos180^o)$✓ + $(F_{app}\Delta x\cos0) + 300(9,8)\Delta x\cos115^o$✓= 0

F_{app} = 1748,76 N
$P_{ave} = Fv_{ave}$✓
= (1748,76) (0,5)✓
= 874,38 W✓ (6)

OPTION 3/*OPSIE 3*

$W_f + W_{app} + W_N + W_g = 0$✓
$F\Delta x\cos\theta + F_{app}\Delta x\cos\theta + 0 + F_g\sin\theta\Delta x\cos\theta = 0$
$(506,26\Delta x\cos0)$ ✓ + $(F_{ap}\Delta x\cos0) + 300\,(9,8)\sin25^o\,\Delta x\cos180)$ ✓= 0
F_{app} = 1 748,76 N

$P_{ave} = Fv_{ave}$✓
= (1 748,76)(0,5)✓ (6)
= 874,38 W✓ **[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*** $f_L = \frac{v}{v - v_s} f_s$ ✓

(1200)✓ $= \frac{343}{343 - v_s}$✓1130 ✓
v_s = 20,01 m·s^{-1}✓
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.✓ (2)
Die spektrumlyne in diagram 2 het verskuif na die blou ent/blou verskuiwing **[11]**

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/*kragtediagram*

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}/$F_{applied}$ *Krag van enjin op vragmotor/F_{net}/$F_{toegepas}$*
f	F_f / friction

(4)

5.3

OPTION 1/*OPSIE 1*	**Notes/*Aantekeninge:***
$W_{net} = \Delta K$ ✓ $W_F + W_f + W_w = K_f - K_i$ $W_F - 8,5 \times 10^4$ ✓+ (5 000)(9,8)(55)cos180°✓ = 0✓ $\therefore W_F = 2,78 \times 10^6$ J✓	Accept/*Aanvaar:* $W_{net} = \Delta E_k$ $W_{net} = E_{kf} - E_{ki}$
OPTION 2/*OPSIE 2*	**Notes/*Aantekeninge:***
$W_{net} = \Delta K$ ✓ $W_F + W_f - \Delta E_p = K_f - K_i$ $W_F - 8,5 \times 10^4$✓ - (5 000)(9,8)(55) ✓ = 0✓ $\therefore W_F = 2,78 \times 10^6$ J ✓	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 $P = \frac{W}{\Delta t}$ ✓

$= \frac{2{,}78 \times 10^6}{60}$ ✓

$= 4{,}63 \times 10^4$ W ✓ (3)

5.5 Smaller than /*Kleiner as*✓
Weight / gravitational force does positive work on the truck. ✓
Gewig / gravitasiekrag verrig positiewe arbeid op die trok. (2)
[16]

QUESTION 6/*VRAAG 6*

6.1 Away (from the observer) ✓

Detected frequency must be less than or equal to 800 Hz. ✓
If the car moves away from the observer, less waves reaches her per unit time. ✓

OR/OF
Away (from the observer) ✓
The apparent wavelength increases. ✓
For the same speed of sound, the apparent frequency decreases. ✓ (3)

6.2 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

800 ✓ $= \frac{340}{340 + v_s}$ ✓ (850) ✓

$\therefore v_s = 21{,}25$ m·s^{-1} ✓

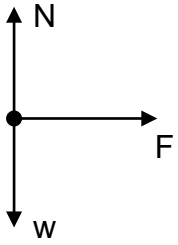
(5)

6.3 **ANY ONE:**
Measurement of foetal heart beat. ✓
Measurement and monitoring blood flow./ Doppler flow meter (1)
[9]

QUESTION 5/*VRAAG 5*

5.1 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 / gewig / mg / gravitasiekrag*
N	F_N / F_{normal} / normal force F_N / $F_{normaal}$ / *normaalkrag*
F	F_{app} / applied force / 10 N F_{toeg} / *toegepaste krag/ 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 $W_{net} = \Delta E_K$ ✓
$W_F + W_w + W_{FN} = ½ m(v_f^2 – v_i^2)$
$(10)(2,5)\cos 0^o + 0 + 0$ ✓$= ½ (3)(v_f^2 – 0^2)$ ✓
$v_f = 4,08 \text{ m·s}^{-1}$ ✓ (4)

