basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

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

NOVEMBER 2016

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 19 pages.
Hierdie memorandum bestaan uit 19 bladsye.

QUESTION 1/*VRAAG 1*

1.1 A ✓✓ (2)

1.2 C ✓✓ (2)

1.3 C ✓✓ (2)

1.4 D ✓✓ (2)

1.5 B ✓✓ (2)

1.6 A ✓✓ (2)

1.7 C ✓✓ (2)

1.8 A ✓✓ (2)

1.9 B ✓✓ (2)

1.10 B ✓✓ (2)

[20]

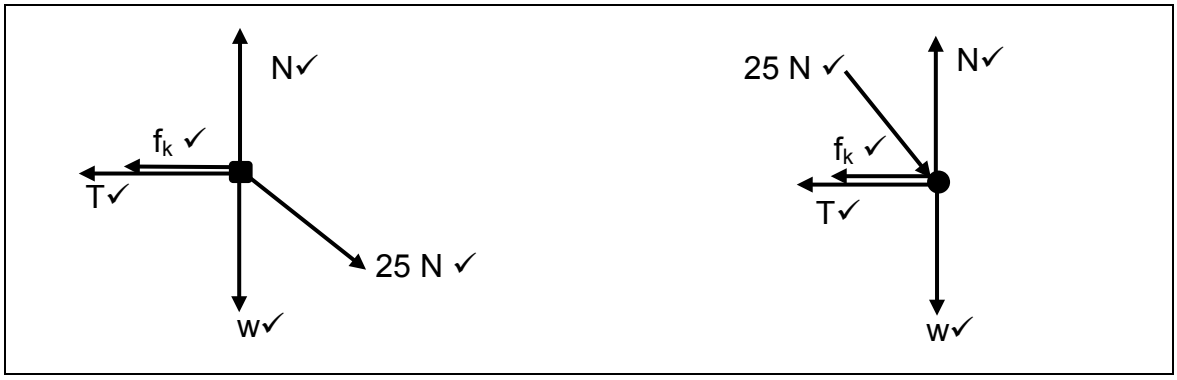
QUESTION 2/*VRAAG 2*

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

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

2.2
$f_k = \mu_k N$✓$= \mu_k mg$
$= (0,15)(3)(9,8)$✓
$= 4,41$ 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*	**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) 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 ✓	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) $a = \frac{17,571 - T}{1,5}$ 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✓

✓either one *enigeen*

✓either one *enigeen*

(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*	**OPTION 2/*OPSIE 2***
Upwards positive/*Opwaarts positief:*	**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} ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $-20 = 0 + \frac{1}{2}(-9,8)\,\Delta t^2$✓ $\Delta t = 2,02$ s $v_f = v_i + a\Delta t$ $= 0 + (-9,8)(2,02)$ ✓ $= -19,80$ m·s^{-1} $= 19,80$ 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}✓	**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 $v_f = v_i + a\Delta t$ $= 0 + (9,8)(2,02)$✓ $= 19,80$ m·s^{-1}✓

✓either one *enigeen*

✓either one *enigeen*

OPTION 3/*OPSIE 3*

$(E_{mech})_{Top/Bo} = (E_{mech})_{Ground/Grond}$
$(E_P + E_K)_{Top} = (E_P + E_K)_{Bottom/Onder}$
$(mgh + ½ mv^2)_{Top/Bo} = (mgh + ½ mv^2)_{Bottom/Onder}$
$\underline{(9,8)(20) + 0}$✓ = $\underline{(0 + ½v_f^{\ 2})}$✓
$v_f = 19,80\ m\cdot s^{-1}$✓

✓1 mark for any
1 punt vir enige

OPTION 4/*OPSIE 4*

$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$0 = mg\Delta h + ½ m\Delta v^2$
0✓ = $\underline{m(9,8)(0 - 20) + ½ m(v_f^2 - 0)}$ ✓
$v_f = 19,80\ m\cdot s^{-1}$✓

OPTION 5/*OPSIE 5*

$W_{net} = \Delta E_k$ ✓
$mg\Delta x\cos 0^o = ½ m(v_f^2 - 0)$
$\underline{m(9,8)(20)(1)}$✓ = $½ mv_f^2$ ✓
$v_f = 19,80\ m\cdot s^{-1}$✓ (4)

