SA-STUDENT

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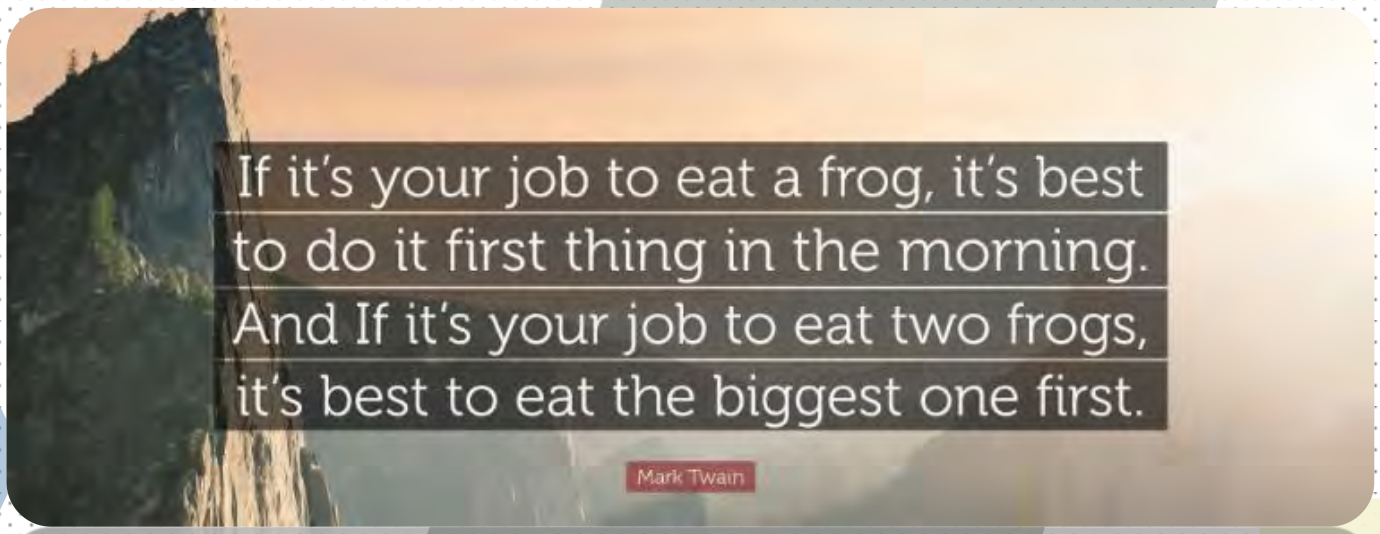


QUESTION 2/*VRAAG 2*

2.1

Marking criteria/*Nasienkriteria*
- Formula to calculate a./*Formule om a te bereken.* ✓
- Correct substitution to calculate a./*Korrekte vervanging om a te bereken.* ✓✓

OPTION 1/*OPSIE 1*

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$\underline{(3,41)^2}$ ✓$= \underline{(0)^2 + (2)a(1,5)}$ ✓

$a = 3,88\ m\cdot s^{-2}$

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$\underline{(-3,41)^2}$ ✓$= \underline{(0)^2 + (2)a(-1,5)}$ ✓

$a = -3,88$

$a = 3,88\ m\cdot s^{-2}$

OPTION 2/*OPSIE 2*

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

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

$1,5 = \left(\frac{0 + 3,41}{2}\right)\Delta t$

$\Delta t = 0,88\ s$

$v_f = v_i + a\Delta t$ ✓

$\underline{-3,41}$ ✓$= \underline{(0) + a(0,88)}$ ✓

$a = -3,88$

$a = 3,88\ m\cdot s^{-2}$

OR/*OF*

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

$\underline{-1,5}$ ✓$= \underline{(0)(0,88) + \frac{1}{2}a(0,88)^2}$ ✓

$a = -3,88$

$a = 3,88\ m\cdot s^{-2}$

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

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

$-1,5 = \left(\frac{0 - 3,41}{2}\right)\Delta t$

$\Delta t = 0,88\ s$

$v_f = v_i + a\Delta t$ ✓

$\underline{3,41}$ ✓$= \underline{(0) + a(0,88)}$ ✓

$a = 3,88\ m\cdot s^{-2}$

OR/*OF*

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

$\underline{1,5}$ ✓$= \underline{(0)(0,88) + \frac{1}{2}a(0,88)^2}$ ✓

$a = 3,88\ m\cdot s^{-2}$

(3)

2.2

ACCEPT/*AANVAAR*

	Accepted symbols/*Aanvaarde simbole*
w ✓	F_g/F_w/weight/*gewig*/mg/gravitational force/*gravitasiekrag*/$F_{Earth\ on\ block}$/ *$F_{Aarde\ op\ blok}$*/*73,5N*
T ✓	Tension/*Spanning*/$F_{Tension}$/*$F_{Spanning}$*/F_{rope}/F_{tou}/F_T/*F*

Notes/*Aantekeninge:*
- Mark awarded for label and arrow./*Punt toegeken vir byskrif en pyltjie.*
- Do not penalise for length of arrows since drawing is not to scale./*Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie.*
- Any other additional force(s)/*Enige ander addisionele krag(te): Max*/*Maks* $\frac{1}{2}$

(2)

2.3

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

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

OR/*OF*
The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force.
Die resulterende/netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum van die voorwwerp in dieselfde rigting as die resulterende/netto krag.

(2)

2.4

Marking criteria/*Nasienkriteria*

- Any correct formula./*Enige korrekte formule.* ✓
- Correct substitution to calculate tension./*Korrekte vervanging om spanning te bereken.*✓✓
- Correct substitution to calculate mass of block A./*Korrekte vervanging om massa van blok A te bereken.* ✓
- Correct final answer/*Korrekte finale antwoord*: 3,25 kg ✓

Calculation of tension (Block B) 3 marks:
Berekening van spanning (Blok B)3 punte:

DOWNWARDS POSITIVE/*AFWAARTS POSITIEF*

$F_{net} = ma$
$F_g + T = ma$
$mg - T = ma$
✓Any one/ *Enige een*

$7{,}5(9{,}8) - T$ ✓$= 7{,}5(3{,}88)$ ✓
$T = 44{,}40$ N

UPWARDS POSITIVE/*OPWAARTS POSITIEF*

$F_{net} = ma$
$T - F_g = ma$
$T - mg = ma$
✓Any one/ *Enige een*

$T - 7{,}5(9{,}8)$ ✓$= 7{,}5(-3{,}88)$ ✓
$T = 44{,}40$ N

Calculation of mass (Block A) 2 marks:
Berekening van massa (Blok A) 2 punte:

UPWARDS POSITIVE
OPWAARTS POSITIEF

$F_{net} = ma$
$T - F_g = ma$
$T - mg = ma$
$44{,}40 - m(9{,}8) = m(3{,}88)$✓
$m = 3{,}25$ kg✓

DOWN POSITIVE
AF POSITIEF

$F_{net} = ma$
$F_g - T = ma$
$mg - T = ma$
$m(9{,}8) - 44{,}40 = m(-3{,}88)$✓
$m = 3{,}25$ kg ✓ (5)

2.5

Marking criteria/*Nasienkriteria*

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

OPTION 1/*OPSIE 1*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

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

$\Delta y = 0,59$ m

Maximum height = 0,59 + 1,5 ✓

= 2,09 m ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

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

$\Delta y = -0,59$

$\Delta y = 0,59$ m

Maximum height = 0,59 + 1,5 ✓

= 2,09 m ✓

OPTION 2/*OPSIE 2*

UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF*

$v_f = v_i + a\Delta t$

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

$\Delta t = 0,35$ s

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

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

$= 0,59$ m

Maximum height = 0,59 + 1,5 ✓

= 2,09 m ✓

DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF*

$v_f = v_i + a\Delta t$

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

$\Delta t = 0,35$ s

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

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

$= -0,59$

$\Delta y = 0,59$ m

Maximum height = 0,59 + 1,5 ✓

= 2,09 m ✓

OPTION 3/*OPSIE 3* **UPWARDS AS POSITIVE/*OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/*AFWAARTS AS POSITIEF***
$v_f = v_i + a\Delta t$ $0 = 3{,}41 + (-9{,}8)\Delta t$ $\Delta t = 0{,}35$ s $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $\Delta y = \left(\frac{3{,}41 + 0}{2}\right)$ ✓ (0,35) ✓ $= 0{,}59$ m Maximum height = 0,59 + 1,5 ✓ = 2,09 m ✓	$v_f = v_i + a\Delta t$ $0 = -3{,}41 + (9{,}8)\Delta t$ $\Delta t = 0{,}35$ s $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $\Delta y = \left(\frac{-3{,}41 + 0}{2}\right)$ ✓ (0,35) ✓ $= -0{,}59$ m Maximum height = 0,59 + 1,5 ✓ = 2,09 m ✓

Note/*Aantekening*:
OPTION 4 TO 5/*OPSIE 4 TOT 5*
Substitution of incorrect mass/*Vervanging van verkeerde massa:*
max/maks: $^3/_5$

OPTION 4/*OPSIE 4*

$(E_{mech})_{top} = (E_{mech})_{bottom}$
$(E_p + E_k)_{top} = (E_p + E_k)_{bottom}$
$(mgh + \frac{1}{2}mv_i^2)_{top} = (mgh + \frac{1}{2}mv_f^2)_{bottom}$
✓Any one/*Enige een*

$(9{,}8)(h) + (0)$ ✓ $= (0) + \frac{1}{2}(3{,}41)^2$ ✓
$h = 0{,}59$ m

Maximum height = 0,59 + 1,5 ✓
= 2,09 m ✓

OPTION 5/*OPSIE 5*

$W_{nc} = \Delta K + \Delta U$
$W_{nc} = \Delta K + mg(h_f - h_i)$
$0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i$
✓Any one/*Enige een*

$(0) = (0) - \frac{1}{2}(3{,}41)^2$ ✓ $+ (9{,}8)(h)$ ✓
$h = 0{,}59$ m

Maximum height = 0,59 + 1,5 ✓
= 2,09 m ✓

OPTION 6/*OPSIE 6*

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

$(9{,}8)(\Delta y)\cos 180°$ ✓ $= 0 - \frac{1}{2}(3{,}41)^2$ ✓
$\Delta y = 0{,}59$ m

Maximum height = 0,59 + 1,5 ✓
= 2,09 m ✓

(5)
[17]

QUESTION 2/*VRAAG 2*

2.1

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

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

OR/*OF*
The resultant/net force acting on an object is equal to the rate of change of momentum of the object. **(2 or 0)**
Die resulterende/netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum. ***(2 of 0)*** (2)

2.2

Accept force diagram/
Aanvaar kragte-diagram:

Accepted labels/*Aanvaarde benoemings*	
w	F_g /F_w /$F_{earth\ on\ P}$ /weight /mg /12,25 N /gravitational force *F_g /F_w /$F_{aarde\ op\ P}$ /gewig /mg /12,25 N /gravitasiekrag*
T	F_T /F_{string} /*F_{tou}* /F_t /tension /*spanning* /*F_s*
f	F_f /f_k /(kinetic) friction /*(kinetiese) wrywing* /1,8 N /*F_w*
N	F_N /Normal /F_{normal} /*$F_{normaal}$* /*Normaal*

Notes/*Aantekeninge*
- Mark awarded for label 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 everything correct, but no arrows/*Indien alles korrek, maar geen pyltjies*: Max/*Maks* $^3/_4$
- If force(s) do not make contact with the dot /*Indien krag(te) nie met die kolletjie kontak maak nie*: Max/*Maks* $^3/_4$

(4)

2.3.1

For P/*Vir P* **RIGHT AS POSITIVE/ *REGS AS POSITIEF***	**For P/*Vir P*** **LEFT AS POSITIVE/ *LINKS AS POSITIEF***
$F_{net} = ma$ $T + f = ma$ $T - f = ma$ } ✓ Any one/ *Enige een*	$F_{net} = ma$ $T + f = ma$ $-T + f = ma$ } ✓ Any one/ *Enige een*
$T - 1,8$ ✓ $= (1,25)(0,1)$ ✓	$-T + 1,8$ ✓ $= (1,25)(-0,1)$ ✓
$T = 1,93$ N ✓ (1,925 N)	$T = 1,93$ N ✓ (1,925 N)

(4)

2.3.2

POSITIVE MARKING FROM QUESTION 2.3.1/ *POSITIEWE NASIEN VANAF VRAAG 2.3.1.*

RIGHT AS POSITIVE/*REGS AS POSITIEF:*

For Q/*Vir Q*

Accept/*Aanvaar*
Sin(90°- θ)

$F_{net} = ma$
$F\cos\theta - T - f = ma$
$F\cos\theta + T + f = ma$
$7,5\cos\theta - 1,93 - 2,2$ ✓ $= (2)(0,1)$ ✓
$\theta = 54,74°$ ✓ (Range:54,55° - 54,78°)

LEFT AS POSITIVE/*LINKS AS POSITIEF:*

For Q/*Vir Q*

Accept/*Aanvaar*
Sin(90°- θ)

$F_{net} = ma$
$-F\cos\theta + T + f = ma$
$F\cos\theta + T + f = ma$
$-7,5\cos\theta + 1,93 + 2,2$ ✓ $= (2)(-0,1)$ ✓
$\theta = 54,74°$ ✓ (Range:54,55° - 54,78°)

(3)

[13]

QUESTION 3/*VRAAG 3*

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

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

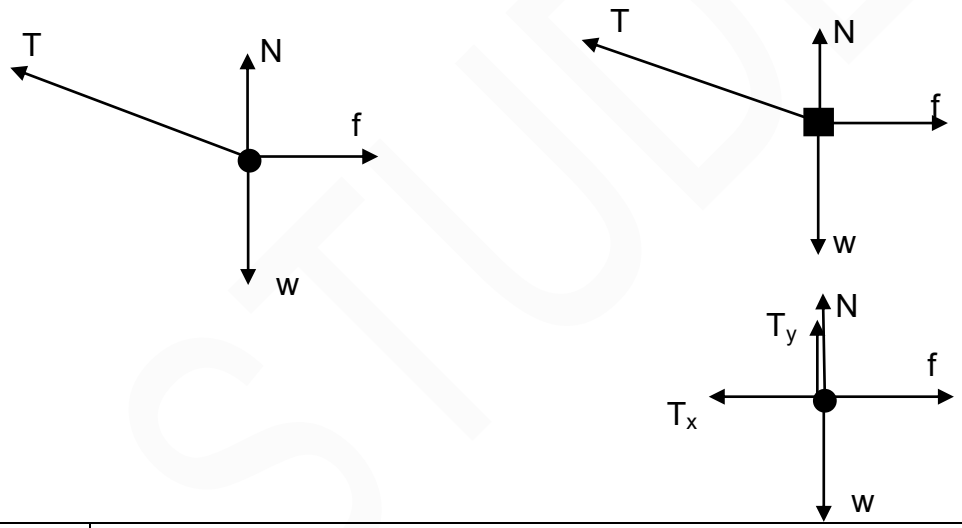
QUESTION 2/*VRAAG 2*

2.1

Marking criteria/*Nasienkriteria:*
If any of the underlined key words/phrases in the correct context are omitted: - 1 mark per word/phrase.
Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per word/frase.

