



Province of the  
**EASTERN CAPE**  
EDUCATION

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE/GRAAD 12**

**SEPTEMBER 2015**

**PHYSICAL SCIENCES P1  
FISIESE WETENSKAPPE V1  
MEMORANDUM**

**MARKS: 150**

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This memorandum consists of 16 pages.  
*Hierdie memorandum bestaan uit 16 bladsye.*

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**QUESTION/VRAAG 1**

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

(10 x 2) **[20]**

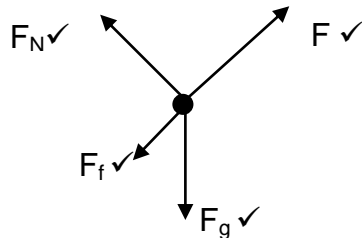
QUESTION 2/VRAAG 2

2.1 When a resultant/net force acts on an object, the object accelerates in the direction of the force. This acceleration 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 ✓ omgekeerd eweredig aan die massa van die voorwerp. ✓*

OR/OF

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

2.2



(4)

2.3 2.3.1 **Up the incline as positive/Teen die skuinste op as positief:**

$$\begin{aligned}
 F_{net} &= ma \\
 F + (f_{kA} + f_{kB} + F_{gll}) &= ma \\
 F + (f_{kA} + f_{kB} + mg\sin 30^\circ) &= (m_A + m_B)a \quad \left. \vphantom{F + (f_{kA} + f_{kB} + mg\sin 30^\circ)} \right\} \checkmark \text{ Any ONE/Enige EEN} \\
 F - \underline{6,8} - \underline{3,4} \quad \checkmark - \underline{(12)(9,8)\sin 30^\circ} \quad \checkmark &= 0 \quad \checkmark \\
 F &= 69 \text{ N} \quad \checkmark
 \end{aligned}$$

(5)

2.3.2  $f_k = \mu_k F_N$  ✓  
 $3,40 = \mu_k (4)(9,8) \cos 30^\circ$  ✓  
 $\mu_k = 0,10$  ✓

(3)

2.4 2.41 **REMAIN THE SAME/BLY DIESELFDE** ✓ (1)

2.4.2 **DECREASES/NEEM AF** ✓  
 Since  $\theta$  increases,  $F_{g\perp}$  decreases, ✓ therefore  $F_N$  decreases ✓ /  $f_k \propto F_N$  ✓ *Omdat  $\theta$  toeneem, sal  $F_{g\perp}$  afneem, ✓ dus sal  $F_N$  afneem* ✓ /  $f_k \propto F_N$ . ✓

(3)

[18]