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

OPTION 1/*OPSIE 1*
Downwards positive/*Afwaarts positief*
$v_f = v_i + a\Delta t$ ✓
$\underline{19,80 = 0 + (9,8)\Delta t}$ ✓
$\Delta t = 2,02$ s ✓
Upwards positive/*Opwaarts positief*
$v_f = v_i + a\Delta t$ ✓
$\underline{-19,80 = 0 + (-9,8)\Delta t}$ ✓
$\Delta t = 2,02$ s ✓

OPTION 2/*OPSIE 2*

Upwards positive/*Opwaarts positief:*
$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓
$\underline{-20 = 0 + ½ (-9,8)\ \Delta t^2}$✓
$\Delta t = 2,02$ s✓

Downwards Positive/*Afwaarts positief*
$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓
$\underline{20 = 0 + ½ (9,8)\ \Delta t^2}$✓
$\Delta t = 2,02$ s✓

OPTION 3/*OPSIE 3*
Downwards positive/*Afwaarts positief:*

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

$$20 = \left(\frac{0 + 19,80}{2}\right)(\Delta t)$$✓

$\Delta t = 2,02$ s✓

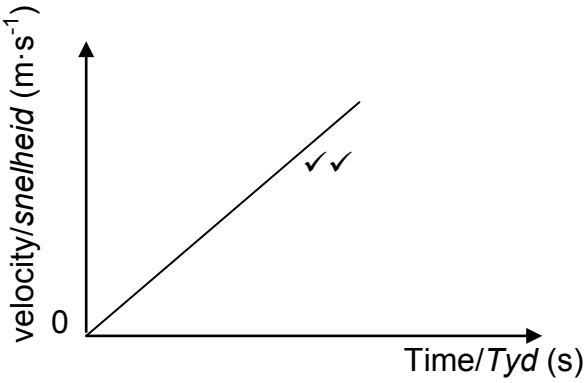
Upwards positive/*Opwaarts positief:*

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

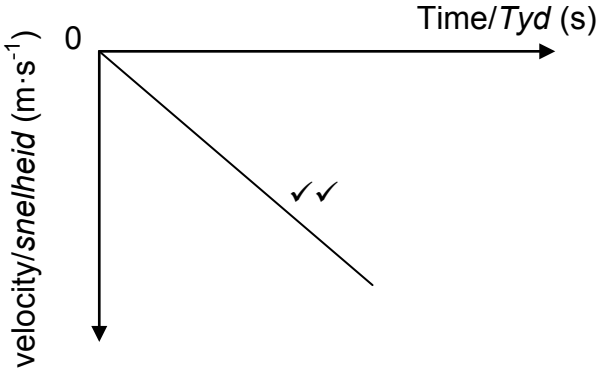
$$-20 = \left(\frac{0 - 19,80}{2}\right)(\Delta t)$$ ✓

$\Delta t = 2,02$ s✓ (3)

3.3 **Downward positive/*Afwaarts positief***



Upward positive/*Opwaarts positief*



Notes/*Aantekeninge*

✓✓	Straight line through the origin. *Reguitlyn deur die oorsprong*

(2)
[11]

QUESTION 4/*VRAAG 4*

4.1 A system on which the resultant/net external force is zero/*'n Sisteem waarop die resulterende krag/netto eksternekrag nul is* ✓
A system which excludes external forces /*'n Sisteem wat eksterne kragte uitlaat.* (1)

4.2.1

OPTION 1/*OPSIE 1*
$p = mv$✓
$\underline{30\ 000 = (1\ 500)v}$ ✓
$v = 20\ m\cdot s^{-1}$✓

OPTION 2/*OPSIE 2*
$\Delta p = mv_f - mv_i$ ✓
$\underline{0 = (1\ 500)v_f - 30\ 000}$ ✓
$v = 20\ m\cdot s^{-1}$✓ (3)

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

OPTION 1/*OPSIE 1*
$\sum p_i = \sum p_f$
$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$ } ✓ 1 mark for any/*1 punt vir enige*
$\underline{30\ 000 + (900)(-15)}$✓ = $\underline{14\ 000 + 900v_B}$✓
$\therefore v_B = 2{,}78\ m\cdot s^{-1}$ ✓east/*oos* ✓ (Accept/*Aanvaar:* to the right/*na regs*)