A body will remain in its state of rest or motion at constant velocity unless a (non-zero) resultant/net force/unbalanced force acts on it. ✓✓
'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid volhard, tensy 'n (nie-nul) resulterende/netto krag/ongebalanseerde krag daarop inwerk.
OR/*OF*
A body will remain in its state of rest or uniform motion in a straight line unless a (non-zero) resultant/net force acts on it. ✓✓
'n Liggaam sal in sy toestand rus of uniforme beweging in 'n reguit lyn volhard, tensy 'n (nie-nul) resulterende/netto krag daarop inwerk. (2)

2.2 **ACCEPT/*AANVAAR***



	Accepted symbols/*Aanvaarde simbole*
N ✓	F_N /Normal/Normal force/*Normaal/Normaalkrag/*$F_{buoyant}$
f ✓	F_f /f_k/frictional force/*wrywingskrag*/kinetic frictional force/*kinetiese wrywingskrag/300 N*
w ✓	F_g/mg/Weight/G*ewig*/$F_{Earth\ on\ man}$/ $F_{Aarde\ op\ man}$/F_w/Gravitational force/ *Gravitasiekrag/* 686 N
T ✓	Tension/*Spanning*/$F_{Tension}$/$F_{Spanning}$ /F_T/F_S / **ACCEPT/ *AANVAAR*** F/$F_{applied}$/$F_{toegepas}$

Notes/*Aantekeninge*
- Mark is awarded for label and arrow./*Punt word toegeken vir byskrif en pyltjie.*
- Do not penalise for length of arrows./*Moenie vir die lengte van die pyltjies penaliseer nie*.
- Deduct 1 mark for any additional force /*Trek 1 punt af vir enige addisionele krag*
- If T is not shown but T_Y and T_X are shown give 1 mark for both.
  Indien T nie aangetoon is nie maar T_Y en T_X *is getoon, ken 1 punt toe vir beide.*

(4)

2.3

OPTION 1/*OPSIE 1*

$F_{net} = ma$
$T\cos50° - F_f = ma$ ✓Any one/*Enige een*
$T\cos50° - 300$ ✓$= 0$ ✓ **OR/*OF*** $T\cos50° = 300$ ✓✓
$T = 466{,}72$ N ✓(468,75 N)

OR/*OF*
$F_{net} = 0$ ✓✓
$T\cos50° = F_f$ ✓✓

OPTION 2/*OPSIE 2*

$W_{net} = \Delta E_k$ ✓
$T\Delta x\cos0º + f\Delta x\cos180º = 0$ ✓
$T\cos50° - 300$ ✓ $= 0$
$T = 466{,}72$ N ✓(468,75 N)

OR/*OF*
$W_{net} = 0$ ✓✓
$T\Delta x\cos50º = -f\Delta x\cos180º$ ✓✓

NOTE/*AANTEKENING*
Can use sin40º instead of cos50º.
Kan ook sin40º i.p.v. cos50º gebruik.

(4)

2.4 Increases/*Neem toe* ✓

F_{net} increases / F_{net} is not zero / $T_x > f$ / $T\cos50º > f$ ✓
F_{net} neem toe / F_{net} is nie nul nie / $T_x > f$ / $T\cos50º > f$

(2)

2.5

Marking criteria Options 1 & 2/*Nasienkriteria Opsies 1 & 2*

- Substitution to calculate a/*Vervanging om a te bereken* ✓
- Formula to calculate $F_{up/water}$/*Formule om $F_{op/water}$ te bereken* ✓
- Substitution to calculate $F_{up/water}$/*Vervanging om $F_{op/water}$ te bereken* ✓✓
- Final answer/*Finale antwoord*: 679,20 N ✓

OPTION 1/*OPSIE 1*

DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF:*

$v_f^2 = v_i^2 + 2a\Delta y$
$0 = (16)^2 + 2a(0{,}8)$ ✓
$a = -160\ m{\cdot}s^{-2}$

$F_{net} = ma$
$F_g - F_{up/op} = ma$ ✓Any one/*Enige een*
$(4)(9{,}8) - F_{up/op}$ ✓$= (4)(-160)$ ✓
$F_{up/op} = -679{,}20$ N
$F_{up/op} = 679{,}20$ N ✓

UPWARDS AS POSITIVE/ *OPWAARTS AS POSITIEF*

$v_f^2 = v_i^2 + 2a\Delta y$
$0 = (-16)^2 + 2a(-0{,}8)$ ✓
$a = 160\ m{\cdot}s^{-2}$

$F_{net} = ma$
$-F_g + F_{up/op} = ma$ ✓Any one/*Enige een*
$-(4)(9{,}8) + F_{up/op}$ ✓$= (4)(160)$ ✓
$F_{up/op} = 679{,}20$ N ✓

OPTION 2/*OPSIE 2*

DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF

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

$0,8 = \left(\frac{16 + 0}{2}\right)\Delta t$

$\Delta t = 0,1$ s

$v_f = v_i + a\Delta t$
$0 = 16 + a(0,1)$ ✓
$a = -160\ m\cdot s^{-2}$

OR/*OF*

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$0,8 = (16)(0,1) + \frac{1}{2}(a)(0,1)^2$ ✓
$a = -160\ m\cdot s^{-2}$

$F_{net} = ma$
$F_g - F_{up/op} = ma$ ✓Any one/*Enige een*
$(4)(9,8) - F_{up/op}$ ✓$= (4)(-160)$ ✓
$F_{up/op} = -679,20$ N
$F_{up/op} = 679,20$ N ✓

UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF

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

$-0,8 = \left(\frac{-16 + 0}{2}\right)\Delta t$

$\Delta t = 0,1$ s

$v_f = v_i + a\Delta t$
$0 = -16 + a(0,1)$ ✓
$a = 160\ m\cdot s^{-2}$

OR/*OF*

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$-0,8 = (-16)(0,1) + \frac{1}{2}(a)(0,1)^2$ ✓
$a = 160\ m\cdot s^{-2}$

$F_{net} = ma$
$-F_g + F_{up/op} = ma$ ✓Any one/*Enige een*
$-(4)(9,8) + F_{up/op}$ ✓$= (4)(160)$ ✓
$F_{up/op} = 679,20$ N ✓

USING ENERGY PRINCIPLES/GEBRUIK VAN ENERGIE BEGINSELS
Marking criteria OPTIONS 3 to 5/Nasienkriteria OPSIES 3 to 5

- Formula / *Formule* ✓
- Substitution / *Vervanging* ✓✓✓
- Final answer/*Finale antwoord*: 679,20 N ✓

OPTION 3/*OPSIE 3*

$W_{net} = \Delta K$
$F_{net}\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓Any one/*Enige een*
$(4)(9,8)(0,8)\cos0°$ ✓ $+ F_{up/op}(0,8)\cos180°$ ✓ $= \frac{1}{2}(4)(0 - 16^2)$ ✓
$F_{up/op} = 679,20$ N ✓

OPTION 4/*OPSIE 4*

$W_{nc} = \Delta K + \Delta U$
$F_{up/op}\Delta x\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i)$ ✓Any one/*Enige een*
$F_{up/op}(0,8)\cos180°$ ✓ $= \frac{1}{2}(4)(0 - 16^2)$ ✓$+ (4)(9,8)(0 - 0,8)$ ✓
$F_{up/op} = 679,20$ N ✓

OPTION 5/*OPSIE 5*

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

$$0,8 = \left(\frac{16 + 0}{2}\right)\Delta t$$

$$\Delta t = 0,1 \text{ s}$$

$F_{net}\Delta t = \Delta p$
$F_{net}\Delta t = (p_{tube/band})_f - (p_{tube/band})_i$
$(F_g - F_{up/op})\Delta t = m(v_{tube/band(f)} - v_{tube/band(i)})$ ✓Any one/*Enige een*

$[(4)(9,8)$ ✓ $- F_{up/op}](0,1)$ ✓ $= (4)(0 - 16)$ ✓
$F_{up/op} = 679,20$ N ✓ (5)

[17]

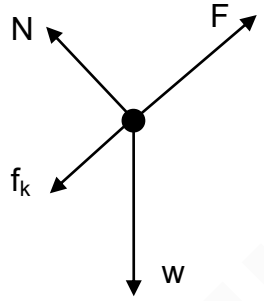
QUESTION 2/*VRAAG 2*

2.1

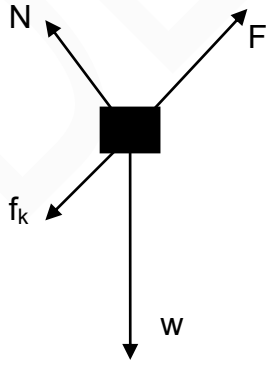
Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark. /*Indien enige van die onderstreepte sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.*

A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force/unbalanced force acts on it. ✓✓
'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid volhard, tensy 'n (nie-nul) resulterende/netto krag/ongebalanseerde krag daarop inwerk.
OR/*OF*
A body will remain in its state of rest or uniform motion in a straight line unless a (non-zero) resultant/net /unbalanced force acts on it. ✓✓
'n Liggaam sal in sy toestand rus of uniforme beweging in 'n reguit lyn volhard, tensy 'n (nie-nul) resulterende/netto/ongebalanseerde krag daarop inwerk. (2)

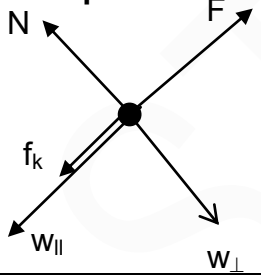
2.2



Accept force diagram/
Aanvaar kragtediagram



Accept/Aan*vaar*



Accepted labels/*Aanvaarde benoemings*	
w	F_g / F_w / weight / mg /196 N / gravitational force *F_g / F_w / gewig / mg / 196 N / gravitasiekrag*
F	F_A / Applied force *F_T / Toegepaste krag*
f_k	(kinetic) Friction /*(kineties)wrywing* / F_f / f /18 N / F_w / f_w
N	F_N / Normal / *Normaal* / 169,74 N

Notes/*Aantekeninge:*
• Mark awarded for label and arrow, but penalise only once if arrows are omitted/*Punt toegeken vir benoeming en pyltjie, maar penaliseer slegs een keer indien pyle uitgelaat is.* • Do not penalise for length of arrows, drawing is not to scale. /*Moenie vir die lengte van die pyltjies penaliseer nie, die tekening is nie volgens skaal nie.* • Any other additional force(s) deduct 1 mark. / *Enige ander addisionele krag(te) trek 1 punt af.* • If force(s) do not make contact with body deduct 1 mark. /*Indien krag(te) nie met die voorwerp kontak maak nie, trek 1 punt af.*

(4)

2.3

OPTION 1/*OPSIE 1*
Positive up the incline/*Positief opwaarts teen skuinsvlak*

$F_{net} = ma$
$F + f_k + w_{||} = ma$
$F + (-f_k) + (-w_{||}) = ma$
$F - (f_k + w_{||}) = ma$
✓Any one/*Enige een*

$F - [18 + (20)(9,8)(\sin 30°)]$ ✓ $= 0$ ✓
$F = 116$ N ✓

NOTE/*LET WEL*
$F_{net} = 0$ ✓✓
$F = f_k + w_{||}$ ✓✓

OPTION 2/*OPSIE 2*
Positive up the incline/*Positief opwaarts teen skuinsvlak*

$W_{net} = \Delta E_k$ ✓
$F\Delta x\cos 0° + f\Delta x\cos 180° + w\Delta x\cos 120°$ ✓$= 0$ ✓
$F\Delta x = 18\Delta x + (20)(9,8)\Delta x(0,5)$
$F = 116$ N ✓

NOTE/*LET WEL*
$W_{net} = 0$ ✓✓
$F\Delta x = f\Delta x + w\Delta x(0,5)$ ✓✓

(4)

2.4 **POSITIVE MARKING FROM QUESTION 2.3 /**
POSITIEWE NASIEN VANAF VRAAG 2.3

116 N / $f + w_{||}$ ✓ Down the incline/opposite to direction of motion /*Teen die helling af* / *in teenoorgestelde rigting van beweging*✓

ACCEPT/*AANVAAR*:
Downwards/down/*Afwaarts/af*

(2)

2.5 **POSITIVE MARKING FROM QUESTION 2.4 /**
POSITIEWE NASIEN VANAF VRAAG 2.4

OPTION 1/*OPSIE 1*
Up the incline positive/*Teen skuinsvlak op positief*

$F_{net} = ma$
$-116 = 20a$ ✓
$a = -5,80$ m·s^{-2}

$v_f^2 = v_i^2 + 2a\Delta x$ ✓ $0 = (2)^2 + (2)(-5,8)\Delta x$✓ $\Delta x = 0,34$ m ✓	$v_f = v_i + \Delta t$ $0 = 2 + (-5,8)\Delta t$ $\Delta t = 0,34$ s **OR/*OF*** $F_{net}\Delta t = m(v_f - v_i)$ $(-116)\Delta t = (20)(0 - 2)$ $\Delta t = 0,34$ s $\Delta x = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= (2)(0,34) + \frac{1}{2}(-5,8)(0,34)^2$✓ $= 0,34$ m ✓	$v_f = v_i + \Delta t$ $0 = 2 + (-5,8)\Delta t$ $\Delta t = 0,34$ s **OR/*OF*** $F_{net}\Delta t = m(v_f - v_i)$ $(-116)\Delta t = (20)(0 - 2)$ $\Delta t = 0,34$ s $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\frac{2 + 0}{2}\right)0,34$ ✓ $= 0,34$ m ✓