5.5 **OPTION 1/*OPSIE 1***
$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$f\Delta x\cos\theta = (mgh_f – mgh^i) + (½ mv_f^2 – ½ mv_i^2)$
$(2)(10)\cos 180^o$ ✓$= (3)(9,8)h_f – 0$ ✓ $+ 0 – ½ (3)(4,08)^2$ ✓
$\therefore h = 0,17$ m ✓

OPTION 2/*OPSIE 2*
$W_{net} = \Delta E_K$ ✓
$W_f + W_w = ½ m(v_f^2 – v_i^2)$
$(2)(10)\cos 180^o$ ✓$+ (3)(9,8)h\cos 180^o$ ✓$= ½ (3)(0^2 – 4,08^2)$ ✓
$\therefore h = 0,17$ m ✓

OPTION 3/*OPSIE 3*
$W_{net} = \Delta E_k$ ✓
$mg\sin\alpha\ \Delta x\cos\theta + f\Delta x\cos\theta = ½ m(v_f^2 – v_i^2)$
$(3)(9,8)(\frac{h}{10})(10)\cos 180^o$ ✓$+ (2)(10)\cos 180^o$ ✓$= ½ (3)(0^2 – 4,08^2)$ ✓
$\therefore h = 0,17$ m ✓ (5)
[15]

4.4.2 Increases / *Verhoog* ✓

- ∆p package increases, thus ∆p boy increases. ✓
  ∆p pakkie vermeerder, dus ∆p 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: $-m_Av_{Af} = m_Bv_{Bf}$
Vanaf die vegelyking in VRAAG 4.3: $-m_Av_{Af} = m_Bv_{Bf}$

- 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* ✓
$-m_Bv_{Bf} = m_pv_{pf}$
$v_B = \frac{-m_pv_{pf}}{m_B}$ ✓ for same m_B, if m_P doubles, ✓ then v_B 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*

$E_{mechanical\ at\ X} = E_{mechanical\ at\ Y}$
$(E_p + E_k)_X = (E_p + E_k)_Y$
$(mgh + ½\ mv^2)_X = (mgh + ½\ mv^2)_Y$
} ✓Any one/*Enige een*

$\underline{5(9,8)(5)} + ½(5)(0^2)$✓$= \underline{(5)(9,8)(1)} + ½(5)v_f^2$ ✓
$v = 8,85\ m\cdot s^{-1}$ ✓

OPTION 2/*OPSIE 2*

$E_{mechanical\ at\ X} = E_{mechanical\ at\ Y}$
$(E_p + E_k)_X = (E_p + E_k)_Y$
$(mgh + ½\ mv^2)_X = (mgh + ½\ mv^2)_Y$
} ✓ Any one/*Enige een*

$\underline{5(9,8)(4)} + ½(5)(0^2)$✓$= \underline{(5)(9,8)(0)} + ½(5)v_f^2$ ✓
$v = 8,85\ m\cdot s^{-1}$ ✓

(4)

5.3 Weight / gravitational (force) / (force of) gravity ✓
Gewig / Gravitasie(krag)
Normal force / *Normaalkrag* ✓ (2)

5.4 Z to/*na* Y ✓ (1)

5.5

OPTION 1/*OPSIE 1*

$W_{net} = \Delta K$ ✓
$W_w + W_f = ½m(v_f^2 - v_i^2)$
$mg\Delta y\cos0° + f\Delta x\cos180° = ½\ m(v_f^2 - v_i^2)$
$(5)(9,8)(1)(1)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= ½(5)(4^2 - 8,85^2)$ ✓
$\Delta x = 20,48$ m ✓

OPTION 2/*OPSIE 2*

$W_{net} = \Delta K$ ✓
$W_w + W_f = ½m(v_f^2 - v_i^2)$
$-\Delta E_p + W_f = ½m(v_f^2 - v_i^2)$
$-(0 - mgh) + f\Delta x\cos180° = ½\ m(v_f^2 - v_i^2)$
$(5)(9,8)(1)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= ½(5)(4^2 - 8,85^2)$ ✓
$\Delta x = 20,48$ m ✓

OPTION 3/*OPSIE 3*

$W_{net} = \Delta K$ ✓
$W_w + W_f = ½m(v_f^2 - v_i^2)$
$-\Delta E_p + W_f = ½m(v_f^2 - v_i^2)$
$-(0 - mgh) + f\Delta x\cos180° = ½\ m(v_f^2 - v_i^2)$
$(5)(9,8)(5)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= ½(5)(4^2 - 0^2)$ ✓
$\Delta x = 20,48$ m ✓

