basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

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

NOVEMBER 2014

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 20 pages.
Hierdie memorandum bestaan uit 20 bladsye.

QUESTION 1/*VRAAG 1*

1.1 A ✓✓ (2)

1.2 A ✓✓ (2)

1.3 D ✓✓ (2)

1.4 C ✓✓ (2)

1.5 B ✓✓ (2)

1.6 C ✓✓ (Accept/ *Aanvaar* R) (2)

1.7 A ✓✓ (2)

1.8 D ✓✓ (2)

1.9 A ✓✓ (2)

1.10 C ✓✓ (2)

[20]

QUESTION 2/*VRAAG 2*

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

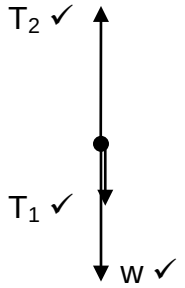
Wanneer 'n resulterende (netto) krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Hierdie versnelling is direk eweredig aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

OR/*OF*

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

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

2.2



(3)

2.3

OPTION 1/*OPSIE 1*

F_{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*

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

$250 - (5)(9,8) - T_1$✓$= 5\ a$ ✓

$201 - T_1 = 5\ a$

$T_1 = 201 - 5a$.....(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:***
$\Delta y = v_i\Delta t + ½\ a\Delta t^2$✓	$\Delta y = v_i\Delta t + ½\ a\Delta t^2$✓
0 ✓$= 15\ \Delta t + ½\ (-9,8)\ \Delta t^2$✓	0✓ $= -15\ \Delta t + ½\ (9,8)\ \Delta t^2$✓
$\Delta t = 3,06$ 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)

OPTION 4/*OPSIE 4*	
Upwards positive/*Opwaarts positief:*	**Downwards positive /*Afwaarts positief:***
$F_{net}\ \Delta t = \Delta p$✓ $mg\ \Delta t = m\ (v_f - v_i)$ $\Delta t = \frac{(0-15)}{-9,8}$ ✓✓ Δt = 1,53 s It takes/*Dit neem* (2)(1,53s) = 3,06 s✓	$F_{net}\ \Delta t = \Delta p$✓ $mg\ \Delta t = m\ (v_f - v_i)$ $\Delta t = \frac{0-(-15)}{9,8}$ ✓✓ Δt = 1,53 s It takes/*Dit neem* (2)(1,53s) = 3,06 s✓

(4)

OPTION 5/*OPSIE 5*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$F_{net}\ \Delta t = \Delta p$✓ $mg\ \Delta t = m\ (v_f - v_i)$ $\Delta t = \frac{-15-(15)}{-9,8}$ ✓✓ = 3,06 s✓	$F_{net}\ \Delta t = \Delta p$✓ $mg\ \Delta t = m\ (v_f - v_i)$ $\Delta t = \frac{15-(-15)}{9,8}$ ✓✓ Δt = 3,06 s✓

(4)

OPTION 5/*OPSIE 6*	
Upwards positive/*Opwaarts positief:*	**Downwards positive/*Afwaarts positief:***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ For ball A/*Vir bal A* $0 = (15)^2 + 2\ (-9,8)\Delta y$✓ Δy_A = 11,48 m $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ $11,48 = \left(\frac{15+0}{2}\right)\Delta t$ ✓ Δt = 1,53 s It takes/*Dit neem* (2)(1,53s) = 3,06 s✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ For ball A/*Vir bal A* $0 = (-15)^2 + 2\ (9,8)\Delta y$✓ Δy_A = -11,48 m $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ $-11,48 = \left(\frac{-15+0}{2}\right)\Delta t$ ✓ Δt = 1,53 s It takes/*Dit neem* (2)(1,53s) = 3,06 s✓

3.3

OPTION 1/*OPSIE 1*

Upwards positive/*Opwaarts positief:*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
For ball A/*Vir bal A*
$0 = (15)^2$✓ + 2 (-9,8)Δy✓
Δy_A = 11,48 m

When A is at highest point
Wanneer A op hoogste punt is

$\Delta y_B = v_i\Delta t + ½ a\Delta t^2$
$= 0 + ½ (-9,8) (1,53)^2$✓✓
Δy_B = -11,47 m
Δy_B = 11,47 m downward/*afwaarts*

Distance/*Afstand* = $y_A + y_B$
= 11,47 + 11,48 ✓
= 22,95 m✓

Downwards positive/*Afwaarts positief:*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
For ball A/*Vir bal A*
$0 = (-15)^2$✓ + 2 (9,8)Δy✓
Δy_A = -11,48 m

When A is at highest point
Wanneer A op hoogste punt is

$\Delta y_B = v_i\Delta t + ½ a\Delta t^2$
$= 0 + ½ (9,8) (1,53)^2$✓✓
Δy_B = 11,47 m
Δy_B = 11,47 m downward/*afwaarts*