OPTION 1/*OPSIE 1*

Down the incline positive /*Teen skuinsvlak af positief*

$F_{net} = ma$

$116 = 20a$ ✓

$a = 5{,}80\ m\cdot s^{-2}$

$v_f^2 = v_i^2 + 2a\Delta x$ ✓ $0 = (-2)^2 + (2)(5{,}8)\Delta x$ ✓ $\Delta x = -0{,}34$ m Distance = 0,34 m ✓ *Afstand*	$v_f = v_i + a\Delta t$ $0 = -2 + (5{,}8)\Delta t$ $\Delta t = 0{,}34$ s **OR/*OF*** $F_{net}\Delta t = m(v_f - v_i)$ $(116)\Delta t = (20)(0 - (-2))$ $\Delta t = 0{,}34$ s $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= (-2)(0{,}34) + \frac{1}{2}(5{,}8)(0{,}34)^2$ ✓ $= -0{,}34$ m ✓ Distance/*Afstand* = 0,34 m ✓	$v_f = v_i + a\Delta t$ $0 = -2 + (5{,}8)\Delta t$ $\Delta t = 0{,}34$ s **OR/*OF*** $F_{net}\Delta t = m(v_f - v_i)$ $(116)\Delta t = (20)(0-(-2))$ $\Delta t = 0{,}34$ s $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\frac{-2 + 0}{2}\right)0{,}34$ ✓ $= -0{,}34$ m ✓ Distance/*Afstand* = 0,34 m ✓

OPTION 2/*OPSIE 2*

$W_{net} = \Delta E_K$
$F_{net}\Delta x\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓Any one/*Enige een*

$(116)\Delta x\cos 180^\circ$ ✓$= \frac{1}{2}(20)(0^2 - 2^2)$ ✓

$\Delta x = 0{,}34$ m ✓

OPTION 3/*OPSIE 3*

$W_{net} = \Delta E_K$
$W_f + W_{wll} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$f\Delta x\cos\theta + (mg\sin 30^\circ)\Delta x\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓Any one/*Enige een*

$(18)\Delta x\cos 180^\circ + (20)(9{,}8)\sin 30^\circ\Delta x\cos 180^\circ$✓$= \frac{1}{2}(20)(0^2 - 2^2)$ ✓

$\Delta x = 0{,}34$ m ✓

OPTION 4/*OPSIE 4*

$W_{net} = \Delta E_K$
$W_f + W_w = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$f\Delta x\cos\theta + mg\Delta x\cos 120^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓Any one/*Enige een*

$(18)\Delta x\cos 180^\circ + (20)(9{,}8)\Delta x\cos 120^\circ$✓$= \frac{1}{2}(20)(0^2 - 2^2)$ ✓

$\Delta x = 0{,}34$ m ✓

OPTION 5/*OPSIE 5*

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

$18\Delta x\cos 180^\circ$✓ $= 20(9{,}8)\Delta x + \frac{1}{2}(20)(0^2 - 2^2)$ ✓

$-18\Delta x = 196\Delta x\sin 30^\circ - 40$

$\Delta x = 0{,}34$ m ✓

(4)

[16]

 Please turn over/Blaai om asseblief

QUESTION 2/*VRAAG 2*

2.1

NOTE/*LET WEL*
-1 mark for each key word/phrase omitted in the correct context.
-1 punt vir elke sleutel woord/frase in die korrekte konteks weggelaat.
The word "resultant/net force" has to be mentioned at least once
Die woord "resultante/netto krag" moet ten minste een keer genoem word

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

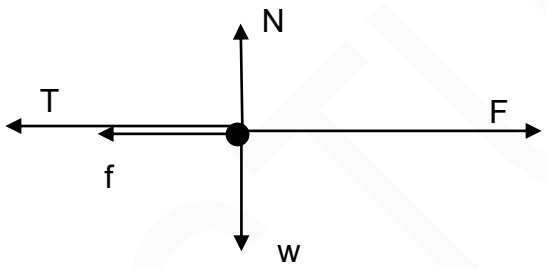
Wanneer 'n (nie-nul) resultante/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel teen 'n versnelling wat direk eweredig is aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

OR/*OF*

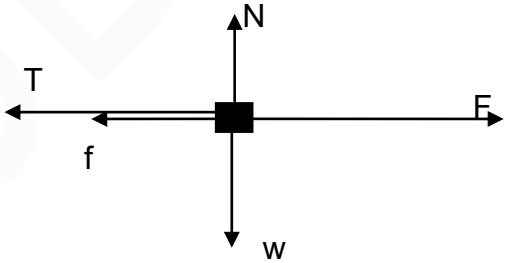
The (non-zero) resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force. ✓✓

Die (nie-nul) resultante/netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum van die voorwerp in die rigting van die resultante/netto krag. (2)

2.2



ACCEPT/*AANVAAR*



Accept the following symbols./*Aanvaar die volgende simbole*:	
N ✓	F_N / Normal / *Normaal* / Normal force / *Normaalkrag* / 78,4 N
f ✓	F_f / f_k / f_r / / F_w / frictional force/*wrywingskrag*/kinetic frictional force / *kinetiese wrywingskrag*
w ✓	F_g,/ mg / weight / $F_{Earth\ on\ block}$/ 78,4 N / gravitational force / g*ewig* / $F_{aarde\ op\ blok}$ / *gravitasiekrag/ gravity / gravitasie*
T ✓	Tension / *Spanning* / F_T / F_s
$F_{applied/toegepas}$ ✓	F / F_A / F_{app} / F_{toeg} / 29,6 N / Applied force / *Toegepaste krag*

Notes/*Aantekeninge*
- Mark is awarded for label and arrow. /*Punt word toegeken vir byskrif en pyltjie*
- Do not penalise for length of arrows.
  Moenie vir die lengte van die pyltjies penaliseer nie.
- Deduct 1 mark for any additional force. /*Trek 1 punt af vir enige addisionele krag.*
- If force(s) do not make contact with body/dot /*Indien krag(te) nie met die voorwerp / kolletjie kontak maak nie:* Max./*Maks:* $^4/_5$
- If arrows missing/*Indien pyltjies uitgelaat is*: Max./*Maks:* $^4/_5$

(5)

2.3

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
8 kg block/*blok:* $F_{net} = ma$ $F_{net} = 0$ $F - (f + T) = ma$ ✓Any one/*Enige een* $29,6 - 10 - T = 0$ ✓ $T = 19,6$ N ✓	2 kg block/*blok:* $F_{net} = ma$ $F_{net} = 0$ $T - w = 0$ ✓Any one/*Enige een* $T = w = mg = (2)(9,8)$ ✓ $T = 19,6$ N ✓

OPTION 3/*OPSIE 3*

$W_{net} = \Delta E_k$ ✓
$W_w + W_N + W_F + W_f + W_T = 0$
$0 + 0 + F\Delta x\cos\theta + f\Delta x\cos\theta + T\Delta x\cos\theta = 0$
$(29,6)\cos0° + (10)\cos180° + T\cos180° = 0$ ✓
$29,6 - 10 - T = 0$
$T = 19,6$ N ✓

OPTION 4/*OPSIE 4*

$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$W_F + W_f + W_T = 0 + 0$
$F\Delta x\cos\theta + f\Delta x\cos\theta + T\Delta x\cos\theta = 0$
$(29,6)\cos0° + (10)\cos180° + T\cos180° = 0$ ✓
$29,6 - 10 - T = 0$
$T = 19,6$ N ✓

(3)

2.4.1

8 kg block/*blok*
$F_{net} = ma$
$F - (f + T) = ma$ ✓Any one/*Enige een*
$50 - 10 - T$ ✓$= 8a$ ✓
$40 - T = 8a$

2 kg block/*blok*
$F_{net} = ma$
$T - mg = ma$
$T - 2(9,8)$ ✓$= 2a$

$40 - 19,6 = 10a$
$20,4 = 10a$
$a = 2,04$ m·s^{-2} ✓

Marking criteria/*Nasienkriteria*
- Appropriate formula / *Geskikte formule* ✓
- Substitution for forces on 8 kg / *Vervanging van kragte op die 8 kg* ✓
- 2a **OR/*OF*** 8a ✓
- Substitution of forces on 2 kg / *Vervanging van kragte op die 2 kg* ✓
- Final answer/*Finale antwoord* 2,04 m·s^{-2} ✓

(5)

2.4.2 **POSITIVE MARKING FROM QUESTION 2.4.1**
POSITIEWE NASIEN VANAF VRAAG 2.4.1

Substitute/*Vervang* a
$T - 2(9,8) = 2a$
$T - 19,6 = 2(2,04)$ ✓
$T = 23,68$ N ✓
OR/*OF*
$40 - T = 8a$
$T = 40 - 8(2,04)$ ✓
$T = 23,68$ N ✓

Marking criteria/*Nasienkriteria*
- Substitution of a/*Vervanging van a* ✓
- Final answer/*Finale antwoord:* 23,68 N ✓

Notes/*Aantekeninge*
If substitution into incorrect equation for T / *Indien vervanging in verkeerde vergelyking vir T:* Max/*Maks* $\frac{1}{2}$

(2)
[17]

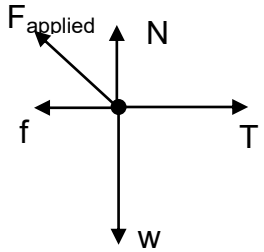
QUESTION 2/*VRAAG 2*

2.1

Marking criteria/*Nasienriglyne*
If any of the underlined key words/phrases in the correct context are omitted: - 1 mark per word/phrase. *Indien enige van die sleutelwoorde/frases in die korrekte konteks weggelaat word: - 1 punt per woord/frase*

The perpendicular force exerted by a surface on an object in contact with the surface. ✓✓
Die loodregte krag deur 'n oppervlak uitgeoefen op 'n voorwerp wat daarmee in kontak is. (2)

2.2



	Accepted symbols/*Aanvaarde simbole*
N ✓	F_N/Normal/Normal force/173,5N /*Normaal/Normaalkrag*
f ✓	F_f /f_k /frictional force/*wrywingskag*/kinetic frictional force/*kinetiese wrywingskrag/5 N*
w ✓	F_g /mg/Weight/$F_{Earth\ on\ block}$/Fw/G*ewig*/Gravitational force/ *Gravitasiekrag/*196 N
T ✓	Tension/*Spanning*/F_T
$F_{applied}$ ✓ $F_{toegepas}$	F/Applied force/35 N/Toegepaste krag/ F_A

Notes/*Aantekeninge*
- Mark is awarded for label and arrow./*Punt word toegeken vir byskrif en pyltjie.*
- Do not penalise for length of arrows./*Moenie vir die lengte van die pyltjies penaliseer nie*.
- Deduct 1 mark for any additional force./*Trek 1 punt af vir enige addisionele krag.*
- If all forces are correctly drawn and labelled, but no arrows, deduct 1 mark. / *Indien all kragte korrek geteken en benoem is, maar geen lyne nie, trek 1punt af.*

(5)

2.3

For the/*Vir die* 20 kg:

$$F_{net} = ma \quad \checkmark$$
$$T - f - F_{Ax} = ma$$
$$T - 5 - 35\cos 40° \checkmark = 0 \checkmark$$
$$T = 31{,}81\ N$$

For/*vir* m:

$$F_{net} = ma$$
$$mg - T = ma$$
$$m(9{,}8) - 31{,}81 \checkmark = 0$$
$$m = 3{,}25\ kg \checkmark$$

Marking criteria/*Nasienriglyne*
- Formula for 20 kg or m kg/*Formule vir 20 kg of m kg* / F_{net} = ma ✓
- Substitution of zero into either formula ✓ *Vervanging van nul in een van die formules*
- All substitutions into F_{net} for 20 kg as shown ✓ *Alle vervanging in F_{net} for 20 kg soos getoon*
- Substitution of value of T in eqn for m /*Substitusie van waarde vir T in vgl vir m* ✓
- Final answer/*finale antwoord*: 3,25 kg ✓

(5)

2.4.1 Decreases/*Neem af* ✓ (1)

2.4.2 **POSITIVE MARKING FROM QUESTION 2.3**
POSITIEWE NASIEN VANAF VRAAG 2.3
Moving to the right/*Beweeg na regs*
Velocity decreases/*snelheid neem af* ✓

Accelerates/Net force to left /*Versnelling/netto krag na links*✓✓

OR/*OF*
As the tension force decreases, the net force/acceleration acts in the opposite direction of motion /to the left. ✓✓
Soos die spanning afneem, is daar 'n netto krag/versnelling in die teenoorgestelde rigting / na links

Moving to the left/Beweeg na links
Velocity increases/*snelheid neem toe* ✓
Accelerates/Net force to left /*Versnelling/netto krag na links*✓✓ (3)
[16]

QUESTION 3/*VRAAG 3*

3.1 (Motion of an object) under the influence of gravity (weight) only. ✓✓ (2 or 0)
(Beweging van 'n voorwerp) slegs onder die invloed van gravitasie (gewig).

