



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.

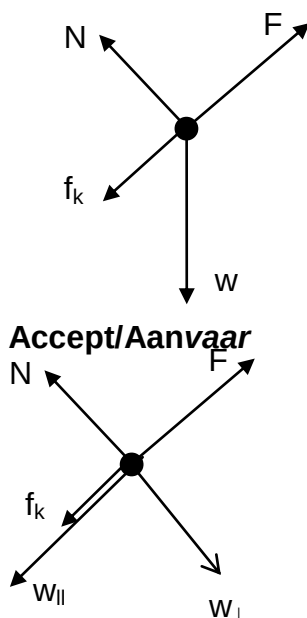
OR/OF

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. ✓✓

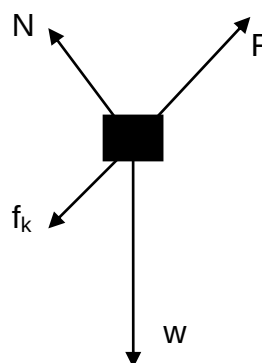
'n Liggaam sal in sy toestand rus of uniforme beweging in 'n reguit lyn volhard, tensy 'n (nie-nul) resulterende/netto/ongebalanseerde krag daarop inwerk.

(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

OPTION 1/OPSIE 1**Positive up the incline/Positief opwaarts teen skuinsvlak**

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 F + f_k + w_{\parallel} &= ma \\
 F + (-f_k) + (-w_{\parallel}) &= ma \\
 F - (f_k + w_{\parallel}) &= ma
 \end{aligned}
 \left. \vphantom{\begin{aligned} F + f_k + w_{\parallel} &= ma \\ F + (-f_k) + (-w_{\parallel}) &= ma \\ F - (f_k + w_{\parallel}) &= ma \end{aligned}} \right\} \checkmark \text{Any one/Enige een}$$

NOTE/LET WEL

$$\begin{aligned}
 F_{\text{net}} &= 0 \checkmark \checkmark \\
 F &= f_k + w_{\parallel} \checkmark \checkmark
 \end{aligned}$$

$$F - [18 + (20)(9,8)(\sin 30^\circ)] \checkmark = 0 \checkmark$$

$$F = 116 \text{ N} \checkmark$$

OPTION 2/OPSIE 2**Positive up the incline/Positief opwaarts teen skuinsvlak**

$$\begin{aligned}
 W_{\text{net}} &= \Delta E_k \checkmark \\
 F\Delta x \cos 0^\circ + f\Delta x \cos 180^\circ + w\Delta x \cos 120^\circ \checkmark &= 0 \checkmark \\
 F\Delta x &= 18\Delta x + (20)(9,8)\Delta x(0,5) \\
 F &= 116 \text{ N} \checkmark
 \end{aligned}$$

NOTE/LET WEL

$$\begin{aligned}
 W_{\text{net}} &= 0 \checkmark \checkmark \\
 F\Delta x &= f\Delta x + w\Delta x(0,5) \checkmark \checkmark
 \end{aligned}$$

(4)

2.4

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

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

ACCEPT/AANVAAR:

Downwards/down/Afwaarts/af

(2)

2.5

POSITIVE MARKING FROM QUESTION 2.4 /**POSITIEWE NASIEN VANAF VRAAG 2.4****OPTION 1/OPSIE 1****Up the incline positive/Teen skuinsvlak op positief**

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 -116 &= 20a \checkmark \\
 a &= -5,80 \text{ m}\cdot\text{s}^{-2}
 \end{aligned}$$

$$\begin{aligned}
 v_f^2 &= v_i^2 + 2a\Delta x \checkmark \\
 0 &= (2)^2 + (2)(-5,8)\Delta x \checkmark \\
 \Delta x &= 0,34 \text{ m} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 v_f &= v_i + \Delta t \\
 0 &= 2 + (-5,8)\Delta t \\
 \Delta t &= 0,34 \text{ s}
 \end{aligned}$$

OR/OF

$$\begin{aligned}
 F_{\text{net}}\Delta t &= m(v_f - v_i) \\
 (-116)\Delta t &= (20)(0 - 2) \\
 \Delta t &= 0,34 \text{ s}
 \end{aligned}$$

$$\begin{aligned}
 \Delta x &= v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark \\
 &= (2)(0,34) + \frac{1}{2}(-5,8)(0,34)^2 \checkmark \\
 &= 0,34 \text{ m} \checkmark
 \end{aligned}$$

$$\begin{aligned}
 v_f &= v_i + \Delta t \\
 0 &= 2 + (-5,8)\Delta t \\
 \Delta t &= 0,34 \text{ s}
 \end{aligned}$$

