



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 2021

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

**This marking guidelines consists of 26 pages.
Hierdie nasienriglyne bestaan uit 26 bladsye.**

QUESTION 1/VRAAG 1

- 1.1 A ✓✓ (2)
- 1.2 B ✓✓ (2)
- 1.3 D ✓✓ (2)
- 1.4 B ✓✓ (2)
- 1.5 C ✓✓ (2)
- 1.6 D ✓✓ (2)
- 1.7 B or/of F ✓✓ (2)
- 1.8 A or/of V_1 ✓✓ (2)
- 1.9 D ✓✓ (2)
- 1.10 D ✓✓ (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.

A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force/unbalanced force acts on it. ✓✓

'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid volhard, tensy 'n (nie-nul) resulterende/netto krag/ongebalanseerde krag daarop inwerk.

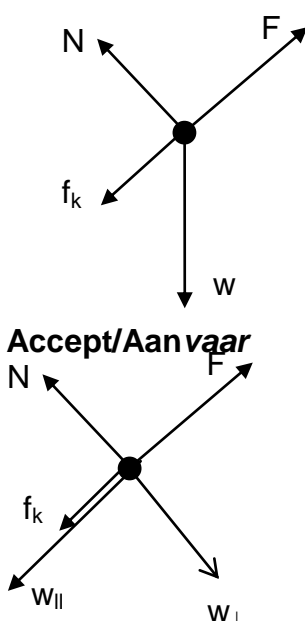
OR/OF

A body will remain in its state of rest or uniform motion in a straight line unless a (non-zero) resultant/net /unbalanced force acts on it. ✓✓

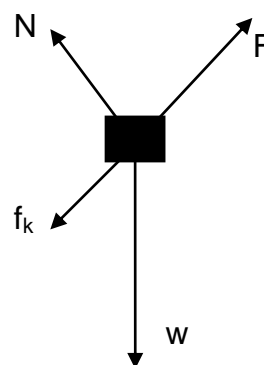
'n Liggaam sal in sy toestand rus of uniforme beweging in 'n reguit lyn volhard, tensy 'n (nie-nul) resulterende/netto/ongebalanseerde krag daarop inwerk.

(2)

2.2



**Accept force diagram/
Aanvaar kragtediagram**



Accepted labels/Aanvaarde benoemings	
W	F_g / F_w / weight / mg / 196 N / gravitational force F_g / F_w / gewig / mg / 196 N / gravitasiekrag
F	F_A / Applied force F_T / Toegepaste krag
f_k	(kinetic) Friction / (kineties)wrywing / F_f / f / 18 N / F_w / f_w
N	F_N / Normal / Normaal / 169,74 N

Notes/Aantekeninge:

- Mark awarded for label and arrow, but penalise only once if arrows are omitted /Punt toegeken vir benoeming en pyltjie, maar penaliseer slegs een keer indien pyle uitgelaat is.
- Do not penalise for length of arrows, drawing is not to scale. /Moenie vir die lengte van die pyltjies penaliseer nie, die tekening is nie volgens skaal nie.
- Any other additional force(s) deduct 1 mark. / Enige ander addisionele krag(te) trek 1 punt af.
- If force(s) do not make contact with body deduct 1 mark. /Indien krag(te) nie met die voorwerp kontak maak nie, trek 1 punt af.

(4)

2.3

<p>OPTION 1/OPSIE 1 Positive up the incline/Positief opwaarts teen skuinsvlak</p>		
$F_{\text{net}} = ma$ $F + f_k + w_{\parallel} = ma$ $F + (-f_k) + (-w_{\parallel}) = ma$ $F - (f_k + w_{\parallel}) = ma$ $F - [18 + (20)(9,8)(\sin 30^\circ)] = 0$ $F = 116 \text{ N}$	<p>✓ Any one/Enige een</p>	
<table border="1" style="margin-left: auto; border-collapse: collapse;"> <tr> <td style="padding: 2px;"> <p>NOTE/LET WEL $F_{\text{net}} = 0$ ✓✓ $F = f_k + w_{\parallel}$ ✓✓</p> </td> </tr> </table>		<p>NOTE/LET WEL $F_{\text{net}} = 0$ ✓✓ $F = f_k + w_{\parallel}$ ✓✓</p>
<p>NOTE/LET WEL $F_{\text{net}} = 0$ ✓✓ $F = f_k + w_{\parallel}$ ✓✓</p>		
<p>OPTION 2/OPSIE 2 Positive up the incline/Positief opwaarts teen skuinsvlak</p>		
$W_{\text{net}} = \Delta E_k$ $F\Delta x \cos 0^\circ + f\Delta x \cos 180^\circ + w\Delta x \cos 120^\circ = 0$ $F\Delta x = 18\Delta x + (20)(9,8)\Delta x(0,5)$ $F = 116 \text{ N}$	<p>✓ = 0 ✓</p>	
<table border="1" style="margin-left: auto; border-collapse: collapse;"> <tr> <td style="padding: 2px;"> <p>NOTE/LET WEL $W_{\text{net}} = 0$ ✓✓ $F\Delta x = f\Delta x + w\Delta x(0,5)$ ✓✓</p> </td> </tr> </table>		<p>NOTE/LET WEL $W_{\text{net}} = 0$ ✓✓ $F\Delta x = f\Delta x + w\Delta x(0,5)$ ✓✓</p>
<p>NOTE/LET WEL $W_{\text{net}} = 0$ ✓✓ $F\Delta x = f\Delta x + w\Delta x(0,5)$ ✓✓</p>		

(4)

2.4

**POSITIVE MARKING FROM QUESTION 2.3 /
 POSITIEWE NASIEN VANAF VRAAG 2.3**

116 N / $f + w_{\parallel}$ ✓ Down the incline/opposite to direction of motion / Teen die helling af / in teenoorgestelde rigting van beweging ✓

ACCEPT/AANVAAR:

Downwards/down/Afwaarts/af

(2)

2.5

**POSITIVE MARKING FROM QUESTION 2.4 /
 POSITIEWE NASIEN VANAF VRAAG 2.4**

<p>OPTION 1/OPSIE 1 Up the incline positive/Teen skuinsvlak op positief</p>		
$F_{\text{net}} = ma$ $-116 = 20a$ $a = -5,80 \text{ m}\cdot\text{s}^{-2}$		
$v_f^2 = v_i^2 + 2a\Delta x$ $0 = (2)^2 + (2)(-5,8)\Delta x$ $\Delta x = 0,34 \text{ m}$	$v_f = v_i + \Delta t$ $0 = 2 + (-5,8)\Delta t$ $\Delta t = 0,34 \text{ s}$ <p>OR/OF</p> $F_{\text{net}}\Delta t = m(v_f - v_i)$ $(-116)\Delta t = (20)(0 - 2)$ $\Delta t = 0,34 \text{ s}$ $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= (2)(0,34) + \frac{1}{2}(-5,8)(0,34)^2$ $= 0,34 \text{ m}$	$v_f = v_i + \Delta t$ $0 = 2 + (-5,8)\Delta t$ $\Delta t = 0,34 \text{ s}$ <p>OR/OF</p> $F_{\text{net}}\Delta t = m(v_f - v_i)$ $(-116)\Delta t = (20)(0 - 2)$ $\Delta t = 0,34 \text{ s}$ $\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$ $= \left(\frac{2 + 0}{2} \right) 0,34$ $= 0,34 \text{ m}$

