basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE/*SENIOR SERTIFIKAAT*
NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

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

NOVEMBER 2020

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 19 pages./
Hierdie nasienriglyne bestaan uit 19 bladsye.

QUESTION 1/*VRAAG 1*

1.1 B ✓✓ (2)

1.2 D ✓✓ (2)

1.3 C ✓✓ (2)

1.4 C ✓✓ (2)

1.5 C ✓✓ (2)

1.6 A ✓✓ (2)

1.7 A ✓✓ (2)

1.8 D ✓✓ (2)

1.9 A ✓✓ (2)

1.10 B ✓✓ (2)

[20]

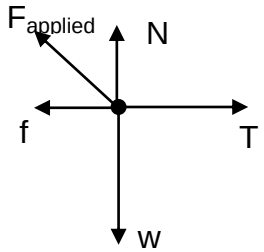
QUESTION 2/*VRAAG 2*

2.1

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

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

2.2



	Accepted symbols/*Aanvaarde simbole*
N ✓	F_N/Normal/Normal force/173,5N /*Normaal/Normaalkrag*
f ✓	F_f /f_k /frictional force/*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:

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

For/*vir* m:

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

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

(2)

3.2.3

POSITIVE MARKING FROM QUESTION 3.2.2
POSITIEWE NASIEN VANAF VRAAG 3.2.2

Marking Criteria/*Nasienriglyne*

- Any appropriate formula/*Enige geskikte formule* ✓
- Correct substitution/*Korrekte vervanging* ✓
- Final answer/*Finale antwoord*: 5,94 to 6,08 $m\cdot s^{-1}$ ✓

OPTION 1/*OPSIE 1*

Upwards positive/*Opwaarts positief*

$v_f = v_i + a\Delta t$ ✓

$0 = v_i + (-9,8)(0,62)$ ✓

$v_i = 6,08\ m\cdot s^{-1}\ (6,076\ m\cdot s^{-1})$ ✓

Downwards positive/*Afwaarts positief*

$v_f = v_i + a\Delta t$ ✓

$0 = v_i + (9,8)(0,62)$ ✓

$v_i = -6,08$

$\therefore 6,08\ m\cdot s^{-1}\ (6,076\ m\cdot s^{-1})$ ✓

OPTION 2/*OPSIE 2*

Upwards positive/*Opwaarts positief*

$\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓

$1,85 = v_i\ (0,62) + ½\ (-9,8)\ (0,62)^2$ ✓

$v_i = 6,02\ m\cdot s^{-1}\ (6,022\ m\cdot s^{-1})$ ✓

Downwards positive/*Afwaarts positief*

$\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓

$1,85 = v_i\ (0,62) + ½\ (9,8)\ (0,62)^2$ ✓

$v_i = -6,02$

$\therefore\ v_i = 6,02\ m\cdot s^{-1}\ (6,022\ m\cdot s^{-1})$ ✓

OPTION 3/*OPSIE 3*

Motion from top to bottom /
Beweging vanaf bo na onder

Downwards positive/*Afwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$v_f^2 = 0 + 2(9,8)(1,85)$ ✓

$v_f = 6,02\ m\cdot s^{-1}$ ✓

initial velocity/*beginsnelheid*=6,02 $m\cdot s^{-1}$

Upwards positive/*Opwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$v_f^2 = 0 + 2(-9,8)(-1,85)$ ✓

$v_f = 6,02\ m\cdot s^{-1}$ ✓

initial velocity/*beginsnelheid*=6,02 $m\cdot s^{-1}$

Motion from bottom to top
Beweging vanaf onder na bo

Downwards positive/*Afwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0^2 = v_i^2 + 2(9,8)(-1,85)$ ✓

$v_i = 6,02\ m\cdot s^{-1}$ ✓

Upwards positive/*Opwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0 = v_i^2 + 2(-9,8)(1,85)$ ✓

$v_i = 6,02\ m\cdot s^{-1}$ ✓

OPTION 4/*OPSIE 4*

Upwards positive/*Opwaarts positief*

$\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓

$0 = v_i(1,23) + ½\ (-9,8)(1,23)^2$ ✓

$v_i = 6,03\ m\cdot s^{-1}$ ✓

Downwards positive/*Afwaarts positief* $\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓

$0 = v_i(1,23) + ½\ (9,8)(1,23)^2$ ✓

$v_i = -6,03\ m\cdot s^{-1}$

speed/*spoed* = 6,03 $m\cdot s^{-1}$ ✓

OPTION 5/*OPSIE 5*

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

$1,85 = \left(\frac{0 + v_i}{2}\right)(0,62)$ ✓

$v_i = 5,97\ m\cdot s^{-1}$ ✓

OPTION 6/*OPSIE 6*

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

$m(9,8)(0,62) = m(0 - v_i)$ ✓

$v_i = 6,08\ m\cdot s^{-1}$ ✓

OPTION 7/*OPSIE 7*

$(E_p + E_k)_{floor/vloer} = (E_p + E_k)_{top/bo}$ ✓

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

$0 + ½\ v^2 = (9,8)(1,85) + 0$ ✓

$v = 6,02\ m\cdot s^{-1}$ ✓

(3)

3.2.4

OPTION/*OPSIE* 1, 2, 3, 4: Marking criteria/*Nasienriglyne*

Calculate initial velocity:
Bereken aanvanklike snelheid:
- Appropriate formula/*Geskikte formule* ✓
- Substitution/*Vervanging* ✓

Calculate/*Bereken* Δt:
- Appropriate formula/*Geskikte formule* ✓
- Substitution/*Vervanging* ✓
- 1,97 s + Δt ✓
- Fin answer/*Fin antwoord*: 2,95 – 2,97 s ✓

Calculate initial velocity: / *Bereken beginsnelheid*

OPTION 1/*OPSIE 1*

Downwards positive/*Afwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0 = v_i^2 + 2(9,8)(-1,2)$ ✓

$v_i = -4,85\ m\cdot s^{-1}$

Upwards positive/*Opwaarts positief*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$0 = v_i^2 + 2(-9,8)(1,2)$ ✓

$v_i = 4,85\ m\cdot s^{-1}$

OPTION 2/*OPSIE 2*

$(E_{mech})_{top} = (E_{mech})_{bot/ond}$
$(E_p + E_k)_{top} = (E_p + E_k)_{Bot/Ond}$
$(mgh + ½mv^2)_{top} = (mgh + ½mv^2)_{Bot/Ond}$
✓Any one/ *Enige een*

$(9,8)(1,2) + 0 = 0 + (½)v^2$ ✓

$v_i = 4,85\ m\cdot s^{-1}$ upwards */opwaarts*

OPTION 3/*OPSIE 3*

$W_{nc} = \Delta E_p + \Delta E_k$
$0 = (0 - mgh) + ½m(v_f^2 - v_i^2)$
✓Any one/ *Enige een*

$0 = -(9,8)(1,2) + ½v_i^2$ ✓

$v_i = 4,85\ m\cdot s^{-1}$ upwards */opwaarts*

OPTION 4/*OPSIE 4*

$W_{net} = \Delta E_k$
$w\Delta x\cos 180° = ½m(v_f^2 - v_i^2)$
✓Any one/ *Enige een*

$(9,8)(1,2)\cos 180° = ½v_i^2$ ✓

$v_i = -4,85\ m\cdot s^{-1}$

Calculate time Δt / *Bereken tyd Δt*

Upwards positive
Opwaarts positief

$\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓

$1,2 = (4,85)\Delta t + ½(-9,8)\Delta t^2$ ✓

$\Delta t = 0,4898\ s / 0,5\ s$

$t = 1,97 + 2(0,4898)$ ✓

$= 2,95\ s / 2,97\ s$ ✓

OR/*OF*

$\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓

$0 = (4,85)\Delta t + ½(-9,8)\Delta t^2$ ✓

$\Delta t = 0,9898\ s$ (or $\Delta t = 0$)

$t = 1,97 + 0,9898$ ✓ $= 2,96\ s$ ✓

Downwards positive
Afwaarts positief

$\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓

$1,2 = (-4,85)\Delta t + ½(9,8)\Delta t^2$ ✓

$\Delta t = 0,4898\ s / 0,5\ s$

$t = 1,97 + 2(0,4898)$ ✓

$= 2,95\ s / 2,97\ s$ ✓

OR/*OF*

$\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓

$0 = (4,85)\Delta t + ½(9,8)\Delta t^2$ ✓

$\Delta t = 0,9898\ s$ (or $\Delta t = 0$)