OPTION 2/*OPSIE 2*
$\Delta p_A = -\Delta p_B$
$p_f - p_i = -(mv_f - mv_i)$ } 1 mark for any/*1 punt vir enige*
$\underline{14\ 000 - 30\ 000}$ ✓= $\underline{900v_f - 900(-15)}$ ✓
$v_f = 2{,}78\ m\cdot s^{-1}$✓ east/*oos* ✓ (Accept/*Aanvaar:* to the right/*na regs*) (5)

4.2.3

OPTION 1/*OPSIE 1*
Slope/*Helling* = $\frac{\Delta p}{\Delta t} = F_{net}$✓
$= \frac{(14\ 000 - 30\ 000)}{(20{,}2 - 20{,}1)}$ ✓ ✓
$= -160\ 000$
$F_{net} = 160\ 000$ N ✓

OPTION 2/*OPSIE 2*
$F_{net}\Delta t = \Delta p$ ✓
$F_{net}(0{,}1)$✓ = $\underline{14\ 000 - 30\ 000}$✓
$F_{net} = -160\ 000$ N
$F_{net} = 160\ 000$ N ✓

POSITIVE MARKING FROM QUESTION 4.2.2/POSITIEWE NASIEN VANAF VRAAG 4.2.2
OPTION 3/*OPSIE 3*
$F_{net}\Delta t = \Delta p$ ✓
$F_{net}(0{,}1)$✓ = $\underline{900[(2{,}78) - (-15)]}$✓
$F_{net} = 160\ 020$ N
$F_A = -F_B$
$F_{net} = 160\ 020$ N ✓

OPTION 4/*OPSIE 4*

$p = mv$

$14\,000 = 1\,500v_f$ ✓

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

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

$= -160\,050$

$= 160\,050$ N ✓

$v_f = v_i + a\Delta t$

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

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

$F_{net} = ma$ ✓

$= 1\,500(-106{,}7)$ ✓

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

$F_{net} = 160\,050$ N ✓ (4)

[13]

QUESTION 5/*VRAAG 5*

5.1.1 $E_k/K = ½ mv^2$ ✓

$= ½ (2)(4{,}95)^2$ ✓

$= 24{,}50$ J ✓ (3)

5.1.2

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

OPTION 1/*OPSIE 1*

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

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

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

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

$h = 0{,}67$ m✓

OPTION 2/*OPSIE 2*

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

$0 = \Delta E_p + \Delta E_k$

$-\Delta E_p = \Delta E_k$

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

$h = 0{,}67$ m ✓

OPTION 3/*OPSIE 3*

Loss Ep bob = Gain in Ek of block ✓

$mg(¾h) = 24{,}5$

$(5)(9{,}8)(¾h)$✓ $= 24{,}5$ ✓

$h = 0{,}67$ m ✓ (4)

OPTION 4 /*OPSIE 4*

Before/*Voor*

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

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

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

After/*Na*

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

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

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

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

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

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

$h = 0{,}67$ m✓

5.2 The net/total work done on an object is equal ✓to the change in the object's kinetic energy ✓
Die netto/totale arbeid op 'n voorwerp verrig is gelyk aan die verandering in die kinetiese energie van die voorwerp.

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

5.3

OPTION 1/*OPSIE 1*

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

OPTION 2/*OPSIE 2*

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

(4)
[13]

QUESTION 6/*VRAAG 6*

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

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

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

6.1.3 **POSITIVE MARKING FROM QUESTION 6.1.2/*POSITIEWE NASIEN VANAF VRAAG 6.1.2***

$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ **OR/*OF*** $f_L = \frac{v \pm v_L}{v \pm v_s} \times \frac{v}{\lambda_s}$ **OR/*OF*** $f_L = \frac{v}{v - v_s} f_s$ **OR/*OF*** $f_L = \frac{f_s}{1 - \frac{v_s}{v}}$ ✓

✓

$f_L = (\frac{340}{340 - 30}$✓$)1214,29$✓ **OR/*OF*** $f_L = (\frac{340}{340 - 30}) \times \frac{340}{0,28}$ **OR/*OF*** $f_L = \frac{1214,29}{1 - \frac{30}{340}}$