<p>OPTION 1/OPSIE 1 Down the incline positive / Teen skuinsvlak af positief</p> <p>$F_{net} = ma$ $116 = 20a$ ✓ $a = 5,80 \text{ m}\cdot\text{s}^{-2}$</p>		
<p>$v_f^2 = v_i^2 + 2a\Delta x$ ✓ $0 = (-2)^2 + (2)(5,8)\Delta x$ ✓ $\Delta x = -0,34 \text{ m}$</p> <p>Distance = 0,34 m ✓ <i>Afstand</i></p>	<p>$v_f = v_i + a\Delta t$ $0 = -2 + (5,8)\Delta t$ $\Delta t = 0,34 \text{ s}$</p> <p>OR/OF $F_{net}\Delta t = m(v_f - v_i)$ $(116)\Delta t = (20)(0 - (-2))$ $\Delta t = 0,34 \text{ s}$</p> <p>$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= (-2)(0,34) + \frac{1}{2}(5,8)(0,34)^2$ ✓ $= -0,34 \text{ m}$ ✓</p> <p>Distance/<i>Afstand</i> = 0,34 m ✓</p>	<p>$v_f = v_i + a\Delta t$ $0 = -2 + (5,8)\Delta t$ $\Delta t = 0,34 \text{ s}$</p> <p>OR/OF $F_{net}\Delta t = m(v_f - v_i)$ $(116)\Delta t = (20)(0 - (-2))$ $\Delta t = 0,34 \text{ s}$</p> <p>$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\frac{-2 + 0}{2}\right)0,34$ ✓ $= -0,34 \text{ m}$ ✓</p> <p>Distance/<i>Afstand</i> = 0,34 m ✓</p>
<p>OPTION 2/OPSIE 2</p> <p>$W_{net} = \Delta E_K$ $F_{net}\Delta x \cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓ Any one/<i>Enige een</i> $(116)\Delta x \cos 180^\circ = \frac{1}{2}(20)(0^2 - 2^2)$ ✓ $\Delta x = 0,34 \text{ m}$ ✓</p>		
<p>OPTION 3/OPSIE 3</p> <p>$W_{net} = \Delta E_K$ $W_f + W_{wll} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $f\Delta x \cos\theta + (mg\sin 30^\circ)\Delta x \cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓ Any one/<i>Enige een</i> $(18)\Delta x \cos 180^\circ + (20)(9,8)\sin 30^\circ \Delta x \cos 180^\circ = \frac{1}{2}(20)(0^2 - 2^2)$ ✓ $\Delta x = 0,34 \text{ m}$ ✓</p>		
<p>OPTION 4/OPSIE 4</p> <p>$W_{net} = \Delta E_K$ $W_f + W_w = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $f\Delta x \cos\theta + mg\Delta x \cos 120^\circ = \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓ Any one/<i>Enige een</i> $(18)\Delta x \cos 180^\circ + (20)(9,8)\Delta x \cos 120^\circ = \frac{1}{2}(20)(0^2 - 2^2)$ ✓ $\Delta x = 0,34 \text{ m}$ ✓</p>		
<p>OPTION 5/OPSIE 5</p> <p>$W_{nc} = \Delta E_p + \Delta E_k$ $f\Delta x \cos\theta = mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓ Any one/<i>Enige een</i> $18\Delta x \cos 180^\circ = 20(9,8)\Delta x + \frac{1}{2}(20)(0^2 - 2^2)$ ✓ $-18\Delta x = 196\Delta x \sin 30^\circ - 40$ $\Delta x = 0,34 \text{ m}$ ✓</p>		

(4)
[16]

QUESTION 3/VRAAG 3

3.1 No/Nee ✓

ANY ONE/ENIGE EEN:

- Gravitational force is not the only force acting on the balloon. /There are other forces acting on the balloon. ✓
Gravitasiekrag is nie die enigste krag wat op die ballon inwerk nie./Daar is ander kragte wat op die ballon inwerk.
- Its acceleration is not 9,8 m·s⁻²/is zero.
Sy versnelling is nie 9,8 m·s⁻²/is nul.
- It has constant velocity/no acceleration.
Dit het 'n konstante snelheid/geen versnelling nie.

(2)

3.2.1

<p>OPTION 1/OPSIE 1 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(-62,68)^2 = v_i^2 + 2(-9,8)(-200)$ ✓ $v_i = 2,96 \text{ m}\cdot\text{s}^{-1}$ ✓</p>	<p>DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $(62,68)^2 = v_i^2 + 2(9,8)(200)$ ✓ $v_i = -2,96 \text{ m}\cdot\text{s}^{-1}$ $= 2,96 \text{ m}\cdot\text{s}^{-1}$ ✓</p>
<p>OPTION 2/OPSIE 2 $(E_{\text{mech/meg}})_{200 \text{ m}} = (E_{\text{mech/meg}})_{\text{bottom/onder}}$ $(E_P + E_K)_{200 \text{ m}} = (E_P + E_K)_{\text{bottom/onder}}$ $(mgh + \frac{1}{2}mv^2)_{200 \text{ m}} = (mgh + \frac{1}{2}mv^2)_{\text{bottom/onder}}$ $m(9,8)(200) + \frac{1}{2}m(v^2) = 0 + \frac{1}{2}m(62,68)^2$ ✓ $v_i = 2,96 \text{ m}\cdot\text{s}^{-1}$ ✓</p> <p style="text-align: right;">} ✓ Any one/Enige een</p> <p>NOTE/LET WEL Mass may be omitted during substitution. <i>Massa mag uitgelaat word tydens vervanging.</i></p>	
<p>OPTION 3/OPSIE 3 $W_{\text{nc}} = \Delta E_p + \Delta E_k$ $0 = mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓ Any one/Enige een $0 = m(9,8)(0 - 200) + \frac{1}{2}m(62,68^2 - v_i^2)$ ✓ $v_i = 2,96 \text{ m}\cdot\text{s}^{-1}$ ✓</p> <p>NOTE/LET WEL Mass may be omitted during substitution. <i>Massa mag uitgelaat word tydens vervanging.</i></p>	
<p>OPTION 4/OPSIE 4 $W_{\text{net}} = \Delta E_k$ $F_{\text{net}}\Delta x \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2)$ } ✓ Any one/Enige een $mg\Delta x \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2)$ } $m(9,8)(200) = + \frac{1}{2}m(62,68^2 - v_i^2)$ ✓ $v_i = 2,96 \text{ m}\cdot\text{s}^{-1}$ ✓</p> <p>NOTE/LET WEL Mass may be omitted during substitution. <i>Massa mag uitgelaat word tydens vervanging.</i></p>	

(3)

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

<p>Marking criteria/Nasienkriteria</p> <ul style="list-style-type: none"> Formula to calculate Δt of stone A ✓ <i>Formule om Δt van klip A te bereken</i> Substitution to calculate Δt of stone A ✓ <i>Vervanging om Δt van klip A te bereken</i> Final answer/<i>Finale antwoord</i>: 6,70 s ✓ Accept/Aanvaar: (6,69 to/tot 6,7) <p>NOTE: The calculation of Δt for A might be split up into two parts. LET WEL: Die berekening van Δt vir A kan in twee dele opgedeel word.</p>	
<p>OPTION 1/OPSIE 1 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $v_f = v_i + a\Delta t$ ✓ $-62,68 = 2,96 + (-9,8)\Delta t$ ✓ $\Delta t = 6,70 \text{ s}$ ✓ (6,698)</p>	<p>DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $v_f = v_i + a\Delta t$ ✓ $62,68 = -2,96 + 9,8\Delta t$ ✓ $\Delta t = 6,70 \text{ s}$ ✓ (6,698)</p>
<p>OPTION 2/OPSIE 2 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $-200 = (2,96)\Delta t + \frac{1}{2} (-9,8)\Delta t^2$ ✓ $\Delta t = 6,70 \text{ s}$ ✓ (6,697)</p>	<p>DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $200 = (-2,96)\Delta t + \frac{1}{2} (9,8)\Delta t^2$ ✓ $\Delta t = 6,70 \text{ s}$ ✓ (6,697)</p>
<p>OPTION 3/OPSIE 3 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $-200 = \left(\frac{+2,96 + (-62,68)}{2}\right)\Delta t$ ✓ $\Delta t = 6,70 \text{ s}$ ✓ (6,698)</p>	<p>DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $200 = \left(\frac{-2,96 + 62,68}{2}\right)\Delta t$ ✓ $\Delta t = 6,70 \text{ s}$ ✓ (6,698)</p>
<p>OPTION 4/OPSIE 4 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF From 200 m upwards: <i>Vanaf 200 m opwaarts:</i> $v_f = v_i + a\Delta t$ ✓ $0 = 2,96 + (-9,8)\Delta t$ ✓ $\Delta t = 0,3 \text{ s}$ (0,302) From max h downwards: <i>Vanaf maks h afwaarts:</i> $v_f = v_i + a\Delta t$ $-62,68 = 0 + (-9,8)\Delta t$ $\Delta t = 6,40 \text{ s}$ (6,369) $t_A = 0,3 + 6,40 = 6,7 \text{ s}$ ✓</p>	<p>DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF From 200 m upwards: <i>Vanaf 200 m opwaarts:</i> $v = v_i + a\Delta t$ ✓ $0 = -2,96 + (9,8)\Delta t$ ✓ $\Delta t = 0,3 \text{ s}$ (0,302) From max h downwards: <i>Vanaf maks h afwaarts:</i> $v_f = v_i + a\Delta t$ $62,68 = 0 + (9,8)\Delta t$ $\Delta t = 6,40 \text{ s}$ (6,369) $t_A = 0,3 + 6,40 = 6,7 \text{ s}$ ✓</p>

