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# basic education

Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**SENIOR CERTIFICATE EXAMINATIONS/  
NATIONAL SENIOR CERTIFICATE EXAMINATIONS  
*SENIORSERTIFIKAAT-EKSAMEN/  
NASIONALE SENIORSERTIFIKAAT-EKSAMEN***

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

**MAY/JUNE/MEI/JUNIE 2024**

**MARKING GUIDELINES/*NASIENRIGLYNE***

**MARKS/*PUNTE*: 150**

**These marking guidelines consist of 21 pages.  
*Hierdie nasienriglyne bestaan uit 21 bladsye.***

**QUESTION 1/VRAAG 1**

- 1.1 B ✓✓ (2)
- 1.2 B ✓✓ (2)
- 1.3 C ✓✓ (2)
- 1.4 A ✓✓ (2)
- 1.5 D ✓✓ (2)
- 1.6 A ✓✓ (2)
- 1.7 A ✓✓ (2)
- 1.8 C ✓✓ (2)
- 1.9 A ✓✓ (2)
- 1.10 C ✓✓ (2)
- [20]**

**QUESTION 2/VRAAG 2**

2.1

**Marking criteria/Nasienkriteria**

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

When a resultant/net force acts on an object, the object will accelerate in the direction of the force. The acceleration is directly proportional to the resultant/net 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. Die versnelling is direk eweredig is aan die netto krag en omgekeerd eweredig aan die massa van die voorwerp.

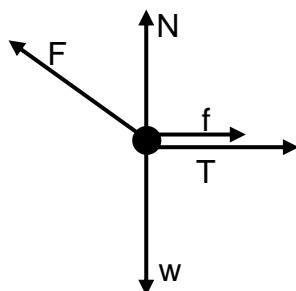
**OR/OF**

The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force.

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

(2)

2.2

**Accepted labels/Aanvaarde benoemings:**

w	$F_g/F_w/40,18 \text{ N}/\text{mg}/\text{weight}/\text{gravitational force}/\text{gewig}/\text{gravitasiekrag}$
T	$F_T/\text{tension}/\text{spanning}/F_{\text{string}}/F_{\text{tou}}$
f	(kinetic) friction/ $F_f/f_k/f_r/(\text{kinetiese}) \text{ wrywing}/f_w$
N	$F_N/\text{Normal}/F_{\text{normal}}/F_{\text{normaal}}/\text{Normaal}$
F	$F_{\text{app}}/F_{\text{toeg}}/49 \text{ N}/F_a/F_A$

**Notes/Aantekeninge:**

- Mark awarded for label and arrow./Punt toegeken vir benoeming 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): Max/Maks  $4/5$
- If everything is correct, but no arrows./Indien alles korrek, maar geen pyltjies nie: Max/Maks  $4/5$
- If force(s) do not make contact with the dot./Indien krag(te) nie met die kolletjie kontak maak nie: Max/Maks  $4/5$
- If forces are superimposed/Indien kragte bo-oor mekaar geteken Max/Maks  $4/5$

(5)

2.3.1

$$\left. \begin{aligned} f_k &= \mu_k F_N \\ f_k &= \mu_k (F_g - F_y) \\ f_k &= \mu_k (mg - F \sin \theta) \end{aligned} \right\} \begin{array}{l} \text{Any one/} \\ \text{Enige een} \end{array}$$

$$= (0,35)[(4,1)(9,8) - 49 \sin 50^\circ] \checkmark$$

$$= 0,93 \text{ N} \checkmark$$

Range/Gebied: (0,92 – 0,93 N)

(3)

2.3.2

**POSITIVE MARKING FROM QUESTION 2.3.1./  
POSITIEWE NASIEN VANAF VRAAG 2.3.1.****For A/Vir A:****LEFT AS POSITIVE/****LINKS AS POSITIEF**

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 F_x - T - f &= ma \\
 F \cos \theta - T - \mu_k F_N &= ma
 \end{aligned}
 \left. \begin{array}{l} \\ \\ \end{array} \right\} \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array}$$

$$\underline{49 \cos 50^\circ - T - 0,93} \checkmark = (4,1)a$$

$$T = 30,57 - 4,1a \dots \text{equation 1}$$

**For B/Vir B:****UPWARDS AS POSITIVE/****OPWAARTDS AS POSITIEF**

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 T - F_g &= ma
 \end{aligned}$$

$$\underline{T - (2,3)(9,8)} \checkmark = (2,3)a$$

$$T = 2,3a + 22,54 \dots \text{equation 2}$$

$\checkmark$  Both/Beide

$$30,57 - 4,1a = 2,3a + 22,54$$

$$a = 1,25 \text{ m} \cdot \text{s}^{-2} \checkmark$$

$$\text{Range/Gebied: } (1,25 - 1,26 \text{ m} \cdot \text{s}^{-2})$$

**For A/Vir A:****RIGHT AS POSITIVE/****REGS AS POSITIEF**

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 -F_x + T + f &= ma \\
 -F \cos \theta + T + \mu_k F_N &= ma
 \end{aligned}
 \left. \begin{array}{l} \\ \\ \end{array} \right\} \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array}$$

$$\underline{-49 \cos 50^\circ + T + 0,93} \checkmark = (4,1)a$$

$$T = 30,57 + 4,1a \dots \text{equation 1}$$

**For B/Vir B:****DOWNWARDS AS POSITIVE/****AFWAARTDS AS POSITIEF**

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 F_g - T &= ma
 \end{aligned}$$

$$\underline{(2,3)(9,8) - T} \checkmark = (2,3)a$$

$$T = 22,54 - 2,3a \dots \text{equation 2}$$

$\checkmark$  Both/Beide

$$30,57 + 4,1a = 22,54 - 2,3a$$

$$a = -1,25 \text{ m} \cdot \text{s}^{-2}$$

$$a = 1,25 \text{ m} \cdot \text{s}^{-2} \checkmark$$

$$\text{Range/Gebied: } (1,25 - 1,26 \text{ m} \cdot \text{s}^{-2})$$

**NOTE/NOTA:** systems approach  $\frac{2}{5}$  marks for formula and correct answer  
 Sisteem benadering  $\frac{2}{5}$  punte vir formule en korrekte antwoord

(5)

**[15]**

**QUESTION 3/VRAAG 3**

- 3.1 Motion during which the only force acting is gravitational force. (2 or 0)  
Beweging waar die enigste krag wat inwerk, gravitasiekrag/swaartekrag is.  
**OR/OF**

Motion under the influence of gravitational force only. ✓✓ (2 or 0)  
Beweging slegs onder die invloed van gravitasiekrag/swaartekrag.