QUESTION 3/VRAAG 3

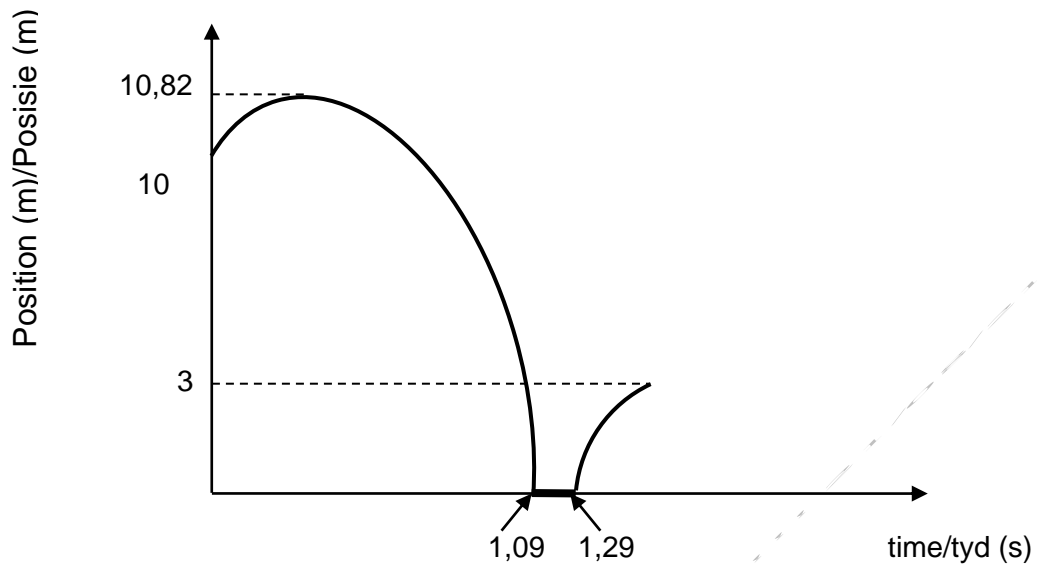
3.1 3.1.1

<p><b>OPTION1/OPSIE 1</b>  <b>Upwards as positive</b>  <b>Opwaarts as positief</b>  <math>v_f = v_i + a\Delta t \checkmark</math>  <math>0 = 4 + (-9,8)\Delta t \checkmark</math>  <math>\Delta t = 0,41 \text{ s} \checkmark</math> (3)</p>	<p><b>Downwards as positive</b>  <b>Afwaarts as positief</b>  <math>v_f = v_i + a\Delta t \checkmark</math>  <math>0 = -4 + (9,8)\Delta t \checkmark</math>  <math>\Delta t = 0,41 \text{ s} \checkmark</math> (3)</p>
<p><b>OPTION2/OPSIE2</b>  <b>Upwards as positive</b>  <b>Opwaarts as positief.</b>  <math>v_f^2 = v_i^2 + 2a\Delta y</math>  <math>0^2 = 4^2 + 2(-9,8)\Delta y \checkmark</math>  <math>\Delta y = 0,82\text{s}</math>  <math>\Delta y = \left(\frac{v_i + v_f}{2}\right) \Delta t</math>  <math>0,82 = \left(\frac{4 + 0}{2}\right) \Delta t \checkmark</math>  <math>\Delta t = 0,41 \text{ s} \checkmark</math> (3)</p>	<p><b>Downwards as positive</b>  <b>Afwaarts as positief</b>  <math>v_f^2 = v_i^2 + 2a\Delta y</math>  <math>0^2 = (-4)^2 + 2(9,8)\Delta y \checkmark</math>  <math>\Delta y = 0,82\text{s}</math>  <math>\Delta y = \left(\frac{v_i + v_f}{2}\right) \Delta t</math>  <math>-0,82 = \left(\frac{-4 + 0}{2}\right) \Delta t \checkmark</math>  <math>\Delta t = 0,41 \text{ s} \checkmark</math> (3)</p>
<p><b>NOTES/AANTEKENINGE:</b>                  Accept/Aanvaar  <math>s = \left(\frac{u+v}{2}\right) t</math>      <math>v^2 = u^2 + 2as</math>      g instead of a                  g in plaas van a</p>	

3.1.2

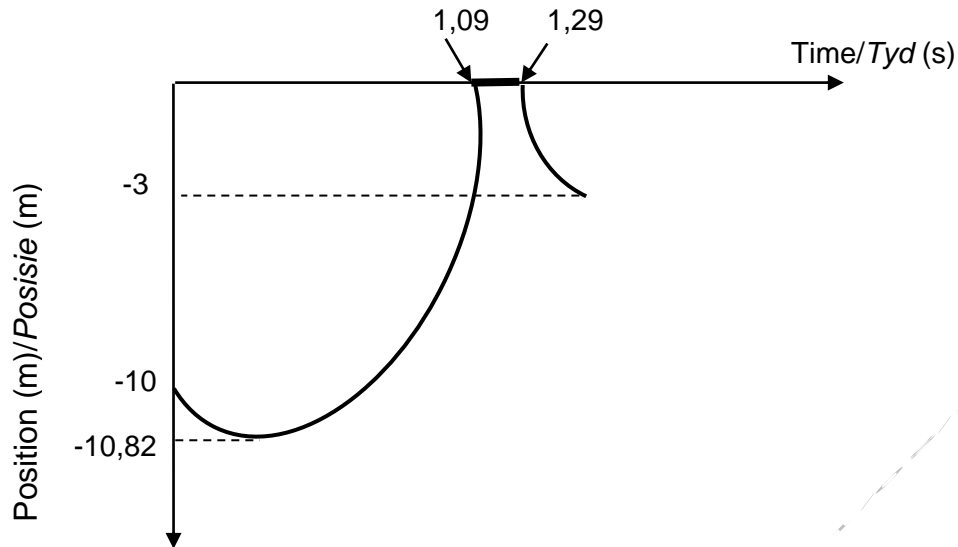
<p><b>OPTION 1/OPSIE1</b>  <b>Upwards as positive</b>  <b>Opwaarts as positief</b>  <math>\Delta y = v_i\Delta t + \frac{1}{2} a \Delta t^2 \checkmark</math>  <math>= (4)(0,41) + \frac{1}{2} (-9,8)(0,41)^2 \checkmark</math>  <math>= 0,82 \text{ m}</math>                  Maximum height/Maksimum hoogte  <math>= 10 \checkmark + 0,82 = 10,82 \text{ m} \checkmark</math> (4)</p>	<p><b>OPTION 1/OPSIE1</b>  <b>Downwards as positive</b>  <b>Afwaarts as positief</b>  <math>\Delta y = v_i\Delta t + \frac{1}{2} a \Delta t^2 \checkmark</math>  <math>= (-4)(0,41) + \frac{1}{2} (9,8)(0,41)^2 \checkmark</math>  <math>= -0,82 \text{ m}</math>                  Maximum height/Maksimum hoogte  <math>= 10 \checkmark + 0,82 = 10,82 \text{ m} \checkmark</math> (4)</p>
<p><b>OPTION 2/OPSIE 2</b>  <b>Upwards as positive</b>  <b>Opwaarts as positief</b>  <math>v_f^2 = v_i^2 + 2a\Delta y \checkmark</math>  <math>0^2 = (4)^2 + 2(-9,8)\Delta y \checkmark</math>  <math>\Delta y = 0,82\text{m}</math>                  Maximum height/Maksimum hoogte  <math>= 10 \checkmark + 0,82 = 10,82 \text{ m} \checkmark</math> (4)</p>	<p><b>OPTION 2/OPSIE 2</b>  <b>Downwards as positive</b>  <b>Afwaarts as positief</b>  <math>v_f^2 = v_i^2 + 2a\Delta y \checkmark</math>  <math>0^2 = (-4)^2 + 2(9,8)\Delta y \checkmark</math>  <math>\Delta y = 0,82\text{m}</math>                  Maximum height/Maksimum hoogte  <math>= 10 \checkmark + 0,82 = 10,82 \text{ m} \checkmark</math> (4)</p>