OPTION 4/*OPSIE 4*

$W_{net} = \Delta K$ ✓
$W_w + W_f = ½m(v_f^2 - v_i^2)$
$mg\Delta x\cos(90^o - \theta) + f\Delta x\cos180° = ½\ m(v_f^2 - v_i^2)$
$mg\Delta x\sin\theta + f\Delta x\cos180° = ½\ m(v_f^2 - v_i^2)$
$mg\Delta x\left(\frac{1}{\Delta x}\right) + f\Delta x\cos180° = ½\ m(v_f^2 - v_i^2)$
$(5)(9,8)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= ½(5)(4^2 - 8,85^2)$ ✓
$\Delta x = 20,48$ m ✓

OPTION 5/*OPSIE 5*
$W_{net} = \Delta K$ ✓
$W_{w\|\|} + W_f = ½m(v_f^2 - v_i^2)$
$mgsin\theta\Delta xcos\theta + f\Delta xcos\theta = ½ m(v_f^2 - v_i^2)$
$mg\left(\frac{1}{\Delta x}\right)\Delta xcos0° + f\Delta xcos180° = ½ m(v_f^2 - v_i^2)$
$(5)(9,8)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= ½(5)(4^2 - 8,85^2)$ ✓
$\Delta x = 20,48$ m ✓
OPTION 6/*OPSIE 6*
$W_{net} = \Delta K$ ✓
$F_{net}\Delta xcos\theta = ½m(v_f^2 - v_i^2)$
$(10 - 49sin\theta)\Delta xcos180° = ½ m(v_f^2 - v_i^2)$
$(10 - 49\left(\frac{1}{\Delta x}\right)$)✓$\Delta xcos180° = ½ m(v_f^2 - v_i^2)$
$(10\Delta x - 49)(-1)$✓ $= ½(5)(4^2 - 8,85^2)$ ✓
$\Delta x = 20,48$ m
OPTION 7/*OPSIE 7*
$W_{nc} = \Delta E_p + \Delta E_k$✓
$f\Delta xcos\theta = (mgh_f - mgh_i) + (½ mv_f^2 - ½ mv_i^2)$
$(10)\Delta xcos180°$ ✓$= [0 - (5)(9,8)(1)]$ ✓ $+ [½ (5)(4)^4 - ½ (5)(8,85)^2$✓
$\Delta x = 20,48$ m✓

(5)

5.6 Equal to / *Gelyk aan* ✓ (1)

[15]

QUESTION 6/*VRAAG 6*

6.1 Doppler flow meter / *Dopplervloeimeter* ✓ (1)

6.2 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

985 ✓ $= \frac{v}{(v - 10,6)}$ ✓$(954,3)$ ✓

$v = 340,1$ m·s^{-1} ✓ (5)

6.3 Decreases / *Afneem* ✓ (1)

6.4 For a constant velocity of sound / speed ✓
if the frequency increases, λ decreases. ✓
Vir 'n konstante snelheid van klank /spoed,
as die frekwensie toeneem neem λ af.

OR/*OF*

$\lambda \alpha \frac{1}{f}$ or $f \alpha \frac{1}{\lambda}$ ✓ at constant velocity/speed / *by konstante snelheid/spoed..* ✓ (2)

[9]

4.4 **POSITIVE MARKING FROM QUESTION 4.2.**
POSITIEF NASIEN VAN VRAAG 4.2.

Option 1/*Opsie 1*:	**Notes/*Aantekeninge:***
$W_{net} = \Delta K$ ✓ **OR /*OF*** $F_{net}\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $(8)\Delta x\cos 180° \checkmark = \frac{1}{2}(2)(0^2 - 1{,}5^2)$ ✓ $\therefore \Delta x = 0{,}28$ m ✓	Accept/*Aanvaar*: E_k
Option 2/*Opsie 2*: $F_{net} = ma$ $\therefore (-8) = 2a$ ✓ $\therefore a = -4\ m\cdot s^{-2}$ $v_f^2 = v_i^2 + 2a\Delta x$ $0^2 = (1{,}5)^2 + 2(-4)\Delta x$ ✓ $\therefore \Delta x = 0{,}28$ m ✓ ✓Both formulae *Beide formules*	**Notes/*Aantekeninge:*** Accept/*Aanvaar*: $v_f^2 = v_i^2 + 2a\Delta y$ $v^2 = u^2 + 2as$