OR/*OF*
(Motion in which) the only force acting on the object is gravity (weight).
(Beweging waar) die enigste krag wat op die voorwerp inwerk, gravitasie (gewig) is. (2)

3.2.1 $\Delta t = 0,67 - 0,64 = 0,03$ s ✓✓ (2)

3.2.2

OPTION 1/*OPSIE 1* $\Delta t = \frac{(1,90-0,67)}{2}$ ✓ = 0,62 s ✓ (0,615 s)	**OPTION 2/*OPSIE 2*** $\Delta x = v_i\Delta t + ½ a\Delta t^2$ $(-1,85) = 0 + ½ (-9,8)\Delta t^2$ ✓ Δt = 0,61 s ✓ (0,6145 s)
OPTION 3/*OPSIE 3* $\Delta t = \frac{(1,90+0,67)}{2}$ = 1,285 s $\Delta t = 1,285 - 0,67$ ✓ = 0,62 s ✓ (0,615 s)	**OPTION 4/*OPSIE 4*** $v_f^2 = v_i^2 + 2a\Delta x$ $0 = v_i^2 + 2(-9,8)(1,85)$ $v_i = 6,02$ m·s^{-1} $v_f = v_i + a\Delta t$ $0 = 6,02 + (-9,8)\Delta t$ ✓ Δt = 0,61 s ✓

(2)

QUESTION 2/*VRAAG 2*

NOTE: -1 mark for each key word/phrase omitted in the correct context
***LET WEL**: -1 punt vir elke sleutel woord/frase in die korrekte konteks weggelaat*

(2)

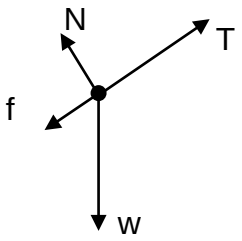
2.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force with an acceleration that is directly proportional to the force and inversely proportional to the mass of the object. ✓✓
Wanneer 'n resultante/netto krag op 'n voorwerp inwerk, sal die voorwerp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

OR/*OF*

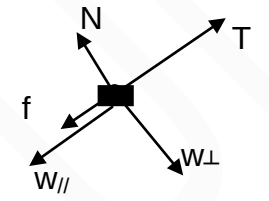
The resultant/net force acting on an object is equal to the rate of change of momentum of the object (in the direction of the resultant/net force.) ✓✓
Die netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum van die voorwerp (in die rigting van die resulterende/netto krag.)

(2)

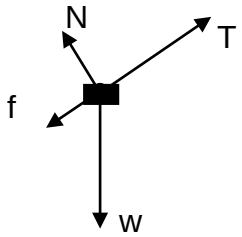
2.2



ACCEPT/*AANVAAR*



OR/*OF*



	Accept the following symbols/*Aanvaar die volgende simbole.*
N ✓	F_N/Normal/*Normaal*/Normal force/*Normaalkrag* /16,97 N
f ✓	F_f / f_k / f_r / frictional force/*wrywingskag*/kinetic frictional force/*kinetiese wrywingskrag*
w ✓	$F_{g,}$/mg/weight/$F_{Earth\ on\ block}$/19,6 N/*g*ravitational force/g*ewig*/$F_{aarde\ op\ blok}$/ *gravitasiekrag*
T ✓	Tension/*Spanning*/F_T / F_A / F / F_s

Notes/*Aantekeninge*
- Mark is awarded for label and arrow. /*Punt word toegeken vir byskrif en pyltjie*
- Do not penalise for length of arrows.
  Moenie vir die lengte van die pyltjies penaliseer nie.
- Deduct 1 mark for any additional force. /*Trek 1 punt af vir enige addisionele krag.*
- If force(s) do not make contact with body/dot /*Indien krag(te) nie met die voorwerp / kolletjie kontak maak nie:* Max./*Maks:* $\frac{3}{4}$
- If arrows missing/*Indien pyltjies uitgelaat is*: Max./*Maks:* $\frac{3}{4}$

(4)

2.3

For the 2 kg (P) block/*Vir die 2 kg (P) blok:*

$\underline{F_{net} = ma}$
$\underline{T + (- w_{II}) + (- f_k)} = ma$ ✓Any one/*Enige een*
$\underline{T - (w_{II} + f_k)} = ma$
$T - \underline{(2)(9,8)\sin30°}$✓ $\underline{- 2,5}$✓ = 2a ✓
$T - 9,8 - 2,5 = 2a$
$T - 12,3 = 2a$ ……(1)

For the 3 kg (Q) block/*Vir die 3 kg (Q) blok:*

$\underline{F_x + (-T) + (- w_{II})} = ma$
$F_x - (T + w_{II}) = ma$
$\underline{[40 \cos 25°}$✓ $- T - \underline{(3)(9,8)\sin30°}$✓] ✓ = 3a
$36,25 - T - 14,7 = 3a$
$21,55 - T = 3a$ ……(2)

$9,25 = 5\ a$
$a = 1,85\ m{\cdot}s^{-2}$✓

Marking criteria/*Nasienriglyne*

- Formula/*Formule* ✓
- Substitution of /*vervanging van* w_{II} for/*vir* 2 kg: (2)(9,8)sin30° ✓
- Substitution of -2,5 N /*Vervanging van -2,5 N* ✓
- 2a **OR/*OF*** 3a ✓
- Calculate/*Bereken* F_x: 40 cos 25° ✓ (40 Sin 65°)
- Substitution of/*vervanging van* w_{II} for/*vir* for 3 kg: (3)(9,8)sin30° ✓
- Left hand side substitution for 3 kg/*Linkerkant vervanging vir 3 kg* ✓
- Final answer/*Finale antwoord*: $1,85\ m{\cdot}s^{-2}$✓

(8)

Systems Approach (Massless String Approximation / *Sisteembenadering (Massalose Tou Benadering)*
(Max 5/8 marks / *Maks 5/8 punte)*

$\underline{F_{net} = ma}$
$\underline{F_x + (- w_{II}) + (- f_k)} = ma$ ✓Any one/*Enige een*
$\underline{F_x - (w_{II} + f_k)} = ma$
$\underline{40\cos25°}$ ✓ $\underline{- (5)(9,8)\sin30°}$✓ $\underline{- 2,5}$✓ = 5a
$a = 1,85\ m{\cdot}s^{-2}$ ✓

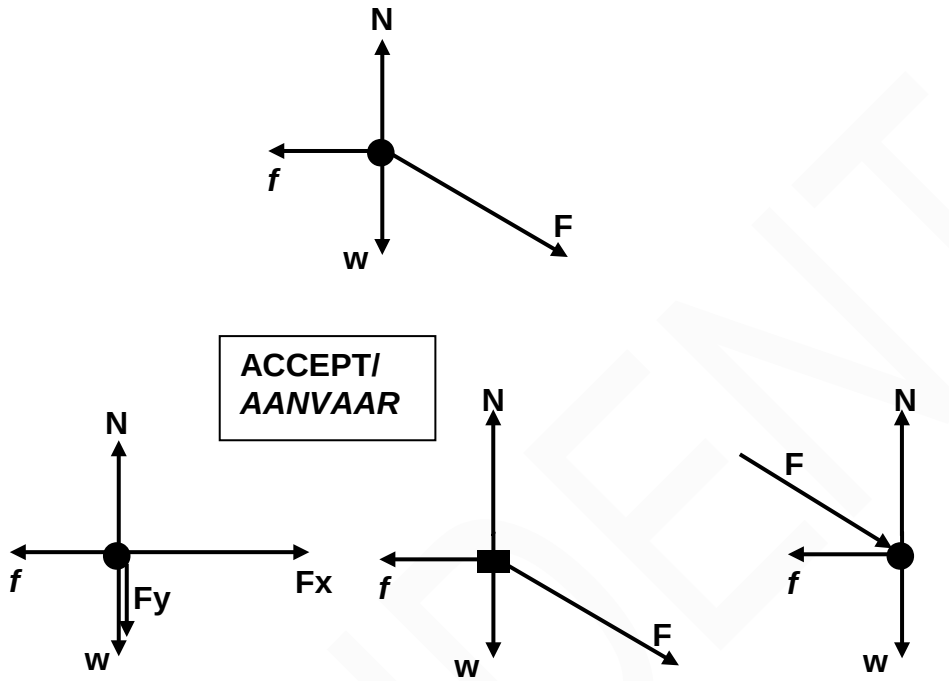
2.4 Greater than/*groter as* ✓
F_{net} increases. /F_{net} *neem toe*. ✓

ACCEPT/*AANVAAR*
There is no friction. /*Daar is geen wrywing nie.*
OR/*OF*
The surface is smooth / *Die oppervlak is glad* (2)

[16]

QUESTION 2/*VRAAG 2*

2.1.1



Accepted labels/*Aanvaarde benoemings*	
F	F_A/90 N/F_{90}
w	F_g / $F_{w/}$weight / mg / gravitational force *F_g / $F_{w/}$ gewig / mg / gravitasiekrag*
f	(Kinetic) Friction / F_f / / f_k / *wrywing* / F_w
N	F_{Normal} / Normal/Normaal / F_N

Notes/*Aantekeninge*

- Mark awarded for label and arrow / *Punt toegeken vir benoeming en pyltjie*
- Do not penalise for length of arrows since drawing is not to scale. /*Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie*
- Any other additional force(s) / *Enige ander addisionele krag(te) Max/Maks* $^3/_4$
- 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)

2.1.2 It is moving at constant speed in a straight line/, the acceleration is zero/ the net force (resultant) acting on it is zero/it is moving at constant velocity ✓
Dit beweeg teen konstante spoed in 'n reguit lyn / versnelling is nul / netto krag (resultant) wat daarop inwerk is nul/ dit beweeg teen konstante snelheid (1)

2.1.3

$F_{net} = ma$
$F_{net} = 0$
$F_x = f$
$F_x - f = 0$
$F\cos 40^o - f = 0$

✓ any one
enige een

$\underline{90 \cos 40^o - f = 0}$✓
$f = 68{,}94$ N✓

OR/OF

$F_{net} = ma$
$F_{net} = 0$
$F_x = f$
$F_x - f = 0$
$F\cos 320^o - f = 0$

✓ any one
enige een

$\underline{90 \cos 320^o - f = 0}$✓
$f = 68{,}94$ N✓

$F_{net} = ma$
$F_{net} = 0$
$F_x = f$
$F_x - f = 0$
$F\sin 50^o - f = 0$

✓ any one
enige een

$\underline{90 \sin 50^o - f = 0}$✓
$f = 68{,}94$ N✓

(3)

NOTE:
1 mark for formula/equation, 1 mark substitution with zero, 1 mark answer.
LW:1 punt vir formule/vergelyking, 1 punt substitusie, 1 punt antwoord.

2.1.4

POSITIVE MARKING FROM 2.1.3 /*POSITIEWE NASIEN VANAF 2.1.3*
OPTION 1/*OPSIE 1*

$v_f = v_i + a\Delta t$
$\underline{2 = 0}$ ✓+ $\underline{a(3)}$ ✓
$a = 0{,}67$ m·s^{-2}

$F_{net} = ma$✓
$\underline{F\cos 40^o}$ ✓$\underline{- 68{,}94}$ ✓ = 15 (0,67)

F = 103,11N✓ (103,05 N – 103,11N)

$F_{net} = ma$✓
$F\cos 320^o - f = 15(0{,}67)$
$\underline{F\cos 320^o}$ ✓$\underline{- 68{,}94}$✓ = 15(0,67)
F = 103,11N✓

POSITIVE MARKING FROM 2.1.3 /*POSITIEWE NASIEN VANAF 2.1.3*
OPTION 2/*OPSIE 2*

$F_{net}.\Delta t = \Delta p$✓

$\underline{F\cos 40^o}$ ✓$\underline{- (68{,}94)}$ ✓$\underline{(3)}$ ✓= $\underline{15(2 - 0)}$ ✓

F = 103,11 N✓

POSITIVE MARKING FROM 2.1.3 /*POSITIEWE NASIEN VANAF 2.1.3*
OPTION 3/*OPSIE 3*

$F_{net} = ma$
$F_x - f_k = ma$
✓ any one / *enige een*

$F_x - 68{,}94\checkmark = 15\ \frac{(2-0)}{3}\checkmark$ ✓

$F_x = 78{,}94$ N

$\tan\theta = \frac{F_y}{F_x}$

$\tan 40^o = \frac{F_y}{78{,}94}$

$F_y = 66{,}24$ N

$F^2 = F_x^2 + F_y^2$

$F^2 = \underline{(78{,}94)^2} + \underline{(66{,}24)^2}\checkmark$

$F = 103{,}05$ N✓

POSITIVE MARKING FROM 2.1.3 /*POSITIEWE NASIEN VANAF 2.1.3*
OPTION 4/*OPSIE 4*

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

$= \frac{(2+0)}{2}\checkmark\ (3)\checkmark$

$\Delta x = 3$ m

$W_{net} = \Delta K$

$W_F + W_f = \Delta K$ ✓

$F\Delta x\cos\theta + f\Delta x\cos\theta = \Delta K$

$\underline{F(3)\cos 40^o}\checkmark + \underline{68{,}94(3)\cos 180^o}\checkmark = ½\ (15)(2^2) - ½\ (15)(0)^2$

$F = 103.06$ N✓

(6)

2.2

OPTION 1/*OPSIE 1*

$F = G\frac{m_1 m_2}{r^2}$ ✓

$20 = (6{,}67\times10^{-11})\frac{m_{planet}(10)}{(6\times10^{5})^2}$ ✓✓

m_{planet} = 1,08 x 10^{22} kg✓

OPTION 2/*OPSIE 2*

$w = mg$
$20 = (10)(g)$✓
$g = 2\ m\cdot s^{-2}$
$g = \frac{GM}{R^2}$

✓ Any one
Enige een

$2 = \frac{(6{,}67\times10^{-11})M}{(6\times10^{5})^2}$ ✓

M = 1,08 x 10^{22} kg✓

(4)
[18]

QUESTION 2/*VRAAG 2*

2.1

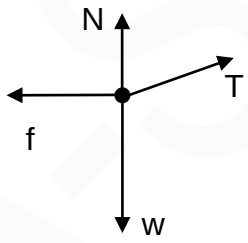
When a (non-zero) resultant/net force acts on an object, the object will accelerate in the direction of the force with an acceleration that is directly proportional to the force and inversely proportional to the mass of the object. ✓✓
Wanneer 'n (nie-nul) resultante/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel teen 'n versnelling wat direk eweredig is aan die (netto) krag en omgekeerd eweredig aan die massa van die voorwerp.

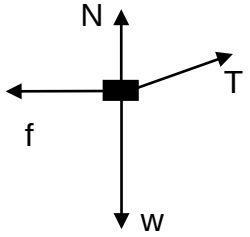
OR/*OF*
The (non-zero) resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force. ✓✓ (2 or 0)
Die (nie-nul) netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum.

ACCEPT/*AANVAAR*
Acceleration is directly proportional to the net force and inversely proportional to the mass of the object.
Versnelling direk eweredig is aan die netto krag en omgekeerd eweredig aan die massa van die voorwerp.