## 3.3 Upwards as positive/Opwaarts as positief:



<b>Criteria for graph/Kriteria vir grafiek:</b>	<b>Marks/Punte</b>
Graph starts at 10 m at $t = 0$ . <i>Grafiek begin by 10 m by <math>t = 0</math>s.</i>	✓
<b>Positive marking from QUESTION 3.1.2</b> <b>Positiewe nasien vanaf VRAAG 3.1.2</b>	✓
Maximum height at 10,82 m <i>Maksimumhoogte by 10,82 m</i>	
Strikes ground at $0 \text{ m}\cdot\text{s}^{-1}$ at $t = 1,09 \text{ s}$ <i>Tref grond by <math>0 \text{ m}\cdot\text{s}^{-1}</math> by <math>t = 1,09 \text{ s}</math></i>	✓
Rebounds on ground at $0 \text{ m}\cdot\text{s}^{-1}$ at $t = 1,29 \text{ s}$ <i>Bons van grond af by <math>0 \text{ m}\cdot\text{s}^{-1}</math> by <math>t = 1,29 \text{ s}</math></i>	✓
Maximum height after bounce at 3 m. <i>Maksimumhoogte van bal by 3 m.</i>	✓

## 3.3 Downwards as positive/Afwaarts as positief



Criteria for graph/Kriteria vir grafiek:	Marks/Punte
Graph starts at -10 m at $t = 0$ s. <i>Grafiek begin by -10 m by <math>t = 0</math>s.</i>	✓
<b>Positive marking from QUESTION 3.1.2</b> <b>Positiewe nasien vanaf VRAAG 3.1.2</b> Maximum height at -10,82 m <i>Maksimumhoogte by -10,82 m</i>	✓
Strike ground at $0 \text{ m}\cdot\text{s}^{-1}$ at $t = 1,09$ s. <i>Tref grond by <math>0 \text{ m}\cdot\text{s}^{-1}</math> by <math>t = 1,09</math> s</i>	✓
Rebounds on ground at $0 \text{ m}\cdot\text{s}^{-1}$ at $t = 1,29$ s <i>Bons van grond af by <math>0 \text{ m}\cdot\text{s}^{-1}</math> by <math>t = 1,29</math> s</i>	✓
Maximum height after bounce at 3 m. <i>Maksimumhoogte van bal by 3 m.</i>	✓

(5)  
[13]

## QUESTION 4/VRAAG 4

- 4.1 TO THE LEFT/NA LINKS ✓  (1)
- 4.2 (Newton's) Third Law (of motion)/(Newton) se Derde (Bewegingswet). ✓ (1)
- 4.3 In an isolated/closed system, ✓ the total mechanical energy is conserve remains constant. ✓  
*In 'n geïsoleerde/geslote sisteem ✓ bly die totale meganiese energie behoue/bly konstant. ✓*

OR/OF

The total mechanical energy of a system remain 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-konservatiewe kragte, nul is. ✓*

OR/OF

In the absence of a non-conservative force, ✓ the total mechanical energy is conserved/remain constant. ✓

In die afwesigheid van 'n nie-konservatiewe 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 die som van kinetiese en gravitasionele potensiele energie behoue/bly konstant. ✓

Notes/Aantekeninge:

Allocate ONE mark for 'isolated system' only in conjunction with energy.