(2)

**NOTE: if projectile is defined 0/2**

**NOTA: indien projektiel gedefinieer is 0/2**

- 3.2. NO/NEE ✓

(1)

- 3.3.1

**Marking criteria/Nasienkriteria:**

- Formula with  $\Delta t$ . / Formule met  $\Delta t$  ✓
- Correct substitution into formula. / Korrekte vervanging in formule. ✓
- Final answer / Finale antwoord: 1,44 s ✓

**OPTION 1/OPSIE 1**

**DOWNWARDS AS POSITIVE/  
AFWAARTS AS POSITIEF**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$15 = 3,4 \Delta t + \frac{1}{2} (9,8) \Delta t^2 \quad \checkmark$$

$$\Delta t = 1,44 \text{ s} \quad \checkmark$$

**UPWARDS AS POSITIVE/  
OPWAARTS AS POSITIEF**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$-15 = -3,4 \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \quad \checkmark$$

$$\Delta t = 1,44 \text{ s} \quad \checkmark$$

**OPTION 2/OPSIE 2**

**DOWNWARDS AS POSITIVE/  
AFWAARTS AS POSITIEF**

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

$$v_f^2 = (3,4)^2 + 2(9,8)(15)$$

$$v_f = 17,48 \text{ m} \cdot \text{s}^{-1}$$

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

$$17,48 = 3,4 + (9,8)\Delta t \quad \checkmark$$

$$\Delta t = 1,44 \text{ s} \quad \checkmark$$

**UPWARDS AS POSITIVE/  
OPWAARTS AS POSITIEF**

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

$$v_f^2 = (-3,4)^2 + 2(-9,8)(-15)$$

$$v_f = -17,48 \text{ m} \cdot \text{s}^{-1}$$

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

$$-17,48 = -3,4 + (-9,8)\Delta t \quad \checkmark$$

$$\Delta t = 1,44 \text{ s} \quad \checkmark$$

**OPTION 3/OPSIE 3**

**DOWNWARDS AS POSITIVE/  
AFWAARTS AS POSITIEF**

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

$$v_f^2 = (3,4)^2 + 2(9,8)(15)$$

$$v_f = 17,48 \text{ m} \cdot \text{s}^{-1}$$

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

$$15 = \left( \frac{3,4 + 17,48}{2} \right) \Delta t \quad \checkmark$$

$$\Delta t = 1,44 \text{ s} \quad \checkmark$$

**UPWARDS AS POSITIVE/  
OPWAARTS AS POSITIEF**

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

$$v_f^2 = (-3,4)^2 + 2(-9,8)(-15)$$

$$v_f = -17,48 \text{ m} \cdot \text{s}^{-1}$$

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

$$-15 = \left( \frac{-3,4 - 17,48}{2} \right) \Delta t \quad \checkmark$$

$$\Delta t = 1,44 \text{ s} \quad \checkmark$$

(3)

## 3.3.2

**POSITIVE MARKING FROM QUESTION 3.3.1.****POSITIEWE NASIEN VANAF VRAAG 3.3.1.****Marking criteria/Nasienkriteria:**

- Correct formula to calculate  $\Delta y$ . / Korrekte formule om  $\Delta y$  te bereken. ✓
- Correct substitution into formula. / Korrekte vervanging in formule. ✓
- Subtraction of displacement from initial height. / Aftrekking van verplasing van oorspronklike hoogte. ✓
- Final answer / Finale antwoord: Range/Gebied: (10,1 - 10,12 m) ✓

**OPTION 1/OPSIE 1****UPWARDS AS POSITIVE/  
OPWAARTS AS POSITIEF**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$\Delta y = -3,4(1,44) + \frac{1}{2}(0)(1,44)^2 \quad \checkmark$$

$$\Delta y = -4,896 \text{ m}$$

$$\text{Height} = 15 - 4,896 \checkmark = 10,1 \text{ m} \quad \checkmark$$

**DOWNWARDS AS POSITIVE/  
AFWAARTS AS POSITIEF**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$\Delta y = 3,4(1,44) + \frac{1}{2}(0)(1,44)^2 \quad \checkmark$$

$$\Delta y = 4,896 \text{ m}$$

$$\text{Height} = 15 - 4,896 \checkmark = 10,1 \text{ m} \quad \checkmark$$

**OPTION 2/OPSIE 2****UPWARDS AS POSITIVE/  
OPWAARTS AS POSITIEF**

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

$$\Delta y = \left( \frac{-3,4 - 3,4}{2} \right) (1,44) \quad \checkmark$$

$$\Delta y = -4,896 \text{ m}$$

$$\text{Height} = 15 - 4,896 \checkmark = 10,1 \text{ m} \quad \checkmark$$

**DOWNWARDS AS POSITIVE/  
AFWAARTS AS POSITIEF**

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

$$\Delta y = \left( \frac{3,4 + 3,4}{2} \right) (1,44) \quad \checkmark$$

$$\Delta y = 4,896 \text{ m}$$

$$\text{Height} = 15 - 4,896 \checkmark = 10,1 \text{ m} \quad \checkmark$$

**OPTION 3/OPSIE 3****UPWARDS AS POSITIVE/  
OPWAARTS AS POSITIEF**

$$v = \frac{\Delta y}{\Delta t} \quad \checkmark$$

$$-3,4 = \frac{\Delta y}{1,44} \quad \checkmark$$

$$\Delta y = -4,896 \text{ m}$$

$$\text{Height} = 15 - 4,896 \checkmark = 10,1 \text{ m} \quad \checkmark$$

**Accept**  $s = \frac{d}{\Delta t}$  **OR**  
Speed =  $\frac{\text{distance}}{\text{time}}$

**DOWNWARDS AS POSITIVE/  
AFWAARTS AS POSITIEF**

$$v = \frac{\Delta y}{\Delta t} \quad \checkmark$$

$$3,4 = \frac{\Delta y}{1,44} \quad \checkmark$$

$$\Delta y = 4,896 \text{ m}$$

$$\text{Height} = 15 - 4,896 \checkmark = 10,1 \text{ m} \quad \checkmark$$

**Aanvaar**  $s = \frac{d}{\Delta t}$  **OF**  
Spoed =  $\frac{\text{afstand}}{\text{tyd}}$

(4)

3.4

**POSITIVE MARKING FROM Q 3.3.1./POSITIEWE NASIEN VANAF VR 3.3.1.****Marking criteria/Nasienkriteria:**

- Correct formula to calculate  $\Delta t$ ./Korrekte formule om  $\Delta t$  te bereken. ✓
- Correct substitution into formula./Korrekte vervanging in formule. ✓
- Addition of three time values./Bymekaartel van drie tydwaardes. ✓
- Final answer/Finale antwoord: Range/Gebied: (2,37 – 2,38 s) ✓

**OPTION 1/OPSIE 1****UPWARDS AS +/OPWAARTS AS +**

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

$$0 = 7,2 + (-9,8)\Delta t \quad \checkmark$$

$$\Delta t = 0,73 \text{ s}$$

**DOWNWARDS AS +/AFWAARTS AS +**

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

$$0 = -7,2 + (9,8)\Delta t \quad \checkmark$$

$$\Delta t = 0,73 \text{ s}$$

**Note/Aantekening:**

Accept for all options if  $v_i$  and  $v_f$  are swapped./Aanvaar vir alle opsies indien  $v_i$  en  $v_f$  omgeruil is.