Distance/*Afstand* = $y_A + y_B$
= 11,48 + 11,47 ✓
= 22,95 m✓

OPTION 2/*OPSIE 2*

Upwards positive/*Opwaarts positief:*

At maximum height $v_f = 0$:
By maksimum hoogte $v_f = 0$:

Ball/*Bal* A
$\Delta y_A = v_i\Delta t + ½ a\Delta t^2$✓
= 15 (1,53) ✓ + ½ (-9,8) $(1,53)^2$✓
= 11,48 m

When A is at highest/point
Wanneer A op hoogste punt is

$\Delta y_B = v_i\Delta t + ½ a\Delta t^2$
$= 0 + ½ (-9,8) (1,53)^2$✓✓
Δy_B = -11,47 m
Δy_B = 11,47 m downward/*afwaarts*

Distance/*Afstand* = $y_A + y_B$
= 11,48 + 11,47✓
= 22,95 m✓

Downwards positive/*Afwaarts positief:*

At maximum height $v_f = 0$:
By maksimum hoogte $v_f = 0$:

Ball/*Bal* A
$\Delta y_A = v_i\Delta t + ½ a\Delta t^2$✓
= (-15) (1,53) ✓+ ½ (9,8) $(1,53)^2$✓
= -11,48 m

When A is at highest point
Wanneer A by hoogste punt is

$\Delta y_B = v_i\Delta t + ½ a\Delta t^2$
$= 0 + ½ (-9,8) (1,53)^2$✓✓
Δy_B = -11,47 m
Δy_B = 11,47 m downward/*afwaarts*

Distance/*Afstand* = ($y_A + y_B$)
= 11,48 + 11,47 ✓
= 22,95 m✓ (7)

OPTION 3/*OPSIE 3*

Upwards positive/*Opwaarts positief:*

Ball A/*Bal A*

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

$\Delta y_A = 15(1,53)$ ✓$+ \frac{1}{2}(-9,8)(1,53)^2$✓

$= 11,48$ m

For ball B/*Vir bal B*

$v_f = v_i + a\Delta t$

$v_f = 0 + (-9,8)(1,53)$

$v_f = 14,99\ m\cdot s^{-1}$

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

$14,99^2$✓ $= 0 + 2(-9,8)\ \Delta y_B$✓

$\Delta y_B = -11,47$ (m)

$= 11,47$ m downward/*afwaarts*

Distance/*Afstand* $= (y_A + y_B)$

$= 11,48 + 11,47$✓

$= 22,95$ m✓

Downwards positive/*Afwaarts positief:*

Ball A/*Bal A*

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

$\Delta y_A = -15\ (1,53)$ ✓ $+ \frac{1}{2}(9,8)(1,53)^2$✓

$= -11,48$ (m)

$= 11,48$ m upward/*opwaarts*

For ball B/*Vir bal B*

$v_f = v_i + a\Delta t$

$v_f = 0 + (9,8)(1,53)$

$v_f = 14,99\ m\cdot s^{-1}$

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

$14,99^2$ ✓$= 0 + 2(9,8)\ \Delta y_B$✓

$\Delta y_B = 11,47$ (m)

Distance/*Afstand* $= (y_A + y_B)$

$= 11,48 + 11,47$✓

$= 22,95$ m✓

(7)

OPTION 4/*OPSIE 4*

Upwards positive/*Opwaarts positief:*

Ball A/*Bal A*

$\Delta y_A = \frac{v_i + v_f}{2}\Delta t$ ✓ $= \frac{(15 + 0)}{2}$ ✓ $(1,53)$ ✓

$= 11,48$ m

For ball B/*Vir bal B*

$v_f = v_i + a\Delta t$

$= 0 + (-9,8)(1,53)$

$= -15\ m\cdot s^{-1}$

$\Delta y = \frac{v_i + v_f}{2}\Delta t = \frac{(0 - 15)\times 1,53}{2}$ ✓

$= -11,47$ m

$= 11,47$ m downward/*afwaarts*

Distance/*Afstand* $= (y_A + y_B)$

$= 11,48 + 11,47$✓

$= 22,95$ m✓

Downwards positive/*Afwaarts positief:*

Ball A/*Bal A*

$\Delta y_A = \frac{v_i + v_f}{2}\Delta t$ ✓ $= \frac{(-15 + 0)}{2}$ ✓ $(1,53)$ ✓

$= -11,48$ (m)

$= 11,48$ m upwards/*opwaarts*

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

$= 0 + (9,8)(1,53)$

$= 15\ m\cdot s^{-1}$

$\Delta y = \frac{v_i + v_f}{2}\Delta t = \frac{(0 + 15)\times 1,53}{2}$ ✓

$= 11,47$m

Distance/*Afstand* $= y_A + y_B$

$= 11,48 + 11,47$✓

$= 22,95$ m✓

(7)