Ken EEN punt toe vir "geïsoleerde/geslote sisteem" slegs indien saam met energie gebruik. 1/2

(2)

4.4

<p><b>OPTION 1/OPSIE 1</b></p> $E_{\text{mechanical at A}} = E_{\text{mechanical at B}}$ $(E_p + E_k)_A = (E_p + E_k)_B$ $(mgh + \frac{1}{2} mv^2)_A = (mgh + \frac{1}{2} mv^2)_B$ $66(9,8)(0) + \frac{1}{2} (66)v^2 \checkmark = 66(9,8)(1,6) \checkmark + \frac{1}{2} (66)(0)^2$ $v = 5,6 \text{ m}\cdot\text{s}^{-1} \checkmark$	<p>} ✓ Any ONE/Enige EEN</p>	(4)
<p><b>OPTION 2/OPTION 2</b></p> $E_{\text{mechanical at A}} = E_{\text{mechanical at B}}$ $(E_p + E_k)_A = (E_p + E_k)_B$ $(mgh + \frac{1}{2} mv^2)_A = (mgh + \frac{1}{2} mv^2)_B$ $v^2 = 2gh \checkmark$ $= (2)(9,8)(1,6) \checkmark$ $v = 5,6 \text{ m}\cdot\text{s}^{-1} \checkmark$	<p>} ✓ Any ONE/Enige EEN</p>	(4)
<p><b>OPTION 3/OPSIE 3</b></p> $W_{\text{net}} = \Delta E_k$ $F_{\text{net}} \Delta y \cdot \cos \theta = \frac{1}{2} m(v_f^2 - v_i^2)$ $m(9,8)(1,6)\cos 0^\circ \checkmark = \frac{1}{2} m(v_f^2 - 0^2) \checkmark$ $v_f = 5,6 \text{ m}\cdot\text{s}^{-1} \checkmark$	<p>} ✓ Any ONE/Enige EEN</p>	(4)
<p><b>NOTES/AANTEKENINGE:</b></p> <p>Accept/Aanvaar</p> $(E_p + E_k)_{\text{top}} = (E_p + E_k)_{\text{bottom}}$ $(U + K)_A = (U + K)_B$ $(U + K)_{\text{top}} = (U + K)_{\text{bottom}}$ $\Delta E_p + \Delta E_{kA} = 0 / \Delta U + \Delta K = 0$		(4)

4.5 POSITIVE MARKING FROM QUESTION 4.4  
POSITIEWE NASIEN VAN VRAAG 4.4

<p><b>OPTION1/OPSIE1</b></p> $\left. \begin{aligned} \sum p_i &= \sum p_f \\ (m_B + m_P)v_{BPi} &= m_B v_f + m_P v_{Pf} \end{aligned} \right\} \quad \checkmark \text{ Any ONE/Enige EEN}$ $(70)(5) \checkmark = (66)(5,6) + 4v_{Pf} \checkmark$ $v_{Pf} = -4,9 \text{ m}\cdot\text{s}^{-1}$ $= 4,9 \text{ m}\cdot\text{s}^{-1} \text{ to the left/na links } \checkmark$	(4)
<p><b>OPTION2/OPSIE2</b></p> $\Delta p_{\text{Boy}} = -\Delta p_{\text{parcel}} \checkmark$ $m_{\text{boy}}(v_f - v_i) = -m_p(v_{pf} - 5) \checkmark$ $(66)(5,6 - 5) \checkmark = -4(v_{pf} - 5) \checkmark$ $v_{Pf} = -4,9 \text{ m}\cdot\text{s}^{-1}$ $= 4,9 \text{ m}\cdot\text{s}^{-1} \text{ to the left/Na links } \checkmark$	(4)
<p><b>OPTION 3/OPSIE3</b></p> $F_{BP} = -F_{PB} \checkmark$ $m_B a_B = -m_P a_P$ $m_B \left[ \frac{v_{Bf} - v_{Bi}}{\Delta t} \right] = -m_P \left[ \frac{v_{Pf} - v_{Pi}}{\Delta t} \right]$ $\frac{(66)(5,6 - 5)}{\Delta t} \checkmark = \frac{-(4)(v_{Pf} - 4,5)}{\Delta t} \checkmark$ $v_{Pf} = -4,9 \text{ m}\cdot\text{s}^{-1}$ $= 4,9 \text{ m}\cdot\text{s}^{-1} \text{ to the left/na links } \checkmark$	(4)
<p><b>Other formulae/Ander formules:</b></p> $m_1 v_{i1} + m_2 v_{i2} = m_1 v_{f1} + m_2 v_{f2}$ $(m_1 + m_2) v = m_1 v_{f1} + m_2 v_{f2}$ $m_1 v_{iB} + m_2 v_{iP} = m_1 v_{fB} + m_2 v_{fP}$ $m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$ <p><math>p_{\text{total before}} = p_{\text{total after}}</math></p> <p>Accept/Aanvaar:</p> $p_{\text{before}} = p_{\text{after}} \quad \text{or/of} \quad p_i = p_f$	(4)

