basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATIONS
SENIORSERTIFIKAAT-EKSAMEN

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

2016

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 18 pages.
Hierdie memorandum bestaan uit 18 bladsye.

QUESTION/*VRAAG 1*

1.1	A✓✓	(2)
1.2	B✓✓	(2)
1.3	D✓✓	(2)
1.4	C✓✓	(2)
1.5	B✓✓	(2)
1.6	B✓✓	(2)
1.7	A✓✓	(2)
1.8	D✓✓	(2)
1.9	C✓✓	(2)
1.10	D✓✓	(2)

[20]

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/*VRAAG 3*

3.1 An object upon which the only force✓ acting is the force of gravity.✓
'n Voorwerp waarop die enigste krag wat inwerk, swaartekrag is

ACCEPT/AANVAAR
An object that falls freely ✓with an acceleration of (g) 9,8 $m \cdot s^{-2}$ ✓
'n Voorwerp wat vryval met 'n versnelling van (g) 9,8 $m \cdot s^{-2}$

An object that is launched ✓(or synonyms) with an initial velocity under the influence of the force of gravity.✓
'n Voorwerp wat met 'n beginsnelheid geprojekteer ✓(of sinonieme) word onder die invloed van die gravitasiekrag✓ (2)

3.2.1

OPTION 1/*OPSIE 1*	
Upward positive ***Opwaarts positief***	**Downward positive** ***Afwaarts positief***
$v_f = v_i + a\Delta t$ ✓ -30 = 30✓ + (-9,8)Δt✓ Δt = 6,12 s✓	$v_f = v_i + a\Delta t$ ✓ 30 = -30✓ + (9,8)Δt✓ Δt = 6,12 s✓

OPTION 2/*OPSIE 2*	
Upward positive ***Opwaarts positief***	**Downward positive** ***Afwaarts positief***
$v_f = v_i + a\Delta t$ ✓ 0 = 30✓ + (-9,8)Δt✓ Δt = 3,06 s Total time/*Totale tyd* = (2)(3,06) = 6,12 s ✓	$v_f = v_i + a\Delta t$ ✓ 0 = -30✓ + (9,8)Δt✓ Δt = 3,06 s Total time/*Totale tyd* = (2)(3,06) = 6,12 s ✓

OPTION 3/*OPSIE 3*	
Upward positive ***Opwaarts positief***	**Downward positive** ***Afwaarts positief***
$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓ 0 = (30) Δt✓ +½ (-9,8)$\Delta t^2$✓ Δt = 6,12 s✓	$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓ 0 = (-30) Δt✓ +½ (9,8)$\Delta t^2$✓ Δt = 6,12 s✓

OPTION 4/*OPSIE 4*	
Upward positive ***Opwaarts positief***	**Downward positive** ***Afwaarts positief***
$F_{net}\Delta t = \Delta p = (mv_f - mv_i)$✓ $mg\Delta t = m(v_f - v_i)$ 9,8Δt✓ = (30-(-30))✓ Δt = 6,12 s✓	$F_{net}\Delta t = \Delta p = (mv_f - mv_i)$✓ $mg\Delta t = m(v_f - v_i)$ -9,8Δt ✓= (-30-30)✓ Δt = 6,12 s✓

OPTION 5/*OPSIE 5*	
Upward positive ***Opwaarts positief*** From top to bottom/*Van bo na onder* $v_f = v_i + a\Delta t$ ✓ $-\underline{30 = 0}$ ✓$+ (-9,8)\Delta t$✓ $\Delta t = 3,06$ s Total time/totale tyd = 2(3,06) = 6,12 s✓	**Downward positive** ***Afwaarts positief*** From top to bottom/*Van bo na onder* $v_f = v_i + a\Delta t$ ✓ $\underline{30 = 0}$✓ $+ (9,8)\Delta t$✓ $\Delta t = 3,06$ s Total time/totale tyd = 2(3,06) = 6,12 s✓

(4)

3.2.2

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

OPTION 1/*OPSIE 1*
Upward positive/*Opwaarts positief*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$\Delta y_{last} = \Delta y_{(6,12)} - \Delta y_{(5,12)}$ } ✓

$= \{30(6,12) + \frac{1}{2}(-9,8)(6,12)^2\}$✓$- \{30\underline{(5,12) + \frac{1}{2}(-9,8)(5,12)^2}\}$✓
$= -25,076$
Distance/*Afstand* = $|\Delta y| = 25,08$ m✓