OPTION 5/*OPSIE 5*

Upwards positive/*Opwaarts positief:*

Ball A/*Bal A*
$W_{net} = \Delta K$✓

OR/*OF*
$\frac{1}{2} m(v_f^2 - v_i^2) = mg(h_f - h_i)\cos\theta$
$\frac{1}{2} m(0 - 15^2)$ ✓$= m(9,8)h_f\cos 180^o$ ✓
h = 11,48 m

OR/*OF*
For Ball B when A is at highest point./ *Vir Bal B wanneer A by sy hoogste punt is.*

$v_f = v_i + a\Delta t$
$= 0 + (-9,8)(1,53) = -15\ m\cdot s^{-1}$ ✓
$\Delta y = \frac{v_i + v_f}{2}\Delta t = \frac{(0 - 15) \times 1,53}{2}$ ✓
=-11,48 m
= 11,48 m downward/*afwaarts*

Distance/*Afstand* = $y_A + y_B$
= 11,48 + 11,48✓
= 22,96 m✓

Downwards positive/*Afwaarts positief:*

Ball A/*Bal A*
$W_{net} = \Delta K$✓

OR/*OF*
$\frac{1}{2} m(v_f^2 - v_i^2) = mg(h_f - h_i)\cos\theta$
$\frac{1}{2} m(0 - 15^2)$ ✓$= m(9,8)h_f\cos 180^o$ ✓
h = 11,48 m

OR/*OF*
For Ball B when A is at highest point./ *Vir Bal B wanneer A by sy hoogste punt is.*

$v_f = v_i + a\Delta t$
$= 0 + (9,8)(1,53) = 15\ m\cdot s^{-1}$ ✓
$\Delta y = \frac{v_i + v_f}{2}\Delta t = \frac{(0 + 15)(1,53)}{2}$ ✓
= 11,48 m downward/*afwaarts*

Distance/*Afstand* = $y_A + y_B$
= 11,48 + 11,48✓
= 22,96 m✓

(7)

OPTION 7/*OPSIE 7*

Upwards positive/*Opwaarts positief:*
Ball A
$\frac{1}{2} m v_i^2 + mgh_i = \frac{1}{2} m v_f^2 + mgh_f$✓
$\frac{1}{2} m(15^2)$ ✓ $+0 = \frac{1}{2} m(0) + m(9,8)h$ ✓
h = 11,48 m

OR/*OF*
For Ball B when A is at highest point.
Vir Bal B wanneer A by sy hoogste punt is.

$v_f = v_i + a\Delta t$
$= 0 + (-9,8)(1,53)$
$= -15\ m\cdot s^{-1}$
$\Delta y = \frac{v_i + v_f}{2}\Delta t$ ✓
$= \frac{(0 - 15)(1,53)}{2}$ ✓
=-11,48 m
= 11,48 m downward/*afwaarts*
Distance/*Afstand* = $y_A + y_B$
= 11,48 + 11,48✓
= 22,96 m✓

Downwards positive/*Afwaarts positief:*
Ball A
$\frac{1}{2} m v_i^2 + mgh_i = \frac{1}{2} m v_f^2 + mgh_f$✓
$\frac{1}{2} m(15^2)$ ✓ $+0 = \frac{1}{2} m(0) + m(9,8)h$ ✓
h = 11,48 m

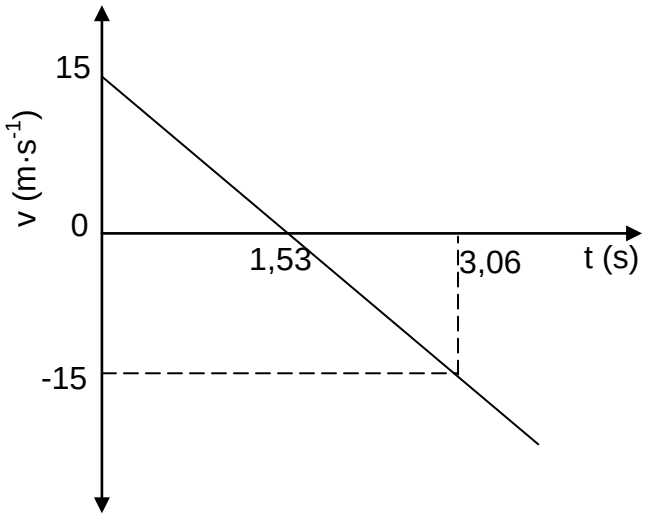
OR/*OF*
For Ball B when A is at highest point.
Vir Bal B wanneer A by sy hoogste punt is.