4.6 INCREASES/VERHOOG  $\checkmark$

$\ominus$   $\Delta p_{\text{parcel}}$  increases, thus  $\Delta p_{\text{boy}}$  increases.  $\checkmark$   
For the same mass of boy,  $v$  will be greater.  $\checkmark$

$\Delta p_{\text{pakkie}}$  vermeerder, dus  $\Delta p_{\text{seun}}$  vermeerder.  $\checkmark$   
Vir dieselfde massa, van die seun sal  $v$  groter wees.  $\checkmark$

OR/OF

If  $v$  of parcel increases, the momentum of the boy increases.  $\checkmark$   
For the same mass of boy, the velocity of parcel increases.  $\checkmark$

Indien  $v$  van die pakkie toeneem, neem die momentum van die seun toe.  $\checkmark$   
Vir dieselfde massa van die seun, vermeerder die snelheid van die pakkie.  $\checkmark$

OR/OF



F on parcel increases, therefore F on boy increases. ✓  
 $F\Delta t$ (boy) increases, for the same mass of boy, thus v will increase. ✓

*F op pakkie neem toe, dus neem F op seun toe. ✓*  
 *$F\Delta t$ (seun) neem toe, dus vir dieselfde massa van seun sal V verhoog. ✓*

**OR/OF**

$-m_B v_{Bf} = m_P v_{Pf}$

**AFR:**  $-m_S v_{Sf} = m_P v_{Pf}$

$v_B = - \frac{m_P v_{Pf}}{m_B}$  ✓ for same  $m_B$ , if  $v_P$  increases, ✓ then  $v_B$  increases.

$v_S = - \frac{m_P v_{Pf}}{m_S}$  ✓ vir dieselfde  $m_S$ , as  $v_P$  toeneem, ✓ neem  $v_S$  toe

(3)  
[15]

**QUESTION 5/VRAAG 5**

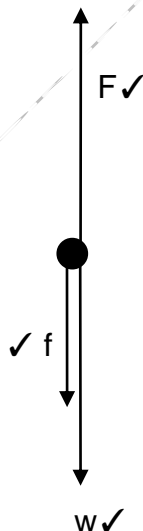
5.1 The net/total work done ✓ is equal to the change in the object's kinetic energy. ✓  
 Die netto/totale arbeid verrig ✓ op 'n voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp. ✓

**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 die voorwerp deur 'n resulterende/netto krag ✓ is gelyk aan die verandering in kinetiese energie van die voorwerp. ✓

(2)

5.2



<b>Accepted labels/Aanvaarde benoemings</b>	
w	$F_g/F_w/mg$ /gravitational force/weight $F_g/F_w$ /gravitasiekrag/gewig
F	$F_{applied}/F_{cable}/Tension/T/17\ 000\ N$ $F_{toegepas}/F_{kabel}/Spanning/T/17\ 000\ N$
f	$F_f/F_{friction}$ /friction/air resistance $F_f/F_{wrywing}$ /wrywing/lugweerstand

(3)

5.3

**OPTION 1/OPSIE 1**

$$W_{\text{net}} = \Delta E_k$$

$$W_T + W_W + W_f = \Delta E_k$$

$$F_T \Delta y \cos \theta + F_g \Delta y \cos \theta + W_f = 0$$

$$(17000)(20) \cos 0^\circ + (1680)(9,8)(20) \cos 180^\circ + W_f = 0$$

$$W_f = -10720 \text{ J}$$

(5)

**OPTION 2/OPSIE 2**

**Downwards as positive**

$$F_{\text{net}} = ma$$

$$-F + f + W = ma$$

$$-17000 + f + (1680)(9,8) = 0$$

$$f = 536 \text{ N}$$

$$W_f = f \Delta y \cos \theta$$

$$= (536)(20) \cos 180^\circ$$

$$= (536)(20)(-1)$$

$$= -10720 \text{ J}$$

(5)

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**Upwards as positive**

$$F_{\text{net}} = ma$$

$$F + f + W = ma$$

$$17000 - f - (1680)(9,8) = 0$$

$$f = 536 \text{ N}$$

$$W_f = f \Delta y \cos \theta$$

$$= (536)(20) \cos 180^\circ$$

$$= (536)(20)(-1)$$

$$= -10720 \text{ J}$$

(5)

[10]

**QUESTION 6/VRAAG 6**

- 6.1 The apparent change in the detected frequency (or pitch)(or wavelength) as a result of the relative motion between a source and an observer (listener).