NOTE/*LET WEL*
If any of the underlined key words in the **correct context** is omitted deduct 1 mark.
*Indien enige van die onderstreepte sleutel woorde in die **korrekte konte**ks uitgelaat is, trek 1 punt af.* (2)

2.2





Notes/*Aantekeninge*
- Mark is awarded for label and arrow
  Punt word toegeken vir byskrif en pyltjie
- Do not penalise for length of arrows
  Moenie vir die lengte van die pyltjies penaliseer nie.
- If T is not shown but $T_{||}$ and $T\perp$ are shown, give 1 mark for both
  Indien T nie aangetoon is nie maat $T_{||}$ en $T\perp$ is getoon. Ken 1 punt toe vir beide.
- If force(s) do not make contact with body/*Indien krag(te) nie met die voorwerp kontak maak nie:* Max/*Maks:* $\frac{3}{4}$
- Deduct 1 mark for any additional force /*Trek 1 punt af vir enige addisionele krag* (4)

	Accept the following symbols /*Aanvaar die volgende simbole.*
N	F_N; Normal;Normal force /*Normaal; Normaalkrag* ✓
f	F_f / f_k / frictional force/*wrywingskag*/kinetic frictional force/ *kinetiese wrywingskrag*✓
w	F_g; mg; Weight;$F_{Earth\ on\ block}$;Fw / G*ewig* ;Gravitational force / *Gravitasiekrag*/ 78,4 N✓
T	Tension/*Spanning*; F_T /F_A, F /16,96 N ✓

2.3.1 The 2/8 kg block /system is accelerating/*Die 2/8 kg blok / sisteem is besig om te versnel* ✓

OR/*OF*
The acceleration is not zero / a ≠ 0 ($m \cdot s^{-2}$) / a = 1,32 $m.s^{-2}$ / *Die versnelling is nie nul nie* ✓

OR/*OF*
Velocity is /increasing/changing/not constant/*Snelheid neem toe/ verander/is nie konstant nie* ✓

OR/*OF*
F_{net} is not equal to zero /F_{net} *is nie gelyk aan nul nie* / F_{net} ≠ 0 (N) ✓

OR/*OF*
The acceleration is changing / *Die versnelling verander* ✓

Accept/Aanvaar
An unbalanced force is acting on it / *'n Ongebalanseerde krag werk in op die liggaam* ✓ (1)

2.3.2 **For 2 kg/*Vir die 2 kg massa***

F_{net} = ma
mg -T= ma } ✓

1 mark for any
1 punt vir

(2)(9,8) – T = 2(1,32) ✓
T = 16,96 N ✓

F_{net} = ma
mg + T = ma
(2)(-9,8) + T = 2(-1,32) ✓
T = 16,96 N ✓

(3)

2.3.3 **POSITIVE MARKING FROM 2.3.2/*POSITIEWE NASIEN VANAF 2.3.2***

F_{net} = ma
$T\cos15^o$ - f = ma } ✓

$T_x = T\cos15^o$
$= 16,96 \cos15^o$
$= 16,38$ N (16,382 N)

16,382 – f ✓ = (8)(1,32) ✓
f = 5,82 N (to the left/*na links*) ✓

OR/*OF*

$F_{net} = ma$
$T\cos15^o + f = ma$ ✓

$T_x = T\cos15^o$
$= 16{,}96\cos15^o$
$= 16{,}38$ N (16,382 N)

$-16{,}382 + f$ ✓ $= (8)(-1{,}32)$ ✓
$f = 5{,}82$ N (to the left/*na links*) ✓ (4)

2.4 **ANY ONE/*ENIGE EEN***
Normal force changes/decreases ✓/*Normaalkrag verander/neem af*
The angle (between string and horizontal) changes/increases. /*Die hoek (tussen die toutjie en die horisontaal) verander/neem toe*
The vertical component of the tension changes/increases/*Die vertikale komponent van die spanning verander / neem toe.* (1)

2.5 Yes✓/*Ja*
The frictional force (coefficient of friction) depends on the nature of the surfaces in contact. ✓
Die wrywingskrag (wrywingskoëffisiënt) is afhanklik van die aard van die oppervlaktes in kontak met mekaar.

ACCEPT/*AANVAAR*
The nature of the surface changes / μ_k changes
Die aard van die oppervlakte verander / μ_k *verander* (2)

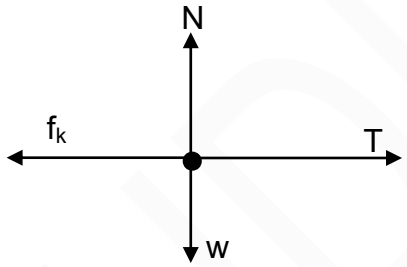
[17]

QUESTION 2/*VRAAG 2*

2.1. A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it. ✓✓
'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid in 'n reguitlyn volhard tensy 'n nie-nul resulterende/netto krag daarop inwerk. (2)

2.2

Accepted labels/*Aanvaarde benoemings*	
w	F_g / F_w/weight / mg / gravitation force *F_g / F_w / gewig / mg / gravitasiekrag*
T	F_T/tension F_s/*spanning*
f_k	(Kinetic) Friction / F_f / 4 N / f / *wrywing* / F_w
N	F_{Normal} / Normal / F_N



(4)

Notes/*Aantekeninge*
- Mark awarded for label and arrow/*Punt toegeken vir benoeming en pyltjie*
- Do not penalise for length of arrows since drawing is not to scale./*Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie*
- Any other additional force(s)/*Enige ander addisionele krag(te)* Max/*Maks* $^3/_4$
- If force(s) do not make contact with body/*Indien krag(te) nie met die voorwerp kontak maak nie:* Max/*Maks:* $^3/_4$

2. 3 Object Q/*Voorwerp Q*

$F_{net} = ma$
$F_{net} = 0$ } ✓
$T + (f_k) = ma$
$T - 3$ ✓ $= 0$ ✓
$T = 3$ N

Object P/*Voorwerp Q*
$F_{net} = ma$
$F_{hor} - (f_k + T) = ma$✓
$(F\cos 30^o) - 5 - 3 = 0$ ✓
$F = 9{,}24$ N✓ (9,238 N) (6)

2.4 3 s✓ (1)

2.5 **Y**✓
Graph **Y** represents the motion of Q after the string breaks.
The graph Y shows a decreasing velocity ✓with a negative acceleration. ✓
This is because the net force (friction) acting on Q is in the opposite direction to its motion, ✓ (accept: only frictional force acts on Q).

Grafiek Y verteenwoordig die beweging van Q na die toutjie breek
Die versnelling is negatief vir grafiek Y en toon 'n afnemende snelheid
Dit is omdat wrywing op Q inwerk (4)
[17]

QUESTION 3/*VRAAG 3*

3.1 10 m·s^{-1}✓ (1)

3.2 The gradient represents the acceleration due to gravity (*g) which is constant* for free fall. ✓
Die helling verteenwoordig die versnelling as gevolg van gravitasie (g) wat konstant vir vry-val is.

[The graphs represent free fall/*Die grafieke verteenwoordig vryval*] (1)

3.3.1

POSITIVE MARKING FROM QUESTION 3.1
POSITIEWE NASIEN VANAF VRAAG 3.1

OPTION 1/*OPSIE 1*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= (10)(2) + \frac{1}{2}(9,8)(2^2)$ ✓ $= 39,6$ m Height/*Hoogte*= 39,6 m ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ $= (-10)(2) + \frac{1}{2}(-9,8)(2^2)$ ✓ $= -39,6$ m Height/*Hoogte* = 39,6 m ✓

OPTION 2/*OPSIE 2*

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

$\Delta x = \left(\frac{10 + 29,6}{2}\right)(2)$ ✓

$\Delta x = 39,6\ m$ ✓

OPTION 3/*OPSIE 3*

$v_f^2 = v_i^2 + 2a\Delta x$ ✓

$(29,6)^2 = (10)^2 + 2(9,8)a\Delta x$ ✓

$\Delta x = 39,6\ m$ ✓

OPTION 4/*OPSIE 4*

Height = Area under the graph
Hoogte = Area onder die grafiek
Any one/*Enige een*✓
=Area of/*van* □+Area of/*van* △
= (10)(2)+(½)(2)(19,6) ✓
= 39,6 m ✓

OPTION 5/*OPSIE 5*

Height = Area of trapezium = *Hoogte = Area van trapesium* ✓
= ½ (10 +29,6) x 2 ✓= 39,6 m ✓

(3)

QUESTION 2/*VRAAG 2*

2.1 The rate of change of velocity. ✓✓
Die tempo van verandering van snelheid.

Accept/*Aanvaar*
Change in velocity per unit time
Verandering in snelheid per eenheidstyd (2)

NOTE:/*LET WEL*
If any one of the underlined key words in the **correct context** is omitted deduct 1 mark.
*Indien enige van die onderstreepte woorde in die **korrekte konteks** uitgelaat is trek 1 punt af.*

2.2

OPTION 1/*OPSIE 1*
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$0,5 = (0)(3) + \frac{1}{2}(a)(3^2)$ ✓
$a = 0,11\ m\cdot s^{-2}$ ✓ (3)

OPTION 2/*OPSIE 2*
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$0,5 = \left(\frac{0 + v_f}{2}\right)(3)$
$v_f = 0,333\ m\cdot s^{-1}$

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

$v_f = v_i + a\Delta t$
$0,33 = 0 + a(3)$ ✓
$a = 0,11\ m\cdot s^{-2}$ ✓ (3)

OPTION 3/*OPSIE 3*
$v_f = v_i + a\Delta t$
$= 0 + 3a$
$v_f = 3a$……..(i)

$v_f^2 = v_i^2 + 2a\Delta y$
$= 0^2 + 2a(0,5)$
$v_f = \sqrt{a}$ ……(ii)

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

$9a^2 = a$ ✓
$\therefore a = 0,11\ m\cdot s^{-2}$ ✓ (3)

2.3 **POSITIVE MARKING FROM 2.2 / *POSITIEWE NASIEN VANAF 2.2***
OPTION 1/*OPSIE 1*
For the 3 kg mass/*vir die 3 kg massa*:
$F_{net} = ma$
$(mg - T)/(mg + T) = ma$ } ✓
$(3)(9,8) - T = (3)(0,11)$ ✓
$T = 29,07\ N$ ✓ (3)

OPTION 2/*OPSIE 2*

For the 3 kg mass/*vir die 3 kg massa*:

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

$$0,5 = \left(\frac{0 + v_f}{2}\right)(3)$$

$v_f = 0,333\ m\cdot s^{-1}$

OR/*OF*

POSITIVE MARKING FROM 2.2/*POSITIEWE NASIEN VANAF 2.2*

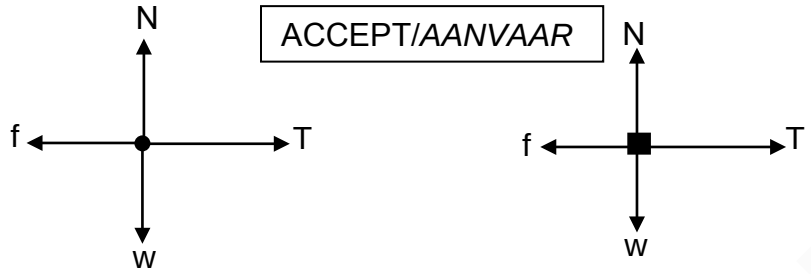
$v_f = v_i + a\Delta t$
$= 0 + (0,11)(3)$
$= 0,33\ m\cdot s^{-1}$

$W_{net} = \Delta E_K$ ✓
$W_w + W_T = ½\ mv_f^2 - ½\ mv_i^2$
$mg\Delta x\cos\theta + T\Delta x\cos\theta = ½\ mv_f^2 - ½\ mv_i^2$
$(3)(9,8)(0,5)\cos0^o + T(0,5)\cos180^o = ½\ (3)(0,33^2 - 0^2)$ ✓
$14,7 - 0,5T = -0,16$
$T = 29,72\ N$ ✓ (3)

OPTION 3/*OPSIE 3*

$W_{nc} = \Delta E_k + \Delta E_p$ ✓
$T\Delta x\cos180^0 = ½\ mv_f^2 - ½\ mv_i^2 + mgh_f - mgh_i$
$T(0,5)\cos180^o = ½\ (3)(0)^2 - ½\ (3)(0,33)^2 + (3)(9,8)(0) - (3)(9,8)(0,5)$ ✓
$T = 29,72\ N$ ✓ (3)

2.4



Accepted labels/*Aanvaarde benoemings*		
w	F_g / F_w / weight / mg / gravitational force *F_g / F_w / gewig / mg / gravitasiekrag*	✓
f	Friction/ F_f / f_k / 27 N/ *wrywing* / *F_w*	✓
N	Normal (force) / F_{normaL} / F_N / $F_{normaal}$ /$F_{reaction}$ / F_{reasie}	✓
T	F_T/tension/spanning	✓

Notes/*Aantekeninge*

- Mark awarded for label and arrow / *Punt toegeken vir benoeming en pyltjie*
- Do not penalise for length of arrows since drawing is not to scale. /*Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie*
- Any other additional force(s) / *Enige ander addisionele krag(te) Max*/*Maks* $^3/_4$
- If force(s) do not make contact with body / *Indien krag(te) nie met die voorwerp kontak maak nie:* Max/*Maks:* $^3/_4$

(4)

2.5

POSITIVE MARKING FROM 2.2 AND 2.3/*POSITIEWE NASIEN VANAF 2.2 EN 2.3*	
For/ *Vir* P F_{net} = ma T- f = ma } ✓ 29,07 - 27 = m(0,11) ✓ m = 18,82 kg ✓ (Range: 18,60 – 18,82)	**OR/*OF*** For/ *Vir* P F_{net} = ma T- f = ma } ✓ 29,72 - 27 = m(0,11) ✓ m = 24,73 kg ✓

(3)
[15]

QUESTION 2 / *VRAAG 2*

2.1.1 An object continues in its state of rest or uniform motion (moving with constant velocity) unless it is acted upon by an unbalanced (resultant/net) force.✓✓

OR

A body will remain in its state of rest or motion at constant velocity unless a resultant/net force acts on it.✓✓

OR

A body will remain in its state of rest or of uniform motion in a straight line at constant velocity/speed unless a non-zero resultant/net force acts on it.✓✓

'n Liggaam sal in sy toestand van rus of uniforme beweging (teen konstante snelheid) volhard tensy 'n ongebalanseerde (resulterende/netto) krag daarop inwerk.