$v_f = v_i + a\Delta t$
$= 0 + (9,8)(1,53)$
$= 15\ m\cdot s^{-1}$
$\Delta y = \frac{v_i + v_f}{2}\Delta t$ ✓
$= \frac{(0 + 15)(1,53)}{2}$ ✓
= 11,48 m downward/*afwaarts*

Distance/*Afstand* = $y_A + y_B$
= 11,48 + 11,48✓
= 22,96 m✓

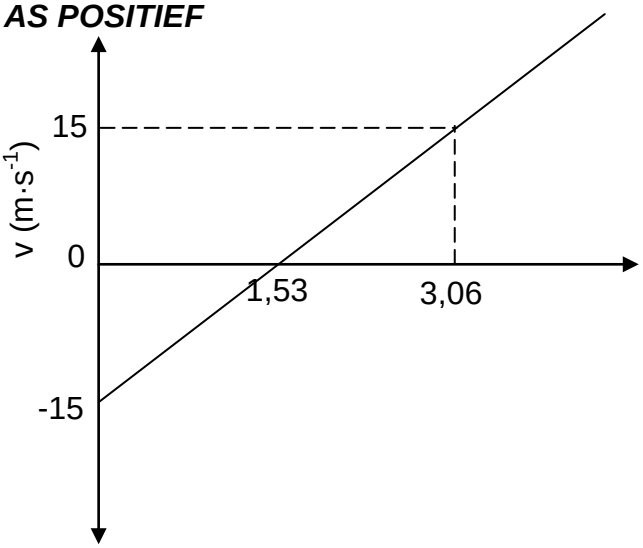
(7)

3.4



(4)
[17]

CONSIDER MOTION DOWNWARD AS POSITIVE/*BESKOU BEWEGING AFWAARTS AS POSITIEF*



Criteria/*Kriteria*	**Marks/*Punte***
Graph starts at correct Initial velocity shown./*Grafiek begin by korrekte beginsnelheid aangetoon.*	✓
Time for maximum height shown (1,53 s)./*Tyd vir maksimum hoogte aangetoon.(1,53 s)*	✓
Time for return shown (3,06 s) /*Tyd om terug te keer (3,06) aangetoon.*	✓
Shape/*Vorm*: Straight line extending beyond 3,06 s/ *Reguitlyn wat verby 3,06 s strek.*	✓

(4)
[17]

QUESTION 4/*VRAAG 4*

4.1 $p = mv$✓
$= 50(5)$✓
$= 250\ kg{\cdot}m{\cdot}s^{-1}$✓ (downward/*afwaarts)*

OR/*OF*
$p = mv$✓
$= 50(-5)$✓
$= -250\ kg{\cdot}m{\cdot}s^{-1}$
$= 250\ kg{\cdot}m{\cdot}s^{-1}$✓ (downward/*afwaarts)* (3)

4.2 The product of the (net) force and the time interval (during which the force acts)✓✓ (2 or 0)
Die produk van die (netto) krag en die tydinterval (waartydens die krag inwerk) (2 of 0). (2)

4.3

OPTION 1/*OPSIE 1*		
$\Delta p = F_{net}\Delta t$✓ $0 - 250$ ✓$= F_{net}(0,2)$ $F_{net} = -1\ 250\ N$ $= 1\ 250\ N$ ✓	$\Delta p = F_{net}\Delta t$✓ $250 - 0$ ✓$= F_{net}(0,2)$ $F_{net} = 1\ 250\ N$ ✓	$\Delta p = F_{net}\Delta t$✓ $50(0 - (-5))$✓$= F_{net}(0,2)$ $F_{net} = 1\ 250\ N$ ✓

(3)

OPTION 2/*OPSIE 2*	
$m(v_f - v_i) = F_{net}\Delta t$✓ $50\ (0 - 5)$ ✓$= F_{net}\ (0,2)$ $F_{net} = -1\ 250\ N$ $= 1\ 250\ N$ ✓	$m(v_f - v_i) = F_{net}\Delta t$✓ $50\ (5 - 0)$ ✓$= F_{net}\ (0,2)$ $F_{net} = 1\ 250\ N$ ✓

(3)

OPTION 3 /*OPSIE 3*	
$v_f = v_i + a\Delta t$ $0 = 5 + a(0,2)$ ✓ $a = -25\ m{\cdot}s^{-2}$ $F_{net} = ma$✓ $= 50\ (-25)$ $= -1\ 250\ N$ $= 1\ 250\ N$✓	$v_f = v_i + a\Delta t$ $5 = 0 + a(0,2)$ ✓ $a = 25\ m{\cdot}s^{-2}$ $F_{net} = ma$✓ $= 50\ (25)$ $= 1\ 250\ N$✓

(3)

4.4 Greater than/*Groter as*✓ (1)

4.5 For the same momentum change, ✓
the stopping time (contact time) ✓will be smaller (less) ✓
∴ the (upward) force exerted (on her) is greater.
Vir dieselfde verandering in momentum,
sal die stilhoutyd (kontaktyd) kleiner wees
∴ *die (opwaartse)krag wat (op haar) uitgeoefen word, sal groter wees.* (3)
[12]

QUESTION 5/*VRAAG 5*

5.1.1 In an isolated/closed system, ✓ the total mechanical energy is conserved / remains constant ✓
In 'n geïsoleerde/geslote sisteem bly die totale meganiese energie behoue / bly konstant.