**OPTION 2/OPSIE 2****UPWARDS AS +/OPWAARTS AS +**

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

$$-7,2 = 7,2 + (-9,8)\Delta t \quad \checkmark$$

$$\Delta t = 1,47 \text{ s}$$

Time to max height/Tyd tot maks hoogte  $\Delta t = 0,73 \text{ s}$

**DOWNWARDS AS +/AFWAARTS AS +**

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

$$7,2 = -7,2 + (9,8)\Delta t \quad \checkmark$$

$$\Delta t = 1,47 \text{ s}$$

Time to max height/Tyd tot maks hoogte  $\Delta t = 0,73 \text{ s}$

**OPTION 3/OPSIE 3****UPWARDS AS +/OPWAARTS AS +**

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

$$0 = (7,2)^2 + 2(-9,8)\Delta y$$

$$\Delta y = 2,64 \text{ m}$$

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

$$2,64 = \left( \frac{7,2 + 0}{2} \right) \Delta t \quad \checkmark$$

$$\Delta t = 0,73 \text{ s}$$

**OR/OF**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$2,64 = 7,2 \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \quad \checkmark$$

$$\Delta t = 0,73 \text{ s}$$

**DOWNWARDS AS +/AFWAARTS AS +**

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

$$0 = (-7,2)^2 + 2(9,8)\Delta y$$

$$\Delta y = -2,64 \text{ m}$$

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

$$-2,64 = \left( \frac{-7,2 + 0}{2} \right) \Delta t \quad \checkmark$$

$$\Delta t = 0,73 \text{ s}$$

**OR/OF**

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$-2,64 = -7,2 \Delta t + \frac{1}{2} (9,8) \Delta t^2 \quad \checkmark$$

$$\Delta t = 0,73 \text{ s}$$

$$t_3 = 1,44 + 0,2 + 0,73 \quad \checkmark$$

$$= 2,37 \text{ s} \quad \checkmark (2,38)$$

(4)  
[14]



**QUESTION 4 / VRAAG 4**

4.1

**Marking criteria/Nasienkriteria:**

If any of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

In an isolated system the total (linear) momentum is conserved/remains constant. ✓✓ (Accept closed system for this exam)

In 'n geïsoleerde sisteem bly die totale (lineêre) momentum behoue/konstant. (Aanvaar geslote sisteem vir hierdie eksamen)

**OR/OF**

**Accept for 1 mark:** In an isolated system the total momentum before the collision is equal to the total momentum after the collision.

**Aanvaar vir 1 punt:** In 'n geïsoleerde sisteem is die totale momentum voor 'n botsing gelyk aan die totale momentum na die botsing.

(2)

4.2

**Marking criteria/Nasienkriteria:**

- Correct momentum formula/Korrekte momentumformule. ✓
- Correct substitution into momentum formula./Korrekte vervanging in momentum formule. ✓✓
- Correct substitution into equation of motion/Korrekte vervanging in bewegingsvergelyking. ✓
- Final correct answer/Finale korrekte antwoord: 0,64 m ✓

**OPTION 1/OPSIE 1****RIGHT AS POSITIVE/REGS AS POSITIEF**

$$\begin{aligned} \sum p_i &= \sum p_f \\ m_A v_{Ai} + m_B v_{Bi} &= m_A v_{Af} + m_B v_{Bf} \quad \left. \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array} \right\} \\ 0 &= (3,2)(-0,4) + (2,6)v_f \quad \checkmark \\ \therefore v_f &= 0,49 \text{ m} \cdot \text{s}^{-1} \end{aligned}$$

**LEFT AS POSITIVE/LINKS AS POSITIEF**

$$\begin{aligned} \sum p_i &= \sum p_f \\ m_A v_{Ai} + m_B v_{Bi} &= m_A v_{Af} + m_B v_{Bf} \quad \left. \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array} \right\} \\ 0 &= (3,2)(0,4) + (2,6)v_f \quad \checkmark \\ \therefore v_f &= -0,49 \text{ m} \cdot \text{s}^{-1} \end{aligned}$$

**OPTION 2/OPSIE 2****RIGHT AS POSITIVE/REGS AS POSITIEF**

$$\begin{aligned} \Delta p_A &= -\Delta p_B \\ m(v_{Af} - v_{Ai}) &= -m(v_{Bf} - v_{Bi}) \quad \left. \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array} \right\} \\ 3,2(-0,4 - 0) &= -2,6(v_{Bf} - 0) \quad \checkmark \\ \therefore v &= 0,49 \text{ m} \cdot \text{s}^{-1} \end{aligned}$$

**LEFT AS POSITIVE/LINKS AS POSITIEF**

$$\begin{aligned} \Delta p_A &= -\Delta p_B \\ m(v_{Af} - v_{Ai}) &= -m(v_{Bf} - v_{Bi}) \quad \left. \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array} \right\} \\ 3,2(0,4 - 0) &= -2,6(v_{Bf} - 0) \quad \checkmark \\ \therefore v &= -0,49 \text{ m} \cdot \text{s}^{-1} \end{aligned}$$

**RIGHT AS POSITIVE/REGS AS POSITIEF**

$$v = \frac{\Delta x}{\Delta t}$$

$$0,49 = \frac{\Delta x}{1,3} \quad \checkmark$$

$$\Delta x_B = 0,64 \text{ m} \quad \checkmark$$

**OR/OF**

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

$$= \left( \frac{0,49 + 0,49}{2} \right) 1,3 \quad \checkmark$$

$$\Delta x_B = 0,64 \text{ m} \quad \checkmark$$

**LEFT AS POSITIVE/LINKS AS POSITIEF**

$$v = \frac{\Delta x}{\Delta t}$$

$$-0,49 = \frac{\Delta x}{1,3} \quad \checkmark$$

$$\Delta x = -0,64 \text{ m ie } \Delta x_B = 0,64 \text{ m} \quad \checkmark$$

**OR/OF**

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

$$= \left( \frac{-0,49 - 0,49}{2} \right) 1,3 \quad \checkmark$$

$$\Delta x = -0,64 \text{ m ie } \Delta x_B = 0,64 \text{ m} \quad \checkmark$$

(5)

4.3 **POSITIVE MARKING FROM QUESTION 4.2.**  
**POSITIEWE NASIEN VANAF VRAAG 4.2.**

<p><b>OPTION 1/OPSIE 1</b>  <b>RIGHT AS POSITIVE/</b>  <b>REGS AS POSITIEF:</b>  <b>For A/Vir A:</b>  <math>F_{\text{net}}\Delta t = \Delta p</math>  <math>F_{\text{net}}\Delta t = m(v_f - v_i)</math> } ✓ Any one/  <i>Enige een</i>  <math>(-4,2)\Delta t = 3,2(-0,4 - 0)</math> ✓  <math>\Delta t = 0,3 \text{ s}</math> ✓</p>	<p><b>LEFT AS POSITIVE/</b>  <b>LINKS AS POSITIEF:</b>  <b>For A/Vir A:</b>  <math>F_{\text{net}}\Delta t = \Delta p</math>  <math>F_{\text{net}}\Delta t = m(v_f - v_i)</math> } ✓ Any one/  <i>Enige een</i>  <math>(4,2)\Delta t = 3,2(0,4 - 0)</math> ✓  <math>\Delta t = 0,3 \text{ s}</math> ✓</p>
<p><b>OPTION 2/OPSIE 2</b>  <b>RIGHT AS POSITIVE/</b>  <b>REGS AS POSITIEF:</b>  <b>For B/Vir B:</b>  <math>F_{\text{net}}\Delta t = \Delta p</math>  <math>F_{\text{net}}\Delta t = m(v_f - v_i)</math> } ✓ Any one/  <i>Enige een</i>  <math>(4,2)\Delta t = 2,6(0,49 - 0)</math> ✓  <math>\Delta t = 0,3 \text{ s}</math> ✓</p>	<p><b>LEFT AS POSITIVE/</b>  <b>LINKS AS POSITIEF:</b>  <b>For B/Vir B:</b>  <math>F_{\text{net}}\Delta t = \Delta p</math>  <math>F_{\text{net}}\Delta t = m(v_f - v_i)</math> } ✓ Any one/  <i>Enige een</i>  <math>(-4,2)\Delta t = 2,6(-0,49 - 0)</math> ✓  <math>\Delta t = 0,3 \text{ s}</math> ✓</p>
<p><b>OPTION 3/OPSIE 3</b>  <math>F_{\text{net}} = ma</math>  <math>4,2 = 3,2a</math>  <math>a = 1,31 \text{ m}\cdot\text{s}^{-2}</math>  <math>v_f = v_i + a\Delta t</math> ✓  <math>0,4 = 0 + (1,31)\Delta t</math> ✓  <math>\Delta t = 0,3 \text{ s}</math> ✓</p>	<p><b>OPTION 4/OPSIE 4</b>  <math>F_{\text{net}} = ma</math>  <math>4,2 = 2,6a</math>  <math>a = 1,62 \text{ m}\cdot\text{s}^{-2}</math>  <math>v_f = v_i + a\Delta t</math> ✓  <math>0,49 = 0 + (1,62)\Delta t</math> ✓  <math>\Delta t = 0,3 \text{ s}</math> ✓</p>