= 1 331,80 Hz✓ (1 331,80 Hz – 1 335,72 Hz) (5)

6.1.4 Decreases/*Verlaag*✓ (1)

6.2 The spectral lines of the star are/should be shifted towards the lower frequency ✓ end, which is the red end (red shift) of the spectrum. ✓
Die spektraallyne van die van die ster is verskuif na die laer frekwensie ent, wat die rooi ent van die spektrum is. (2)
[13]

QUESTION 7/*VRAAG 7*

7.1.1 The (magnitude of the) electrostatic force exerted by one (point) charge on another is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between their (centres) them. ✓
Die (grootte) van die elektrostatiese krag wat een (punt) lading op 'n ander uitoefen, is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte. (2)

7.1.2 F_E/Electrostatic force/*Elektrostatiese krag*✓ (1)

7.1.3 The electrostatic force is inversely proportional to the square of the distance between the charges ✓
Die elektrostatiese krag is omgekeerd eweredig aan die kwadraat van die afstand tussen die ladings

OR/OF
The electrostatic force is directly proportional to the inverse of the square of the distance between the charged spheres (charges). ✓
Die elektrostatiese krag is direk eweredig aan omgekeerde van die kwadraat van die afstand tussen die gelaaide sfere (ladings).

OR/OF
$F \alpha \frac{1}{r^2}$ ✓

OR/*OF*
They are inversely proportional to each other /*Hulle is omgekeerd eweredig aan mekaar* (1)

7.1.4

OPTION 1/OPSIE 1

1 mark for using slope/
1 punt vir die gebruik van helling

Slope/*Helling* = $\frac{\Delta F_E}{\Delta \frac{1}{r^2}}$ ✓ $= \frac{(0,027 - 0)}{(5,6 - 0)}$ ✓

$= 4,82 \times 10^{-3}$ N·m^2 $(4,76 \times 10^{-3} – 5 \times 10^{-3})$

Slope/*Helling* = $F_E r^2 = kQ_1Q_2 = kQ^2$ ✓

$4,82 \times 10^{-3}$ ✓ $= \frac{9 \times 10^9 \, Q^2}{}$ ✓

$\therefore Q = 7,32 \times 10^{-7}$C ✓

OPTION 2/*OPSIE 2*

Accept any pair of points on the line/*Aanvaar enige paar punte op die lyn*

$F = \frac{kQ_1Q_2}{r^2}$ ✓

( ) ✓ = $\frac{(9 \times 10^9)Q^2}{(\ )}$ ✓✓

$Q = 7,32 \times 10^{-7}$C ✓ $(7,32 \times 10^{-7} – 7,45 \times 10^{-7}$ C)

Examples/*Voorbeelde*

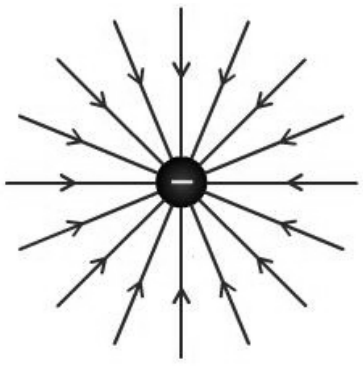
(0,005) ✓ = $\frac{(9 \times 10^9)Q^2}{(\ 1\ )}$ ✓✓

$Q = 7,45 \times 10^{-7}$ C ✓

(0,027) ✓ = $\frac{(9 \times 10^9)Q^2}{(\ \frac{1}{5,6}\ )}$ ✓✓

$Q = 7,32 \times 10^{-7}$ C ✓ (6)

7.2.1



Criteria for drawing electric field: ***Kriteria vir teken van elektriese veld:***	**Marks/*Punte***
Direction /*Rigting*	✓
Field lines radially inward/*Veldlyne radiaal inwaarts*	✓