OR/*OF*
The total mechanical energy of a system is conserved/ remains constant ✓ in the absence of friction.✓
Die totale meganiese energie van 'n sisteem bly behoue/bly konstant in die afwesigheid van wrywing.

OR/*OF*
The total mechanical energy of a system remains constant ✓provided the net work done by external non conservative forces is zero.✓
Die totale meganiese energie van 'n sisteem bly konstant, mits die arbeid verrig deur eksterne nie-konserwatiewe kragte, nul is.

OR/*OF*
In the absence of a non-conservative force, the total mechanical energy is conserved/remains constant
In die afwesigheid van 'n nie-konserwatiewe krag, bly die totale meganiese energie behoue / konstant

OR/*OF*
In an isolated/closed system, ✓ the sum of kinetic and gravitational potential energy is conserved / remains constant ✓
In 'n geïsoleerde/geslote sisteem bly som van kinetiese en gravitasionele potensiële energie behoue / bly konstant.

5.1.2 No/*Nee*✓ (1)

5.1.3

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

(6)

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

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

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

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

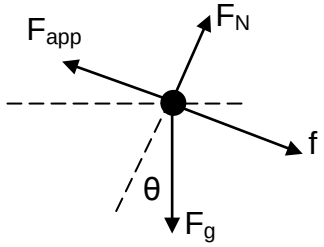
<u>OPTION 2/*OPSIE 2*</u>
Along **AC**/*Langs* **AC**

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

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

5.2.2

<u>OPTION 1/*OPSIE 1*</u>



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

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

OPTION 2/*OPSIE 2*

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

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

OPTION 3/*OPSIE 3*

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

$P_{ave} = Fv_{ave}$✓
= (1 748,76)(0,5)✓
= 874,38 W✓ (6)
[18]

QUESTION 6/*VRAAG 6*

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

6.1.2 Towards/*Na*✓

Observed/detected frequency is greater than the actual frequency.✓
Waargenome frekwensie is groter as die werklike frekwensie. (2)

6.1.3 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ **OR/*OF*** $f_L = \frac{v}{v - v_s} f_s$ ✓

$(1200)^{\checkmark} = \frac{343^{\checkmark}}{343 - v_s} 1130$ ✓
v_s = 20,01 m·s^{-1}✓
Accept/*Aanvaar:* (19,42 – 20,01 m·s^{-1}) (5)

6.2 The star is approaching the earth. ✓
Die ster nader die aarde.
OR/*OF*
The earth and the star are approaching (moving towards) each other.✓
Die aarde en die ster nader mekaar.

The spectral lines in diagram 2 are shifted towards the blue end/blue shifted.✓ (2)
Die spektrumlyne in diagram 2 het verskuif na die blou ent/blou verskuiwing **[11]**

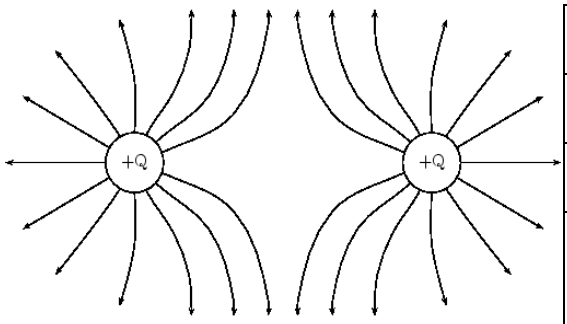
QUESTION 7/*VRAAG 7*

7.1 To ensure that charge does not leak to the ground/insulated. ✓
Om te verseker dat die lading nie na die grond toe lek nie/isoleer. (1)

Notes/*Aantekeninge*
Accept/*Aanvaar* In order retain original charge✓/To insulate the charges./ *Om oorspronklike lading te behou/ Om lading te isoleer.*

7.2 Net charge/*Netto lading* = $\frac{Q_R + Q_S}{2} = \frac{+8 + (-4)}{2}$ ✓= 2 µC✓ (2)

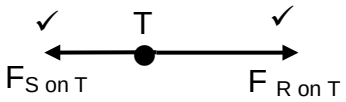
7.3



Criteria for sketch:/*Kriteria vir skets:*	Marks/ *Punte*
Correct direction of field lines *Korrekte rigting van veldlyne*	✓
Shape of the electric field *Vorm van elektrieseveld*	✓
No field line crossing each other / No field lines inside the spheres/ *Geen veldlyne wat maekaar kruis nie / Geen veldlyne binne sfeer nie*	✓