$t = 1,97 + 0,9898$ ✓ $= 2,96\ s$ ✓

OR/*OF*

$v_f = v_i + a\Delta t$ ✓

$-4,85 = 4,85 + (-9,8)\Delta t$ ✓

$\Delta t = 0,9898\ s$

$\Delta t = 1,97 + 0,9898$ ✓ $= 2,96\ s$ ✓

OR/*OF*

Upwards positive
Opwaarts positief

$v_f = v_i + a\Delta t$ ✓

$0 = 4,85 + (-9,8)\Delta t$ ✓

$\Delta t = 0,4949\ s$

$\Delta t = 1,97 + (2)(0,4949)$ ✓

$= 2,96\ s$ ✓

OR/*OF*

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

$1,2 = \left(\frac{0 + 4,85}{2}\right)\Delta t$ ✓ $\Delta t = 0,4948 s$

$\Delta t_{total} = 2(0,4948) = 0,99\ s$

$\Delta t = 1,97 + 0,99$ ✓ $= 2,96\ s$ ✓

OPTION 5/*OPSIE 5*	**OPTION 5: Marking criteria/ *OPSIE 5: Nasienriglyne***
Downwards positive/*Afwaarts positief* $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $\underline{1,2}$ ✓= $\underline{0 + \frac{1}{2}(9,8)\,\Delta t^2}$✓ $\Delta t = 0,49$ s t = 1,97 + ✓ 2(0,49) ✓ = 2,96 s ✓ Upwards positive/*Opwaarts positief* $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $\underline{-1,2}$ ✓= $\underline{0 + \frac{1}{2}(-9,8)\Delta t^2}$✓ $\Delta t = 0,49$ s t = 1,97 + ✓ 2(0,49) ✓ = 2,96 s ✓	• Formula ✓/*Formule* • Substitution/*Vervanging* $\Delta y = 1,2$ ✓ • Substitution/*Vervanging* $0 + \frac{1}{2}(9,8)\,\Delta t^2$ • 1,97 s + ✓ • 2 Δt ✓ • Final answer/*Finale antwoord*: 2,95 - 2,97 s ✓

(6)
[15]

QUESTION *4/VRAAG 4*

4.1 (Linear) momentum (of an object) is the $\underline{\text{product of mass and velocity}}$. ✓✓
(Liniêre) momentum (van 'n voorwerp) is die $\underline{\text{produk van massa en snelheid.}}$
(2 or/*of* 0) (2)

4.2.1

OPTION 1/*OPSIE 1*
East as positive/*Oos as positief*
$\sum p_i = \sum p_f$ $m_pv_{pi} + m_Qv_{Qi} = m_pv_{pf} + m_Qv_{Qf}$ } ✓Any one/*Enige een* $\underline{(0,16)(10) + (0,2)(-15)}$ ✓= $\underline{(0,16)(-5) + (0,2)v_{Qf}}$ ✓ $v_{Qf} = -3$ m·s^{-1} $v_{Qf} = 3$ m·s^{-1} ✓ west/*wes* ✓
OPTION 2/*OPSIE 2*
West as positive/*Wes as positief*
$\sum p_i = \sum p_f$ $m_pv_{pi} + m_Qv_{Qi} = m_pv_{pf} + m_Qv_{Qf}$ } ✓Any one/*Enige een* $\underline{(0,16)(-10) + (0,2)(15)}$ ✓= $\underline{(0,16)(5) + (0,2)Q_{Nf}}$ ✓ $v_{Qf} = 3$ m·s^{-1} ✓ west/*wes* ✓
OPTION 3/*OPSIE 3*
$\Delta p_p = -\Delta p_Q$ ✓ $\underline{(0,16)(-5 - 10)}$ ✓= $\underline{-(0,2)(v - (-15))}$✓ $v = -3$ m·s^{-1} = 3 m·s^{-1} ✓west/*wes* ✓

(5)

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*
$\Delta K = -1\,200$ 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)cos180° ✓✓ = 0
W_{engine} = 27 215,20 J

OR/*OF*

$W_{net} = \Delta K$ ✓✓
$W_N + W_{engine} + W_{w||} + W_f = 0$
$W_N + W_{engine} + mg\sin\theta\Delta x\cos180^o + W_f = 0$
$0 + W_{engine}$ - (200)(9,8)✓$\left(\frac{13,12}{\Delta x}\right)\Delta x(-1)$ + (50)(2)(15)cos180° ✓✓ = 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)cos0°
= 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]

QUESTION 6/*VRAAG 6*

6.1

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

The change in frequency✓ (or pitch) (of the sound) detected by a listener because the source and the listener have different velocities relative to the medium of propagation. ✓
Die verandering in die frekwensie (of toonhoogte) (van die klank) waargeneem deur 'n luisteraar omdat die bron en die luisteraar verskillende snelhede relatief tot die voortplantingsmedium het.