(4)
[12]

QUESTION 5/*VRAAG 5*

5.1 The <u>total mechanical energy remains constant</u>/is conserved✓
in <u>an isolated</u>/closed system. ✓
Die <u>totale meganiese energie bly konstant</u>/bly behoue
in <u>'n geïsoleerde</u>/geslote sisteem

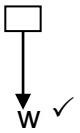
OR/*OF*
The <u>sum of the potential and kinetic energy remains constant</u> ✓
in <u>an isolated</u>/closed system. ✓
Die <u>som van die potensiële en kinetiese energies bly konstant</u>
in <u>'n geïsoleerde</u>/geslote sisteem

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** **Accept/*Aanvaar*:** Force diagram/*kragtediagram*
Vrye kragtediagram

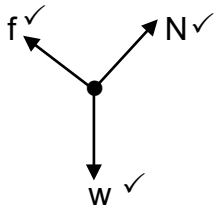


Accepted labels/*Aanvaarde benoemings*	
w	F_g/F_w/force of Earth on boy/weight/392 N/mg/gravitational force *F_g/F_w/krag van Aarde op seun/gewig/392 N/mg/gravitasiekrag*

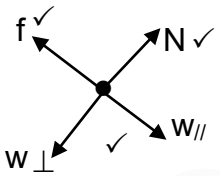
(1)

5.2.2

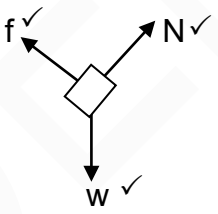
Free-body diagram
Vrye kragtediagram



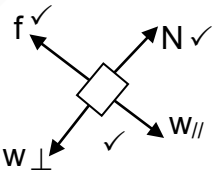
OR/*OF*



Accept: <u>Force diagram</u>
Aanvaar: Kragtediagram



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 *$F_{wrywing}/F_f/F_w$/wrywing*
N	F_N/F_{normal}/normal force/force of slide or surface on girl

(3)

5.3

$K_i + U_i = K_f + U_f$ ✓ OR $\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$

$0 + (40)(9,8)(1,5)$ ✓ $= \frac{1}{2}(40)v_f^2 + 0$ ✓

$\therefore v_f = 5,42\ m\cdot s^{-1}$ ✓

<u>Notes/*Aantekeninge*</u>:
Accept/*Aanvaar*
E_p & E_k

(4)

5.4

Option 1/*Opsie 1* $W_{net} = \Delta K$ ✓ $w\Delta x\cos\theta + f\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $mg\Delta x\cos\theta + f\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $(22)(9,8)(3)\cos60° \checkmark + (1,9)(3)\cos180° \checkmark = \frac{1}{2}(22)(v_f^2 - 0^2)$ ✓ $\therefore v_f = 5,37\ m\cdot s^{-1}$ ✓	**Accept/ *Aanvaar:*** $\Delta y/\Delta x$
Option 2/*Opsie 2* $W_{net} = \Delta K$ ✓ $w//\Delta x\cos\theta + f\Delta x\cos\theta = ½\ mv_f^2 - ½\ mv_i^2$ $mg\sin\theta\, x\cos\theta + f\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $(22)(9,8)\sin30°(3)\cos0° \checkmark + (1,9)(3)\cos180° \checkmark = \frac{1}{2}(22)(v_f^2 - 0^2)$ ✓ $\therefore v_f = 5,37\ m\cdot s^{-1}$ ✓	**Accept/ *Aanvaar*:** $\Delta y/\Delta x$
Option 3/*Opsie 3* $W_{net} = \Delta K$ ✓ $mgh\cos\theta + f\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $(22)(9,8)(1,5)\cos0° \checkmark + (1,9)(3)\cos180° \checkmark = \frac{1}{2}(22)(v_f^2 - 0^2)$ ✓ $\therefore v_f = 5,37\ m\cdot s^{-1}$ ✓	**Accept/ *Aanvaar*** $h/\Delta y/\Delta x$
Option 4/*Opsie 4* $W_{net} = \Delta K$ ✓ $-\Delta U + W_f = \Delta K$ $-(mgh_f - mgh_i) + W_f = \Delta K$ $-(0 - (22)(9,8)(1,5) \checkmark + (1,9)(3)\cos180° \checkmark = \frac{1}{2}(22)(v_f^2 - 0^2)$ ✓ $\therefore v_f = 5,37\ m\cdot s^{-1}$ ✓	**Accept/ *Aanvaar*** $h/\Delta y/\Delta x$