OR/*OF*

POSITIVE MARKING FROM QUESTIONS 3.2.1
POSITIEWE NASIEN VANAF VRAAG 3.2.1
Downward positive/*Afwaarts positief*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$\Delta y_{last} = \Delta y_{(6,12)} - \Delta y_{(5,12)}$ } ✓

$= \{-30(6,12) + \frac{1}{2}(9,8)(6,12)^2\}$✓$- \{-30(5,12) + \frac{1}{2}(9,8)(5,12)^2\}$✓
$= 25,076$
Distance/*Afstand* = $|\Delta y| = 25,08$ m✓

OPTION 2/*OPSIE 2*	
Upward positive **Opwaarts positief**	**Downward positive** **Afwaarts positief**
$v_f = v_i + a\Delta t$ $= 0 + (-9,8)(2,06)$ ✓ $= -20,188\ m\cdot s^{-1}$	$v_f = v_i + a\Delta t$ $= 0 + (9,8)(2,06)$✓ $= 20,188\ m\cdot s^{-1}$
$\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓ $= \underline{(-20,188)(1) + ½\ (-9,8)(1)^2}$ ✓ $= -25,09$ m	$\Delta y = v_i\Delta t + ½\ a\Delta t^2$✓ $= \underline{(20,188)(1) + ½\ (9,8)(1)^2}$ ✓ $= 25,09$ m
Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,09 m ✓	Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,09 m✓
OR/*OF*	**OR/*OF***
$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $= \left(\frac{-20,188 + (-30)}{2}\right)(1)$ ✓ $= -25,09$ m	$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $= \left(\frac{20,188 + 30}{2}\right)(1)$ ✓ $= 25,09$ m
Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,09 m ✓	Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,09 m✓
OR/*OF*	**OR/*OF***
$v_f^2 = v_i^2 + 2a\Delta x$ ✓ $\underline{(-30)^2 = (-20,188)^2 + 2(-9,8)\Delta x}$✓ $\Delta x = -25,12$ m	$v_f^2 = v_i^2 + 2a\Delta x$✓ $\underline{(30)^2 = (20,188)^2 + 2(9,8)\Delta x}$✓ $\Delta x = 25,12$ m
Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,12 m ✓	Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,12 m✓
OPTION 3/*OPSIE 3*	
$v_f = v_i + a\Delta t$ $= 0 + (-9,8)(2,06)$✓ $= -20,188\ m\cdot s^{-1}$	$v_f = v_i + a\Delta t$ $= 0 + (9,8)(2,06)$✓ $= 20,188\ m\cdot s^{-1}$
$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $= \left(\frac{-20,188 + 30}{2}\right)(5,12)$ ✓ $= 25,12$ m	$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $= \left(\frac{20,188 - 30}{2}\right)(5,12)$ ✓ $= -25,12$ m
Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,12 m✓	Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,12 m✓

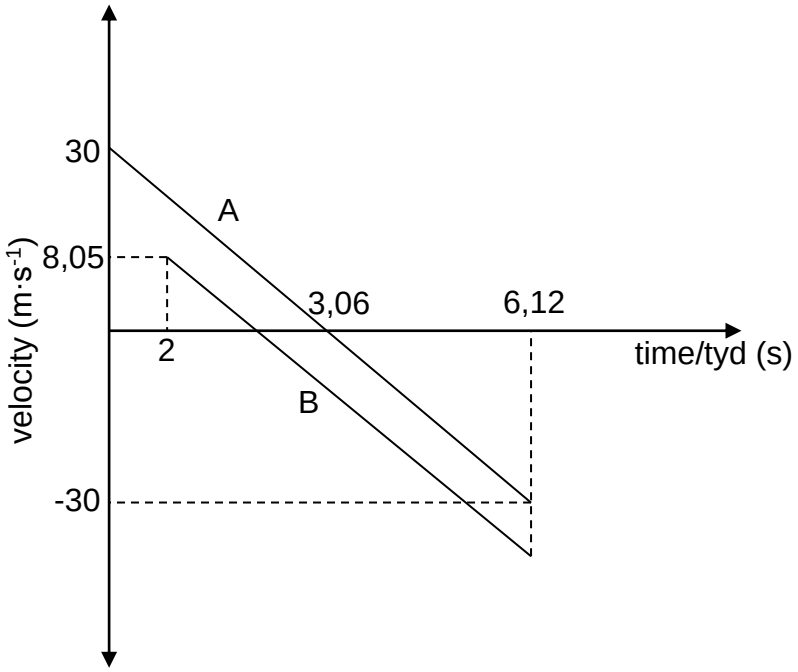
OPTION 4/*OPSIE* 4		
Upward positive **Opwaarts positief** Distance travelled in the first second = distance travelled in the last second *Afstand afgelê in die eerste sekonde = afstand afgelê in laaste sekonde* $\Delta y = v_i\Delta t + ½ \Delta t^2$ ✓ $= (30)(1) + ½ (-9,8)(1)^2$ ✓ $= 25,1$ m ✓ Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,1 m ✓	**Downward positive** **Afwaarts positief** Distance travelled in the first second = distance travelled in the last second *Afstand afgelê in die eerste sekonde = afstand afgelê in laaste sekonde* $\Delta y = v_i\Delta t + ½ \Delta t^2$✓ $= (-30)(1) + ½ (9,8)(1)^2$ ✓ $= -25,1$ m ✓ Distance /*Afstand* = $\lvert\Delta y\rvert$ = 25,1 m ✓	(4)