OR/*OF*
An (apparent) change in (observed/detected) frequency (pitch), as a result of the relative motion between a source and an observer (listener).
'n (Skynbare) verandering in (waargenome) frekwensie (toonhoogte), as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/ luisteraar. (2)

6.2 Towards/*Nader* ✓ (1)

6.3

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

$3148 \checkmark = \left(\frac{340+0}{340-v_s}\right) f_s \checkmark$ $\quad 2073 \checkmark = \left(\frac{340-0}{340+v_s}\right) f_s \checkmark$

$$\frac{3148(340-v_s)}{340+0} = \frac{2073(340+v_s)}{340-0}$$

$v_s = 70\ m \cdot s^{-1} \checkmark$ (69,95 - 70,16 $m \cdot s^{-1}$) (6)

6.4

POSITIVE MARKING FROM QUESTION 6.3
POSITIEWE NASIEN VANAF VRAAG 6.3

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***	**OPTION 3/*OPSIE 3***
$\Delta t = \frac{\Delta x}{v}$ $\Delta t = \frac{350}{70}$ ✓ $\Delta t = 5\ s$ ✓	$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ $350 = 70\Delta t + 0$ ✓ $\Delta t = 5\ s$ ✓	$\Delta x = \left(\frac{v_i + v_f}{2}\right) \Delta t$ $350 = \left(\frac{70+70}{2}\right) \Delta t$ ✓ $\Delta t = 5\ s$ ✓

(2)
[11]

QUESTION 7/*VRAAG 7*

7.1

$$n = \frac{Q}{e} \checkmark$$

$$= \frac{(-)4 \times 10^{-6}}{(-)1,6 \times 10^{-19}} \checkmark$$

$$= 2,5 \times 10^{13} \checkmark$$

(3)

7.2 **Electrostatic force on B due to A:/*Elektrostatiese krag op B a.g.v. A:***

$$F_{AB} = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$= \left[\frac{9 \times 10^{9}\,(4 \times 10^{-6})(3 \times 10^{-6})}{0,2^2}\right] \checkmark$$

Ignore negative signs
Ignoreer negatiewe tekens

$$= 2,7 \text{ N} \checkmark$$

(3)

7.3

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

Electric field is a region (in space) where (in which) an (electric) charge experiences a (electric) force. ✓✓
Elektriese veld is 'n gebied (in die ruimte) waarin 'n (elektriese) lading 'n (elektriese) krag ondervind.

(2)

7.4

Marking criteria/*Nasienriglyne*

- Appropriate formula/*Geskikte formule* ✓
- Correct substitution for A and B/*Korrekte vervanging van A en B* ✓✓
- Subtraction of electric fields/*Aftrek van elektrieseveld*e✓
- Final answer/*Finale antwoord*: 2,3 x10^6 N·C^{-1}✓

OPTION 1/*OPSIE* 1

Electric field at M due to / *Elektriese veld by M as gevolg van*: -4 x10^{-6} C

$E_{AM} = k\frac{Q}{r^2}$ ✓

$= 9\times10^9 \frac{(4\times10^{-6})}{(0,3)^2}$ ✓

= 4,0 x 10^5 N·C^{-1} (to left /*links*)

Electric field at M due to / *Elektriese veld by M as gevolg van*: +3 x10^{-6} C,

$E_{BM} = k\frac{Q}{r^2}$

$= 9x10^9 \frac{(3\times10^{-6})}{(0,1)^2}$ ✓

= 2,7 x10^6 N·C^{-1} (to right /*regs*)

Net electric field at M /*Netto elektrieseveld by M*

$E_{net} = E_{BM} + E_{AM}$

= 4,0 x10^5 – 2,7 x10^6 ✓

= 2,3 x10^6 N·C^{-1} ✓(right/*regs*)

OR/*OF*

Net electric field at M /*Netto elektrieseveld by M*

$E_{net} = E_{BM} + E_{AM}$

= -4,0 x10^5 + 2,7 x10^6 ✓

= - 2,3 x10^6 N·C^{-1}

= 2,3 x10^6 N·C^{-1} ✓ (right)