(3)

4.4 **LESS THAN** ✓

Final momentum/change in momentum/impulse remains constant. ✓

If mass/inertia increases, velocity decreases/velocity inversely proportional to mass ✓

**OR**

From  $F_{\text{net}}\Delta t = m\Delta v$  if  $F_{\text{net}}\Delta t$  remains constant ✓ and  $m$  increase then  $\Delta v$  decreases and  $v_c$  decreases ✓

**OR**

From  $F_{\text{net}} = ma$  if  $F_{\text{net}}$  remains constant ✓ and  $a$  is inversely proportional to  $m$  then  $m$  increases and  $a$  decreases and therefore  $v_c$  decreases. ✓

**KLEINER AS**

*Finale momentum/verandering in momentum/impuls bly konstant.*

*Indien massa/traagheid toeneem, sal snelheid afneem/snelheid omgekeerd eweredig aan massa.*

**OF**

*Van  $F_{\text{net}}\Delta t = m\Delta v$  indien  $F_{\text{net}}\Delta t$  konstant bly en  $m$  neem toe dan sal  $\Delta v$  afneem en  $v_c$  afneem*

**OF**

*Van  $F_{\text{net}} = ma$  indien  $F_{\text{net}}$  konstant bly en  $a$  is omgekeerd eweredig aan  $m$  dan as  $m$  toeneem dan sal  $a$  afneem en  $v_c$  afneem*

(3)  
**[13]**

**QUESTION 5/VRAAG 5**

5.1

**Marking criteria/Nasienkriteria**

If any of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The total mechanical energy/sum of the gravitational potential energy and kinetic energy/sum of  $E_p$  and  $E_k$  in an isolated system is conserved/remains constant. ✓✓ (Accept closed system for this exam)

**OR**

If the sum of the non-conservative forces is zero, then total mechanical energy/sum of the gravitational potential energy and kinetic energy/sum of  $E_p$  and  $E_k$  is conserved/remains constant.

Die totale meganiese energie/som van die gravitasie potensiële energie en kinetiese energie/som van  $E_p$  en  $E_k$  in 'n geïsoleerde sisteem bly behoue/konstant. (Aanvaar geslote sisteem vir hierdie eksamen)

**OF**

Indien die som van die nie-konserwatiewe kragte nul is, sal die totale meganiese energie/som van die gravitasie potensiële energie en kinetiese energie/som van  $E_p$  en  $E_k$  behoue/konstant bly.

(2)

5.2

**OPTION 1/OPSIE 1**

$$\left. \begin{aligned} (E_{\text{mech}})_{A/\text{Top}/\text{Bo}/i} &= (E_{\text{mech}})_{B/\text{Bottom}/\text{Onder}/f} \\ (E_p + E_k)_{A/\text{Top}/\text{Bo}/i} &= (E_p + E_k)_{B/\text{Bottom}/\text{Onder}/f} \\ (mgh + \frac{1}{2}mv^2)_{A/\text{Top}/\text{Bo}/i} &= (mgh + \frac{1}{2}mv^2)_{B/\text{Bottom}/\text{Onder}/f} \\ (18)(9,8)(3) + 0 &= 0 + (\frac{1}{2})(18)v^2 \quad \checkmark \\ v &= 7,67 \text{ m}\cdot\text{s}^{-1} \quad \checkmark \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

**OPTION 2/OPSIE 2**

$$\left. \begin{aligned} W_{\text{nc}} &= \Delta K + \Delta U \\ W_{\text{nc}} &= \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i) \\ W_{\text{nc}} &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 + mgh_f - mgh_i \\ mgh_{\text{bottom}} - mgh_{\text{top}} &= -(\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) \\ \Delta E_k &= -\Delta E_p \\ 0 &= \frac{1}{2}(18)(v_f^2 - 0^2) + (18)(9,8)(0 - 3) \quad \checkmark \quad \text{OR} \quad \frac{1}{2}(18)(v_f^2 - 0^2) = -[(18)(9,8)(0 - 3)] \\ v &= 7,67 \text{ m}\cdot\text{s}^{-1} \quad \checkmark \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

**OPTION 3/OPSIE 3**

$$\left. \begin{aligned} W_{\text{net}} &= \Delta E_k \\ mg\Delta y \cos\theta &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$(18)(9,8)(3)\cos 0^\circ = \frac{1}{2}(18)v_f^2 - 0 \quad \checkmark$$

$$v = 7,67 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

(3)

5.3

**Marking criteria/Nasienkriteria**

If any of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The net/total work done (on an object) is equal to the change in the object's kinetic energy. ✓✓

Die netto/totale arbeid wat (op 'n voorwerp) verrig is, is gelyk aan die verandering in die voorwerp se kinetiese energie.

**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 resultante/netto krag is gelyk aan die verandering in die voorwerp se kinetiese energie.

(2)

5.4

**POSITIVE MARKING FROM QUESTION 5.2.****POSITIEWE NASIEN VANAF VRAAG 5.2.****OPTION 1/OPSIE 1**

$$\left. \begin{aligned} W_{\text{net}} &= \Delta E_k / E_{\text{kf}} - E_{\text{ki}} / \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ W_f &= \Delta E_k / E_{\text{kf}} - E_{\text{ki}} / \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ f\Delta x \cos 180^\circ &= \Delta E_k / E_{\text{kf}} - E_{\text{ki}} / \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$(40,6)\Delta x(-1) \checkmark = \frac{1}{2}(18)[(0)^2 - (7,67)^2] \checkmark$$

$$\Delta x = 13,04 \text{ m} \checkmark \quad \text{Range/Gebied: (13,03 – 13,04 m)}$$