OF

'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid bly tensy 'n resulterende/netto krag daarop inwerk

OF

'n Liggaam sal in sy toestand van rus of uniforme beweging in 'n reguitlyn teen konstante snelheid/spoed volhard tensy 'n nie-nul resulterende/netto krag daarop inwerk. (2)

2.1.3

Accepted Labels/*Aanvaarde benoemings*	
w	F_g / F_w/weight/mg /78,4 N/gravitational force *F_g / F_w /gewig/mg/78,4 N/gravitasiekrag*
F	F_{app}/F_A / applied force (Accept T / tension) $F_{toegepas}$/ F_T / toegepaste krag *(Aanvaar T / spanning)*
f_k	(kinetic) Friction/F_f/f/*(kineties) wrywing*/F_w
N	F_N/Normal (force)/*Normaal(krag)*/ 67,9 N

(4)

2.1.3

$F_{net} = ma$ ✓
$F_{net} = 0$
$F+(-f_k) + (-F_{g||}) = ma$
$F- (f_k + F_{g||}) = ma$
$F - 20,37$✓ $- (8)(9,8)\sin 30^o$✓ $= 0$
$F = 59,57$ N ✓ (5)

2.1.4

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$F_{net} = ma$ $(F_{g\|\|} - f_k) = ma$ } ✓ $(8)(9,8)\sin 30^o - 20,37$✓ $= 8a$ ✓ ∴magnitude/*grootte:* $a = 2,35\ m\cdot s^{-2}$✓	$F_{net} = ma$ $(f_k - F_{g||}) = ma$ } ✓ $20,37 + [-(8)(9,8)\sin 30^o]$✓ $= 8a$ ✓ $\therefore a = -2,35\ m\cdot s^{-2}$ ∴ magnitude/*grootte:* $a = 2,35\ m\cdot s^{-2}$✓

(4)

2.2.1

Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses ✓ and inversely proportional to the square of the distance between their centres. ✓
Elke liggaam in die heelal trek elke ander liggaam aan met 'n krag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul middelpunte.

OR/*OF*
Every particle in the universe attracts every other particle with a force along a line joining them. The force is directly proportional to the product of the masses ✓ of the particles and inversely proportional to the square of the distance between them. ✓
Elke partikel in die heelal trek elke ander partikel aan met 'n krag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hulle. (2)

2.2.2

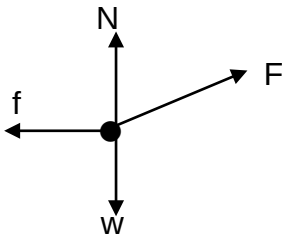
OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$g = \frac{GM}{r^2}$ ✓ ✓ $6 = \frac{(6,67 \times 10^{-11})M}{(700 \times 10^3)^2}$✓ $M = 4,41 \times 10^{22}$ kg ✓	$F = G\frac{m_1 m_2}{r^2}$ $mg = \frac{GmM}{r^2}$ ✓ ✓ $(200)(6) = \frac{(6,67 \times 10^{-11})(200)M}{(700 \times 10^3)^2}$ ✓ $M = 4,41 \times 10^{22}$ kg ✓

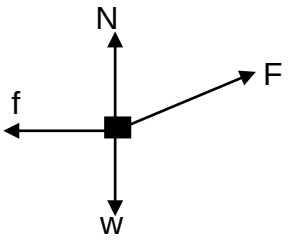
(4)
[21]

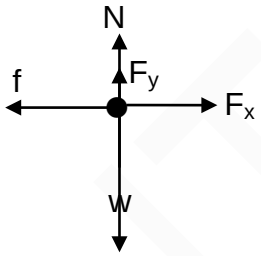
QUESTION/*VRAAG 2*

2.1.1

ACCEPT/*AANVAAR*







Accepted labels/*Aanvaarde benoemings*		
w	F_g/F_w/weight/mg/gravitational force *F_g/F_w/gewig/mg/gravitasiekrag*	✓
f	Friction/F_f/f_k/3 N/*wrywing*/*F_w*	✓
N	Normal (force)/$F_{normaL}/F_N/F_{normaal}/F_{reaction/reaksie}$	✓
F	$F_A/F_{applied/toegepas}$	✓

Notes/*Aantekeninge*

- Mark awarded for label and arrow/*Punt toegeken vir benoeming en pyltjie*
- Deduct 1 mark if arrow(s) is (are) missing/*Trek 1 punt af indien pylpunt(e) nie aangeheg is nie*
- Do not penalise for length of arrows since drawing is not to scale./*Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie*
- Any other additional force(s)/*Enige ander addisionele krag(te)* Max/*Maks* $\frac{3}{4}$
- If force(s) do not make contact with body/*Indien krag(te) nie met die voorwerp kontak maak nie:* Max/*Maks:* $\frac{3}{4}$

(4)

2.1.2 $f_k = \mu_k N$ ✓ (can use F_N for N in equation/ *kan F_N vir N gebruik in vergelyking)*
$3 = (0,2)N$ ✓
$N = 15$ N ✓ (3)

2.1.3 **POSITIVE MARKING FROM QUESTION 2.1.2**
POSITIEWE NASIEN VANAF VRAAG 2.1.2

$F_{net} = ma$
$N + F_{vert} - w = 0$
$N + F_{vert} = w$

✓any of the three/*enige van die drie*

$\underline{F\sin 20^o}$ ✓$= \underline{(2)(9,8) - 15}$ ✓
$F = 13,45$ N✓ (4)

2.1.4 **POSITIVE MARKING FROM QUESTION 2.1.3**
POSITIEWE NASIEN VANAF VRAAG 2.1.3

$F_{net} = ma$
$F\cos 20^o - f = ma$

✓any of the two/*enige van die twee*

$\underline{13,45\cos 20^o - 3 = 2a}$✓
$a = 4,82$ m.s^{-2} ✓ (3)

2.2

2.2.1 Any two particles (objects) in the universe will attract each other with a force which is directly proportional to the product of the masses ✓and inversely proportional to the square of the distance between them (their centres). ✓
Enige twee deeltjies (voorwerpe) in die heelal sal mekaar aantrek met 'n krag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul (middelpunte). (2)

2.2.2 Increases/*Neem toe*✓

Gravitational force is inversely proportional to the square of the distance between the (centres of the) objects✓
Gravitasiekrag is omgekeerd eweredig aan die kwadraat van die afstand tussen die voorwerpe se middelpunte

OR/*OF*

$F \alpha \frac{1}{r^2}$ ✓

(2)
[18]

QUESTION/*VRAAG 3*

3.1 The only force acting on the ball is the gravitational force. ✓✓
Die enigste krag wat op die bal inwerk is die gravitasiekrag.

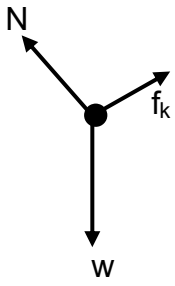
OR/*OF*
The only force acting on the ball is its weight.
Die enigste krag wat op die bal inwerk is sy gewig.

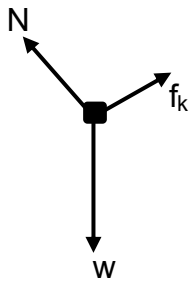
ACCEPT/*AANVAAR*
The only force acting on the ball is gravity.
Die enigste krag wat op die bal inwerk is gravitasie. (2)

QUESTION 2/*VRAAG 2*

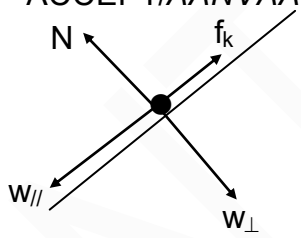
2.1 0 N/zero/*nul*✓ (1)

2.2





ACCEPT/*AANVAAR*



1 mark if BOTH components of weight are shown.
All other rules in the table apply.
1 punt indien BEIDE komponente van die gewig getoon is
Al die ander reels in die tabel geld

Accepted labels/*Aanvaarde benoemings*	
w	F_g/F_w/weight/mg/gravitational force/N/19,6 N *F_g/F_w/gewig/mg/gravitasiekrag/19,6* N
f	$F_{friction}/F_f$/friction/f_k *$F_{wrywing}/F_w$/wrywing/f_k*
N	F_N/F_{normal}/normal force $F_N/F_{normaal}$/*normaalkrag*
	Deduct 1 mark for any additional force. *Trek een punt af vir enige addisionel krag*
	Mark is given for both arrow and label *Punt word toegeken vir beide pylpunt en benoeming*

(3)

2.3.1 $F_{net} = ma$
$\underline{f_k - mg\sin\theta} = 0$
$\underline{f_k = mg\sin\theta}$ ✓

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

$\underline{f_k} = \underline{(2)(9,8)\sin7^o}$ ✓
$f_k = 2,39$ N ✓ (2,389) N (3)

2.3.2 **POSITIVE MARKING FROM QUESTION 2.3.1/*POSITIEWE NASIEN VANAF VRAAG 2.3.1***

$f_k = \mu_k N$
$= \mu_k mg\cos7^o$ ✓

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

$2,389 = \underline{\mu_k(2)(9,8)\cos7^o}$ ✓
$\mu_k = 0,12$ ✓ (3)

2.3.3 **POSITIVE MARKING FROM QUESTION 2.3.2/*POSITIEWE NASIEN VANAF VRAAG 2.3.2***

OPTION 1/*OPSIE 1*

$F_{net} = ma$
$- f_k = ma$
$- \mu_k N = ma$
$- \mu_k(mg) = ma$ ✓

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

$-(0,12)(2)(9,8)$ ✓ $= 2a$ ✓
$a = -1,176\ m.s^{-2}$ (-1,18)

$v_f^2 = v_i^2 + 2a\Delta x$
$0 = (1,5)^2 + 2(-1,176)\Delta x$ ✓
$\Delta x = 0,96\ m$

Distance is/*Afstand is* 0,96 m ✓

OPTION 2/*OPSIE 2*

$W_{net} = \Delta K$

$W_{net} = \Delta E_K$

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

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

$\mu_k N \Delta x \cos\theta = ½ mv_f^2 - ½ mv_i^2$

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

NOTE: substituting into any of the above equations will lead to the following:
LET WEL: *vervanging in enige van hierdie vergelyking sal lei to die volgende*

$(0,12)(2)(9,8)$ ✓ $\Delta x \cos 180^o$ ✓ $= 0 - ½(2)(1,5)^2$ ✓

$\Delta x = 0,957\ m$ ✓

(5)
[15]

QUESTION 1/*VRAAG 1*

1.1 A ✓✓ (2)

1.2 C ✓✓ (2)

1.3 C ✓✓ (2)

1.4 D ✓✓ (2)

1.5 B ✓✓ (2)

1.6 A ✓✓ (2)

1.7 C ✓✓ (2)

1.8 A ✓✓ (2)

1.9 B ✓✓ (2)

1.10 B ✓✓ (2)

[20]

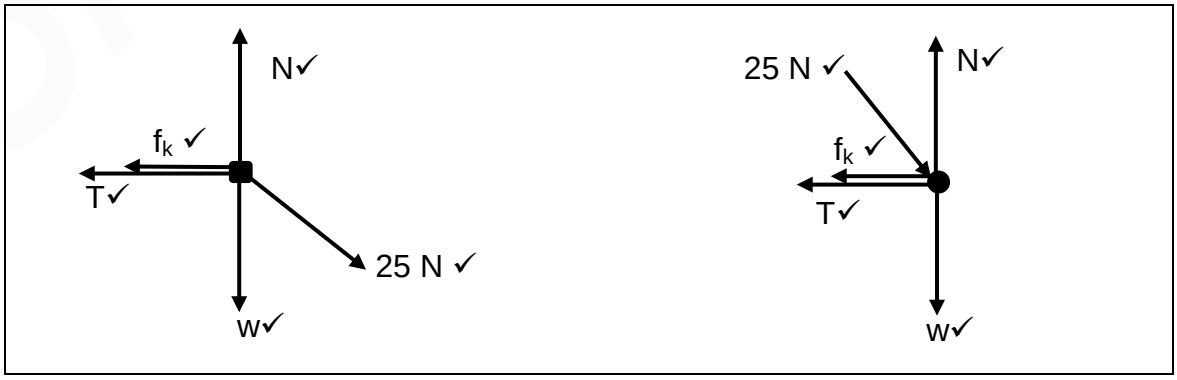
QUESTION 2/*VRAAG 2*

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

OR/*OF*
The resultant/net force acting on the object is equal (is directly proportional to) to the rate of change of momentum of an object (in the direction of the force). ✓✓
Die resulterende/netto krag wat op 'n voorwerp inwerk, is gelyk aan (is direk eweredig aan) die tempo van verandering van momentum van die voorwerp (in die rigting van die netto krag). (2)

2.2
$f_k = \mu_k N$✓ $= \mu_k mg$
$= (0,15)(3)(9,8)$✓
$= 4,41$ N✓ (3)

2.3



Accepted Labels/*Aanvaarde benoemings*	
w	F_g/F_w/force of Earth on block/weight/14,7 N/mg/gravitational force *F_g/F_w/krag van Aarde op blok/gewig/14,7 N/mg/gravitasiekrag*
N	F_N/F_{normal}/normal force F_N/$F_{normaal}$/normalekrag
T	Tension/F_T *Spanning*/F_T
f_k	$f_{kinetic\ friction}$/*kinetiesewrywing*/$f_{f/w}$/f//$F_{f/w}$kinetic friction/*kinetiesewrywing*
25 N	$F_{applied}$/F_A/F $F_{toegepas}$/F_A/F

2.4.1

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$f_k = \mu_k N = \mu_k(25\sin 30^o + mg)$ $= 0{,}15[(25\sin 30^o)\checkmark + (1{,}5)(9{,}8)\checkmark]$ $= 4{,}08$ N✓	$f_k = \mu_k N = \mu_k(25\cos 60^o + mg)$ $= 0{,}15[(25\cos 60^o)\checkmark + (1{,}5)(9{,}8)\checkmark]$ $= 4{,}08$ N✓

(3)