(3)

7.4



(2)

7.5

OPTION 1/*OPSIE 1*

$F = k\frac{Q_1Q_2}{r^2}$ ✓

$F_{ST} = (9\times10^9)\frac{(1\times10^{-6})(2\times10^{-6})}{(0,2)^2}$ ✓ ✓ = 0,45 N / 4,5 x 10^{-1} N left/*links*

OR/*OF*

$F_{TS} = \frac{1}{4}F_{RT} = \frac{1}{4}(1,8) = 0,45$ N

$F_{RT} = 9\times10^9 \times \frac{(2\times10^{-6})(1\times10^{-6})}{(0,1)^2}$ ✓ = 1,8 N right/*regs*

OR/*OF*

$F_{RT} = 4F_{ST} = 4(0,45) = 1,8$ N right /*regs*

$F_{net} = F_{ST} + F_{RT} = \underline{1,8 + (-0,45)}$ ✓

= <u>1,35 N</u> or towards sphere S / *na sfeer* or/*of* <u>right/*regs S*</u>✓ (6)

OPTION 2/*OPSIE 2*

$E_R = \frac{kQ}{r^2} = \frac{(9\times10^9)(2\times10^{-6})}{(0,1)^2}$ ✓= 1,8 x 10^6 N.C^{-1} right/*regs*

$E_s = \frac{kQ}{r^2} = \frac{(9\times10^9)(2\times10^{-6})}{(0,2)^2}$ ✓= 4,5 x 10^5 N.C^{-1} left/*links*

E_{net} = 1,8 x 10^6 - 4,5 x 10^5 ✓= 1,35 x 10^6 N.C^{-1}right/*regs*

F = EQ ✓= (1,35 x 10^6)(1 x 10^{-6}) ✓
= 1,35 N towards sphere S / na sfeer S right/*regs* ✓ (6)

7.6 Force experienced ✓per unit positive charge ✓placed at that point.
Krag ondervind per eenheid positiewe lading by daardie punt. (2)

7.7

OPTION 1/*OPSIE 1*

$E = \frac{F}{q}$ ✓ = $\frac{1,35}{1\times10^{-6}}$ ✓= 1,35 x 10^6 N·C^{-1}✓ (3)

OPTION 2/*OPSIE 2*

$E_R = \frac{kQ}{r^2}$ ✓ = $\frac{(9\times10^9)(2\times10^{-6})}{(0,1)^2}$ ✓= 1,8 x 10^6 N·C^{-1} right/*regs*

$E_s = \frac{kQ}{r^2} = \frac{(9\times10^9)(2\times10^{-6})}{(0,2)^2}$ = 4,5 x 10^5 N·C^{-1} left/*links*

E_{net} = 1,8 x 10^6 - 4,5 x 10^5 = 1,35 x 10^6 N·C^{-1}✓ (3)

OPTION 3/*OPSIE 3*

$E = \frac{F}{q}$ ✓ = $\frac{1,8}{1\times10^{-6}}$ ✓= 1,8 x 10^6 N·C^{-1}

$E = \frac{F}{q} = \frac{0,45}{1\times10^{-6}}$ = 4,5 x 10^5 N·C^{-1}

E_{net} = 1,8 x 10^6 - 4,5 x 10^5 = 1,35 x 10^6 N·C^{-1}✓ (3)