<p>OPTION 5/OPSIE 5 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF From 200 m upwards: Vanaf 200 m opwaarts: $v_f = v_i + a\Delta t$ ✓ $0 = 2,96 + (-9,8)\Delta t$ ✓ $\Delta t = 0,3 \text{ s (0,302)}$</p> <p>From 200 m downwards: Vanaf 200 m afwaarts: $v_f = v_i + a\Delta t$ $-62,68 = -2,96 + (-9,8)\Delta t$ $\Delta t = 6,09 \text{ s (6,094)}$ $t_A = 2(0,3) + 6,09 = 6,69 \text{ s}$ ✓</p>	<p>DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF From 200 m upwards: Vanaf 200 m opwaarts: $v_f = v_i + a\Delta t$ ✓ $0 = -2,96 + (9,8)\Delta t$ ✓ $\Delta t = 0,3 \text{ s (0,302)}$</p> <p>From 200 m downwards: Vanaf 200 m afwaarts: $v_f = v_i + a\Delta t$ $62,68 = 2,96 + (9,8)\Delta t$ $\Delta t = 6,09 \text{ s (6,094)}$ $t_A = 2(0,3) + 6,09 = 6,69 \text{ s}$ ✓</p>
<p>OPTION 6/OPSIE 6 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF $F_{\text{net}}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $g\Delta t = v_f - v_i$ $(-9,8)\Delta t = (-62,68) - (2,96)$ ✓ $\Delta t = 6,69 \text{ s}$ ✓</p>	<p>DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF $F_{\text{net}}\Delta t = m(v_f - v_i)$ ✓ $mg\Delta t = m(v_f - v_i)$ $g\Delta t = v_f - v_i$ $(9,8)\Delta t = 62,68 - (-2,96)$ ✓ $\Delta t = 6,69 \text{ s}$ ✓</p>

(3)

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

<p>Marking criteria/Nasienkriteria</p> <ul style="list-style-type: none"> • Formula to calculate Δy of stone B ✓ <i>Formule om Δy van klip B te bereken</i> • Substitution of $t = 1,7 \text{ s}$ ✓ ($t_A - 5$) <i>Vervanging van $t = 1,7 \text{ s}$ ($t_A - 5$)</i> • Substitution to calculate Δy of stone B ✓ <i>Vervanging om Δy van klip B te bereken</i> • Substitution to calculate Δy of balloon ✓ <i>Vervanging om Δy van ballon te bereken</i> • Calculating distance between balloon and stone B ✓ <i>Berekening van afstand tussen ballon en klip B</i> • Final answer/<i>Finale antwoord</i>: 14,16 m ✓ (14,11 to/tot 14,16) 	
<p>OPTION 1/OPSIE 1 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF Stone B/Klip B: $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓ $= 2,96(6,7 - 5) + \frac{1}{2}(-9,8)(6,7 - 5)^2$ ✓ $= -9,13 \text{ m}$ (-9,09 to/tot -9,13) Distance travelled by stone B: 9,13 m <i>Afstand afgelê deur klip B: 9,13 m</i></p> <p>Hot-air balloon/Lugballon $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ $= 2,96(6,7 - 5)$ ✓ + 0 $= 5,03 \text{ m}$ Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon: 5,03 m</i></p> <p>Distance between hot-air balloon and stone B/<i>Afstand tussen lugballon en klip B</i> = $9,13 + 5,03$ ✓ $= 14,16 \text{ m}$ ✓ (14,11 - 14,16)</p>	<p>DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF Stone B/Klip B: $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓ $= -2,96(6,7 - 5) + \frac{1}{2}(9,8)(6,7 - 5)^2$ ✓ $= 9,13 \text{ m}$ (9,09 to/tot 9,13) Distance travelled by stone B: 9,13 m <i>Afstand afgelê deur klip B: 9,13 m</i></p> <p>Hot-air balloon/Lugballon $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ $= -2,96(6,7 - 5)$ ✓ + 0 $= -5,03 \text{ m}$ Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon: 5,03 m</i></p> <p>Distance between hot-air balloon and stone B/<i>Afstand tussen lugballon en klip B</i> = $9,13 + 5,03$ ✓ $= 14,16 \text{ m}$ ✓ (14,11 - 14,16)</p>

<p>OPTION 2/OPSIE 2 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF Stone B/Klip B:</p> $v_f = v_i + a\Delta t$ $= 2,96 + (-9,8)(6,70 - 5)$ $= -13,7 \text{ m}\cdot\text{s}^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $(-13,7)^2 = (2,96)^2 + 2(-9,8)\Delta y \checkmark$ $\Delta y = -9,13 \text{ m}$ <p>Distance travelled by stone B: 9,13 m <i>Afstand afgelê deur klip B</i>: 9,13 m</p> <p>Hot-air balloon/Lugballon</p> $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= -2,96(6,70 - 5) + 0 \checkmark$ $= -5,03 \text{ m}$ <p>Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon</i>: 5,03 m</p> <p>Distance between hot-air balloon and stone B/<i>Afstand afgelê deur lugballon en klip B</i> = 9,13 + 5,03 \checkmark = 14,16 m \checkmark (14,11 - 14,16)</p>	<p>DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF Stone B/Klip B:</p> $v_f = v_i + a\Delta t$ $= -2,96 + (9,8)(6,70 - 5)$ $= 13,7 \text{ m}\cdot\text{s}^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $(13,7)^2 = (-2,96)^2 + 2(9,8)\Delta y \checkmark$ $\Delta y = 9,13 \text{ m}$ <p>Distance travelled by stone B: 9,13 m <i>Afstand afgelê deur klip B</i>: 9,13 m</p> <p>Hot-air balloon/Lugballon</p> $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= -2,96(6,70 - 5) + 0 \checkmark$ $= -5,03 \text{ m}$ <p>Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon</i>: 5,03 m</p> <p>Distance between hot-air balloon and stone B/<i>Afstand afgelê deur lugballon en klip B</i> = 9,13 + 5,03 \checkmark = 14,16 m \checkmark (14,11 - 14,16)</p>
<p>OPTION 3/OPSIE 3 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF Stone B/Klip B:</p> $v_f = v_i + a\Delta t$ $= 2,96 + (-9,8)(6,70 - 5)$ $= -13,7 \text{ m}\cdot\text{s}^{-1}$ $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t \checkmark$ $= \left(\frac{+2,96 + (-13,7)}{2}\right)(6,70 - 5) \checkmark$ $= -9,13 \text{ m}$ <p>Distance travelled by stone B: 9,13 m <i>Afstand afgelê deur klip B</i>: 9,13 m</p> <p>Hot-air balloon/Lugballon</p> $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= 2,96(6,70 - 5) + 0 \checkmark$ $= 5,03 \text{ m}$ <p>Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon</i>: 5,03 m</p> <p>Distance between hot-air balloon and stone B/<i>Afstand afgelê deur lugballon en klip B</i> = 9,13 + 5,03 \checkmark = 14,16 m \checkmark (14,11 - 14,16)</p>	<p>DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF Stone B/Klip B:</p> $v_f = v_i + a\Delta t$ $= -2,96 + (9,8)(6,70 - 5)$ $= 13,7 \text{ m}\cdot\text{s}^{-1}$ $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t \checkmark$ $= \left(\frac{-2,96 + (13,7)}{2}\right)(6,70 - 5) \checkmark$ $= 9,13 \text{ m}$ <p>Distance travelled by stone B: 9,13 m <i>Afstand afgelê deur klip B</i>: 9,13 m</p> <p>Hot-air balloon/Lugballon</p> $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= -2,96(6,70 - 5) + 0 \checkmark$ $= -5,03 \text{ m}$ <p>Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon</i>: 5,03 m</p> <p>Distance between hot-air balloon and stone B/<i>Afstand afgelê deur lugballon en klip B</i> = 9,13 + 5,03 \checkmark = 14,16 m \checkmark (14,11 - 14,16)</p>