Die skynbare verandering in waargenome frekwensie (of toonhoogte)(of golflengte)  
as gevolg van die relatiewe beweging tussen die bron en waarnemer/luisteraar.

(2)

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

$$f_L = \frac{340 + (340 - 310)}{340} 280$$

$$= 304,71 \text{ Hz}$$

(5)

6.3 SMALLER/KLEINEER ✓

- ⊖ The listener moves away from the siren, with constant velocity/speed ✓  
 $\lambda$  increases and the frequency decreases. ✓  
 Die luisteraar beweeg weg van die sirene met konstante snelheid/spoed. ✓  
 $\lambda$  neem toe en frekwensie neem af. ✓

OR/OF

$\lambda \propto \frac{1}{f}$  or/of  $f \propto \frac{1}{\lambda}$  ✓ At constant velocity (speed) ✓  
 By kontante snelheid (spoed) ✓

(3)

- 6.4 Determines the rate at which blood flow. } ✓ Any ONE  
 Monitor and measures the heartbeat of a foetus }  
 Bepaal die tempo waarteen bloed vloei. } ✓ Enige EEN  
 Monitor en meet die hartklop van 'n fetus. }

(1)

6.5 AWAY/WEG ✓  
⊖

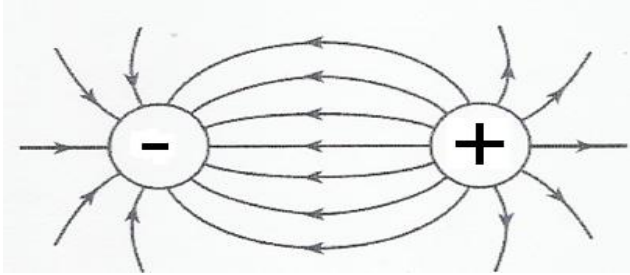
- Light from a star is shifted towards a longer wavelength/towards the red end of the spectrum. ✓  
 Die ster se lig word verskuif na 'n langer golflengte/na die rooi kant van die spektrum. ✓

(2)

[13]

## QUESTION 7/VRAAG 7

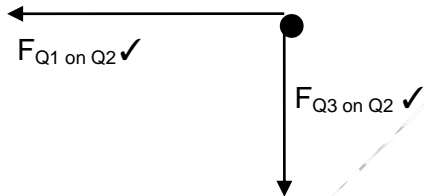
7.1



Criteria for sketch/ <i>Kriteria vir skets:</i>	Marks/ <i>Punte</i>
Correct shape <i>Korrekte vorm</i>	✓
Correct direction <i>Korrekte rigting</i>	✓
Field lines must be perpendicular to surfaces of spheres. (Field lines not touching each other/cross). <i>Veldlyne moet reghoekig wees aan oppervlak van sferes.</i> ( <i>Veldlyne raak nie mekaar nie/kruis nie.</i> ) <i>Veldlyne begin op sferes/moet NIE die sferes binnegaan NIE.</i>	✓

(3)

7.2



(2)

$$7.3 \quad F_{Q1 \text{ on } Q2} = \frac{kQ_1Q_2}{r^2} \checkmark = \frac{(9 \times 10^9)(3 \times 10^{-9})(3 \times 10^{-9})}{(10 \times 10^{-2})^2} \checkmark = 8,1 \times 10^{-6} \text{ N}$$

$$F_{Q3 \text{ on } Q2} = \frac{kQ_3Q_2}{r^2} = \frac{(9 \times 10^9)(2 \times 10^{-9})(3 \times 10^{-9})}{(5 \times 10^{-2})^2} \checkmark = 2,16 \times 10^{-5} \text{ N}$$

$$F_{\text{net}} = \sqrt{(F_{Q1 \text{ on } Q2})^2 + (F_{Q3 \text{ on } Q2})^2} = \sqrt{(8,1 \times 10^{-6})^2 + (2,16 \times 10^{-5})^2} \checkmark = 2,31 \times 10^{-5} \text{ N}$$

$$\tan \theta = \frac{2,16 \times 10^{-5}}{8,1 \times 10^{-6}} \checkmark = 2,67$$

$$\theta = 69,44^\circ$$

**OR/OF**

$$\theta = \tan^{-1}\left(\frac{2,16 \times 10^{-5}}{8,1 \times 10^{-6}}\right) \checkmark$$

$$\theta = 69,44^\circ$$

$$F_{\text{net}} = 2,31 \times 10^{-5} \text{ N} \checkmark 69,44^\circ / \text{On a bearing of } 200,56^\circ \text{ (Or any appropriate direction)} \checkmark$$