OPTION 2/*OPSIE* 2

$F_{AM} = \frac{kQ_1Q_2}{r^2} = \frac{(9\times10^9)(4\times10^{-6})Q}{(0,3)^2}$ ✓ = 4 x 10^5Q N

$F_{BM} = \frac{kQ_1Q_2}{r^2} = \frac{(9\times10^9)(3\times10^{-6})Q}{(0,1)^2}$ ✓ = 2,7 x 10^6Q N

F_{net} = 2,7 x 10^6Q + (-4 x 10^5Q)✓ = 2,3 x 10^6Q

$E = \frac{F}{q}$ ✓= $\frac{2,3\times10^6Q}{Q}$ = 2,3 x 10^6 N·C^{-1} ✓(right/*regs*)

(5)

7.5 Positive/*Positief* ✓ (1)

7.6

POSITIVE MARKING FROM 7.2/*POSITIEWE NASIEN VANAF 7.2*

Marking criteria/*Nasienriglyne*

- Correct substitution into Pythagoras's equation/*Korrekte vervanging in Pythagoras se vergelyking* ✓
- Correct substitution into Coulomb's Law/*Korrekte vervanging in Coulomb se wet* ✓
- Correct answer/*Korrekte antwoord* ✓

$(F_{net})^2 = (F_{AD})^2 + (F_{AB})^2$

$\underline{(7,69)^2 = (F_{AD})^2 + (2,7)^2}$ ✓

$F_{AD} = 7,2$ N

$F_{AD} = \frac{kQ_1Q_2}{r^2}$

$7,2 = \frac{(9\times10^9)(4\times10^{-6})Q}{(0,15)^2}$ ✓

$Q_D = 4,5 \times 10^{-6}$ C ✓

OR/*OF*

$F_{AD} = k\frac{Q_1Q_2}{r^2}$

$= 9\times10^9 \frac{(4\times10^{-6})Q}{0,15^2}$ ✓

$= 1,6 \times 10^6$ Q

$F_{net} = \sqrt{F_{AB}^{\ 2} + F_{AD}^{\ 2}}$ **OR/*OF*** $F_{net}^{\ 2} = F_{AB}^{\ 2} + F_{AD}^{\ 2}$

$7,69 = \sqrt{2,7^2 + (1,6\times10^6 Q)^2}$ ✓

$Q = 4,50 \times 10^{-6}$ C ✓

(3)

[17]

QUESTION 8/*VRAAG 8*

8.1

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

(Maximum) energy provided (work done) by a battery per coulomb/unit charge passing through it. ✓✓
(Maksimum) energie verskaf (arbeid verrig) deur 'n battery per coulomb/ eenheidslading wat daardeur beweeg.

Work done by the battery to move a unit coulomb of charge across the circuit./*Arbeid verrig deur die battery om 'n eenheidslading oor die stroombaan te beweeg*. (2)

8.2 Energy (per coulomb of charge) is converted to heat in the battery due to the internal resistance. ✓✓
Energie (per coulomb lading) word na hitte omskep binne-in die battery a.g.v. interne weerstand. (2)

8.3.1

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

$$I = \frac{1,5}{0,5} \checkmark$$

$= 3\ A$ ✓ (3)

8.3.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓	$R_p = \frac{R_1 R_2}{R_1 + R_2}$ ✓
$\frac{1}{R_P} = \frac{1}{25} + \frac{1}{15}$ ✓	$R_p = \frac{(25)(15)}{25+15}$ ✓
$R_p = 9,375\ \Omega$	$R_p = 9,375\ \Omega$
$R_{ext} = 9,375$ + 4 ✓ = 13,38 Ω ✓ (13,375 Ω)	$R_{ext} = 9,375$ + 4 ✓ = 13,38 Ω ✓ (13,375 Ω)

(4)

8.3.3

POSITIVE MARKING FROM QUESTIONS 8.3.1 AND 8.3.2. ***POSITIEWE NASIEN VANAF VRAAG 8.3.1 EN 8.3.2.***
OPTION 1/*OPSIE 1*
$\mathcal{E} = I(R + r)$ ✓ $= 3(13,38 + 0,5)$ ✓ $= 41,64$ V ✓ (Range/*Gebied:* 41,625 – 41,64)
OPTION 2/*OPSIE 2*
$\mathcal{E} = V_{ext/eks} + V_{int}$ ✓ $= (3)(13,38) + 1,5$ ✓ $= 41,64$ V ✓ (Range/*Gebied:* 41,625 – 41,64)

(3)

8.4 Yes. ✓/*Ja*

For the same voltage/potential difference, ✓
a larger current will flow through a smaller resistor ($I = \frac{V}{R}$) ✓
Vir dieselfde spanning/ potensiaalverskil
sal 'n groter stroom deur die kleiner weerstand vloei ($I = \frac{V}{R}$).