2.4.2

POSITIVE MARKING FROM
QUESTION 2.2 AND QUESTION 2.4.1
POSITIEWE NASIEN VANAF VRAAG 2.2 EN VRAAG 2.4.1
OPTION 1/*OPSIE 1*

For the 1,5 kg block/*Vir die 1,5 kg blok*

$F_{net} = ma$ } ✓
$F_x + (-T) + (-f_k) = ma$ }

$25\cos 30^o - T - f_k = 1{,}5a$
$(25\cos 30^o - T) - 4{,}08$ ✓$= 1{,}5a$
$17{,}571 - T = 1{,}5a$ …….(1)

✓either one
enigeen

For the 3 kg block
Vir die 3 kg blok
$T - f_k = 3a$
$T - 4{,}41$✓ $= 3a$ ……(2)
$13{,}161 = 4{,}5\ a$
$a = 2{,}925\ m{\cdot}s^{-2}$
$T = 13{,}19$ N ✓ (13,17 N – 13,19 N)

OPTION 2/*OPSIE 2*

For the 1,5 kg block/*Vir die 1,5 kg blok*

$F_{net} = ma$
$F_x + (-T) + (-f_k) = ma$ ✓
$25\cos 30^o - T - f_k = 1,5a$
$(25\cos 30^o - T) - 4,08$ ✓$= 1,5a$
$17,571 - T = 1,5a$ …….(1)

✓either one *enigeen*

For the 3 kg block
Vir die 3 kg blok
$T - f_k = 3a$
$T - 4,41$✓ $= 3a$ ……(2)

$35,142 - 2T = T - 4,41$
$T = 13,18$ N ✓

OPTION 3/*OPSIE 3*

For the 1,5 kg block/*Vir die 1,5 kg blok*

$F_{net} = ma$
$F_x + (-T) + (-f_k) = ma$ ✓
$25\cos 30^o - T - f_k = 1,5a$
$(25\cos 30^o - T) - 4,08$ ✓$= 1,5a$
$17,571 - T = 1,5a$ …….(1)
$a = \frac{17,571 - T}{1,5}$

✓either one *enigeen*

For the 3 kg block
Vir die 3 kg blok
$T - f_k = 3a$
$T - 4,41$✓ $= 3a$ ……(2)
$a = \frac{T - 4,41}{3}$
$\frac{17,571 - T}{1,5} = \frac{T - 4,41}{3}$
$T = 13,18$ N✓ (5)

[18]

QUESTION 3/*VRAAG 3*

3.1 The motion of an object under the influence of gravity/weight/gravitational force only / Motion in which the only force acting is the gravitational force.✓✓
Die beweging van 'n voorwerp slegs onder die invloed van swaartekrag/gewig gravitasiekrag.
Beweging waarin die enigste krag wat op die liggaam inwerk, die gravitasiekrag is. (2)

3.2.1

OPTION 1/*OPSIE 1*

Upwards positive/*Opwaarts positief:*
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= 0^2 + (2)(-9,8)$✓(-20)✓
$v_f = 19,80$ m·s^{-1} ✓

Downwards positive
Afwaarts positief
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= 0^2 + (2)(9,8)$✓(20)✓
$v_f = 19,80$ m·s^{-1}✓

OPTION 2/*OPSIE 2*

Upwards positive/*Opwaarts positief:*
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$-20 = 0 + \frac{1}{2}(-9,8)\,\Delta t^2$✓
$\Delta t = 2,02$ s
$v_f = v_i + a\Delta t$

✓either one *enigeen*

$= 0 + (-9,8)(2,02)$ ✓
$= -19,80$ m·s^{-1}
$= 19,80$ m·s^{-1} ✓

Downwards positive
Afwaarts positief
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$20 = 0 + \frac{1}{2}(9,8)\,\Delta t^2$✓
$\Delta t = 2,02$ s
$v_f = v_i + a\Delta t$

✓either one *enigeen*

$= 0 + (9,8)(2,02)$✓
$= 19,80$ m·s^{-1}✓

QUESTION 2/*VRAAG 2*

2.1 **For the 5 kg mass/*Vir die 5 kg massa***:

2.1.1 $T - f = ma$
$T - \mu_k(mg) = ma$✓
$T - (0,4)(5)(9,8)$✓ $= 5a$✓…….(1)

NOTE/*LET WEL*:
1 mark for any of the 2 formulae
1 punt vir enige van die 2 formules

For the 20 kg mass/*Vir die 20 kg massa*
$mg - T = ma$
$\underline{20(9,8) - T = 20a}$✓…….(2)

$176,4 = 25a$ (1) + (2)
$\therefore a = 7,06\ (7,056)\ m\cdot s^{-2}$✓ (5)

ACCEPT/*AANVAAR* (4 marks/*4 punte*)
$F_{net} = ma$
$Mg - f = (M + m)\ a$✓
$[20(9,8) - (0,4)(5)(9,8)]$✓ $= 25a$✓
$\therefore a = 7,06\ m\cdot s^{-2}$✓ (4)

2.1.2

POSITIVE MARKING FROM QUESTION 2.1.1
POSITIEWE NASIEN VANAF VRAAG 2.1.1
OPTION 1/*OPSIE 1*
$v_f^{\ 2} = v_i^{\ 2} + 2a\Delta y$✓
$= 0$✓ $+ (2)(7,056)(6)$✓
$v_f = 9,20\ m\cdot s^{-1}$✓

POSITIVE MARKING FROM QUESTION 2.1.1
POSITIEWE NASIEN VANAF VRAAG 2.1.1
OPTION 2/*OPSIE 2*
The 5 kg mass travels as fast as the 20 kg mass
Die 5 kg massa beweeg net so vinnig soos die 20 kg massa
$W_{net} = \Delta K$✓
$\underline{(5)(7,056)(6\cos 0^0)}$✓ $= \underline{\frac{1}{2}(5)(v_f^{\ 2} - 0)}$✓
$v_f = 9,20\ m\cdot s^{-1}$✓

OPTION 3/*OPSIE 3*
For the 20 kg mass/*Vir die 20 kg massa*
$W_{net} = \Delta K$✓
$Mg - T = Ma$
$(20)(9,8) - T = (20)(7,056)$✓
$T = 54,88\ N$

$W_{net} = \Delta K$
$W_T + W_g = \frac{1}{2}m(v_f^{\ 2} - v_i^{\ 2})$
$\underline{(54,88)(6)(\cos 180) + 20(9,8)(6)(\cos 0) = \frac{1}{2}(20)\ (v_f^{\ 2} - 0)}$✓
$v_f = 9,202\ m\cdot s^{-1}$✓

OPTION 4/*OPSIE 4*
$W_{nc} = \Delta K + \Delta U$✓
$W_{nc} = f_k \Delta x \cos\theta = \mu_k N \Delta x \cos\theta = \Delta U + \Delta K$
$(0,4)(5)(9,8)(6)\cos 180^{o}$✓$= (20)(9,8)(0 - 6) + ½ (25)(v_f^{\ 2} - 0)$ ✓
$-117,6 = (20)(9,8)(-6) + ½(25)(v_f^{\ 2} - 0)$
$v_f = 9,202\ m \cdot s^{-1}$✓ (4)

2.1.3 6 m✓ (1)

2.2

2.2.1 Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses ✓and inversely proportional to the square of the distance between their centres. ✓
Elke liggaam in die heelal trek elke ander liggaam aan met 'n krag wat direk eweredig is aan die produk van hul massas ✓ *en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul middelpunte.* ✓ (2)

2.2.2 $F = \frac{Gm_1m_2}{r^2}$ ✓

On the mountain/*Op die berg*

$F_g = \frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(65)}{(6,38 \times 10^6 + 6 \times 10^3)^2}$ ✓✓
= 627,2 N

On the ground/*Op die grond*

$F_g = W = mg$
= (65 x 9,8)✓
= 637 N

$F_g = \frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(65)}{(6,38 \times 10^6)^2}$
= 636,94 N

Difference/*Verskil* = (637 – 627,2)✓
= 9,8 N✓ (6)
[18]

QUESTION/*VRAAG 2*

2.1 A body will remain in its state of rest or motion at constant velocity ✓unless a resultant/net force✓ acts on it.
'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid bly tensy 'n resulterende/netto krag daarop inwerk

OR/*OF*
Every body continues in its state of rest or of uniform motion in a straight line ✓unless a resultant/net force ✓acts on it.
Elke liggaam bly in sy toestand van rus of uniforme beweging in 'n reguitlyn tensy 'n resulterende/netto krag daarop inwerk (2)

2.2 0 (N)✓/zero/*nul* (newton)
NOTE: No penalisation if the unit is omitted
LET WEL: *Geen penalisering as eenheid weggelaat is nie* (1)

2.3

Accepted labels/*Aanvaarde byskrifte*	
w	F_g / F_w / weight / mg / gravitational force *F_g / F_w / gewig / mg / gravitasiekrag*
T	F_T / tension F_S / *spanning*
15 N	F_a / F_{15N} / $F_{applied}$ / F_t / $F_{toegepas}$ / F

Accept/*Aanvaar*

(3)

Notes/*Aantekeninge*
- Mark awarded for label and arrow/*Punt toegeken vir byskrif en pyltjie*
- Do not penalise for length of arrows since drawing is not to scale./*Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie*
- Any other additional force(s)/*Enige ander addisionele krag(te)* Minus 1 (-1) mark/*punt*
- If force(s) do not make contact with body/*Indien krag(te) nie met die voorwerp kontak maak nie:* Minus 1 (-1) mark/*punt*
- Minus 1 mark if all arrows are omitted but correctly labelled / *Minus 1 punt indien alle pyltjies weggelaat is maar korrek benoem*

2.4

2 kg block/*blok*

$F_{net} = ma$
$F_a + F_g + (-T) = ma$ ✓
$F_a + mg + (-T) = ma$
$[15 + (2)(9,8) - T]$✓ $= (2)(1,2)$✓
$T = 32,2$ N

10 kg block/*blok*

$T + (-f_k) = ma$
$T - \mu_k N = ma$ ✓
$T - \mu_k mg = ma$
$32,2 - (\mu_k)(10)(9,8)$✓ $= (10)(1,2)$✓
$\mu_k = 0,21$✓

NOTE:*LET WEL*
If f_k is calculated separately – award one mark. *Indien f_k apart bereken is - ken een punt toe*

Massless string approximation/Systems approach /*Massalose toutjie benadering /Sisteem Benadering* $(\frac{4}{7})$

$F_{net} = ma$✓
$F_A - f_k + w = (M + m)a$
$15 - \mu_k Mg + mg = (M + m)a$
$15 - \mu_k(10(9,8) + (2)(9,8)$✓ $= (10 + 2)(1,2)$✓
$\mu_k = 0,21$✓ (7)

2.5 Smaller than / *Kleiner as* ✓ (1)

2.6 Remains the same / *Bly dieselfde* ✓

The coefficient of kinetic friction is independent of the (apparent microscopic) surface areas in contact. ✓
Die kinetiese wrywingskoëffisiënt is onafhanklik van die (waarskynlike mikroskopiese) oppervlakareas waarmee in kontak is

OR/*OF*
The coefficient of kinetic friction depends only on the type of materials used✓
Die kinetiese wrywingskoëffisiënt hang slegs af van die tipe materiaal gebruik (2)
[16]

QUESTION 2/*VRAAG 2*

2.1.1 When body A exerts a force on body B, body B exerts a force of equal magnitude in the opposite direction on body A. ✓✓
Wanneer liggaam A 'n krag uitoefen op liggaam B, oefen liggaam B 'n krag van gelyke grootte in die teenoorgestelde rigting op liggaam A uit.
OR/*OF*
If body A exerts a force on body B, then body B exerts an equal ✓ and opposite✓ force on body A
Indien liggaam A 'n krag uitoefen op liggaam B, dan sal liggaam B 'n gelyke maar teenoorgestelde krag op liggaam A uitoefen (2)

2.1.2

For 2,5 kg block/*Vir 2,5 kg blok*	**OR/*OF***	**OR/*OF***
T = mg✓ ∴T = (2,5)(9,8)✓ = 24,5 N✓	F_{net} = ma T – mg = (2,5)(0) } ✓ T – (2,5)(9,8)✓ = 0 T = 24,5 N ✓	F_{net} = ma mg - T = (2,5)(0) } ✓ (2,5)(9,8) - T✓ = 0 T = 24,5 N ✓

(3)

2.1.3

POSITIVE MARKING FROM 2.1.2 ***POSITIEWE NASIEN VANAF 2.1.2***	
For mass M/*Vir mass M* $f_s = \mu_s N$✓ ∴ N = $\frac{24,5}{0,2}$ ✓✓ = 122,5 N N = Mg = 122,5 N M(9,8) = 122,5 N✓ M = 12,5 kg✓	**OR/*OF*** $\mu_s N$✓ = μ_sMg 24,5✓= (0,2)✓M(9,8) ✓ M = 12,5 kg✓

(5)

2.1.4

For the 5 kg block/*Vir die 5 kg blok*:
$f_k = \mu_k N$
f_k = (0,15)(5)(9,8) ✓
= 7,35 N
F_{net} = ma
T – f_k = ma } ✓
T – 7,35 = 5a✓

For the 2,5 kg block/*Vir die 2,5 kg blok*
w – T = ma
(2,5)(9,8) – T = 2,5 a ✓

17,15 = 7,5 a
a = 2,29 m·s^{-2}✓ (5)

2.2

$F = G\frac{m_1 m_2}{r^2}$ ✓

$F = \frac{(6{,}67 \times 10^{-11})(6{,}5 \times 10^{20})(90)}{(550 \times 10^3)^2}$ ✓ ✓

= 12,90 N✓ (12,899 N)

(4)

OR/*OF*

$g = \frac{Gm}{r^2}$ ✓

$g = \frac{(6{,}67 \times 10^{-11})(6{,}5 \times 10^{20})}{(550 \times 10^3)^2}$ ✓

$= 0{,}143... m \cdot s^{-2}$

$w = mg$

$= (90)(0{,}143..)$✓

= 12,89 N✓(*downwards/afwaarts*)

(4)

[19]

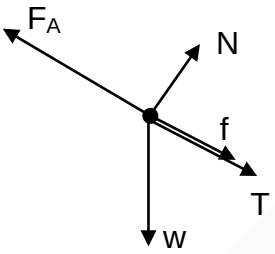
QUESTION 2/*VRAAG 2*

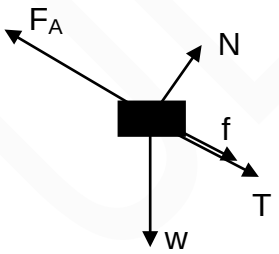
2.1 When one body exerts a force on a second body, the second body exerts a force of equal magnitude in the opposite direction on the first body.
Wanneer een liggaam 'n krag op 'n tweede liggaam uitoefen, oefen die tweede liggaam 'n krag van gelyke grootte in die teenoorgestelde rigting op die eerste liggaam.