7.2.2 $E = \frac{kQ}{r^2}$ ✓

Take right as positive/*Neem regs as positief*

$E_{PA} = \frac{(9 \times 10^9)(0{,}75 \times 10^{-6})}{(0{,}09)^2}$ ✓

$= 8{,}33 \times 10^5$ N·C^{-1} to the left/*na links*

$E_{PB} = \frac{(9 \times 10^9)(0{,}8 \times 10^{-6})}{(0{,}03)^2}$ ✓

$= 8 \times 10^6$ N·C^{-1} to the left/*na links*

$E_{net} = E_{PA} + E_{PC}$

$= [-8{,}33 \times 10^5 + (-8 \times 10^6)]$ ✓

$= -8{,}83 \times 10^6$

$= 8{,}83 \times 10^6$ N·C^{-1} ✓

1 mark for the addition of same signs/
1 punt vir optelling van dieselfde tekens

Take left as positive/*Neem links as positief*

$E_{PA} = \frac{(9 \times 10^9)(0{,}75 \times 10^{-6})}{(0{,}09)^2}$ ✓

$= 8{,}33 \times 10^5$ N·C^{-1} to the left/*na links*

$E_{PB} = \frac{(9 \times 10^9)(0{,}8 \times 10^{-6})}{(0{,}03)^2}$ ✓

$= 8 \times 10^6$ N·C^{-1} to the left/*na links*

$E_{net} = E_{PA} + E_{PC}$

$= \underline{(8{,}33 \times 10^5} + \underline{8 \times 10^6})$ ✓

$= 8{,}83 \times 10^6$ N·C^{-1} ✓

1 mark for the addition of same signs/
1 punt vir optelling van dieselfde tekens

(5)
[17]

QUESTION 8/*VRAAG 8*

8.1.1 (Maximum) energy provided (work done) by a battery per coulomb/unit charge passing through it ✓✓ / *Energie verskaf (arbeid verrig) deur 'n battery per coulomb/eenheid lading wat daardeur vloei.* (2)

8.1.2 12 (V)✓ (1)

8.1.3 0 (V) / Zero/*nul* ✓ (1)

8.1.4 $\varepsilon = I(R + r)$
$\varepsilon = V_{ext} + V_{int}$ } ✓
$12 = 11,7 + Ir$
$\underline{0,3 = I_{tot}(0,2)}$ ✓
$I_{tot} = 1,5$ A ✓

OR/*OF*
$V = IR$ ✓ (Accept/Aanvaar: $V_{"lost"} = Ir$)
$\underline{0,3 = I_{tot}(0,2)}$ ✓
$I_{tot} = 1,5$ A✓ (3)

8.1.5

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$\frac{1}{R_{//}} = \frac{1}{R_1} + \frac{1}{R_2}$ $\frac{1}{R} = \frac{1}{10} + \frac{1}{15}$ } ✓Any one *Enigeen* $R = 6\ \Omega$ ✓	$R_{\|\|} = \frac{R_1 R_2}{R_1 + R_2}$ $= \frac{(10)(15)}{10 + 15}$ } ✓Any one *Enigeen* $= 6\ \Omega$ ✓

(2)

8.1.6

POSITIVE MARKING FROM QUESTIONS 8.1.4 AND 8.1.5/*POSITIEWE NASIEN VANAF VRAE 8.1.4 EN 8.1.5*

OPTION 1/*OPSIE 1*

	OR/OF
$V = IR$ ✓ $11,7$✓ $= \underline{1,5(6 + R)}$ ✓ $R = 1,8\ \Omega$ ✓	$V = IR$ ✓ $\underline{11,7 = 1,5R}$ ✓ $R = 7,8\ \Omega$ ↘ $R_R = 7,8 - 6$ ✓ $= 1,8\ \Omega$ ✓

OPTION 2/*OPSIE 2*

$\varepsilon = I(R + r)$ ✓
$12 = 1,5(R + 0,2)$ ✓
$R = 7,8\ \Omega$
$R_R = 7,8 - 6$ ✓
$= 1,8\ \Omega$ ✓

OPTION 3/*OPSIE 3*

$V_{||} = IR_{||}$
$= (6)(1,5)$ ✓
$= 9$ V

$V_R = IR$ ✓
$(11,7 - 9) = (1,5)R$✓
$R = 1,8\ \Omega$✓ (4)

8.2.1

$P_{ave/gemid} = Fv_{ave/gemid}$ ✓$= mg(v_{ave/gemid})$
$= (0,35)(9,8)(0,4)$✓
$= 1,37$ W✓