**OPTION 2/OPSIE 2**

$$\left. \begin{aligned} W_{\text{nc}} &= \Delta E_p + \Delta E_k \\ W_{\text{nc}} &= mg(h_C - h_B) + \frac{1}{2}m(v_f^2 - v_i^2) \\ W_f &= \Delta E_p + \Delta E_k \\ f\Delta x \cos 180^\circ &= mg\Delta h + \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

$$(40,6)\Delta x(-1) \checkmark = 0 + \frac{1}{2}(18)[(0)^2 - (7,67)^2] \checkmark$$

$$\Delta x = 13,04 \text{ m} \checkmark \quad \text{Range/Gebied: (13,03 – 13,04 m)}$$

(4)

5.5

Smaller than/Kleiner as ✓

- Total mechanical/Gravitational potential energy (at A) is less ✓  
*Totale meganiese/Gravitasie potensiële energie (by A) is minder*
- Velocity(speed) at B is less/Kinetic energy at B/ΔE<sub>k</sub> will be less from B to C/rest ✓  
*Snelheid(spoed) by B is minder/Kinetiese energie by B/ΔE<sub>k</sub> sal minder wees vanaf B tot C/rus*

(3)

**[14]**

**QUESTION 6/VRAAG 6**

6.1

**Marking criteria/Nasienkriteria**

If any of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark./Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

It is the (apparent) change in frequency/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 (skynbare) verandering in frekwensie/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 as a result of the relative motion between a source and an observer (listener) ✓✓.

*'n (Skynbare) verandering in (waargenome) frekwensie/toonhoogte as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer (luisteraar).*

(2)

6.2

**MOVING TOWARDS OBSERVER/****BEWEGING NA LUISTERAAR:**

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

$$615 = \left( \frac{v}{v - 26} \right) f_s \quad \checkmark$$

$$f_s = \frac{615(v - 26)}{v} \quad \text{equation 1/vergelýking 1}$$

✓ Any one/  
Enige een

**MOVING AWAY FROM OBSERVER/****BEWEGING WEG VAN LUISTERAAR:**

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

$$526 = \left( \frac{v}{v + 26} \right) f_s \quad \checkmark$$

$$f_s = \frac{526(v + 26)}{v} \quad \text{equation 2/vergelýking 2}$$

$$\frac{615(v - 26)}{v} = \frac{526(v + 26)}{v} \quad \checkmark \quad \text{(equating to solve for } v \text{)}$$

$$v = 333,33 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \quad \text{Range/Gebied: } (331,88 - 333,33 \text{ m} \cdot \text{s}^{-1})$$

(5)

6.3

**POSITIVE MARKING FROM QUESTION 6.2./POSITIEWE NASIEN VANAF VRAAG 6.2.****Substitution into equation 1/  
Vervanging in vergelyking 1**

$$f_s = \frac{615(333,33 - 26)}{333,33}$$

✓ **OR/OF**

$$f_s = 567,03 \text{ Hz}$$

**Substitution into equation 2/  
Vervanging in vergelyking 2**

$$f_s = \frac{526(333,33 + 26)}{333,33}$$

$$f_s = 567,03 \text{ Hz}$$

$$v = f\lambda \quad \checkmark$$

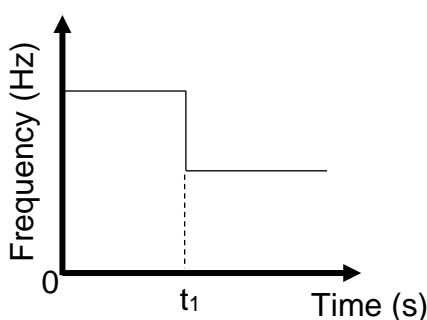
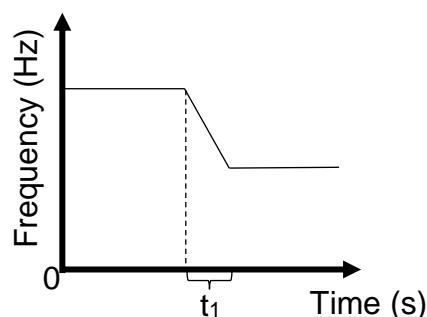
$$333,33 = 567,03\lambda \quad \checkmark$$

$$\lambda = 0,59 \text{ m} \quad \checkmark$$

Range/Gebied: (0,585 – 0,59 m)

(4)

6.4

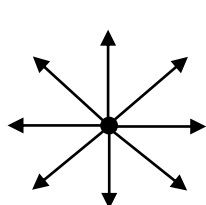
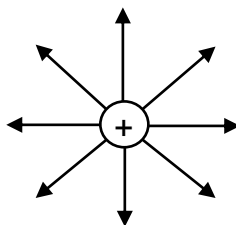
**OR/OF**

<b>Criteria for graph/Kriteria vir grafiek:</b>	
The lines before and after $t_1$ are horizontal./Die lyne voor en na $t_1$ is horisontaal. (If this criteria is not met/Indien nie aan hierdie kriteria voldoen nie: $0/3$ )	✓
The frequency after $t_1$ is less than before $t_1$ ./Die frekwensie na $t_1$ is kleiner as voor $t_1$ .	✓
Time $t_1$ correctly indicated where the frequency changes if everything else is correct./Tyd $t_1$ word korrek aangedui wanneer frekwensie verander indien alles anders korrek is.	✓

(3)

**[14]****QUESTION 7/VRAAG 7**

7.1.1

**OR/OF**

**NOTE/NOTA:** more than one charge or combined field drawn/meer as een lading of gekombineerde veld geteken  $0/2$

<b>Criteria for sketch/Kriteria vir skets:</b>	
Correct shape./Korrekte vorm.	✓
Correct direction away from the charge./Korrekte rigting weg van die lading.	✓
<b>Note/Nota:</b> If electric field lines cross or touch/Indien elektriese veldlyne kruis of raak. Max/Maks $1/2$	

(2)

7.1.2

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

$$= \frac{(9 \times 10^9)(4 \times 10^{-9})}{(0,025)^2} \checkmark$$

$$= 5,76 \times 10^4 \text{ N} \cdot \text{C}^{-1} \checkmark \quad (57\,600 \text{ N} \cdot \text{C}^{-1})$$

(3)

7.2.1

**Marking criteria/Nasienkriteria**

If any of the underlined key words/phrases in the **correct context** is omitted, deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The magnitude of the electrostatic force exerted by one point charge on another is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance between them. ✓✓

Die grootte van die elektrostatiese krag wat een puntlading op 'n ander uitoefen, is direk eweredig aan die produk van die grootte van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. ✓✓

(2)

**NOTE/NOTA:** If mass is mentioned/Indien massa genoem <sup>0</sup>/<sub>2</sub>

7.2.2

**Marking criteria/Nasienkriteria:**

- Correct substitution of mg with angle 9° or 81°/Korrekte vervanging van mg met hoek 9° of 81° ✓
- Correct trig-expression equated to  $F_E$  /Korrekte trig-uitdrukking gelykstel aan  $F_E$  ✓
- Correct Coulombs' formula/Korrekte Coulomb-formule ✓
- Correct substitution into  $F_E$ /Coulombs' formula/Korrekte vervanging in  $F_E$ /Coulomb-formule ✓
- Calculating 2Q/Berekening van 2Q ✓
- Final correct answer/Finale korrekte antwoord: Range/Gebied ( $2,88 \times 10^{-7} - 2,98 \times 10^{-7} \text{ C}$ ) ✓