<p>OPTION 4/OPSIE 4 UPWARDS POSITIVE/ OPWAARTS POSITIEF: Stone B/Klip B: $v_f = v_i + a\Delta t$ $= 2,96 + (-9,8)(6,70 - 5)$ $= -13,7 \text{ m}\cdot\text{s}^{-1}$ Balloon's height after 5 s: 214,8 m <i>Ballon se hoogte na 5 s: 214,8 m</i></p> <p>$E_{\text{mech/meg}}_{214,8 \text{ m}} = (E_{\text{mech/meg}})_{1,7 \text{ s}}$ $(E_P + E_K)_{214,8 \text{ m}} = (E_P + E_K)_{1,7 \text{ s}}$ ✓ $(mgh + \frac{1}{2}mv^2) = (mgh + \frac{1}{2}mv^2)_{1,7 \text{ s}}$ $(9,8)(214,8) + \frac{1}{2}(2,96)^2 =$ $(9,8)h + \frac{1}{2}(13,7)^2$ ✓ $\therefore h = 205,67 \text{ m}$</p> <p>Distance travelled by stone B/ <i>Afstand afgelê deur klip B:</i> $214,8 - 205,67 = 9,13 \text{ m}$</p> <p>Hot-air balloon/Lugballon $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= \underline{2,96(6,70 - 5)}$ ✓ + 0 $= 5,03 \text{ m}$ Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon: 5,03 m</i></p> <p>Distance between hot-air balloon and stone B/Afstand tussen lugballon en <i>klip B: $\underline{9,13 + 5,03}$ ✓ = 14,16 m ✓</i> (14,11 to/tot 14,16)</p>	<p>DOWNWARDS POSITIVE/ AFWAARTS POSITIEF: Stone B/Klip B: $v_f = v_i + a\Delta t$ $= -2,96 + (9,8)(6,70 - 5)$ $= 13,7 \text{ m}\cdot\text{s}^{-1}$ Balloon's height after 5 s: 214,8 m <i>Ballon se hoogte na 5 s: 214,8 m</i></p> <p>$(E_{\text{mech/meg}})_{214,8 \text{ m}} = (E_{\text{mech/meg}})_{1,7 \text{ s}}$ $(E_P + E_K)_{214,8 \text{ m}} = (E_P + E_K)_{1,7 \text{ s}}$ ✓ $(mgh + \frac{1}{2}mv^2) = (mgh + \frac{1}{2}mv^2)_{1,7 \text{ s}}$ $(9,8)(214,8) + \frac{1}{2}(2,96)^2 =$ $(9,8)h + \frac{1}{2}(13,7)^2$ ✓ $\therefore h = 205,67 \text{ m}$</p> <p>Distance travelled by stone B/ <i>Afstand afgelê deur klip B:</i> $214,8 - 205,67 = 9,13 \text{ m}$</p> <p>Hot-air balloon/Lugballon $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= \underline{-2,96(6,70 - 5)}$ ✓ + 0 $= -5,03 \text{ m}$ Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon: 5,03 m</i></p> <p>Distance between hot-air balloon and stone B/Afstand tussen lugballon en <i>klip B: $9,13 + 5,03$ ✓ = 14,16 m ✓</i> (14,11 to/tot 14,16)</p>
---	---

<p>OPTION 5/OPSIE 5 UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF Stone B/Klip B:</p> $v_f = v_i + a\Delta t$ $= 2,96 + (-9,8)(6,70 - 5)$ $= -13,7 \text{ m}\cdot\text{s}^{-1}$ $W_{\text{net}} = \Delta E_K \checkmark$ $F_{\text{net}}\Delta x \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $= \frac{1}{2}m(v_f^2 - v_i^2)$ $(9,8)\Delta h \cos 0^\circ = \frac{1}{2}(13,7^2 - 2,96^2) \checkmark$ $\Delta h = 9,13 \text{ m}$ <p>Distance travelled by stone B/ <i>Afstand afgelê deur klip B:</i> 9,13 m</p> <p>Hot-air balloon/Lugballon</p> $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= 2,96(6,70 - 5) \checkmark + 0$ $= 5,03 \text{ m}$ <p>Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon:</i> 5,03 m</p> <p>Distance between hot-air balloon and stone B/Afstand tussen lugballon en <i>klip B:</i> $9,13 + 5,03 \checkmark = 14,16 \text{ m} \checkmark$ (14,11 to/tot 14,16)</p>	<p>DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF Stone B/Klip B:</p> $v_f = v_i + a\Delta t$ $= -2,96 + (9,8)(6,70 - 5)$ $= 13,7 \text{ m}\cdot\text{s}^{-1}$ $W_{\text{net}} = \Delta E_K \checkmark$ $F_{\text{net}}\Delta x \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $= \frac{1}{2}m(v_f^2 - v_i^2)$ $(9,8)\Delta h \cos 0^\circ = \frac{1}{2}(13,7^2 - 2,96^2) \checkmark$ $\Delta h = 9,13 \text{ m}$ <p>Distance travelled by stone B/ <i>Afstand afgelê deur klip B:</i> 9,13 m</p> <p>Hot-air balloon/Lugballon</p> $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= -2,96(6,70 - 5) \checkmark + 0$ $= -5,03 \text{ m}$ <p>Distance travelled by hot-air balloon/ <i>Afstand afgelê deur lugballon:</i> 5,03 m</p> <p>Distance between hot-air balloon and stone B/Afstand tussen lugballon en <i>klip B:</i> $9,13 + 5,03 \checkmark = 14,16 \text{ m} \checkmark$ (14,11 to/tot 14,16)</p>
<p>OPTION 6/OPSIE 6 Using relative velocities/Deur relatiewe snelhede te gebruik:</p>	
<p>UPWARDS AS POSITIVE/ OPWAARTS AS POSITIEF</p> $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $= (2,96 - 2,96)(1,7) + \frac{1}{2}(-9,8)(1,7)^2$ $= -14,16 \text{ m}$ <p>Distance between hot-air balloon and stone B/Afstand tussen lugballon en <i>klip B:</i> 14,16 m \checkmark</p>	<p>DOWNWARDS AS POSITIVE/ AFWAARTS AS POSITIEF</p> $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $= (2,96 - 2,96)(1,7) + \frac{1}{2}(9,8)(1,7)^2$ $= 14,16 \text{ m} \checkmark$

OPTION 7/OPSIE 7

**UPWARDS AS POSITIVE/
 OPWAARTS AS POSITIEF**

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

$$= \underline{(2,96)(1,7) + \frac{1}{2} (-9,8)(1,7)^2} \checkmark$$

$$= -9,13 \text{ m}$$

Distance travelled by stone **B**: 9,13 m
 Afstand afgelê deur klip **B**: 9,13 m

**DOWNWARDS AS POSITIVE/
 AFWAARTS AS POSITIEF**

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

$$= \underline{(-2,96)(1,7) + \frac{1}{2} (9,8)(1,7)^2} \checkmark$$

$$= 9,13 \text{ m}$$

Height of stone B from the ground = 200 + 14,8 – 9,13 = 205,63 m

Hoogte van klip B vanaf die grond:

Height of balloon from the ground = 200 + (6,7)(2,96)✓ = 219,83 m

Hoogte van ballon vanaf die grond:

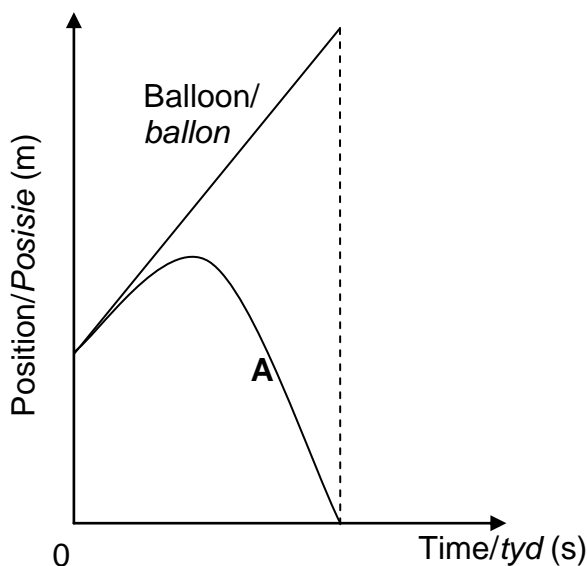
Distance between B and the balloon = 219,83 – 205,63 ✓ = 14,16 m✓

Afstand tussen B en die ballon:

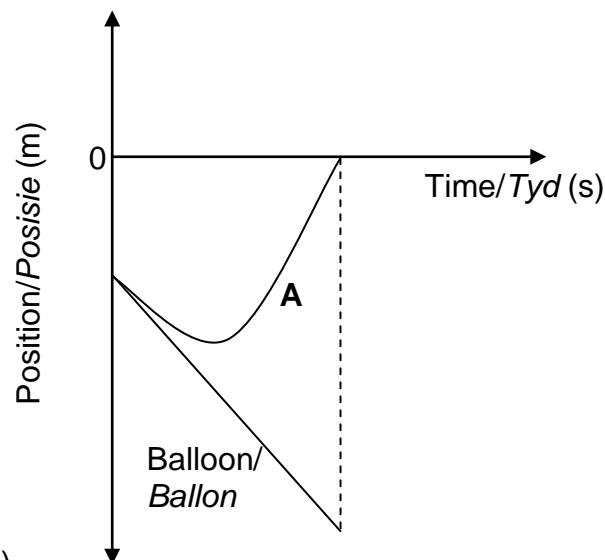
(6)

3.3

**UPWARDS POSITIVE
 OPWAARTS POSITIEF**



**DOWNWARDS POSITIVE
 AFWAARTS POSITIEF**



Criteria for graph/Kriteria vir grafiek	
Correct shape for stone A not starting from 0 m./Korrekte vorm vir klip A wat nie by 0 m begin nie.	✓
Correct shape and initial position for hot-air balloon. /Korrekte vorm en aanvanklike posisie vir lugballon.	✓
Gradient for hot-air balloon is higher than that of stone A until stone A reaches the maximum height./Gradiënt vir lugballon is groter as dié vir klip A totdat klip A sy maksimum hoogte bereik.	✓
Both graphs starting at the same position and ending at the same time. / Beide grafieke begin by dieselfde posisie en eindig by dieselfde tyd.	✓

(4)
 [18]

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 sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.
NOTE/LET WEL
 If "total" is omitted: minus 1 mark / Indien "totaal" uitgelaat is: minus 1 punt
 A collision in which both the total momentum and total kinetic energy are conserved. ✓✓
 'n Botsing waar die totale momentum en die totale kinetiese energie behoue bly.