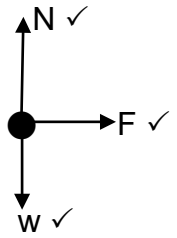
(5)

5.5 Equal to/*Gelyk aan*✓ (1)

[16]

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 $W_{net} = \Delta E_k/\Delta K$ ✓ **OR/*OF*** $F_{net}\Delta x\cos\theta = ½ m(v_f^2 - v_i^2)$
$F_{net}(1{,}02)\cos180° ✓ = ½ (1\,200)(0 - 20^2)$ ✓
$F_{net} = 235\,294{,}12$ N ✓ ($2{,}35 \times 10^5$ N)
(4)

5.3.2

OPTION 1 /*OPSIE 1*	**OPTION 2/*OPSIE 1***
$F_{net}\Delta t = m\Delta v$ ✓ $\therefore (-235\,294{,}12)\Delta t$ ✓$= (1\,200)(0 - 20)$ ✓ $\therefore \Delta t = 0{,}1$ s ✓(0,102 s)	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ 1,02 ✓$= \left(\frac{20 + 0}{2}\right)\Delta t$ ✓ $\Delta t = 0{,}1$ 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 $v = f\lambda$ ✓
$340 = f(0{,}2)$ ✓
$\therefore f = 1\,700$ 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) ✓
$\therefore v_s = 10$ m·s^{-1} ✓
(5)
[11]

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:*
$W_{net} = \Delta K$ ✓
$mg\Delta y\cos\theta + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$(2)(9,8)(2)\cos0° \checkmark + W_f \checkmark = \frac{1}{2}(2)(5)^2 \checkmark - 0$ ✓
$\therefore W_f = -14,2$ J ✓

Option 2/*Opsie 2:*
$W_{net} = \Delta K$ ✓
$-\Delta U + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$mgh + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$(2)(9,8)(2) \checkmark + W_f \checkmark = \frac{1}{2}(2)(5)^2 \checkmark - 0$ ✓
$\therefore W_f = -14,2$ J ✓ (6)

5.3 No/Nee ✓
Friction is present/*Wrywing is aanwesig*. ✓ (2)

5.4.1 $\Sigma p_{before} = \Sigma p_{after}$ ✓
$(2)(5) + (9)(0) \checkmark = 2v_{f2} + (9)(1)$ ✓

$\therefore v_{f2} = 0,5\ m\cdot s^{-1}$ ✓ (4)

Notes/*Aantekeninge:*
Other formulae/*Ander formules*:
$m_1v_{i1} + m_2v_{i2} = m_1v_{f1} + m_2v_{f2}$
$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

5.4.2 K(total after/*total na*) $= \frac{1}{2}m_1v_f^2 + \frac{1}{2}m_2v_f^2$ ✓
$= \frac{1}{2}(2)(0,5)^2 \checkmark + \frac{1}{2}(9)(1)^2 \checkmark$
$= 4,75$ J ✓
K(total before) $\neq$ K(total after) ✓
$\therefore$ inelastic

K(totaal na) $\neq$ *K(totaal voor)* ✓
$\therefore$ *onelasties* (5)
[19]

Option 4 / *Opsie 4*:	
Force on truck / *Krag op vragmotor:* To the right as positive / *Na regs as positief:* $v_f = v_i + a\,\Delta t$ ✓ Both formulae/ *Beide formules* $\therefore$ -10 = -20 + a(0,5) ✓ $\therefore a = 20$ $F_{net} = ma = (5\,000)(20)$ ✓ $\therefore F_{net} = 1 \times 10^5$ N ✓ (100 000 N) $\therefore F_{net} > 85\,000$ N Yes, collision is fatal. / *Ja, botsing is fataal.* ✓	Force on truck / *Krag op vragmotor:* To the left as positive / *Na links as positief:* $v_f = v_i + a\,\Delta t$ ✓ Both formulae/ *Beide formules* $\therefore$ 10 = 20 + a(0,5) ✓ $\therefore a = -20$ $F_{net} = ma = (5\,000)(-20)$ ✓ $\therefore F_{net} = -1 \times 10^5$ N ✓ (-100 000 N) $\therefore F_{net} = 1 \times 10^5$ N (100 000 N) $\therefore F_{net} > 85\,000$ N Yes, collision is fatal. / *Ja, botsing is fataal.* ✓