**OPTION 1/OPSIE 1**

$$F_E = w(\tan\theta)$$

$$F_E = \frac{mg(\tan\theta)}{w}$$

$$F_E = \frac{w}{\tan(90^\circ - \theta)}$$

$$F_E = \frac{(0,012)(9,8)(\tan 9^\circ)}{1} \checkmark$$

$$= 0,0186 \text{ N}$$

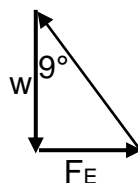
$$F_E = \frac{kQ_A Q_B}{r^2} \checkmark$$

$$0,0186 = \frac{(9 \times 10^9)(Q^2)}{0,1^2} \checkmark$$

$$Q = 1,44 \times 10^{-7} \text{ C}$$

$$Q_B = 2(1,44 \times 10^{-7}) \checkmark$$

$$= 2,88 \times 10^{-7} \text{ C} \checkmark$$





**OPTION 2/OPSIE 2**

$$w = mg$$

$$= (0,012)(9,8)$$

$$= 0,1176 \text{ N}$$

$$T_y = w$$

$$T \sin 81^\circ = 0,1176$$

$$\text{OR } T \cos 9^\circ = 0,1176$$

$$T = 0,1191 \text{ N}$$

$$\checkmark F_E = T_x$$

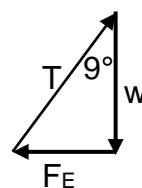
$$\frac{kQ_A Q_B}{r^2} = T \cos 81^\circ \checkmark \quad \text{OR } T \sin 9^\circ$$

$$\frac{(9 \times 10^9)(Q^2)}{0,1^2} = (0,1191) \cos 81^\circ \checkmark \quad \text{OR } = (0,1191) \sin 9^\circ$$

$$Q = 1,4388 \times 10^{-7} \text{ C}$$

$$Q_B = 2(1,44 \times 10^{-7}) \checkmark$$

$$= 2,88 \times 10^{-7} \text{ C} \checkmark$$

(6)  
[13]**QUESTION 8/VRAAG 8**8.1 The resistor/ $R_z$  is short circuited./Die resistor/ $R_z$  word gekortsluit.  $\checkmark$ **OR/OF**

Current follows the path of least resistance./Stroom volg die pad van minste weerstand.

**OR/OF**

Branch with switch has no resistance./Tak met skakelaar het geen weerstand nie.

(1)

8.2

**Marking criteria/Nasienkriteria:**

- Correct emf or  $V_{int}$  formula/Korrekte emk of  $V_{int}$ -formule.  $\checkmark$
- Correct substitution into emf or  $V_{int}$  formula./Korrekte vervanging in emk of  $V_{int}$ -formule.  $\checkmark$
- Correct  $R_p$  formula ( $R_x = R$ )/Korrekte  $R_p$ -formule ( $R_x = R$ )  $\checkmark$
- Correct substitution into  $R_p$  formula./Korrekte vervanging in  $R_p$ -formule
- Final correct answer/Finale korrekte antwoord:  
Range/Gebied: (5,92  $\Omega$  – 5,96  $\Omega$ )  $\checkmark$

**OPTION 1/OPSIE 1**

$$\frac{1}{R_p} = \frac{1}{R_x} + \frac{1}{R_y} \checkmark$$

**OR/OF**

$$R_p = \frac{R_x R_y}{R_x + R_y} \checkmark$$

$$\frac{1}{R_p} = \frac{1}{R} + \frac{1}{2R} \checkmark$$

$$R_p = \frac{(R)(2R)}{R + 2R} \checkmark$$

$$R_p = 0,67R$$

$$R_p = 0,67R$$

$$\epsilon = I(R + r) \checkmark$$

$$12 = 5,5(0,67R + 0,2) \checkmark$$

$$R = 2,97 \Omega \quad (\text{Range/gebied } 2,96 - 2,97 \Omega)$$

$$R_y = 2(2,97)$$

$$= 5,95 \Omega \checkmark$$



**OPTION 2/OPSIE 2**

$$\begin{aligned} \varepsilon &= I(R + r) \checkmark \\ 12 &= 5,5(R + 0,2) \checkmark \\ R &= 1,98 \, \Omega \end{aligned}$$

**OR/OF**

$$\begin{aligned} \frac{1}{R_p} &= \frac{1}{R_X} + \frac{1}{R_Y} \checkmark \\ \frac{1}{1,98} &= \left( \frac{1}{R} + \frac{1}{2R} \right) \checkmark \quad (R_X = R) \\ R &= 2,97 \, \Omega \\ R_Y &= 2(2,97) \\ &= 5,95 \, \Omega \checkmark \end{aligned}$$

$$\begin{aligned} R_p &= \frac{R_X R_Y}{R_X + R_Y} \checkmark \\ 1,98 &= \frac{(R)(2R)}{R + 2R} \checkmark \quad (R_X = R) \\ R &= 2,97 \, \Omega \\ R_Y &= 2(2,97) \\ &= 5,95 \, \Omega \checkmark \end{aligned}$$

**OPTION 3/OPSIE 3**

$$\begin{aligned} \varepsilon &= I(R + r) \checkmark \\ \varepsilon &= V_{\text{ext}} + Ir \quad \checkmark \text{ Any one/} \\ &\quad \text{Enige een} \quad \text{OR} \quad V_{\text{int}} = Ir \checkmark \\ &\quad \text{OF} \quad = (5,5)(0,2) \checkmark \\ &\quad \quad \quad = 1,1 \, \text{V} \\ \underline{V_{\text{ext}} + 5,5(0,2)} \checkmark &\quad V_p = 12 - 1,1 = 10,9 \, \text{V} \\ V_{\text{ext}} &= 10,9 \, \text{V} \end{aligned}$$

**Marking criteria for branch only:**

- Correct ratio for  $R_p$
- Correct substitution for final answer
- Final correct answer

**Nasienriglyne vir slegs tak:**

- Korrekte verhouding vir  $R_p$
- Korrekte vervanging vir finale antwoord
- Korrekte finale antwoord

$$\begin{aligned} \frac{1}{R_p} &= \frac{1}{R_X} + \frac{1}{R_Y} \checkmark \\ \text{OR/OF} & \\ \frac{1}{R_p} &= \left( \frac{1}{R} + \frac{1}{2R} \right) \checkmark \\ R_p &= 0,67R \\ R_p &= \frac{V_p}{I_T} \\ 0,67R &= \frac{10,9}{5,5} \\ R &= 2,97 \, \Omega \\ R_Y &= 2(2,97) \\ &= 5,95 \, \Omega \checkmark \end{aligned}$$

$$\begin{aligned} R_p &= \frac{V_p}{I_T} \\ &= \frac{10,9}{5,5} \\ &= 1,98 \, \Omega \\ \frac{1}{R_p} &= \frac{1}{R_X} + \frac{1}{R_Y} \checkmark \\ \frac{1}{1,98} &= \left( \frac{1}{R} + \frac{1}{2R} \right) \checkmark \\ R &= 2,97 \, \Omega \\ R_Y &= 2(2,97) \\ &= 5,95 \, \Omega \checkmark \end{aligned}$$

$$\begin{aligned} \frac{1}{3}(5,5) &= 1,83 \, \text{A} \checkmark \\ V &= IR \\ 10,9 &= 1,83R \checkmark \\ R_Y &= 5,95 \, \Omega \checkmark \end{aligned}$$