3.3

POSITIVE MARKING FROM QUESTION 3.2.1 ***POSITIEWE NASIEN VANAF VRAAG 3.2.1***		
Upward positive ***Opwaarts positief***	**Downward positive** ***Afwaarts positief***	
$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓ -50✓$= [\underline{v_i (4,12)}] + [½ (-9,8)(4,12)^2]$✓ $v_i = 8,05$ m·s^{-1} speed/*spoed* = 8,05 m·s^{-1}✓	$\Delta y = v_i\Delta t + ½ a\Delta t^2$✓ 50✓$= \underline{v_i (4,12) + [½ (9,8)(4,12)^2]}$✓ $v_i = -8,05$ m·s^{-1} speed/*spoed* = 8,05 m·s^{-1}✓	(4)

3.4

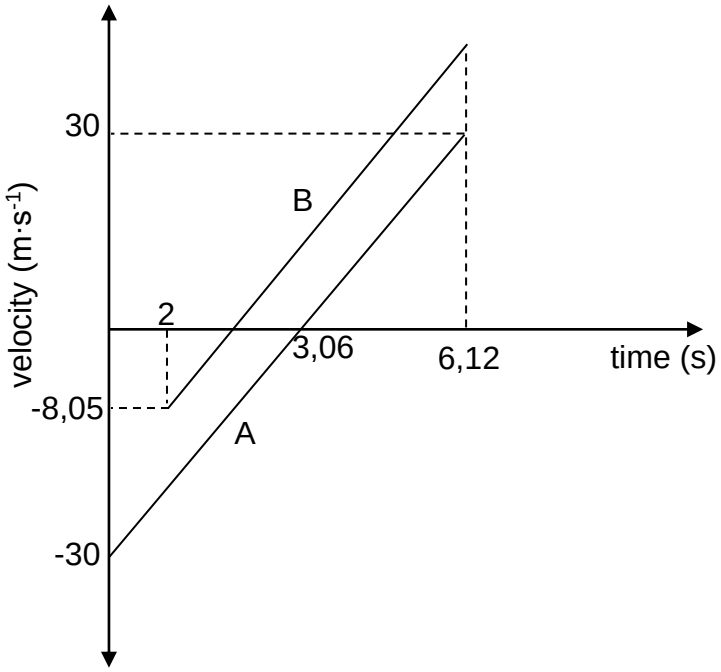
POSITIVE MARKING FROM QUESTIONS 3.2.1 AND 3.2.2 ***POSITIEWE NASIEN VANAF VRAAG 3.2.1 EN 3.2.2*** **Upward positive/ *Opwaarts positief***



Criteria/*Kriteria*	Marks/*Punte*
Correct shape of A *Korrekte vorm van A*	✓
Correct shape of Graph B parallel to A below A *Korrekte vorm van Grafiek parallel met A onder A*	✓
Time at which both A and B reach the ground (6,12 s) *Tyd wat beide A en B die grond bereik (6,12 s)*	✓
Time for A to reach the maximum height (3,06 s) shown *Tyd vir A om maksimum hoogte te bereik (3,06 s) aangedui*	✓

NOTE/*LET WEL*
Do not penalise if velocities are not indicated
Moenie penaliseer indien snelhede nie aangedui is nie