(2)

4.2

OPTION 1/OPSIE 1
 $\sum E_{Ki} = \sum E_{Kf}$
 $\frac{1}{2}m_1v_{i1}^2 + \frac{1}{2}m_2v_{i2}^2 = \frac{1}{2}m_1v_{f1}^2 + \frac{1}{2}m_2v_{f2}^2$
 $\frac{1}{2}m_xv_{ix}^2 + \frac{1}{2}m_yv_{iy}^2 = \frac{1}{2}m_xv_{fx}^2 + \frac{1}{2}m_yv_{fy}^2$ } ✓ Any one/Enige een
 $\frac{1}{2}(10)(2)^2 + \frac{1}{2}(2)v_{iy}^2 = 0 + 36$ ✓
 $v_y = \pm 4 \text{ m}\cdot\text{s}^{-1}$
 $v_y = 4 \text{ m}\cdot\text{s}^{-1}$ ✓ west/wes ✓ **ACCEPT/AANVAAR: left/links**

OPTION 2/OPSIE 2
 $E_{Ki} = \frac{1}{2} m_y v_f^2$
 $36 = \frac{1}{2} (2) v_f^2$
 $v_f = 6 \text{ m}\cdot\text{s}^{-1}$
 $\sum p_i = \sum p_f$
 $m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$
 $m_xv_{xi} + m_yv_{yi} = m_xv_{xf} + m_yv_{yf}$
 $(10)(2) + (2)v_y = 0 + (2)(6)$ ✓ } ✓ Any one/Enige een
 $v_y = -4 \text{ m}\cdot\text{s}^{-1}$
 $v_y = 4 \text{ m}\cdot\text{s}^{-1}$ ✓ west/wes ✓ **ACCEPT/AANVAAR: left/links**

OPTION 3/OPSIE 3
 $E_{Ki} = \frac{1}{2} m_y v_f^2$
 $36 = \frac{1}{2} (2) v_f^2$
 $v_f = 6 \text{ m}\cdot\text{s}^{-1}$
 $\Delta p_x = -\Delta p_y$
 $m_x(v_{xf} - v_{xi}) = -m_y(v_{yf} - v_{yi})$ } ✓ Any one/Enige een
 $(10)(0 - 2) = -(2)(6 - v_y)$ ✓
 $v_{yf} = -4 \text{ m}\cdot\text{s}^{-1}$
 $v_y = 4 \text{ m}\cdot\text{s}^{-1}$ ✓ west/wes ✓ **ACCEPT/AANVAAR: left/links**

(5)

4.3 **POSITIVE MARKING FROM QUESTION 4.2 FOR Y; OPTIONS 1, 3 and 6**
POSITIEWE NASIEN VANAF VRAAG 4.2 VIR Y; OPSIES 1, 3 en 6

<p>OPTION 1/OPSIE 1 EAST POSITIVE/OOS POSITIEF: For Y/Vir Y: $F_{net}\Delta t = \Delta p$ $F_{net}\Delta t = m(v_f - v_i)$ } ✓ Any one/ Enige een $F_{net}(0,1) = 2\{6 - (-4)\}$ ✓ $F_{net} = 200 \text{ N}$ ✓</p>	<p>WEST POSITIVE/WES POSITIEF: For Y/Vir Y: $F_{net}\Delta t = \Delta p$ $F_{net}\Delta t = m(v_f - v_i)$ } ✓ Any one/ Enige een $F_{net}(0,1) = 2(-6 - 4)$ ✓ $F_{net} = -200 \text{ N}$ $F_{net} = 200 \text{ N}$ ✓</p>
<p>OPTION 2/OPSIE 2 EAST POSITIVE/OOS POSITIEF: For X/Vir X: $F_{net}\Delta t = \Delta p$ $F_{net}\Delta t = m(v_f - v_i)$ } ✓ Any one/ Enige een $F_{net}(0,1) = 10(0 - 2)$ ✓ $F_{net} = -200 \text{ N}$ $F_{net} = 200 \text{ N}$ ✓</p>	<p>WEST POSITIVE/WES POSITIEF For X/Vir X: $F_{net}\Delta t = \Delta p$ $F_{net}\Delta t = m(v_f - v_i)$ } ✓ Any one/ Enige een $F_{net}(0,1) = 10\{0 - (-2)\}$ ✓ $F_{net} = 200 \text{ N}$ ✓</p>
<p>OPTION 3/OPSIE 3 EAST POSITIVE/OOS POSITIEF: For Y/Vir Y: $v_f = v_i + a\Delta t$ $6 = -4 + a(0,1)$ $a = 100 \text{ m}\cdot\text{s}^{-2}$ $F_{net} = ma$ ✓ $= \underline{2(100)}$ ✓ $= 200 \text{ N}$ ✓</p>	<p>WEST POSITIVE/WES POSITIEF For Y/Vir Y: $v_f = v_i + a\Delta t$ $-6 = 4 + a(0,1)$ $a = -100 \text{ m}\cdot\text{s}^{-2}$ $F_{net} = ma$ ✓ $= \underline{2(-100)}$ ✓ $= -200 \text{ N}$ $F_{net} = 200 \text{ N}$ ✓</p>
<p>OPTION 4/OPSIE 4 EAST POSITIVE/OOS POSITIEF: For X/Vir X: $v_f = v_i + a\Delta t$ $0 = 2 + a(0,1)$ $a = -20 \text{ m}\cdot\text{s}^{-2}$ $F_{net} = ma$ ✓ $= \underline{10(-20)}$ ✓ $= -200 \text{ N}$ $F_{net} = 200 \text{ N}$ ✓</p>	<p>WEST POSITIVE/WES POSITIEF For X/Vir X: $v_f = v_i + a\Delta t$ $0 = -2 + a(0,1)$ $a = 20 \text{ m}\cdot\text{s}^{-2}$ $F_{net} = ma$ ✓ $= \underline{10(20)}$ ✓ $F_{net} = 200 \text{ N}$ ✓</p>
<p>OPTION 5/OPSIE 5 EAST POSITIVE/OOS POSITIEF: For X/Vir X:</p> $v_f = v_i + a\Delta t \qquad v_f^2 = v_i^2 + 2a\Delta x \qquad \Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$ $0 = 2 + a(0,1) \qquad 0 = (2)^2 + 2(-20)\Delta x \qquad = \left(\frac{0+2}{2}\right)(0,1)$ $a = -20 \text{ m}\cdot\text{s}^{-2} \qquad \Delta x = 0,10 \text{ m} \qquad = 0,10 \text{ m}$ $W_{net} = \Delta E_k \checkmark$ $F_{net}\Delta x \cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$ $F_{net}(0,1)\cos 180^\circ = \frac{1}{2} (10)(0^2 - 2^2) \checkmark$ $F_{net} = 200 \text{ N} \checkmark$	

OPTION 5/OPSIE 5

WEST POSITIVE/WES POSITIEF:

For X/Vir X:

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

$$0 = -2 + a(0,1) \qquad 0 = (-2)^2 + 2(20)\Delta x \qquad = \left(\frac{0 + (-2)}{2} \right) (0,1)$$

$$a = 20 \text{ m}\cdot\text{s}^{-2} \qquad \Delta x = -0,10 \text{ m} \qquad = -0,10 \text{ m}$$

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

$$F_{\text{net}}\Delta x \cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$F_{\text{net}}(0,1)\cos 180^\circ = \frac{1}{2} (10)(0^2 - 2^2) \checkmark$$

$$F_{\text{net}} = 200 \text{ N} \checkmark$$

OPTION 6/OPSIE 6

EAST POSITIVE/OOS POSITIEF:

For Y/Vir Y:

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

$$6 = -4 + a(0,1) \qquad (6)^2 = (-4)^2 + 2(100)\Delta x \qquad = \left(\frac{6 - 4}{2} \right) (0,1)$$

$$a = 100 \text{ m}\cdot\text{s}^{-2} \qquad \Delta x = 0,10 \text{ m} \qquad = 0,10 \text{ m}$$

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

$$F_{\text{net}}\Delta x \cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$F_{\text{net}}(0,1)\cos 0^\circ = \frac{1}{2} (2)(6^2 - (-4)^2) \checkmark$$

$$F_{\text{net}} = 200 \text{ N} \checkmark$$

OPTION 6/OPSIE 6

WEST POSITIVE/WES POSITIEF:

For Y/Vir Y:

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

$$-6 = 4 + a(0,1) \qquad (-6)^2 = (4)^2 + 2(-100)\Delta x \qquad = \left(\frac{-6 + 4}{2} \right) (0,1)$$

$$a = -100 \text{ m}\cdot\text{s}^{-2} \qquad \Delta x = -0,10 \text{ m} \qquad = -0,10 \text{ m}$$

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

$$F_{\text{net}}\Delta x \cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$F_{\text{net}}(0,1)\cos 0^\circ = \frac{1}{2} (2)((-6)^2 - (4)^2) \checkmark$$

$$F_{\text{net}} = 200 \text{ N} \checkmark$$

(3)
[10]

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 sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.