**OPTION 4/OPSIE 4**

$$\begin{aligned} \varepsilon &= IR + Ir \checkmark \\ \varepsilon &= I \left( \frac{R_1 R_2}{R_1 + R_2} \right) + Ir \checkmark \\ 12 &= 5,5 \left( \frac{(R)(2R)}{R + 2R} \right) \checkmark + (5,5)(0,2) \checkmark \\ R_X &= 2,97 \, \Omega \\ R_Y &= 2R_X \\ &= 2(2,97) \\ &= 5,95 \, \Omega \checkmark \end{aligned}$$

8.3 **POSITIVE MARKING FROM QUESTION 8.2. (Take the values of range into account)****POSITIEWE NASIEN VANAF VRAAG 8.2. (Neem waardes van gebied in ag)**

$V_p = I_T R_p$ $= (5,5)(1,98) \checkmark$ $= 10,89 \text{ V}$  <b>OR/OF</b>  $\epsilon = I(R + r)$ $\epsilon = V_{\text{ext}} + Ir$ $12 = V_{\text{ext}} + 5,5(0,2) \checkmark$ $V_{\text{ext}} = 10,9 \text{ V}$ $V_p = 10,9 \text{ V}$	$I_x = \frac{2}{3}(5,5) \checkmark$ $= 3,67 \text{ A}$  <b>OR/OF</b> $I_x = \frac{R_{//}}{R_x} I_{\text{total}}$ $= \frac{1,98}{2,97}(5,5) \checkmark$ $= 3,67 \text{ A}$	<b>OR/OF</b> $I_x = \frac{V_p}{R_x}$ $= \frac{10,9}{2,97} \checkmark$ $= 3,67 \text{ A}$  <b>OR/OF</b> $I_x = 5,5 - 1,83 \checkmark$ $= 3,67 \text{ A}$
<b>OPTION 1/OPSIE 1</b>	<b>OPTION 2/OPSIE 2</b>	<b>OPTION 3/OPSIE 3</b>
$P = I^2 R \checkmark$  $= (3,67)^2(2,97) \checkmark$ $= 40 \text{ W} \checkmark$	$P = \frac{V^2}{R} \checkmark$ $= \frac{10,9^2}{2,97} \checkmark$ $= 40 \text{ W} \checkmark$	$P = VI \checkmark$  $= (10,9)(3,67) \checkmark$ $= 40 \text{ W} \checkmark$
If 10,9 V already calculated in 8.2 award 4 marks		
Range/Gebied: (39,84 – 40 W)		

(4)

8.4 **POSITIVE MARKING FROM QUESTION 8.2. (Take the values of range into account)****POSITIEWE NASIEN VANAF VRAAG 8.2. (Neem waardes van gebied in ag)**

$V = IR \checkmark$

$= 1,3(5,95) \checkmark$

$= 7,72 \text{ V} \checkmark$  Range/Gebied: (7,7 – 7,75 V)

(3)

8.5

**POSITIVE MARKING FROM QUESTION 8.2 and 8.4. (Take the values of range into account)****POSITIEWE NASIEN VANAF VRAAG 8.2 en 8.4. (Neem waardes van gebied in ag)****Marking criteria/Nasienkriteria:**Calculation of  $R_z$ /Berekening van  $R_z$ :

- Correct formula  $\varepsilon = I(R + r)$ ./Korrekte formule  $\varepsilon = I(R + r)$ . ✓
- Correct substitution into formula./Korrekte vervanging in formule. ✓
- Correct substitution to calculate  $R_z$ ./Korrekte vervanging om  $R_z$  te bereken. ✓

Calculation of  $I$ /Berekening van  $I$ :

- Addition of  $R_p$  and  $R_z$ ./Bymekaartel van  $R_p$  en  $R_z$ .
- Correct substitution to calculate  $I$ ./Korrekte vervanging om  $I$  te bereken.
- Correct final answer./Korrekte finale antwoord: Range/Gebied: (2,26 A – 2,29 A)

**S<sub>1</sub> AND S<sub>2</sub> OPEN/S<sub>1</sub> EN S<sub>2</sub> OOP:**

$$\varepsilon = I(R + r) \checkmark$$

$$12 = 1,3(R_T + 0,2) \checkmark$$

$$R_T = 9,03 \Omega$$

$$R_T = R_Y + R_Z$$

$$9,03 = 5,95 + R_Z \checkmark$$

$$R_Z = 3,08 \Omega$$

**OR/OF**

$$\varepsilon = I(R + r) \checkmark$$

$$IR = 12 - (1,3 \times 0,2)$$

$$IR = 11,74 \text{ V}$$

$$V_{ex} = V_{R_Y} + V_{R_Z}$$

$$11,74 = 7,75 + V_{R_Z} \checkmark$$

$$V_{R_Z} = 3,99 \text{ V}$$

$$V = IR$$

$$3,99 = 1,3R_Z \checkmark$$

$$R_Z = 3,07 \Omega$$

**S<sub>1</sub> OPEN AND S<sub>2</sub> CLOSED/S<sub>1</sub> OOP EN S<sub>2</sub> GESLUIT:**

$$R_p = 0,67R$$

$$= (0,67)(2,97)$$

$$= 1,98 \Omega$$

$$\varepsilon = I(R + r)$$

$$12 = 5,5(R + 0,2)$$

$$R_p = 1,98 \Omega$$

$$\frac{1}{R_p} = \frac{1}{R_X} + \frac{1}{R_Y}$$

$$\frac{1}{R_p} = \frac{1}{2,97} + \frac{1}{5,94}$$

$$R_p = 1,98 \Omega$$

$$R_p = \frac{R_X R_Y}{R_X + R_Y}$$

$$R_p = \frac{(2,97)(5,94)}{2,97 + 5,94}$$

$$R_p = 1,98 \Omega$$

Possibly already calculated in/Moontlik reeds bereken in Q8.2

$$R_{ex} = 3,08 + 1,98 \checkmark$$

$$R_{ex} = 5,06 \Omega$$

$$\varepsilon = I(R + r)$$

$$12 = I(5,06 + 0,2) \checkmark$$

$$I = 2,28 \text{ A} \checkmark$$

$$R_T = \frac{V}{I}$$

$$5,26 = \frac{12}{I} \checkmark$$

$$I = 2,28 \text{ A} \checkmark$$

(6)  
[19]

**QUESTION 9/VRAAG 9**

9.1 Y to/na X ✓✓ (2)

9.2 Mechanical/Kinetic to electrical energy. ✓  
 Meganiese/Kineties na elektriese energie. (1)

9.3 **Marking criteria/Nasienkriteria**

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The rms potential difference is the alternating current potential difference which dissipates/produces the same amount of energy/heating effect as an equivalent DC potential difference. ✓✓

Die wgk-potensiaalverskil is die wisselstroom potensiaalverskil wat dieselfde hoeveelheid energie/verhittingseffek verbruik/vervaardig as die ekwivalente GS-potensiaalverskil. (2)

9.4 
$$V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$$
  

$$= \frac{125}{\sqrt{2}} \checkmark$$
  

$$= 88,39 \text{ V} \checkmark$$
 (3)