OR/OF

$$\begin{aligned}
 F_{\text{net}}\Delta t &= m(v_f - v_i) \\
 (-116)\Delta t &= (20)(0 - 2) \\
 \Delta t &= 0,34 \text{ s}
 \end{aligned}$$

$$\begin{aligned}
 \Delta x &= \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark \\
 &= \left(\frac{2 + 0}{2} \right) 0,34 \checkmark \\
 &= 0,34 \text{ m} \checkmark
 \end{aligned}$$

OPTION 1/OPSIE 1**Down the incline positive / Teen skuinsvlak af positief**

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

$$116 = 20a \checkmark$$

$$a = 5,80 \text{ m} \cdot \text{s}^{-2}$$

$$v_f^2 = v_i^2 + 2a\Delta x \checkmark$$

$$0 = (-2)^2 + (2)(5,8)\Delta x \checkmark$$

$$\Delta x = -0,34 \text{ m}$$

Distance = 0,34 m $\checkmark$
Afstand

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

$$0 = -2 + (5,8)\Delta t$$

$$\Delta t = 0,34 \text{ s}$$

OR/OF

$$F_{\text{net}}\Delta t = m(v_f - v_i)$$

$$(116)\Delta t = (20)(0 - (-2))$$

$$\Delta t = 0,34 \text{ s}$$

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

$$= (-2)(0,34) + \frac{1}{2}(5,8)(0,34)^2 \checkmark$$

$$= -0,34 \text{ m} \checkmark$$

Distance/*Afstand* = 0,34 m $\checkmark$

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

$$0 = -2 + (5,8)\Delta t$$

$$\Delta t = 0,34 \text{ s}$$

OR/OF

$$F_{\text{net}}\Delta t = m(v_f - v_i)$$

$$(116)\Delta t = (20)(0 - (-2))$$

$$\Delta t = 0,34 \text{ s}$$

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

$$= \left(\frac{-2 + 0}{2} \right) 0,34 \checkmark$$

= -0,34 m $\checkmark$
 Distance/*Afstand*
 = 0,34 m $\checkmark$

OPTION 2/OPSIE 2

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

$$F_{\text{net}}\Delta x \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2) \checkmark \text{ Any one/Enige een}$$

$$(116)\Delta x \cos 180^\circ \checkmark = \frac{1}{2}(20)(0^2 - 2^2) \checkmark$$

$$\Delta x = 0,34 \text{ m} \checkmark$$

OPTION 3/OPSIE 3

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

$$W_f + W_{\text{wll}} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$f\Delta x \cos \theta + (mg \sin 30^\circ)\Delta x \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2) \checkmark \text{ Any one/Enige een}$$

$$(18)\Delta x \cos 180^\circ + (20)(9,8)\sin 30^\circ \Delta x \cos 180^\circ \checkmark = \frac{1}{2}(20)(0^2 - 2^2) \checkmark$$

$$\Delta x = 0,34 \text{ m} \checkmark$$

OPTION 4/OPSIE 4

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

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

$$f\Delta x \cos \theta + mg\Delta x \cos 120^\circ = \frac{1}{2}m(v_f^2 - v_i^2) \checkmark \text{ Any one/Enige een}$$

$$(18)\Delta x \cos 180^\circ + (20)(9,8)\Delta x \cos 120^\circ \checkmark = \frac{1}{2}(20)(0^2 - 2^2) \checkmark$$

$$\Delta x = 0,34 \text{ m} \checkmark$$

OPTION 5/OPSIE 5

$$W_{\text{nc}} = \Delta E_p + \Delta E_k$$

$$f\Delta x \cos \theta = mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2) \checkmark \text{ Any one/Enige een}$$

$$18\Delta x \cos 180^\circ \checkmark = 20(9,8)\Delta x + \frac{1}{2}(20)(0^2 - 2^2) \checkmark$$

$$-18\Delta x = 196\Delta x \sin 30^\circ - 40$$

$$\Delta x = 0,34 \text{ m} \checkmark$$

(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 $9,8 \text{ m}\cdot\text{s}^{-2}$ /is zero.
Sy versnelling is nie $9,8 \text{ m}\cdot\text{s}^{-2}$ /is nul.
- It has constant velocity/no acceleration.
Dit het 'n konstante snelheid/geen versnelling nie.