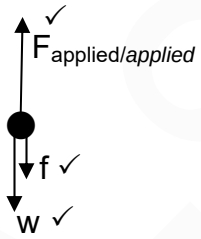
(5)
[17]

QUESTION 5 / *VRAAG 5*

5.1 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) ✓

OR / *OF*
The work done (on an object) by a net (resultant) force ✓
is equal to the change in (the object's) kinetic energy. ✓
Die arbeid verrig (op 'n voorwerp) deur 'n netto (resulterende) krag ✓
is gelyk aan die verandering in kinetiese energie (van die voorwerp.) ✓ (2)

5.2



(3)

5.3 Gravitational force/weight (of soldier) ✓
Gravitasiekrag/gewig (van soldaat) (1)

5.4 $W_{net} = \Delta K$ ✓

$F\Delta y\cos\theta + F_w\Delta y\cos\theta + W_f = \Delta K$

(960)(20)cos0° ✓+ (80)(9,8)(20)cos180° ✓ + W_f = 0 ✓

19 200 – 15 680 + W_f = 0

W_f = - 3 520 J ✓ (5)
[11]

QUESTION 5/*VRAAG 5*

5.1

Option 1/*Opsie 1*:
Direction of motion as positive / *Rigting van beweging as positief:*

$F_{net} = ma$ ✓
$-30 = (3)a$ ✓
$\therefore a = -10\ m\cdot s^{-2}$

$v_f^2 = v_i^2 + 2a\Delta x$ ✓
$= (7)^2$ ✓ $+ 2(-10)(2)$ ✓
$\therefore v_f = 3\ m\cdot s^{-1}$

Option 2/*Opsie 2*:

$W_{net} = \Delta K$ ✓ or/*of* ΔE_k
$F\Delta x\cos\theta$ ✓ $= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$(30)(2)\cos180°$ ✓ $= \frac{1}{2}(3)v_f^2$ ✓ $- \frac{1}{2}(3)(7)^2$ ✓
$-60 = 1{,}5v_f^2 - 73{,}5 \therefore v_f = 3\ m\cdot s^{-1}$

Option 3/*Opsie 3*:

$W_{appl} = \Delta U + \Delta K + W_f$ 0/5

$W_{appl} = \Delta U + \Delta K - W_f$ **Max./*Maks.*:** 4/5
$0 = 0 + (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) - F\Delta x\cos\theta$ ✓
$0 = 0 + \frac{1}{2}(3)v_f^2$ ✓ $- \frac{1}{2}(3)(7)^2$ ✓ $- (30)(2)\cos180°$ ✓
$0 = 1{,}5v_f^2 - 73{,}5 + 60 \therefore v_f = 3\ m\cdot s^{-1}$

Option 4 / *Opsie 4*:

$(U + K)_i - W_f = (U + K)_f$ 0/5

$(U + K)_i + W_f = (U + K)_f$ **Max./*Maks.*:** 4/5
$(0 + \frac{1}{2}mv_i^2) + F\Delta x\cos\theta$ ✓ $= 0 + \frac{1}{2}mv_f^2$
$0 + \frac{1}{2}(3)(7)^2$ ✓ $+ 30(2)\cos180°$ ✓ $= 0 + \frac{1}{2}(3)v_f^2$ ✓
$73{,}5 - 60 = 1{,}5v_f^2 \therefore v_f = 3\ m\cdot s^{-1}$

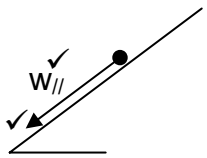
Option 5 / *Opsie 5*:

$(U + K)_i = (U + K)_f + W_f$ 0/5

$(U + K)_i = (U + K)_f - W_f$ **Max./*Maks.*:** 4/5
$(0 + \frac{1}{2}mv_i^2) = 0 + \frac{1}{2}mv_f^2 - F\Delta x\cos\theta$ ✓
$0 + \frac{1}{2}(3)(7)^2$ ✓ $= 0 + \frac{1}{2}(3)v_f^2$ ✓ $- 30(2)\cos180°$ ✓
$73{,}5 = 1{,}5v_f^2 + 60 \therefore v_f = 3\ m\cdot s^{-1}$

[12.1.3] (5)

5.2



Any one of the following labels / *Enige een van volgende benoemings:*

- $w_{parallel}$ or/of $w_{//}$
- $F_{g(parallel)}$ or/of $F_{g//}$
- mgsin20°
- 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*:

$(U + K)_i = (U + K)_f$ ✓
$0 + \frac{1}{2}mv_i^2 = mgh + 0$
$0 + \frac{1}{2}(3)(3)^2$ ✓ $= (3)(9,8)h + 0$ ✓
$\therefore$ h = 0,46 m

$\sin 20° = \frac{h}{d}$ ✓ $= \frac{0,46}{d}$ $\therefore$ d = 1,34 m ✓

As single step/*As een stap:*
$(U + K)_i = (U + K)_f$ ✓
$0 + \frac{1}{2}(3)(3)^2$ ✓ $= (3)(9,8)h + 0$ ✓
$\frac{1}{2}(3)(3)^2 = (3)(9,8)(d\sin 20°)$ ✓
$\therefore$ d = 1,34 m ✓

Option 2/*Opsie 2*:

$W_{net} = \Delta K$ ✓ (or/*of* ΔEk)
$F_{g//}\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$(3)(9,8)\sin 20°$ ✓ $(d)\cos 180°$ ✓ $= 0 - \frac{1}{2}(3)(3)^2$ ✓
$-10,06d = -13,5$ $\therefore$ d = 1,34 m ✓

Option 3/*Opsie 3*:

$W_{net} = \Delta K$ ✓ (or/*of* ΔEk)
$W_{gravity} = K_f - K_i$
$mgh\cos 180^o$ ✓ $= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$(3)(9,8)h(-1)$ ✓ $= 0 - \frac{1}{2}(3)(3)^2$ ✓ $\therefore$ h = 0,46 m

$\sin 20° = \frac{h}{d}$ ✓ $= \frac{0,46}{d}$ $\therefore$ d = 1,34 m ✓

Option 4 / *Opsie 4*:
Direction of motion as positive / *Rigting van beweging as positief:*

$F_{net} = ma$ ✓
$mg\sin 20° = ma$
$-(3)(9,8)\sin 20° = 3a$ ✓ $\therefore a = -3,35\ m\cdot s^{-2}$

$v_f^2 = v_i^2 + 2a\Delta x$ ✓
$0^2 = (3)^2 + 2(-3,35)(d)$ ✓

$\therefore d = 1,34\ m$ ✓

[12.1.3] (5)
[12]

QUESTION 6 / *VRAAG 6*

6.1 $m_m v_{im} + m_b v_{bi} = (m_m + m_b)v_f$ ✓

$(87)v_{im} + 0$ ✓ $= (87 + 22)(2,4)$ ✓

$v_{im} = 3,01\ m\cdot s^{-1}$ ✓ [12.2.3] (4)

6.2

Option 1/*Opsie 1:*
K(before/*voor*) $= \frac{1}{2}mv^2$ ✓
$= \frac{1}{2}(87)(3,01)^2 + 0$ ✓
$= 394,11\ J$ ✓
$= (391,5$ if $3\ m\cdot s^{-1})$

K(after/*na*) $= \frac{1}{2}mv^2$
$= \frac{1}{2}(109)(2,4)^2$ ✓
$= 313,92\ J$ ✓

Collision is inelastic / No ✓
Botsing is nie-elasties / Nee

Option 2/*Opsie 2:*
ΔK = K(after/*na*) - K(before/*voor*)
$= \frac{1}{2}mv^2$(after/*na*) - $\frac{1}{2}mv^2$(before/*voor*) ✓
$= \frac{1}{2}(109)(2,4)^2$ ✓ – $(\frac{1}{2}(87)(3,01)^2 + 0)$ ✓
$= 313,92 - 394,11$
$= -80,19\ J$ ✓✓

Collision is inelastic / No ✓
Botsing is nie-elasties / Nee

[12.2.3] (6)