9.5 **OPTION 1/OPSIE 1**

$$I_{\text{max}} = \frac{V_{\text{max}}}{R} \checkmark$$
  

$$= \frac{125}{42,4} \checkmark$$
  

$$= 2,95 \text{ A} \checkmark$$

**OPTION 2/OPSIE 2**

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{R}$$
  

$$= \frac{88,39}{42,4}$$
  

$$= 2,08 \text{ A}$$

$$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}} \checkmark$$

$$2,08 = \frac{I_{\text{max}}}{\sqrt{2}} \checkmark$$

$$I_{\text{max}} = 2,94 \text{ A} \checkmark$$

Range/Gebied: (2,94 - 2,95 A)

**OR/OF**

$$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R}$$
  

$$P_{\text{ave}} = \frac{88,39^2}{42,4}$$
  

$$P_{\text{ave}} = 184,26 \text{ W}$$

$$P_{\text{ave}} = I_{\text{rms}}^2 R$$
  

$$184,26 = I_{\text{rms}}^2 (42,4)$$
  

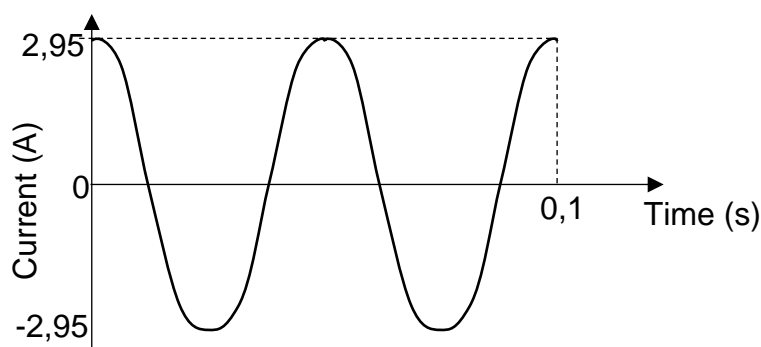
$$I_{\text{rms}} = 2,08 \text{ A}$$

**Notes/Aantekeninge:**

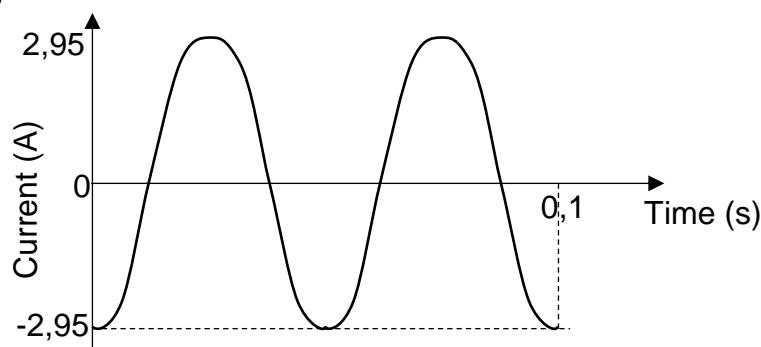
Do not deduct a mark if subscripts are omitted from  $V = IR$  formula./

Moenie penaliseer indien onderskrifte uitgelaat is uit die formule  $V = IR$  nie. (3)

## 9.6 POSITIVE MARKING FROM 9.5/POSITIEWE NASIEN VANAF 9.5



OR/OF



Criteria for graph/Kriteria vir grafiek	
Two complete cycles indicated./Twee volledige siklusse aangedui.	✓
Graph stops at 0,1 s <b>OR</b> one cycle in 0,05 s./ Grafiek stop by 0,1 s <b>OF</b> een siklus in 0,05 s	✓
Maximum current (2,94/2,95 A) as a positive or negative value correctly indicated./ Maksimum stroom (2,94/2,95 A) as 'n positiewe of negatiewe waarde korrek aangedui.	✓
Correct shape (cosine graph)./Korrekte vorm (cosinus grafiek)	✓

(4)  
[15]

## QUESTION 10/VRAAG 10

10.1

**Marking criteria/Nasienkriteria**

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

The process whereby electrons are ejected from a (metal) surface when light of suitable frequency is incident on that surface. ✓✓

Die proses waartydens elektrone vrygestel word vanaf 'n (metaal) oppervlak wanneer lig van geskikte frekwensie invalend is op die oppervlak.

(2)

10.2

**OPTION 1/OPSIE 1**

$$E = W_0 + K_{\max}$$

$$\frac{hc}{\lambda} = hf_0 + \frac{1}{2}mv_{\max}^2 \quad \left. \vphantom{\frac{hc}{\lambda} = hf_0 + \frac{1}{2}mv_{\max}^2} \right\} \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array}$$

$$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{4,7 \times 10^{-7}} \checkmark = (6,63 \times 10^{-34})(4,37 \times 10^{14}) \checkmark + \frac{1}{2}(9,11 \times 10^{-31})v_{\max}^2 \checkmark$$

$$v_{\max} = 5,41 \times 10^5 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (541\,292,69 \text{ m} \cdot \text{s}^{-1})$$

Range/Gebied:  $(541\,289,67 \text{ m} \cdot \text{s}^{-1} - 541\,292,69 \text{ m} \cdot \text{s}^{-1})$ **OPTION 2/OPSIE 2**

$$c = f\lambda$$

$$3 \times 10^8 = f(4,7 \times 10^{-7})$$

$$f = 6,38 \times 10^{14} \text{ Hz}$$

$$E = W_0 + K_{\max}$$

$$hf = hf_0 + \frac{1}{2}mv_{\max}^2 \quad \left. \vphantom{hf = hf_0 + \frac{1}{2}mv_{\max}^2} \right\} \begin{array}{l} \checkmark \text{ Any one/} \\ \text{Enige een} \end{array}$$

$$(6,63 \times 10^{-34})(6,38 \times 10^{14}) \checkmark = (6,63 \times 10^{-34})(4,37 \times 10^{14}) \checkmark + \frac{1}{2}(9,11 \times 10^{-31})v_{\max}^2 \checkmark$$

$$v_{\max} = 5,41 \times 10^5 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (541\,292,69 \text{ m} \cdot \text{s}^{-1})$$

Range/Gebied:  $(541\,289,67 \text{ m} \cdot \text{s}^{-1} - 541\,292,69 \text{ m} \cdot \text{s}^{-1})$ 

(5)

10.3.1 Higher than/Hoër as  $\checkmark$ 

(1)

- 10.3.2
- (Photons of UV light) eject electrons (from the disc/Zn).  $\checkmark$
  - The negative charge on the electroscope decreases/becomes zero.  $\checkmark$
  - The electrostatic/repulsive force on the foil decreases/becomes zero.  $\checkmark$
  - (Fotone van UV lig) stel elektrone vry (vanaf die skyf/Zn).
  - Die negatiewe lading op die elektrokoop verlaag/word nul.
  - Die elektrostatische/afstotende krag op die foelie verlaag/word nul.

(3)

10.3.3 No/Nee  $\checkmark$ 

(Increasing the intensity increases the number of photons) does not increase the energy of the photon(s) **OR** photons will still have the same energy **OR** frequency stays the same/does not increase  $\checkmark$

(Verhoging van intensiteit verhoog die aantal fotone) en nie die energie van die foton(e) nie **OF** fotone sal nog steeds dieselfde enegie besit **OF** frekwensie bly dieselfde/sal nie toeneem nie.

(2)

**[13]****TOTAL/TOTAAL:****150**