3.4 **POSITIVE MARKING FROM QUESTIONS 3.2.1 AND 3.2.2**
POSITIEWE NASIEN VANAF VRAAG 3.2.1 EN 3.2.2
Downward positive/*Afwaarts positief*



Criteria/*Kriteria*	Marks/*Punte*
Correct shape of A *Korrekte vorm van A*	✓
Correct shape of Graph B parallel to A above A *Korrekte vorm van Grafiek parallel met A bo A*	✓
Time at which both A and B reach the ground (6,12 s) *Tyd wat beide A en B die grond bereik (6,12 s)*	✓
Time for A to reach the maximum height (3,06 s) shown *Tyd vir A om maksimum hoogte te bereik (3,06 s) aangedui*	✓

(4)
[18]

QUESTION/*VRAAG 4*

4.1 The total (linear) momentum of an isolated (closed) system ✓is constant (is conserved) ✓
Die totale (lineêre) momentum van 'n geïsoleerde (geslote) sisteem is konstant (bly behoue)

OR/*OF*
In an isolated (closed) system, the total (linear) momentum ✓before collision is equal to the total linear momentum after collision. ✓
In 'n geïsoleerde (geslote) sisteem is die totale (lineêre) momentum✓ voor botsing gelyk aan die totale (lineêre) momentum van botsing ✓ (2)

4.2.1

$\sum p_i = \sum p_f$
$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$
$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2)v_f$
$(5)(4) + (3)(0)$ ✓ $= (5 + 3)v_f$✓
$\therefore v = 2,5\ m\cdot s^{-1}$ ✓

1 mark for any
1 punt vir enige

OR/*OF*
$\Delta p_{5kg} = -\Delta p_{3kg}$ ✓
$mv_f - mv_i = mv_f - mv_i$
$5v_f – (5)(4)$✓ $= 3v_f – (3)(0)$ ✓
$v_f = 2,5\ m\cdot s^{-1}$ ✓ (4)

4.2.2

OPTION 1/*OPSIE 1*
POSITIVE MARKING FROM QUESTION 4.2.1
POSITIEWE NASIEN VANAF VRAAG 4.2.1

$F_{net}\Delta t = \Delta p = (p_f – p_i) = (mv_f – mv_i)$ ✓
$F_{net}(0,3)$ ✓ $= 8\ [(0 – (2,5)]$✓
$F_{net} = - 66,67$ N
$\therefore F_{net} = 66,67$ N✓

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM 4.2.1
POSITIEWE NASIEN VANAF 4.2.1
$F_{net} = ma$ ✓
$= \frac{m(v_f - v_i)}{\Delta t}$
$= \frac{8(0 - 2,5)}{0,3}$ ✓ ✓ $= - 66,67$ N
$\therefore F_{net} = 66,67$ N✓

OPTION 3/*OPSIE 3*
POSITIVE MARKING FROM 4.2.1
POSITIEWE NASIEN VANAF 4.2.1
$v_f = v_i + a\Delta t$
$0 = 2,5 + a(0,3)$ ✓
$a = - 8,333\ m\cdot s^{-2}$
$F_{net} = ma$ ✓
$= 8\ (-8,333)$ ✓
$= - 66,67$ N
$\therefore F_{net} = 66,67$ N✓ (4)

OPTION 4/*OPSIE 4*

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

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

[10]

QUESTION/*VRAAG 5*

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

NOTE/*LET WEL*
If total or isolated/closed is omitted (max: 1/2)
Indien totale of geslote (geïsoleerde) weggelaat is (maks: 1 2) (2)

5.2.1
$W = F\Delta x\cos\theta$✓
$= (30)(\frac{5}{\sin 30^o})\cos\theta$
$= (30)(10)\cos 180^o$ ✓
$= (30)(10)(-1)$
$= -300$ J✓ (3)

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

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM 5.2.1/*POSITIEWE NASIEN VANAF 5.2.1*
$W_{net} = \Delta E_K$
$W_g + W_f = \frac{1}{2}m(v_f^2 - v_i^2)$ ✓
$W_g + (-300) = \underline{½\ (20)(v_f^2 - 0)}$✓
$[(20)(9,8)\sin 30^o\ \frac{5}{0,5}\ \cos 0\ ]$ ✓ $+ (-300)$ ✓ $= 10v_f^2$
$v_f = 8,25\ m\cdot s^{-1}$✓ (5)