OR/***OF***:
When body A exerts a force on body B, body B will exert a force of equal magnitude but opposite in direction on body A.
Indien liggaam A 'n krag uitoefen op liggaam B, sal B 'n krag van gelyke grootte maar teenoorgesteld in rigting op liggaam A uitoefen.

ACCEPT/*AANVAAR* (for 1 mark only/*vir slegs 1 punt*)
Action and reaction are equal and opposite.
Aksie en reaksie is gelyk en teenoorgesteld (2)

2.2



Accept/Aanvaar Force diagram *Kragtediagram*	**Notes/*Aantekeninge***
	Do not penalise for length of arrows *Moenie vir die lengte van die pyltjies penaliseer nie* If w is not shown but $F_{//}$ and $F_{\perp}$ are shown give 1 mark for both. *Indien w nie aangetoon is nie maar $F_{//}$ en $F_{\perp}$ is getoon, ken 1 punt toe vir beide.*

Accept the following symbols/*Aanvaar die volgende simbole.*	
N	F_N; Normal;/*Normaal* ✓
F_A	40 N✓
f	F_f,f_k ✓
w	F_G Weight/G*ewig*; Gravitational force/*Gravitasiekrag*✓
T	Tension/*Spanning*; F_T ; ✓

(5)

2.3.1 **OPTION 1/*OPSIE 1***

For the 1 kg block/*Vir die 1 kg blok*;

$f_k = \mu_k N$

$= \mu_k \, mg\cos\theta$✓

$= 0,29 \, (1 \times 9,8 \cos 30^o)$ ✓

$= 2,46$ N✓

OPTION 2/*OPSIE 2*

BY PROPORTION:/*DEUR EWEREDIGHEID*

The smaller mass = ¼ of the larger mass✓

Die kleiner massa = ¼ die groter massa

∴frictional force/*wrywingskrag* = ¼ (10) ✓

= 2,5 N✓ (3)

2.3.2 **POSITIVE MARKING FROM QUESTION 2.2**
POSITIEWE NASIEN VANAF VRAAG 2.2

OPTION 1/*OPSIE 1*

$F_{net} = ma$✓

For 1 kg block/*Vir 1 kg blok*

$F_A - \{(T+f_k) + mg\sin\theta\} = ma$

$40 - \{T + 2,46 + 1(9,8)(\sin 30^o)\}$✓$= (1 \times) a$ ✓

$40 - T - 7,36 = a$

$32,64 - T = a$.....(1)

For 4 kg block/*Vir 4 kg blok*

$T - (mg \sin\theta + f_k) = 4a$

$T - (4 \times 9,8 \sin 30^o + 10) = 4a$✓

$T - 29,6 = 4a$.....(2)

From (1) and (2)/*Vanaf (1) en (2)*

$a = 0,61 \text{ m·s}^{-2}$

$T = 29,6 + (4(0,61)$ ✓

$T = 32,04$ N✓

OPTION 2/*OPSIE 2*

Consider the blocks as a single system.
Beskou die blokke as 'n enkele sisteem.

$F_A - [(f_{tot}) - \{(4+1) g\sin 30^o\}] = (4+1)a$

$40 - (10 - 2,46) - (5(9,8)\sin 30^o)$ ✓$= 5a$✓

$\therefore a = 0,61 \text{ m·s}^{-2}$

For 1 kg block/*Vir 1 kg blok*

$F_{net} = ma$✓

$F_A - \{(T+f_k) + mg\sin\theta\} = ma$

$40 - \{T + 2,46 + 1(9,8)(\sin 30^o)\} = (1 \times) a$ ✓

$40 - T - 7,36 = a$

$32,64 - T = 0,61$✓

$T = 32,04$ N✓

Notes/*Aantekeninge*

Learners need not show how (1) and (2) were combined
Leerders hoef nie aan te toon hoe (1) en (2) gekombineer is nie.

The first correct substitution for equation (1) should carry 2 marks.
The second substitution must carry 1 mark.
Die eerste korrekte vervanging vir vergelyking (1) moet 2 punte tel.
Die tweede vervanging tel 1 punt.

OR/*OF*

For 4 kg block/*Vir 4 kg blok*
Fnet - ma
$\underline{T - (mg \sin\theta + f_k) = 4a}$
$\underline{T - (4 \times 9,8 \sin 30^o + 10) = 4a}$✓
T- 29,6 = 4a
T = 29,6 + (4)(0,61) ✓
= 32,04 N✓ (6)
[16]

QUESTION 3/*VRAAG 3*

3.1 Free fall/*Vrye val*

ACCEPT/*AANVAAR*
Vertically accelerated motion/projectile motion.
Vertikale versnelde beweging /projektielbeweging (1)

3.2.1 **Downward motion as positive**
Afwaartse beweging as positief

$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓
30✓ = $\underline{v_i (1,5) + ½ (9,8)(1,5)^2}$ ✓
v_i = 12,65 m·s^{-1}✓

Upward motion as positive
Opwaartse beweging as positief

$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓
-30✓ = $\underline{v_i (1,5) + ½ (-9,8)(1,5)^2}$ ✓
v_i = 12,65 m·s^{-1}✓ (4)

Notes / *Aantekeninge*
Accept/*Aanvaar* g or/*of* a $\Delta x = v_i\Delta t + ½ a\Delta t^2$✓ $s = ut + ½ at^2$

3.2.2

OPTION 1/*OPSIE 1*	**Notes / *Aantekeninge***
Positive marking from QUESTION 3.2.1 ***Positiewe nasien vanaf VRAAG 3.2.1*** **Downward motion as positive** ***Afwaartse beweging as positief*** $v_f^2 = v_i^2 + 2a\Delta y$✓ $12,65^2$ ✓= $\underline{0 + 2(9,8)\ \Delta y}$✓ Δy = 8,16 m✓ Height/*Hoogte* **XC** = **XB + BC** (30 + 8,16) = 38,16 m Height is/*Hoogte is* 38,16 m✓	For/*Vir* **XB** Accept/*Aanvaar* g or/*of* a $v^2 = u^2 + 2as$ The height must be written down in order to score the final mark. *Die hoogte moet neergeskryf word om die finale punt te kry.*

QUESTION 1/*VRAAG 1*

1.1 A ✓✓ (2)

1.2 A ✓✓ (2)

1.3 D ✓✓ (2)

1.4 C ✓✓ (2)

1.5 B ✓✓ (2)

1.6 C ✓✓ (Accept/ *Aanvaar* R) (2)

1.7 A ✓✓ (2)

1.8 D ✓✓ (2)

1.9 A ✓✓ (2)

1.10 C ✓✓ (2)

[20]

QUESTION 2/*VRAAG 2*

2.1 When a resultant (net) force acts on an object, the object will accelerate in the direction of the force. This acceleration is directly proportional to the force✓ and inversely proportional to the mass of the object.✓

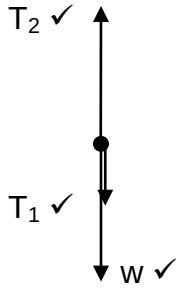
Wanneer 'n resulterende (netto) krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Hierdie versnelling is direk eweredig aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

OR/*OF*

The net force acting on an object is equal to the rate of change of momentum ✓✓ of the object (in the direction of the force). (2 or 0)

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

2.2



(3)

2.3

OPTION 1/*OPSIE 1*

F_{net} = ma✓

For 5 kg block/*Vir 5 kg-blok*

$T_2 + (-mg) + (-T_1) = ma$

$250 - (5)(9,8) - T_1$✓ = 5 a ✓

$201 - T_1 = 5\ a$

$T_1 = 201 - 5a$.....(1)

For 20 kg block/*Vir 20 kg-blok*

$T_1 + (-mg) = ma$.....(2)

$T_1 + [-20(9,8)]$ ✓ = 20a

$5 = 25\ a$

$a = 0,2\ m{\cdot}s^{-2}$ upwards/*opwaarts*

$\therefore T_1 = 201 - 5(0,2)$ ✓

$= 200$ N ✓

OR/*OF* $T_1 = 20(9,8) + 20(0,2)$ ✓

$= 200$ N ✓

(6)

OPTION 2 /*OPSIE 2*

F_{net} = ma✓

For 5 kg block/*Vir 5 kg-blok*

$T_2 + (-mg) + (-T_1) = ma$

$250 - (5)(9,8) - T_1$✓ = 5 a ✓

$201 - T_1 = 5a$

$T_1 = 201 - 5a$.....(1)

For 20 kg block/*Vir 20 kg-blok* ,

$T_1 + (-mg) = ma$.....(2)

$T_1 + [-20(9,8)]$ ✓ = 20a

(1) x 4 : $4T_1 = 804 - 20a$

$\therefore T_1 - 196 = 804 - 4T_1$ ✓

$\therefore 5T_1 = 1\ 000$

$\therefore T_1 = 200$ N ✓

(6)

OPTION 3/*OPSIE 3*

$F_{net} = ma$✓

For 5 kg block/*Vir 5 kg-blok*

$T_2 + (-mg) + (-T_1) = ma$

$250 - (5)(9,8) - T_1$✓$= 5a$ ✓

$201 - T_1 = 5a$

$T_1 = 201 - 5a$.....(1)

$\therefore a = \frac{201 - T_1}{5}$

For 20 kg block/*Vir 20 kg-blok* ,

$T_1 + (-mg) = ma$.....(2)

$T_1 + [-(20)(9,8)]$ ✓ $= 20a$

$\therefore T_1 - 196 = 20(\frac{201 - T_1}{5})$✓

$\therefore T_1 = 200$ N✓ (6)

2.4 **Q** ✓ (1)

[12]

QUESTION 3/*VRAAG 3*

3.1 An object moving / Motion under the influence of gravity / weight / gravitational force only (and there are no other forces such as friction).✓✓ (2 or/*of* 0)
('n Voorwerp wat / Beweging slegs onder die invloed van swaartekrag / gewig / gravitasiekrag (en daar is geen ander kragte soos wrywing nie). (2)

3.2

OPTION 1/*OPSIE 1*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$✓	$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$✓
0 ✓$= 15\ \Delta t + \frac{1}{2} (-9,8)\ \Delta t^2$✓	0✓ $= -15\ \Delta t + \frac{1}{2} (9,8)\ \Delta t^2$✓
$\Delta t = 3,06$ s	$\Delta t = 3,06$ s
It takes/*Dit neem* 3,06 s✓	It takes/*Dit neem* 3,06 s✓

(4)

OPTION 2/*OPSIE 2*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$v_f = v_i + a\Delta t$✓	$v_f = v_i + a\Delta t$✓
0✓ $= 15 + (-9,8)\Delta t$✓	0✓ $= -15 + (9,8)\Delta t$✓
$\Delta t = 1,53$ s	$\Delta t = 1,53$ s
It takes (2)(1,53) = 3,06 s✓	It takes/*Dit neem* 3,06 s✓

(4)

OPTION 3 / *OPSIE 3*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$v_f = v_i + a\Delta t$✓	$v_f = v_i + a\Delta t$✓
-15 ✓$= 15 + (-9,8)\Delta t$✓	15 ✓$= -15 + (9,8)\Delta t$✓
$\Delta t = 3,06$ s✓	$\Delta t = 3,06$ s✓

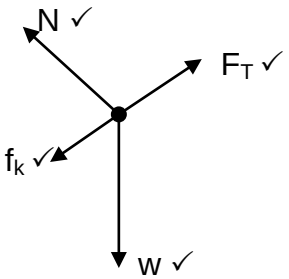
(4)

QUESTION 2/*VRAAG 2*

2.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force. This acceleration is directly proportional to the force ✓and inversely proportional to the mass of the object. ✓
Wanneer 'n resulterende/netto krag op 'n liggaam inwerk, sal die liggaam in die rigting van die krag versnel. Hierdie versnelling is direk eweredig aan die krag en omgekeerd eweredig aan die massa van die liggaam. (2)

2.2 Remains the same / *Bly dieselfde* ✓ (1)

2.3



Accepted labels/*Aanvaarde benoemings*	
w	F_g / F_w / weight / mg / gravitational force *F_g / F_w / gewig / mg / gravitasiekrag*
f	$F_{friction}$ / F_f / friction *$F_{wrywing}$ / F_w / wrywing*
N	F_N / F_{normal} / normal force F_N / $F_{normaal}$ / *normaalkrag*
F_T	F_t / T / tension F_t / T / *spanning*

(4)

2.4

2.4.1 Up the incline as positive/*Teen die skuinste op as positief:*

$F_{net} = ma$
$F_T + f_k + w_{//} = ma$
$F_T + \mu_k N + w\sin30° = ma$
$F_T + \mu_k mg\cos30° + mg\sin30° = ma$
} ✓ Any one/*Enige een*

$F_T – (0,2)(6)(9,8)\cos30°$✓ $- (6)(9,8)\sin30°$✓ $= (6)(4)$ ✓
$\therefore F_T = 63,58$ N ✓ (5)

2.4.2 Up the incline as positive/*Teen die skuinste op as positief:*

$F_{net} = ma$
$F + f_{k(6\ kg)} + f_{k(3\ kg)} + w_{//} = ma$
$F + \mu_k N_{(6\ kg)} + \mu_k N_{(3\ kg)} + mg\sin30° = ma$
} ✓ Any one/*Enige een*

$F – (0,2)(6)(9,8)\cos30°$✓ $- (0,1)(3)(9,8)\cos30°$✓ $- (9)(9,8)\sin30°$✓ $= 0$ ✓
$\therefore F = 56,83$ N ✓ (6)

2.5 Decreases / *Afneem* ✓ (1)

[19]