*In 'n rigting van 200,56° (Of enige toepaslike rigting)*  $\checkmark$  (8)

$$7.4 \quad \left. \begin{array}{l} E_{\text{net}} = 0 \\ E_P + E_R = 0 \\ \frac{kQ_P}{r_P^2} + \frac{kQ_R}{r_R^2} = 0 \end{array} \right\} \checkmark \text{ Any ONE/Enige EEN}$$

$$\frac{(9 \times 10^9)(8 \times 10^{-9})}{(2 \times 10^{-2})^2} \checkmark - \frac{(9 \times 10^9) Q_R}{(1 \times 10^{-2})^2} \checkmark = 0$$

$$Q_R = +2 \times 10^{-9} \text{ C } (+2 \text{ nC}) \checkmark$$

(5)  
[18]

## QUESTION 8/VRAAG 8

8.1 Alternating current/Wisselstroom ✓ (1)

8.2 The bulb converts 100 J of energy per second (to heat and light). ✓  
Die gloeilamp sit 100 J energie per sekonde om (in hitte en lig). ✓ (1)

8.3

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$ $100 = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark \times I_{\text{rms}}$ $= \frac{311}{\sqrt{2}} \times I_{\text{rms}} \checkmark$ $I_{\text{rms}} = 0,45 \text{ A} \checkmark$	$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark = \frac{311}{\sqrt{2}} = 219,91 \text{ V}$ $P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$ $100 = 219,91 \times I_{\text{rms}} \checkmark$ $I_{\text{rms}} = 0,45 \text{ A} \checkmark$
(4)	(4)

8.4 AC can be stepped up at power stations. ✓ (AC voltage can be stepped down)  
Reduced energy loss during transmission. ✓ /AC can be stepped up of  
stepped down using transformers at substations.

WS kan by kragstasies verhoog word. ✓ (WS spanning kan verlaag word)  
Verminderde energieverlies tydens transmissie. ✓ WS kan met behulp van  
transformators by substasie verhoog of verlaag word.

(2)  
[8]

## QUESTION 9/VRAAG 9

9.1 9.1.1 1,5 V ✓ (1)

9.1.2 POSITIVE MARKING FROM QUESTION 9.1.1  
POSITIEWE NASIEN VANAF VRAAG 9.1.1

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2 (Or any other gradient)
$\text{Gradient} = \frac{\Delta I}{\Delta V}$ $= \frac{0 - 1,8 \checkmark}{1,5 - 0 \checkmark} = -1,20$ $\frac{1}{r} = 1,20$ $r = \frac{1}{1,20} \checkmark$ $= 0,83 \Omega \checkmark$	$\text{Gradient} = \frac{\Delta I}{\Delta V} \text{ (Of enige ander gradient)}$ $= \frac{0 - 0,9 \checkmark}{1,5 - 0,75 \checkmark} = -1,20$ $\frac{1}{r} = 1,20$ $r = \frac{1}{1,20} \checkmark$ $= 0,83 \Omega \checkmark$
(4)	(4)

9.2. 9.2.1 INCREASES/VERMEERDER ✓

⊖

(1)

9.2.2 ε remains constant/ε bly konstant ✓

Ir decreases ✓, V<sub>ext</sub> Increases ✓

Ir neem af ✓, V<sub>eks</sub> Neem toe ✓

(3)

9.3 9.3.1 6 V ✓✓ (2)

9.3.2 (a)  $R = \frac{V}{I}$  ✓  
 $4 = \frac{2}{I}$  ✓  
 $I = 0,5 \text{ A}$  (3)

(b) POSITIVE MARKING FROM QUESTION 9.3.1  
POSITIEWE NASIEN VAN VRAAG 9.3.1

**OPTION 1/OPSIE 1**

$$\begin{aligned} \mathcal{E} &= I(R + r) \checkmark \\ 6 \checkmark &= 0,5 [R_p + 4 \checkmark + 4(0,25)] \checkmark \\ R_p &= 7 \Omega \\ \frac{1}{R_p} &= \frac{1}{r_1} + \frac{1}{r_2} \checkmark \\ \frac{1}{7 \checkmark} &= \frac{1}{14} + \frac{1}{R_x} \checkmark \\ R_x &= 14 \Omega \checkmark \end{aligned}$$