ACCEPT/AANVAAR
 For isolated system:

- Closed system/Geslote sisteem.
- Only conservative forces act on the system/Slegs konserwatiewe kragte werk in op die sisteem.
- No external forces act on system/Geen eksterne kragte werk in op die sisteem.

The total mechanical energy in an isolated system remains constant / the same. ✓✓
 Die totale meganiese energie in 'n geïsoleerde sisteem bly konstant / dieselfde.

OR/OF

The sum of the kinetic and gravitational potential energies in an isolated system remains constant/the same.
 Die som van die kinetiese en gravitasie potensiële energie in 'n geïsoleerde/geslote sisteem bly konstant/dieselfde.

(2)

5.2

NOTE/LET WEL

- Mass may be omitted during substitution. /Massa mag uitgelaat word tydens vervanging.
- If equations of motion are used. Max 1/3 for correct answer. / Indien bewegingsvergelings gebruik word. Maks 1/3 vir korrekte antwoord.

OPTION 1/OPSIE 1

$$E_{P/mech\ top/meg\ bo} = E_{Q/mech\ ground /meg\ grond}$$

$$(E_p + E_k)_{P/top/bo} = (E_p + E_k)_{Q/bottom/onder}$$

$$(mgh + \frac{1}{2}mv^2)_{P/top/bo} = (mgh + \frac{1}{2}mv^2)_{Q/bottom/onder}$$

$$(2)(9,8)(5) + 0 = 0 + \frac{1}{2}(2)v_f^2 \quad \checkmark$$

$$v_f = 9,90\ m \cdot s^{-1} \quad \checkmark (9,899)$$

} ✓ Any one/Enige een

OPTION 2/OPSIE 2

$$\Delta E_p + \Delta E_k = 0$$

$$(mgh_f - mgh_i) + \frac{1}{2}m(v_f^2 - v_i^2) = 0$$

$$0 - (2)(9,8)(5) + \frac{1}{2}(2)(v_f^2 - 0) \quad \checkmark = 0$$

$$v_f = 9,90\ m \cdot s^{-1} \quad \checkmark (9,899)$$

} ✓ Any one/Enige een

(3)

5.3

POSITIVE MARKING FROM QUESTION 5.2.
POSITIEWE NASIEN VANAF VRAAG 5.2.

OPTION 1/OPSIE 1

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

$$W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$W_N + W_f + W_w = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$f\Delta x \cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$f(10)\cos 180^\circ \quad \checkmark = \frac{1}{2}(2)(4^2 - 9,90^2) \quad \checkmark$$

$$f = 8,2\ N \quad \checkmark$$

} ✓ Any one/Enige een

OPTION 2/OPSIE 2

$$\begin{aligned}
 W_{nc} &= \Delta E_K + \Delta E_p \\
 W_f &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\
 W_N + W_f &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\
 f\Delta x \cos\theta &= \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i) \\
 \underline{f(10)\cos 180^\circ} &\checkmark = \underline{\frac{1}{2}(2)(4^2 - 9,90^2)} + 0 \checkmark \\
 f &= 8,2 \text{ N} \checkmark
 \end{aligned}$$

} ✓ Any one/Enige een

(4)

5.4

LEFT NEGATIVE/LINKS NEGATIEF

$$\begin{aligned}
 F_{net}\Delta t &= \Delta p \\
 F_{net}\Delta t &= mv_f - mv_i \\
 F_{net}\Delta t &= m(v_f - v_i) \\
 \underline{-14 = 2(v_f - 4)} &\checkmark \\
 v_f &= -3 \text{ m}\cdot\text{s}^{-1}
 \end{aligned}$$

} ✓ Any one/Enige een

ACCEPT/AANVAAR
 Impulse/Impuls = $m\Delta v$

$$\begin{aligned}
 \Delta E_K &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark \\
 &= \underline{\frac{1}{2}(2)[(-3)^2 - 4^2]} \checkmark \\
 &= -7 \text{ J} \checkmark
 \end{aligned}$$

Do not penalise if +3 is substituted.
 Moenie penaliseer indien +3 vervang is.

ACCEPT/AANVAAR

$$\begin{aligned}
 \Delta E_K &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark \\
 &= \underline{\frac{1}{2}(2)[(0)^2 - (-3)^2]} \checkmark \\
 &= -9 \text{ J} \checkmark
 \end{aligned}$$

Do not penalise if +3 is substituted.
 Moenie penaliseer indien +3 vervang is.

RIGHT NEGATIVE/REGS NEGATIEF

$$\begin{aligned}
 F_{net}\Delta t &= \Delta p \\
 F_{net}\Delta t &= mv_f - mv_i \\
 F_{net}\Delta t &= m(v_f - v_i) \\
 \underline{14 = 2(v_f - (-4))} &\checkmark \\
 v_f &= 3 \text{ m}\cdot\text{s}^{-1}
 \end{aligned}$$

} ✓ Any one/Enige een

ACCEPT/AANVAAR
 Impulse/Impuls = $m\Delta v$

$$\begin{aligned}
 \Delta E_K &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark \\
 &= \underline{\frac{1}{2}(2)[(3)^2 - (-4)^2]} \checkmark \\
 &= -7 \text{ J} \checkmark
 \end{aligned}$$

Do not penalise if +4 is substituted.
 Moenie penaliseer indien +4 vervang is.

ACCEPT/AANVAAR

$$\begin{aligned}
 \Delta E_K &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark \\
 &= \underline{\frac{1}{2}(2)[(0)^2 - (-3)^2]} \checkmark \\
 &= -9 \text{ J} \checkmark
 \end{aligned}$$

Do not penalise if +3 is substituted.
 Moenie penaliseer indien +3 vervang is.

(5)
 [14]

QUESTION 6/VRAAG 6

6.1 $v = f\lambda$ ✓
 $340 = 680\lambda$ ✓
 $\lambda = 0,5 \text{ m}$ ✓ (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 sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.

The change in frequency/pitch/wavelength of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓

Die verandering in frekwensie/toonhoogte/golflengte van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klank voortplanting 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)

6.3.1 Decreased/Afgeneem ✓ (1)

6.3.2 Increased/Toegeneem ✓ (1)

6.4 **POSITIVE MARKING FROM QUESTION 6.1 /**
POSITIEWE NASIEN VANAF VRAAG 6.1

<u>OPTION 1/OPSIE 1</u>	<u>OPTION 2/OPSIE 2</u>
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR } f_L = \frac{v}{v - v_s} f_s$ ✓	$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR } f_L = \frac{v}{v - v_s} f_s$ ✓
$f_L = \frac{v}{\lambda_L}$	$\frac{v}{\lambda_L} = \left(\frac{v+0}{v-v_s} \right) f_s$
$= \frac{340}{0,5 - 0,05}$ ✓	$\frac{340}{0,5 - 0,05} = \left(\frac{340+0}{340-v_s} \right) 680$ ✓
$= \frac{340}{0,45}$	$\frac{340}{0,45} = \left(\frac{340+0}{340-v_s} \right) 680$
$= 755,56 \text{ Hz}$	$v_s = 34 \text{ m} \cdot \text{s}^{-1}$ ✓ (33,67 - 34,04)
$755,56 = \left(\frac{340+0}{340-v_s} \right) 680$ ✓	
$v_s = 34 \text{ m} \cdot \text{s}^{-1}$ ✓ (33,67 - 34,04)	