OR/*OF*

$P = \frac{W_{nc}}{\Delta t}$ ✓$= \frac{\Delta E_k + \Delta E_p}{\Delta t} = \frac{0 + (0,35)(9,8)(0,4 - 0)}{1}$ ✓$= 1,37$ W ✓

OR/*OF*

$P = \frac{W}{\Delta t}$ ✓$= \frac{E_p}{\Delta t} = \frac{(0,35)(9,8)(0,4)}{1}$ ✓$= 1,37$ W ✓ (3)

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

OPTION 1/*OPSIE 1*

$P = VI$
$1,37 = (3)I$ ✓
$I = 0,46$ A

$\varepsilon = V_{ext} + V_{int}$
$= V_T + V_X + V_{int}$
$12 = V_T + 3 + (0,2)(0,46)$ ✓
$V_T = 8,91$ V

$V_T = IR_T$
$8,91 = (0,46)R_T$ ✓
$R_T = 19,37\ \Omega$✓

✓Any one *Enigeen*

OPTION 2/*OPSIE 2*

$P = \frac{V^2}{R}$

$1,37 = \frac{3^2}{R}$ ✓
$R = 6,57\ \Omega$

$P = VI$
$1,37 = (3)I$ ✓
$I = 0,46$ A

$\varepsilon = I(R + r)$
$12 = 0,46(6,57 + R_T + 0,2)$ ✓
$R_T = 19,38\ \Omega$ ✓

✓Any one *Enigeen*

OPTION 3/*OPSIE 3*

$P = VI$ ✓
$1,37 = (3)I$ ✓
$I = 0,46$ A

$P_{tot} = P_r + P_{motor} + P_T$
$(12)(0,46)$✓ $= (0,46)^2(0,2) + 1,37 + (0,46)^2R_T$ ✓
$R_T = 19,41\ \Omega$ ✓

OR/*OF*

$P = VI$ ✓
$1,37 = (3)I$ ✓
$I = 0,46$ A

$P_{tot} = P_r + P_{motor} + P_T$
$(12)(0,46) = (0,46)^2(0,2) + 1,37 + P_T$ ✓
$P_T = 4,07$ W

$P=I^2R$
$4,07 = (0,46)^2R_T$ ✓
$R_T = 19,49\ \Omega$ ✓

OPTION 4/*OPSIE 4*

$P = VI$
$1,37 = (3)I$ ✓
$I = 0,46$ A

$\varepsilon = I(R + r)$
$12 = (0,46)(R + 0,2)$ ✓
$R = 25,87\ \Omega$

✓Any one
Enigeen

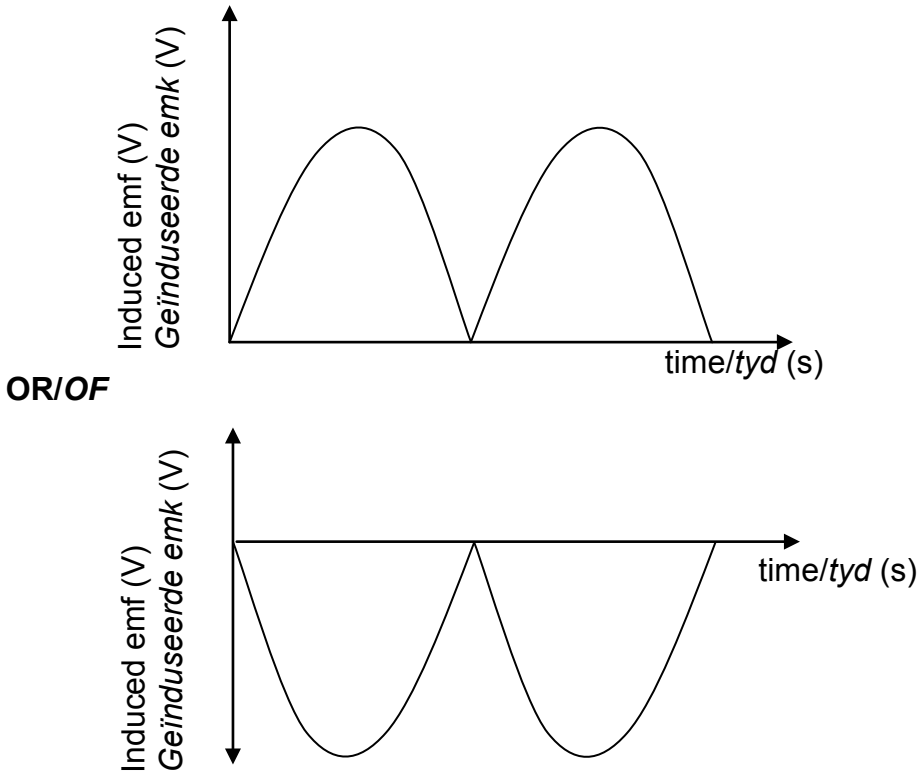
$V = IR$ $3 = (0,46)R$✓ $R = 6,52\ \Omega$ $R_T = 25,87 - 6,52$ $= 19,35\ \Omega$ ✓	$P = I^2R$ $1,37 = (0,46)^2R$✓ $R = 6,47\ \Omega$ $R_T = 25,87 - 6,47$ $= 19,4\ \Omega$ ✓	$P_{motor} = \frac{V^2}{R}$ $1,37 = \frac{3^2}{R}$ ✓ $R = 6,56\ \Omega$ $R_T = 25,87 - 6,56$ $= 19,31\ \Omega$ ✓