OR/*OF*

$I \alpha \frac{1}{R}$ ✓, V = constant /*konstant*✓
I is inversely proportional to R and V is constant.
I is omgekeerd eweredig aan R en V is konstant.

OR/*OF*

$V_{||} = IR$
$= (3)(9,38)$
$= 28,14$ V

$I_{R2} = \frac{V}{R} = \frac{28,14}{25} = 1,13$ A ✓
$I_{R3} = \frac{V}{R} = \frac{28,14}{15} = 1,88$ A ✓

OR/*OF*

V is the same / *V is dieselfde* ✓

$I_{15\Omega} = \frac{25}{40} I$
$I_{25\Omega} = \frac{15}{40} I$ ✓

(3)

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

[18]

QUESTION 9/*VRAAG 9*

9.1.1 (DC) motor/*(GS-)motor* ✓ (1)

9.1.2 **POSITIVE MARKING FROM QUESTION 9.1.1**
POSITIEWE NASIEN VANAF VRAAG 9.1.1
Electrical to mechanical /kinetic (energy) ✓✓ **(2 or 0)**
Elektriese na meganiese/kinetiese (energie) ***(2 of 0)*** (2)

9.1.3 Split ring/commutator/*Splitring/kommutator* ✓ (1)

9.1.4 Anticlockwise/*antikloksgewys* ✓✓ (2)

9.2.1 (The rms voltage/value of AC is) the AC voltage/potential difference which dissipates the same amount of energy/heat/power as an equivalent DC voltage/potential difference. ✓✓ **(2 or 0)**
(Die wgk-waarde van WS is) die WS-potensiaalverskil/spanning wat dieselfde hoeveelheid energie/hitte/drywing verbruik as 'n ekwivalente GS-spanning/potensiaalverskil. **(*2 of 0*)**

ACCEPT/*AANVAAR*
The rms voltage/value of AC is the DC potential difference which dissipates the same amount of energy/heat/power as AC.
Die wgk-waarde van WS is die GS-potensiaalverskil wat dieselfde hoeveelheid energie/hitte/drywing verbruik as die WS. (2)

9.2.2

Marking criteria/*Nasienriglyne*
- Appropriate formula for P_{ave}/*Geskikte formule* vir P_{ave} ✓
- Substitution to calculate/*Vervanging vir berekening van* R ✓
- Final answer/*Finale antwoord*: 242 Ω ✓

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***	**OPTION 3/*OPSIE 3***
$P_{ave} = \frac{V_{rms}^2}{R}$ ✓ $200 = \frac{220^2}{R}$ ✓ R = 242 Ω ✓	$P_{ave} = V_{rms}I_{rms}$ ✓ $200 = I_{rms}(220)$ I_{rms} = 0,909 A (0,91) $R = \frac{V_{rms}}{I_{rms}}$ or/*of* $R = \frac{V}{I}$ $R = \frac{220}{0,909}$ ✓ R = 242 Ω ✓ (241,76 Ω)	$P_{ave} = V_{rms}I_{rms}$ ✓ $200 = I_{rms}(220)$ I_{rms} = 0,909 A(0,91) $P_{ave} = I_{rms}^2R$ $200 = (0,909)^2R$ ✓ R = 242 Ω ✓ (241,52 Ω)

(3)

9.2.3

Marking criteria for options 1,2 and 3 /*Nasienriglyne vir opsies 1,2 en 3*

- Appropriate formula to calculate P or I_{rms} /*Geskikte formule om* P *of* I_{rms} te bereken ✓
- Substitution/*Vervanging* ✓
- Formula for P or W containing Δt/*Formule vir P of W wat Δt bevat* ✓
- Substitution/*Vervanging* ✓
- Final answer/Finale antwoord: 55 785,12 J ✓