5.3

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

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

(4)
[14]

QUESTION/*VRAAG 6*

6.1 **X** ✓ (1)

6.2 As ambulance approaches the hospital the waves are compressed✓or wavelengths are shorter. Since the speed of sound is constant✓ the observed frequency must increase✓. Therefore the hospital must be located on the side of X (from $v = f\lambda$)
Soos die ambulans die hospitaal nader word die golwe saamgepers of golflengtes word korter. Aangesien die spoed van klank konstant is, moet die waargenome frekwensie verhoog. Die hospitaal moet dus aan die kant van X wees (vanaf $v = f\lambda$)

OR/*OF*
The number of wave fronts per second reaching the observer are more at X✓✓. For the same constant speed, this means that the observed frequency increases ✓therefore the hospital must be located on the side of X. (from $v = f\lambda$)
Die aantal golffronte per sekonde wat die waarnemer bereik, is meer by X. Vir dieselfde konstante spoed moet die waargenome frekwensie verhoog, dus is die hospitaal aan die kant van X geleë (vanaf $v = f\lambda$) (3)

6.3

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

$f_L = \frac{340\ ✓}{(340 \pm 30)} (400\ ✓)$

$f_L = 438,71$ Hz✓

NOTE/*LET WEL*
If any other value for the speed of sound is used subtract 2 marks. One for substitution and one for answer / *Indien enige ander waarde vir die spoed van klank gebruik word, trek 2 punte af. Een vir vervanging en een vir die antwoord.* (5)

6.4

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

(3)
[12]

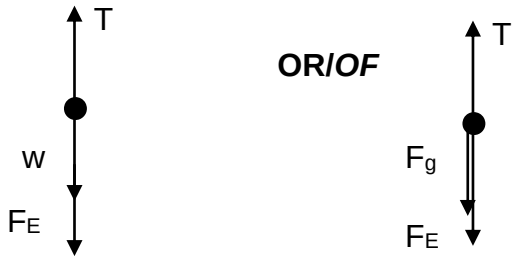
QUESTION/*VRAAG 7*

7.1

$n = \frac{Q}{e}$ ✓ $= \frac{-32\times10^{-9}}{-1,6\times10^{-19}}$ ✓ = 2 x 10^{11} ✓electrons/*elektrone* **NOTE:/*LET WEL*** Answer must be positive (-1 mark) *Antwoord moet positief wees (-1 punt)*	$n = \frac{Q}{e}$ ✓ $= \frac{32\times10^{-9}}{1,6\times10^{-19}}$ ✓ = 2 x 10^{11} ✓ electrons/*elektrone*

(3)

7.2



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*
F_E	$F_{electrostatic}$/F_{Q1Q2} /Coulomb force/F $F_{elektrostaties}F_{Q1Q2}$ /*Coulomb krag/F*

(3)

7.3

$F_{net} = 0$
$mg + F_E = T$
$mg + k\frac{Q_1Q_2}{r^2}$ ✓ $- T = 0$
$(0,007)(9,8)$ ✓ $+ (9\times10^9)\frac{(32\times10^{-9})(55\times10^{-9})}{(0,025)^2}$ ✓ $= T$
$\therefore T = 9,39(4) \times 10^{-2}$ N ✓ (Accept/*Aanvaar*: 0,1 N)

ACCEPT/*AANVAAR*
$F_E = w_{Q2}$ ✓
(0,007)(9,8) ✓+ (0,007)(9,8)✓✓ = T
T = 0,137 N ✓

(5)

[11]

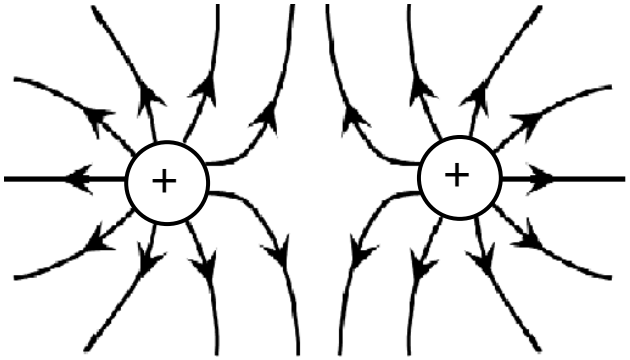
QUESTION/*VRAAG 8*

8.1 The (electrostatic) force experienced by a unit positive charge (placed at that point).✓✓

Die (elektrostatiese) krag ondervind per eenheid positiewe lading by daardie punt.