(5)
[21]

QUESTION 9/*VRAAG 9*

9.1.1 DC/*GS*-generator✓
Uses split ring/commutator/*Gebruik spleetring/kommutator*✓ (2)

9.1.2



(2)

9.2.1

OPTION 1/*OPSIE 1*	**OR/*OF***
$V_{rms/wgk} = \frac{V_{max/maks}}{\sqrt{2}}$ $P_{ave/gem} = V_{rms/wgk} I_{rms/wgk}$ ✓ $800 = \frac{340}{\sqrt{2}} \left(I_{rms/wgk}\right)$ ✓ $I_{rms/wgk}$ = 3,33 A ✓	$V_{rms/wgk} = \frac{V_{max/maks}}{\sqrt{2}} = \frac{340}{\sqrt{2}} = 240{,}416$ $P_{ave/gem} = V_{rms/wgk} I_{rms/wgk}$ ✓ $800 = I_{rms/wgk}(240{,}416)$ ✓ $I_{rms/wgk}$ = 3,33 A ✓

OPTION 2/*OPSIE 2*

✓ $P_{ave/gem} = \left(\frac{V^2_{rms/wgk}}{R}\right) = \frac{\left(V^2_{max/maks}\right)}{(2)(R)}$

$800 = \frac{(340)^2}{\left(\sqrt{2}\right)^2(R)}$

$R = 72{,}25\ \Omega$

$P_{ave/gem} = I_{rms/wgk}^2\ R$
$\underline{800 = I_{rms/wgk}^2\ (72{,}25)}$ ✓
$I_{rms/wgk} = 3{,}33$ A ✓

$V_{rms/wgk} = I_{rms/wgk}R$

$I_{rms/wgk} = \frac{240{,}416}{72{,}25}$ ✓

$= 3{,}33$ A ✓ (3)

9.2.2 **POSITIVE MARKING FROM QUESTION 9.2.1**
POSITIEWE NASIEN VANAF VRAAG 9.2.1
OPTION 1/*OPSIE 1*

$P_{ave/gemid} = V_{rms/wgk}\,I_{rms/wgk}$ ✓

for the kettle/*vir die ketel*:

$2000 = \frac{340}{\sqrt{2}}\left(I_{rms/wgk}\right)$ ✓

$I_{rms/wgk} = 8{,}32$ A
$I_{tot} = (8{,}32 + 3{,}33)$ ✓
$= 11{,}65$ A ✓

OPTION 2/*OPSIE 2*

$P_{ave/gemid} = \left(\frac{V^2_{rms/wgk}}{R}\right)$ ✓ $= \frac{\left(V^2_{max/maks}\right)}{(2)(R)}$

$800 = \frac{(340)^2}{\left(\sqrt{2}\right)^2(R)}$ ✓

$R = 72{,}25\ \Omega$

$2\,000 = \frac{(340)^2}{\left(\sqrt{2}\right)^2\left(R_{2000}\right)}$

$R = 28{,}9\ \Omega$

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ → $R = \frac{(28{,}9)(72{,}25)}{(28{,}9 + 72{,}25)} = 20{,}64\ \Omega$