OPTION 3/OPSIE 3	OPTION 4/OPSIE 4
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR } f_L = \frac{v}{v - v_s} f_s \checkmark$ $\frac{v}{\lambda_L} = \left(\frac{v+0}{v-v_s} \right) \frac{v}{\lambda_s}$ $\therefore \frac{1}{\lambda_L} = \left(\frac{v+0}{v-v_s} \right) \frac{1}{\lambda_s}$ $\frac{1}{0,5 - 0,05} = \left(\frac{340+0}{340-v_s} \right) \frac{1}{0,5} \checkmark$ $\frac{1}{0,45} = \left(\frac{340+0}{340-v_s} \right) \frac{1}{0,5}$ $v_s = 34 \text{ m}\cdot\text{s}^{-1} \checkmark \quad (33,67 - 34,04)$	$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR } f_L = \frac{v}{v - v_s} f_s \checkmark$ $v_1 = v_2$ $f_s \lambda_1 = f_L \lambda_2$ $(600)(0,5) = f_L(0,45) \checkmark$ $f_L = 755,56 \text{ Hz}$ $755,56 = \left(\frac{340+0}{340-v_s} \right) 680 \checkmark$ $v_s = 34 \text{ m}\cdot\text{s}^{-1} \checkmark \quad (33,67 - 34,04)$

(5)
[12]

QUESTION 7/VRAAG 7

7.1.1 Added/Toegevoeg \checkmark

(1)

7.1.2 **NOTE/LET WEL**

Ignore signs of the charges./ Ignoreer tekens van die ladings.

$$n = \frac{Q}{q_e} \checkmark$$

$$= \frac{-1,95 \times 10^{-6}}{-1,6 \times 10^{-19}} \checkmark$$

$$= 1,22 \times 10^{13} \checkmark \quad (1,21875 \times 10^{13})$$

(3)

7.1.3 **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 sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.

The (electrostatic) force experienced per unit positive charge placed at that point.

Die (elektrostatiese) krag per eenheid positiewe lading wat by die punt geplaas is.

NOTE/LET WEL (1 mark for:/1 punt vir:)

An electric field is a region of space in which an electric charge experiences a force.

'n Gebied in die ruimte waarin 'n elektriese lading 'n krag ondervind.

(2)

7.1.4

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

$$= \frac{(9 \times 10^9)(1,95 \times 10^{-6})}{(0,5)^2} \checkmark$$

$$= 7,02 \times 10^4 \text{ N}\cdot\text{C}^{-1} \checkmark$$

(3)

7.2

OPTION 1/OPSIE 1

Marking criteria/Nasienkriteria:

- Coulomb's Law formula/Coulomb se formule ✓
- Correct substitution for F_{q1} **OR** F_{q2} into $\frac{kQ_1Q_2}{r^2}$ ✓
*Korrekte substitusie van F_{q1} **OF** F_{q2} in $\frac{kQ_1Q_2}{r^2}$*
- Correct substitution of 1,38 N for $F_{(net)}$ /*Korrekte substitusie van 1,38 N vir $F_{(net)}$* ✓
- Subtracting (vector addition) electrostatic forces /*Aftrek (vektoraddisie) van elektrostatiese kragte* ✓
- Final answer/*Finale antwoord*: $1,11 \times 10^{-7} \text{ C}$ ✓ ($1,106 \times 10^{-7} \text{ C}$)

$$F_{E(net)} = F_{q2} + F_{q1}$$

$$1,38 \checkmark = \left(+ \frac{kQ_1Q_2}{r^2} \right) + \left(- \frac{kQ_1Q_2}{r^2} \right) \checkmark$$

$$1,38 = \left(+ \frac{(9 \times 10^9)(1,95 \times 10^{-6})q_2}{(0,03)^2} \right) + \left(- \frac{\checkmark (9 \times 10^9)(1,95 \times 10^{-6})q_2}{(0,05)^2} \right) \checkmark$$

$$q_2 = 1,11 \times 10^{-7} \text{ C} \checkmark (1,106 \times 10^{-7} \text{ C})$$

OPTION 2/OPSIE 2

Marking criteria/Nasienkriteria:

- $E = \frac{kQ}{r^2}$ ✓
- Correct substitution of $7,08 \times 10^5 \text{ N} \cdot \text{C}^{-1}$ /*Korrekte substitusie van $7,08 \times 10^5 \text{ N} \cdot \text{C}^{-1}$* ✓
- Correct substitution for E_{q1} **OR** E_{q2} into $\frac{kQ_2}{r^2}$ ✓
*Korrekte substitusie van E_{q1} **OF** E_{q2} in $\frac{kQ_2}{r^2}$*
- Subtracting electric fields/*Aftrek van elektriese velde* ✓
- Final answer/*Finale antwoord*: $1,11 \times 10^{-7} \text{ C}$ ✓ ($1,106 \times 10^{-7} \text{ C}$)

$$E = \frac{F}{q} = \frac{1,38}{1,95 \times 10^{-6}}$$

$$= 7,08 \times 10^5 \text{ N} \cdot \text{C}^{-1} (707692,30)$$

$$E_{net} = E_{q2} + E_{q1}$$

$$7,08 \times 10^5 \checkmark = \left(+ \frac{kQ_2}{r^2} \right) + \left(- \frac{kQ_1}{r^2} \right) \checkmark$$

$$= \left(+ \frac{(9 \times 10^9)q_2}{(0,03)^2} \right) + \left(- \frac{\checkmark (9 \times 10^9)q_1}{(0,05)^2} \right) \checkmark$$

$$q_2 = 1,11 \times 10^{-7} \text{ C} \checkmark (1,106 \times 10^{-7} \text{ C})$$

(5)
 [14]

QUESTION 8/VRAAG 8

8.1.1 12 V ✓ (1)

8.1.2 0 (V) ✓ (1)

8.2 **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.

The rate at which work is done or energy is expended/transferred.
 Die tempo waarteen arbeid verrig word of energie oorgedra word. (2)

8.3 **OPTION 1/OPSIE 1**
 $P = I^2R$ ✓
 $5,76 = (1,2^2)R$ ✓
 $R = 4 \Omega$ ✓

OPTION 2/OPSIE 2

$P = VI$
 $5,76 = V(1,2)$
 $V = 4,8 V$

$P = \frac{V^2}{R}$ ✓
 $5,76 = \frac{(4,8)^2}{R}$ ✓
 $R = 4 \Omega$ ✓

$V = IR$ ✓
 $4,8 = (1,2)R$ ✓
 $R = 4 \Omega$ ✓

(3)

8.4 **POSITIVE MARKING FROM QUESTION 8.3**
POSITIEWE NASIEN VANAF VRAAG 8.3

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ $\frac{1}{R_p} = \frac{1}{6} + \frac{1}{8,4}$ ✓ $R_p = 3,5 \Omega$ $R_T = 3,5 + 4$ ✓ $= 7,5 \Omega$ ✓	$R_p = \frac{R_1 R_2}{R_1 + R_2}$ $R_p = \frac{(6)(8,4)}{6 + 8,4}$ ✓ $R_p = 3,5 \Omega$ $R_T = 3,5 + 4$ ✓ $= 7,5 \Omega$ ✓

(3)

8.5 **POSITIVE MARKING FROM QUESTION 8.3**
POSITIEWE NASIEN VANAF VRAAG 8.3

<p>CALCULATE V_p/BEREKEN V_p Marking criteria/Nasienkriteria</p> <ul style="list-style-type: none"> Formula/Formule: $V = IR \checkmark$ Substitution to calculate V_p/ Vervanging om V_p te bereken. \checkmark 	<p>CALCULATE V_2/BEREKEN V_2 Marking criteria/Nasienkriteria</p> <ul style="list-style-type: none"> Substitution to calculate I_{branch} or ratio of R_{branch}/Vervanging om I_{tak} of verhouding van R_{tak} te bereken. \checkmark Substitution to calculate V_2/ Vervanging om V_2 te bereken. \checkmark Final Answer/Finale antwoord: 3 V \checkmark
<p>OPTION 1/OPSIE 1 $V_p = IR$ $= (1,2)(3,5) \checkmark$ $= 4,2 \text{ V}$</p>	<p>$I = \frac{V}{R}$ $= \frac{4,2}{8,4} \checkmark$ $= 0,5 \text{ A}$</p>
<p>OPTION 2/OPSIE 2 $P_x = VI$ $5,76 = V(1,2)$ $V_x = 4,8 \text{ V}$ $I_{6\Omega} = \frac{8,4}{14,4} \times 1,2$ $= 0,7 \text{ A}$ $V_{6\Omega} = IR$ $= (0,7)(6) \checkmark$ $= 4,2 \text{ V}$</p>	<p>$V_2 = IR \checkmark$ $= (0,5)(6) \checkmark$ $= 3 \text{ V} \checkmark$</p> <p>OR/OF</p>
<p>OPTION 3/OPSIE 3 $\varepsilon = I(R + r)$ $12 = 1,2(7,5 + r)$ $r = 2,5 \Omega$ $V_p = 12 - 1,2(2,5 + 4) \checkmark = 4,2 \text{ V}$</p>	<p>$R_{2,4} : R_6 = 2,4 : 6 \checkmark$ $= 2 : 5$ $V_{2,4} : V_6 = 1,2 : 3 \checkmark \checkmark$ $V_2 = 3 \text{ V} \checkmark$</p>
<p>CALCULATION OF $I_{8,4\Omega}$ AND V_2/BEREKENING VAN $I_{8,4\Omega}$ EN V_2 OPTION 4/OPSIE 4</p> <p>$I_{8,4\Omega} = \left(\frac{6}{14,4}\right)(1,2) \text{ OR/OF } \left(\frac{3,5}{8,4}\right)(1,2)$ $= 0,5 \text{ A} \checkmark \checkmark$ $V_2 = IR \checkmark$ $= (0,5)(6) \checkmark$ $= 3 \text{ V} \checkmark$</p>	
<p>OPTION 5/OPSIE 5</p> <p>$V_x = IR$ $= (1,2)(4)$ $= 4,8 \text{ V}$</p> <p>$V_{\text{ext}} = IR_{\text{ext}}$ $= (1,2)(7,5)$ $= 9 \text{ V}$</p> <p>$V_p = 9 - 4,8 \checkmark = 4,2 \text{ V}$</p> <p>$V_{8,4\Omega} = IR$ $4,2 = I(8,4) \checkmark$ $I = 0,5 \text{ A}$</p> <p>$V_2 = IR \checkmark$ $= (0,5)(6) \checkmark$ $= 3 \text{ V} \checkmark$</p>	