NOTE/*LET WEL*
If the words "unit positive" is omitted (max 1/2)
Indien die woorde "eenheid positiewe" weggelaat is (maks 1/2) (2)

8.2



Guideline for allocating marks/*Riglyne vir toekenning van punte*		
	Lines must not cross / Lines must touch the spheres but not enter spheres *Lyne moet nie kruis nie/Lyne moet die sfere raak maar nie binnegaan nie*	✓
	Arrows point outwards *Pyle uitwaarts gerig*	✓
	Correct shape *Korrekte vorm*	✓

(3)

8.3

$$E = \frac{kQ}{r^2} \checkmark$$

$$E_{Q1X} = \frac{(9\times10^{9})(30\times10^{-6})}{(x)^2} \checkmark$$

$$E_{Q2X} = \frac{(9\times10^{9})(45\times10^{-6})}{(0,15+x)^2} \checkmark$$

$E_{net} = 0$

$E_{Q1X} = E_{Q2X}$

$$\frac{(9\times10^{9})(30\times10^{-6})}{(x)^2} \checkmark = \frac{(9\times10^{9})(45\times10^{-6})}{(0,15+x)^2}$$

For equating equations
Vir gelykstelling van vergelykings

$$\frac{5,477}{x} = \frac{6,708}{0,15+x}$$

$x = 0,67$ m $(0,667$ m) ✓ (5)

[10]

QUESTION/*VRAAG 9*

9.1.1

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***	**OPTION 3/*OPSIE 3***
$P = \frac{V^2}{R}$ ✓ $4 = \frac{V^2}{R} = \frac{(12)^2}{R}$ ✓ R = 36 Ω✓	P = VI 4 = I(12) I = 0,33...A V = IR✓ 12 = 0,33R✓ R = 36,36 Ω✓	P = V I 4 = I(12) I = 0,33 ..A $P = I^2 R$ ✓ $4 = (0,33^2) R$✓ R = 36,73 Ω✓

(3)

9.1.2 Increase/*Toeneem*✓ (1)

9.1.3 - No change/*Geen verandering nie*✓

Same potential difference✓ (and resistance)
Dieselfde potensiaalverskil (en weerstand) (2)

9.2.1

V = IR ✓		
5 = I(6) ✓		
∴ I = 0,83 A		
$V_{"lost"}$ = Ir	**OR/*OF***	ε = I(R + r)
1 = (0,83)r ✓		6 = (0,83)(6 + r) ✓
r = 1,20 Ω✓		r = 1,23 Ω✓

(4)

9.2.2 Work done ✓in moving a unit charge ✓ through a cell.
Arbeid verrig ✓om 'n eenheidslading ✓deur 'n sel te beweeg.

ACCEPT/AANVAAR
Energy transferred per unit charge/*Energie oorgedra per eenheidslading*
Work done in moving in 1 C of charge. / *Arbeid verrig deur 1 C lading te beweeg* (2)

9.2.3

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

$V_{"lost"}$ = Ir		
1,5✓ = I(1,2)		
I = 1,25 A		
$V_{\|\|} = I_6R_6$		
4,5 = I_6(6)✓		
I_6 = 0,75 A		
$V_x = IR_x$✓	**or/*of***	V = IR
4,5 = (1,25 – 0,75)R_x✓		
Rx = 9 Ω✓		

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM 9.2.1/*POSITIEWE NASIEN VANAF 9.2.1*

$V_{"lost"} = Ir$
$1,5\checkmark = I(1,2)$
$I = 1,25$ A

$V_{||} = I_pR_p$
$4,5 = (1,25)R_p\checkmark$
$R_p = 3,6\ \Omega$

$\frac{1}{R_{//}} = \frac{1}{R_X} + \frac{1}{R_6}$ ✓
$\frac{1}{R_{//}} = \frac{1}{R_X} + \frac{1}{6}\checkmark$
$\therefore R_{//} = \frac{6R_X}{R_X + 6} = 3,6$
$R_X = 9\ \Omega\checkmark$

$R_{//} = \frac{R_X R_6}{R_X + R_6}$ ✓
$3,6 = \frac{(R_X)(6)}{(R_X + 6)}$ ✓
$R_X = 9\ \Omega\checkmark$

(5)
[17]