$V_{rms/wgk} = I_{rms/wgk}\ R$
$\underline{240{,}42 = I_{rms/wgk}\ (20{,}64)}$ ✓
$\underline{I_{rms/wgk} = 11{,}65\text{ A}}$ ✓

OPTION 3/*OPSIE 3*

$P_{ave/gemid} = V_{rms/wgk}\ I_{rms/wgk}$ ✓ = $\frac{V_{max/maks} I_{max/maks}}{2}$

2 800✓ = $\frac{(340)\ I_{max/maks}}{2}$ ✓

$I_{max/maks}$ = 16,47 A

$I_{rms} = \frac{I_{max/maks}}{\sqrt{2}} = \frac{16,47}{\sqrt{2}}$

$I_{rms/wgk}$ = 11,65 A✓

OPTION 4/*OPSIE 4*

$P_{ave/gemid} = V_{rms/wgk}\ I_{rms/wgk}$✓

2 800 ✓= $\frac{340}{\sqrt{2}}\ I_{rms/wgk}$✓

$I_{rms/wgk}$ = 11,65 A ✓

OPTION 5/*OPSIE 5*

P_T : P_K

800 : 2 000 ✓

1 : 2,5

I_T : I_K

3,33 : 8,325 ✓

I_{rms} = 3,33 + 8,325 ✓

= 11,66 A ✓ (4)

[11]

QUESTION 10/*VRAAG 10*

10.1.1 The minimum frequency (of a photon/light) needed✓ to emit electrons from (the surface of) a metal. (substance) ✓

Die minimum frekwensie (van 'n foton/lig) benodig om elektrone vanaf die (oppervlakte van)'n metaal (stof) vry te stel

OR/OF

The frequency (of a photon/light) needed✓ to emit electrons from (the surface of) a metal. (substance) with zero kinetic energy✓

Die frekwensie (van 'n foton/lig) benodig om elektrone vanaf die (oppervlakte van)'n metaal (stof) met nul/geen kinetiese energie vry te stel (2)

10.1.2 Silver/*Silwer*✓

Threshold/cutoff frequency (of Ag) is higher/*Drumpel/afsnyfrekwensie (van Ag) is hoër*✓
W_o α f_o / $W_o = hf_o$ ✓
OR/*OF*
To eject electrons with the same kinetic energy from each metal, light of a higher frequency/energy is required for silver. ✓ Since $E = W_o + E_{k(max)}$ (and E_k is constant), the higher the frequency/energy of the photon/light required, the greater is the work function/W_o.✓
Om elektrone met dieselfde kinetiese energie van elke metal vry te stel,is lig van hoër frekwensie benodig vir silwer. Aangesien $E = W_o + E_{k(maks)}$ (en $E_{k(maks)}$ is konstant) word fotone/lig van hoër frekwensie/energie benodig, dus is arbeidsfunksie hoër (3)

10.1.3 Planck's constant /*Planck se konstante* ✓ (1)

10.1.4 Sodium/*Natrium*✓ (1)

10.2.1 Energy radiated per second by the blue light /*Energie per sekonde uitgestraal deur die bloulig* = $(\frac{5}{100})(60 \times 10^{-3})$ ✓ = 3×10^{-3} J·s^{-1}

$E_{photon/foton} = \frac{hc}{\lambda}$ ✓

$= \frac{(6{,}63 \times 10^{-34})(3 \times 10^{8})}{470 \times 10^{-9}}$ ✓

$= 4{,}232 \times 10^{-19}$J

Total number of photons incident per second/*Totale aantal fotone wat per sekonde inval* = $\frac{3 \times 10^{-3}}{4{,}232 \times 10^{-19}}$ ✓

$= 7{,}09 \times 10^{15}$ ✓ (5)

10.2.2 **POSITIVE MARKING FROM QUESTION 10.2.1**
POSITIEWE NASIEN VANAF VRAAG 10.2.1

$7{,}09 \times 10^{15}$ (electrons per second/*elektron per sekonde*) ✓

OR/*OF*
Same number as that calculated in Question 10.2.1 above/*Dieselfde as die in Vraag 10.2.1 hierbo bereken* (1)
[13]

TOTAL/*TOTAAL*: 150