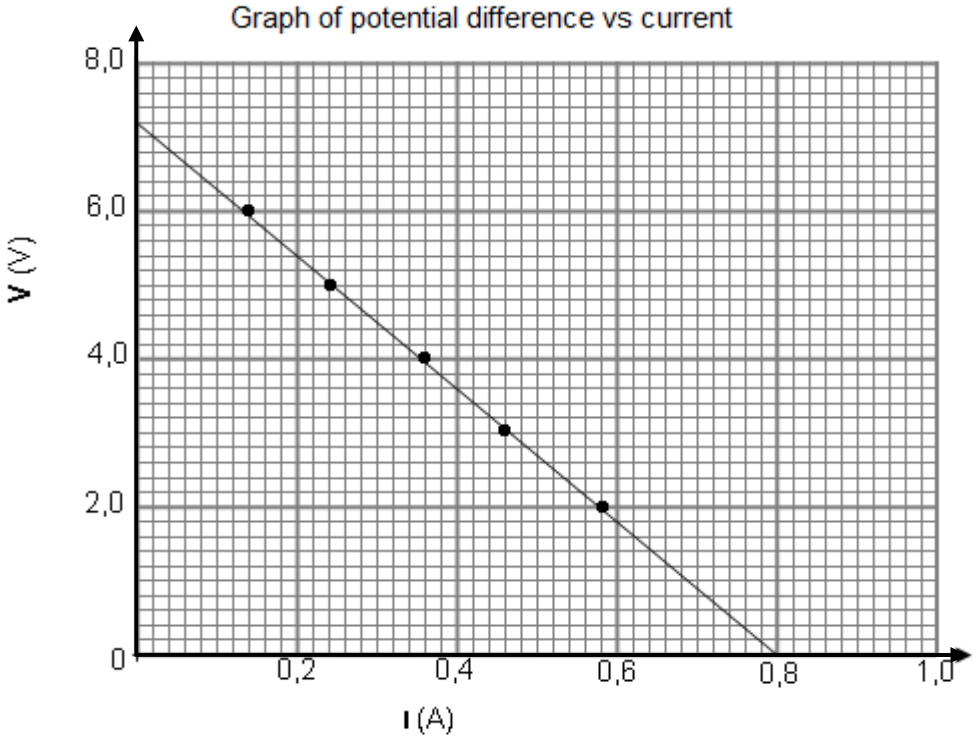
[19]

QUESTION 8/*VRAAG 8*

8.1.1 Keep the temperature (of battery) constant.
Hou die temperatuur (van battery) konstant (1)

8.1.2

Grafiek van potensiaalverskil teenoor stroom



Criteria for drawing line of best fit:/*Kriteria vir teken van lyn van beste pas:*	Marks/ *Punte*
ALL points correctly plotted (at least 4 points) *ALLE punte korrek gestip (ten minste 4 punte)*	✓✓
Correct line of best fit if all plotted points are used (at least 3 point) *Korrekte lyn van beste pas indien alle punte gebruik word (ten minste 3 punte)*	✓

(3)

8.1.3 7,2 V✓
(Accept any readings between 7,0 V and 7,4 V or the value of the y-intercept
/*Aanvaar enige lesing tussen 7,0 V en 7,4 V of die waarde van die y-afsnit* (1)

8.1.4

$$\text{Slope/}\textit{Helling} = \frac{\Delta V}{\Delta I}$$
$$= \frac{0 - 7{,}2}{0{,}8 - 0} \checkmark\checkmark = -9$$
$$r = 9\ \Omega\checkmark$$

(3)

8.2.1

OPTION 1/*OPSIE 1*

$P = VI$ ✓
$100 = 20(I)$ ✓
$I = 5$ A ✓ (3)

OPTION 2/*OPSIE 2*

$P = \frac{V^2}{R}$ ✓
$100 = \frac{(20)^2}{R}$
$R = 4\ \Omega$

$V = IR$
$20 = I(4)$ ✓
$I = 5$ A ✓ (3)

OPTION 3/*OPSIE 3*

$P = \frac{V^2}{R}$ ✓
$100 = \frac{(20)^2}{R}$
$R = 4\ \Omega$

$P = I^2R$
$100 = I^2(4)$ ✓
$I = 5$ A ✓

8.2.2

OPTION 1/*OPSIE 1*

$P = \frac{V^2}{R}$ ✓
$R = \frac{(20)^2}{150}$ ✓
$= 2{,}67\ \Omega$ ✓ (3)

OPTION 2/OPSIE 2

$P = VI$ ✓
$150 = (20)I$
$I = 7{,}5$ A

$V = IR$
$20 = (7{,}5)R$ ✓
$R = 2{,}67\ \Omega$ ✓

OR/*OF*

$P = I^2R$
$150 = (7{,}5)^2R$ ✓
$R = 2{,}67\ \Omega$ ✓ (3)

OPTION 3/*OPSIE 3*

I_X : I_Y
5 : 7,5
1 : 1,5

R_X : R_Y
1,5 : 1✓
4 ✓: 2,67 Ω✓

(3)

8.2.3

OPTION 1/*OPSIE 1*

$P = VI$ **OR/*OF*** $P = I^2R$

$I_{150W} = \frac{150}{20}$ ✓ = 7,5 A $I_{150W} = \sqrt{\frac{150}{2,67}}$ ✓ = 7,5 A

I_{tot} = (5 + 7,5) ✓
$\varepsilon = I(R + r)$ ✓
24 = 12,5(R + r)
24 = $V_{ext} + V_{ir}$
24 = 20 + 12,5(r) ✓
r = 0,32 Ω ✓

(5)

OPTION 2/*OPSIE 2*

$V = Ir$✓
I_{tot} = (5 + 7,5) ✓
(24 - 20) ✓= 12,5 r✓
$\therefore r = \frac{4}{12,5}$
r = 0,32 Ω✓