QUESTION/*VRAAG 10*

10.1.1 a to b/*a na b* ✓ (1)

10.1.2 Fleming's left hand rule /Left hand motor rule✓
Fleming se linkerhandreël / Linkerhand motorreël

ACCEPT/*AANVAAR*
Right hand rule
Regterhandreël (1)

10.1.3 Split rings /commutator ✓ (1)
Splitringe / kommutator

10.2.1 Mechanical/Kinetic energy to electrical energy. ✓✓ (2 or/*of* 0)
Meganiese /kinetiese energie na elektriese energie (2)

10.2.2

OPTION 1/*OPSIE 1*

$V_{rms} = \frac{V_{max}}{\sqrt{2}}\checkmark$
$= \frac{430}{\sqrt{2}}\checkmark$
$= 304,06$ V
$I = \frac{V}{R}\checkmark$
$= \frac{304,06}{400}$ ✓
$= 0,76$ A✓

OPTION 2/*OPSIE 2*

$V_{max} = I_{max}R$ ✓
$430 = I_{max}(400)$ ✓
$I_{max} = 1,075$
$I_{rms} = \frac{I_{max}}{\sqrt{2}}\checkmark = \frac{1,075}{\sqrt{2}}$ ✓
$= 0,76$ A✓

(5)

OPTION 3/*OPSIE 3*	**OPTION 4/*OPSIE 4***
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓ $= \frac{430}{\sqrt{2}}$ ✓ = 304,06 V $P_{average} = \frac{V^2_{rms}}{R} = \frac{(304,06)^2}{400}$ = 231,13 W $P_{ave} = I_{rms}V_{rms}$✓ 231,13 = I_{rms} (304,06) ✓ I_{rms} = 0,76 A✓	$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓ $= \frac{430}{\sqrt{2}}$ ✓ = 304,06 V $P_{average} = \frac{V^2_{rms}}{R} = \frac{(304,06)^2}{400}$ = 231,13 W $P_{ave} = I^2_{rms}R$✓ 231,13 = I^2_{rms} (400) ✓ I_{rms} = 0,76 A✓

[10]

QUESTION/*VRAAG 11*

11.1.1 It tells us that light has a particle nature.✓
Dit sê vir ons dat lig 'n deeltjie-aard het (1)

11.1.2 Remain the same. ✓
Bly dieselfde

For the same colour/ frequency/wavelength the energy of the photons will be the same✓. (The brightness causes more electrons to be released, but they will have the same maximum kinetic energy.)
Vir dieselfde kleur / frekwensie/ golflengte is die energie van die fotone dieselfde. (Die helderheid veroorsaak dat meer elektrone vrygestel word, maar hulle sal dieselfde maksimum kinetiese energie hê.)

OR/*OF*
Intensity only affects the number of ejected photo-electrons and not the maximum kinetic energy or maximum speed of the ejected photo-electrons
Intensiteit beinvloed slegs die aantal vrygestelde foto-elektrone en nie die maksimum kinetiese energie of maksimum spoed van die foto-elektrone.
OR/OF
Maximum kinetic energy of ejected photo-electrons is independent of intensity of radiation
Maksimum kinetiese energie van vrygestelde foto-elektrone is onafhanklik van die intensiteit van straling. (2)

11.1.3
$E = W_0 + E_k$
$hf = hf_0 + E_k$
$hf = hf_0 + ½ mv^2$
$E = W_0 + ½ mv^2$
✓ Any one/*Enige een*

$$\frac{(6,63\times10^{-34})(3\times10^{8})}{420\times10^{-9}}\checkmark = \frac{(6,63\times10^{-34})(3\times10^{8})}{\lambda_0}\checkmark + \frac{1}{2}(9,11\times10^{-31})(4,76\times10^{5})^2\checkmark$$

λ_o = 5,37 x 10^{-7} m
∴ the metal is sodium / *die metaal is natrium* ✓ (5)

11.2 **Q**✓ and/*en* **S** ✓

-

Emission spectra occur when excited <u>atoms /electrons drop from higher energy levels to lower energy levels.</u> ✓✓
Emissiespektra ontstaan wanneer opgewekte <u>atome/elektrone vanaf hoër energievlakke na laer energievlakke beweeg.</u>
(Characteristic frequencies are emitted/*Kenmerkende frekwensies word vrygestel.*) (4)

[12]

TOTAL/*TOTAAL*: 150