(5)

- 8.6 Decreases/Neem af ✓
 Total resistance decreases. / Totale weerstand neem af. ✓
 Current increases. / Stroom neem toe. ✓
 V_{internal} / Internal voltage (“lost volts”) increases. / Interne potensiaalverskil neem toe. ✓
 V_{external} / external voltage decreases. / Eksterne potensiaalverskil neem af.

NOTE/LET WEL

Do not penalise if “total” is omitted. / Moenie penaliseer indien “totaal” uitgelaat is nie.

(4)
 [19]

QUESTION 9/VRAAG 9

- 9.1 Slip rings/Sleepringe ✓

ACCEPT/AANVAAR

Split ring/slip ring commutator /splitring/sleepring kommutator

(1)

- 9.2 Y to/na X ✓✓

(2)

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 sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.

The AC potential difference which dissipates the same amount of energy as an equivalent DC potential difference.

Die WS-potensiaalverskil wat dieselfde hoeveelheid energie verbruik as die ekwivalente/soortgelyke GS-potensiaalverskil.

ACCEPT/AANVAAR

The DC potential difference which dissipates the same amount of energy as an equivalent AC potential difference.

Die GS-potensiaalverskil wat dieselfde hoeveelheid energie verbruik as die ekwivalente/soortgelyke WS-potensiaalverskil.

(2)

- 9.4

<u>OPTION 1/OPSIE 1</u>	<u>OPTION 2/OPSIE 2</u>	<u>OPTION 3/OPSIE 3</u>
$V_{\text{rms/wgk}} = \frac{V_{\text{max/maks}}}{\sqrt{2}}$ $= \frac{100}{\sqrt{2}} \checkmark$ $= 70,71 \text{ V}$ $I_{\text{rms/wgk}} = \frac{V_{\text{rms/wgk}}}{R} \checkmark$ $= \frac{70,71}{25} \checkmark$ $= 2,83 \text{ A} \checkmark$ <p><u>ACCEPT/AANVAAR</u> If subscripts omitted in $V = IR$ Indien onderskrifte uitgelaat is in $V = IR$</p>	$I_{\text{max/maks}} = \frac{V_{\text{max/maks}}}{R}$ $= \frac{100}{25} \checkmark$ $= 4 \text{ A}$ $I_{\text{rms/wgk}} = \frac{I_{\text{max/maks}}}{\sqrt{2}} \checkmark$ $= \frac{4}{\sqrt{2}} \checkmark$ $= 2,83 \text{ A} \checkmark$	$P_{\text{ave}} = \frac{V_{\text{rms}}^2}{R}$ $= \frac{100^2}{25} \checkmark = 200 \text{ W}$ $P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$ $200 = \left(\frac{100}{\sqrt{2}} \right) I_{\text{rms}} \checkmark$ $I_{\text{rms}} = 2,83 \text{ A} \checkmark$

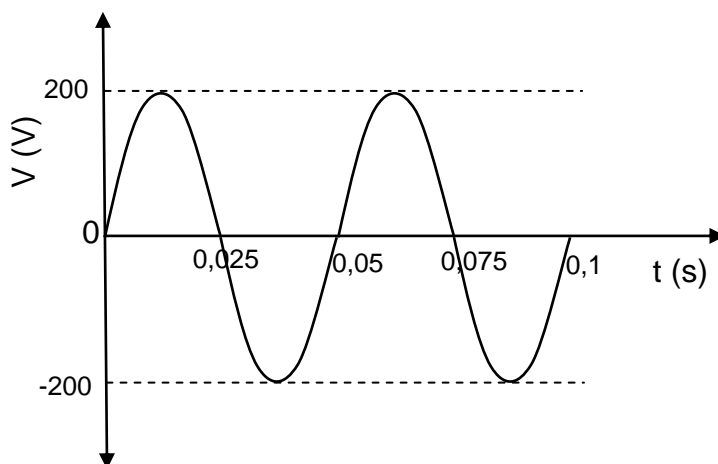
(4)

9.5 **POSITIVE MARKING FROM QUESTION 9.4 /
 POSITIEWE NASIEN VANAF VRAAG 9.4**

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2	OPTION 3/OPSIE 3
$P_{\text{ave/gem}} = \frac{V_{\text{rms/wgk}}^2}{R} \checkmark$ $= \frac{70,71^2}{25} \checkmark$ $= 200,00 \text{ W } \checkmark \text{ (200 W)}$	$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$ $= (70,71)(2,83) \checkmark$ $= 200,11 \text{ W } \checkmark$	$P_{\text{ave/gem}} = I_{\text{rms/wgk}}^2 R \checkmark$ $= (2,83)^2 (25) \checkmark$ $= 200,22 \text{ W } \checkmark$
OPTION 4/OPSIE 4 $I_{\text{rms/wgk}} = \frac{I_{\text{max/maks}}}{\sqrt{2}}$ $2,83 = \frac{I_{\text{max}}}{\sqrt{2}}$ $I_{\text{max/maks}} = 4 \text{ A}$ $P_{\text{ave/gem}} = \frac{V_{\text{max/maks}} I_{\text{max/maks}}}{2} \checkmark$ $= \frac{(100)(4)}{2} \checkmark$ $= 200 \text{ W } \checkmark$		

(3)

9.6



Marking criteria/Nasienkriteria

- 2 waves ✓
2 golwe
- Period of wave is 0,05 s ✓
Periode van golf is 0,05 s
- Amplitude = 200 V ✓

(3)
[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 sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.

The minimum frequency of light needed to eject electrons from a metal / surface. ✓✓

Minimum frekwensie van lig benodig om elektrone vanaf 'n metaal / oppervlak vry te stel. (2)

10.2

Greater than/Groter as ✓✓

(2)

10.3

OPTION 1/OPSIE 1
 $E = W_o + E_{k(max)}$ ✓
 $f_x = \left(\frac{1}{6,63 \times 10^{-34}} \right) \checkmark (23,01 \times 10^{-19}) \checkmark + 10,40 \times 10^{14} \checkmark$
 $= 4,51 \times 10^{15} \text{ (Hz)} \checkmark (45,1 \times 10^{14} \text{ Hz})$

OPTION 2/OPSIE 2
 $m = \frac{1}{h}$ ✓
 $\frac{f_x - 10,4 \times 10^{14} \checkmark}{23,01 \times 10^{-19} - 0 \checkmark} = \frac{1}{6,63 \times 10^{-34} \checkmark}$
 $f_x = 4,51 \times 10^{15} \text{ (Hz)} \checkmark (45,1 \times 10^{14} \text{ Hz})$

OPTION 3/OPSIE 3
 $E = W_o + E_{k(max)}$ ✓
 $hf = hf_0 + E_{k(max)}$
 $6,63 \times 10^{-34} f_x \checkmark = (6,63 \times 10^{-34})(10,40 \times 10^{14}) \checkmark + 23,01 \times 10^{-19} \checkmark$
 $f_x = 4,51 \times 10^{15} \text{ (Hz)} \checkmark (45,1 \times 10^{14} \text{ Hz})$

(5)

10.4

10.4.1 No effect/Geen effek nie ✓

(1)

10.4.2 Increases/Verhoog ✓

(1)

10.4.3 No effect/Geen effek nie ✓

(1)

[12]

TOTAL/TOTAAL:

150