(5)

OPTION 3/*OPSIE 3*

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{1}{R_{//}} = \frac{1}{4} + \frac{1}{2,67}$ ✓ OR/*OF* $R_{//} = \frac{(4)(2,67)}{4 + 2,67}$

$\therefore R_{||}$ =1,6 Ω

$I_{tot} = \frac{20}{1,6}$ = 12,5 A✓

$\varepsilon = I(R + r)$ ✓

24 = 12,5(R + r)
24 = $V_{ext} + V_{ir}$
24 = 20 + 12,5(r) ✓
r = 0,32 Ω ✓

(5)

OPTION 4/*OPSIE 4*

$P = VI$ ✓
$250 = (20)I$ ✓
$I = 12,5$ A

$V = Ir$ ✓
$4 = (12,5)r$ ✓
$r = 0,32\ \Omega$ ✓ (5)

8.2.4 Device Z is a voltmeter ✓.
Toestel Z is 'n voltmeter (1)

8.2.5 Device **Z** should be a voltmeter (or a device with very high resistance) because it has a very high resistance ✓ and will draw very little current. ✓
The current through **X** and **Y** will remain the same hence the device can operate as rated.
*Toestel **Z** moet 'n voltmeter wees (of 'n toestel met 'n baie hoë weerstand) omdat dit 'n baie hoë weerstand het en baie min sal stroom trek*
*Die stroom deur **X** en **Y** sal dieselfde bly, gevolglik kan die toestel werk soos ontwerp.* (2)
[22]

QUESTION 9/*VRAAG 9*

9.1 Electromagnetic induction / *Elektromagnetiese induksie* ✓ (1)

9.2 Rotate the coil faster/Increase the number of coils/ Increase the strength of the magnetic field.
Roteer die spoel vinniger/Verhoog die aantal spoele / Verhoog die sterkte van die magneetveld. (1)

9.3 Slip rings/*Sleepringe* ✓ (1)

9.4.1 It is the value of the voltage in a DC circuit ✓ that will have the same heating effect as an AC circuit. ✓
Dit is die waarde van die potensiaalverskil in 'n GS-stroombaan ✓ wat dieselfde verhittingseffek het as 'n WS-stroombaan ✓ (2)

9.4.2 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓
$= \frac{339,45}{\sqrt{2}}$ ✓
$V_{rms} = 240,03$ V ✓ (3)
[8]

QUESTION 10/*VRAAG 10*

10.1 The minimum frequency (of a photon/light) needed to emit electrons ✓ from (the surface of) a metal. (substance) ✓
Die minimum frekwensie (van 'n foton/lig) benodig om elektrone vanaf die (oppervlakte van)'n metaal (stof) vry te stel. (2)

10.2 **OPTION 1/*OPSIE 1***

$E = W_o + E_{k(max)}$
$E = W_o + \frac{1}{2}mv^2_{max}$
$h\frac{c}{\lambda} = hf_0 + \frac{1}{2}mv^2_{max}$
✓Any one / *Enige een*

$\frac{(6{,}63 \times 10^{-34})(3 \times 10^8)}{\lambda}$ ✓$= (6{,}63 \times 10^{-34})(5{,}548 \times 10^{14})$ ✓$+ \frac{1}{2}(9{,}11 \times 10^{-31})(5{,}33 \times 10^5)^2$ ✓

$\lambda = 4 \times 10^{-7}$ m✓ (5)

OPTION 2/*OPSIE 2*

$E = W_o + E_{k(max)}$
$E = W_o + \frac{1}{2}mv^2_{max}$
$hf = hf_0 + \frac{1}{2}mv^2_{max}$
✓Any one / *Enige een*

$(6{,}63 \times 10^{-34})f = (6{,}63 \times 10^{-34})(5{,}548 \times 10^{14})$ ✓$+ \frac{1}{2}(9{,}11 \times 10^{-31})(5{,}33 \times 10^5)^2$ ✓

$f = 7{,}5 \times 10^{14}$ Hz

$c = f\lambda$
$3 \times 10^8 = (7{,}5 \times 10^{14})\lambda$✓
$\lambda = 4 \times 10^{-7}$ m ✓ (5)

10.3 Smaller (less) than ✓
Kleiner (minder) as (1)

10.4 The wavelength/frequency/energy of the incident light (photon/hf) is constant✓.
Die golflengte/frekwensie/energie van die invallende lig (foton/hf) is konstant

Since the speed is larger, the kinetic energy is larger ✓ the work function/W_0/threshold frequency smaller. ✓

Aangesien die spoed vergroot, is die kinetiese energie groter, is die arbeidsfunksie / W_0 / drumpel frekwensie kleiner (3)
[11]

GRAND TOTAL/*GROOTTOTAAL*: 150