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

OPTION 1/*OPSIE 1*
Marking criteria / *Nasienriglyne*

- Appropriate formula for W containing V/*Geskikte formule vir W wat V bevat* ✓✓
- Substitution/*Vervanging* ✓✓
- Final answer/*Finale antwoord*: 55 785,12 J ✓

$$W = \frac{V^2\Delta t}{R} \checkmark\checkmark$$
$$= \frac{(150^2)(10 \times 60)}{242} \checkmark \checkmark$$
$$= 55\,785{,}12 \text{ J} \checkmark$$

OPTION 2/*OPSIE 2*

$$P_{ave} = \frac{V_{rms}^2}{R} \checkmark$$
$$= \frac{150^2}{242} \checkmark$$
P_{av} = 92,975 W
$$P = \frac{W}{\Delta t} \checkmark$$
$$92{,}975 = \frac{W}{(10)(60)} \checkmark$$
W = 55 785,12 J ✓
(55785,12 – 55896 J)

OPTION 3/*OPSIE 3*

$$R = \frac{V_{rms}}{I_{rms}} \checkmark / \ R = \frac{V}{I}$$
$$242 = \frac{150}{I_{rms}} \checkmark$$
I_{rms} = 0,620 A
$P_{ave} = I_{rms}V_{rms}$
= (0,62)(150)
= 92,97 W (93 W)
$$P = \frac{W}{\Delta t} \checkmark$$
$$92{,}975 = \frac{W}{(10)(60)} \checkmark$$
W = 55 785,12 J ✓
(55785,12 – 55896 J)

OPTION 4/*OPSIE 4*

$$R = \frac{V_{rms}}{I_{rms}} \checkmark / \ R = \frac{V}{I}$$
$$242 = \frac{150}{I_{rms}} \checkmark$$
I_{rms} = 0,620 A
$W = I^2R\Delta t$ ✓
$= (0{,}62)^2(242)(10)(60)$ ✓
= 55 814,88 J ✓
(55785,12 – 55896 J)

OR/*OF*
W = VIΔt
= (150)(0,62)(600)
= 55 800 J

OPTION 5/*OPSIE 5*

$$P_{ave} = \frac{V_{rms}^2}{R} \checkmark = \frac{150^2}{242} \checkmark = 92{,}975 \text{ W}$$
$P_{ave} = I_{rms}^2R$
$92{,}975 = I_{rms}^2(242)$
I_{rms} = 0,6198 A
$W = I^2R\Delta t$ ✓
$= (0{,}6198)^2(242)(10)(60)$ ✓
= 55 778,88 J ✓

(5)
[16]

QUESTION 10/*VRAAG 10*

10.1 Photoelectric effect/*Fotoëlektriese effek* ✓ (1)

10.2 Work function (of potassium)/*Werksfunksie/Arbeidsfunksie (van kalium)* ✓ (1)

10.3 Potassium/*Kalium* ✓
It has the lowest work function / threshold frequency / highest threshold wavelength. ✓
Dit het die laagste arbeidsfunksie / drumpelfrekwensie / hoogste drumpel golflengte. (2)

10.4

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

The work function of a metal is the minimum energy that an electron (in the metal) needs✓ to be emitted/ejected from the metal / surface. ✓
Die werkfunksie/arbeidsfunskie van 'n metaal is die minimum energie benodig om 'n elektron vanaf 'n oppervlak / metaal vry te stel. (2)

10.5.1 $W_o = hf_o$ ✓
$= (6{,}63 \times 10^{-34})(1{,}75 \times 10^{15})$ ✓
$= 1{,}160 \times 10^{-18}$ J ✓

OR/*OF*
$E = W_o + E_{k(max)}$
$hf = W_o + E_{k(max)}$
✓ Any one / *Enigeen*
$(6{,}63 \times 10^{-34})(1{,}75 \times 10^{15}) = W_o + 0$ ✓
$W_o = 1{,}160 \times 10^{-18}$ J ✓ (3)

10.5.2 **POSITIVE MARKING FROM QUESTION 10.5.1.**
POSITIEWE NASIEN VANAF VRAAG 10.5.1.

$E = W_0 + E_{k(max)}$
$hf = hf_o + \frac{1}{2}mv_{max}^2$
✓Any one/*Enige een*

$(6{,}63 \times 10^{-34})f$ ✓ $= 1{,}160 \times 10^{-18} + \frac{1}{2}(9{,}11 \times 10^{-31})(5{,}60 \times 10^{5})^2$ ✓

$\therefore f = 1{,}97 \times 10^{15}$ Hz ✓ (4)
[13]

TOTAL/*TOTAAL*: 150