(8)

**OPTION 2/OPSIE 2**

$$\begin{aligned} \mathcal{E} &= V_{\text{external}} + V_{\text{internal}} \checkmark \\ \mathcal{E} &= V_{\text{external}} + Ir \checkmark \\ 6 \checkmark &= V_{\text{external}} + (0,5)(4)(0,25) \checkmark \\ V_{\text{external}} &= 5,50 \text{ V} \\ V_{\text{external}} &= V_P + V_S \\ 5,50 &= V_P + 2 \checkmark \\ V_P &= 3,50 \text{ V} \\ R_p &= \frac{V_P}{I_P} \\ &= \frac{3,50}{0,50} \\ &= 7 \Omega \\ \frac{1}{R_p} &= \frac{1}{R_{14}} + \frac{1}{R_x} \checkmark \\ \frac{1}{7 \checkmark} &= \frac{1}{14} + \frac{1}{R_x} \checkmark \\ R_x &= 14 \Omega \checkmark \end{aligned}$$

(8)

**OPTION 3/OPSIE 3**

$$\begin{aligned} \mathcal{E} &= V_{\text{external}} + V_{\text{internal}} \checkmark \\ \mathcal{E} &= V_{\text{external}} + Ir \checkmark \\ 6 \checkmark &= V_{\text{external}} + (0,5)(4)(0,25) \checkmark \\ V_{\text{external}} &= 5,50 \text{ V} \\ V_{\text{external}} &= V_P + V_S \\ 5,50 &= V_P + 2 \checkmark \\ V_P &= 3,50 \text{ V} \\ R_{14} &= \frac{V_{14}}{I_{14}} \\ 14 &= \frac{3,50}{I_{14}} \\ I_{14} &= 0,25 \text{ A} \\ I_P &= I_x + I_{14} \\ 0,5 &= I_x + 0,25 \checkmark \\ I_x &= 0,25 \text{ A} \\ R_x &= \frac{V_P}{I_x} \\ &= \frac{3,5}{0,25} \\ &= 14 \Omega \checkmark \end{aligned}$$

(8)

(8)  
[20]

## QUESTION 10/VRAAG 10

10.1 Photo-electric effect/*Fotoëlektriese effek* ✓ (1)

10.2 The minimum frequency of light needed to emit electrons ✓ from a metal surface. ✓  
*Die minimum frekwensie van lig benodig om elektrone te verwyder ✓ vanaf die oppervlak van 'n metaal. ✓* (2)

10.3  $n = \frac{Q}{e^-}$  OR/OF  $n = \frac{Q}{q_{e^-}}$  ✓

$$(1,01 \times 10^9) = \frac{Q}{(1,6 \times 10^{-19})} \quad \checkmark \text{ SS}$$

$$Q = 1,62 \times 10^{-10} \text{ C } (1,616 \times 10^{-10} \text{ C})$$

$$Q = I \Delta t \quad \checkmark \checkmark$$

$$1,62 \times 10^{-10} = I (1) \quad \checkmark$$

$$I = 1,62 \times 10^{-10} \text{ A} \quad \checkmark \quad (5)$$

10.4 DECREASES/NEEM AF ✓ (1)

10.5.1  $\ominus$  SMALLER/KLEINER AS ✓ (1)

10.5 10.5.2 The wavelength/frequency/energy of the incident light remains constant. ✓  
 Since the threshold frequency is greater, the work function is greater. ✓  
*Die golflengte/frekwensie/energie van die inkomende lig bly konstant. ✓*  
*Aangesien die drumpel frekwensie vergroot, is die werksfunksie groter. ✓* (2)

10.6 The wavelengths of light that are absorbed in the absorption spectrum ✓ correspond exactly to the wavelength of light that is emitted in the line emission spectrum of the same gas. ✓

*Die golflengte van lig geabsorbeer in die absorpsie spektrum, ✓ stem presies ooreen met die golflengte van lig wat vrygestel is in die lynemissiespektrum van dieselfde gas. ✓*

OR/OF

The dark lines in the absorption spectrum ✓ correspond exactly with the colour lines present in the line emission spectrum of the same gas. ✓

*Die donkerlyne in die absorpsie spektrum, ✓ stem presies ooreen met die kleurlyne in die lynemissie spektrum van dieselfde gas. ✓*

(2)  
[14]

TOTAL/TOTAAL: 150