(2)

3.2.1

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

(3)

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

Marking criteria/Nasienkriteria - 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/Finale antwoord: 6,70 s ✓ Accept/Aanvaar: (6,69 to/tot 6,7)	
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.	
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)	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)
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)	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)
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)	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)
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) $t_A = 0,3 + 6,40 = 6,7 \text{ s}$ ✓	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) $t_A = 0,3 + 6,40 = 6,7 \text{ s}$ ✓

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

(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

Marking criteria/Nasienkriteria

- Formula to calculate Δy of stone **B** ✓
*Formule om Δy van klip **B** te bereken*
- Substitution of $t = 1,7 \text{ s}$ ✓ ($t_A - 5$)
Vervanging van $t = 1,7 \text{ s}$ ($t_A - 5$)
- Substitution to calculate Δy of stone **B** ✓
*Vervanging om Δy van klip **B** te bereken*
- Substitution to calculate Δy of balloon ✓
Vervanging om Δy van ballon te bereken
- Calculating distance between balloon and stone **B** ✓
*Berekening van afstand tussen ballon en klip **B***
- Final answer/*Finale antwoord*: 14,16 m ✓ (14,11 to/tot 14,16)

OPTION 1/OPSIE 1

**UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF**

Stone B/Klip B:

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

$$= \underline{2,96(6,7 - 5) + \frac{1}{2}(-9,8)(6,7 - 5)^2} \checkmark$$

$$= -9,13 \text{ m } (-9,09 \text{ to/tot } -9,13)$$

Distance travelled by stone **B**: 9,13 m

*Afstand afgelê deur klip **B***: 9,13 m

Hot-air balloon/Lugballon

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

$$= \underline{2,96(6,7 - 5)} \checkmark + 0$$

$$= 5,03 \text{ m}$$

Distance travelled by hot-air balloon/

Afstand afgelê deur lugballon: 5,03 m

Distance between hot-air balloon and stone **B**/*Afstand tussen lugballon en klip **B*** = $\underline{9,13 + 5,03} \checkmark$

$$= 14,16 \text{ m } \checkmark (14,11 - 14,16)$$

**DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF**

Stone B/Klip B:

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

$$= \underline{-2,96(6,7 - 5) + \frac{1}{2}(9,8)(6,7 - 5)^2} \checkmark$$

$$= 9,13 \text{ m } (9,09 \text{ to/tot } 9,13)$$

Distance travelled by stone **B**: 9,13 m

*Afstand afgelê deur klip **B***: 9,13 m

Hot-air balloon/Lugballon

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

$$= \underline{-2,96(6,7 - 5)} \checkmark + 0$$

$$= -5,03 \text{ m}$$

Distance travelled by hot-air balloon/

Afstand afgelê deur lugballon: 5,03 m

Distance between hot-air balloon and stone **B**/*Afstand tussen lugballon en klip **B*** = $\underline{9,13 + 5,03} \checkmark$

$$= 14,16 \text{ m } \checkmark (14,11 - 14,16)$$

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

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

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 = $200 + 14,8 - 9,13 = 205,63 \text{ m}$

Hoogte van klip B vanaf die grond:

Height of balloon from the ground = $200 + (6,7)(2,96) \checkmark = 219,83 \text{ m}$

Hoogte van ballon vanaf die grond:

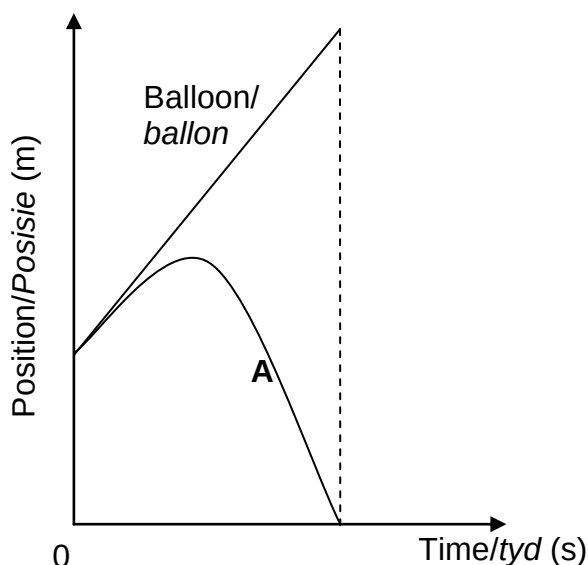
Distance between B and the balloon = $219,83 - 205,63 \checkmark = 14,16 \text{ m} \checkmark$

Afstand tussen B en die ballon:

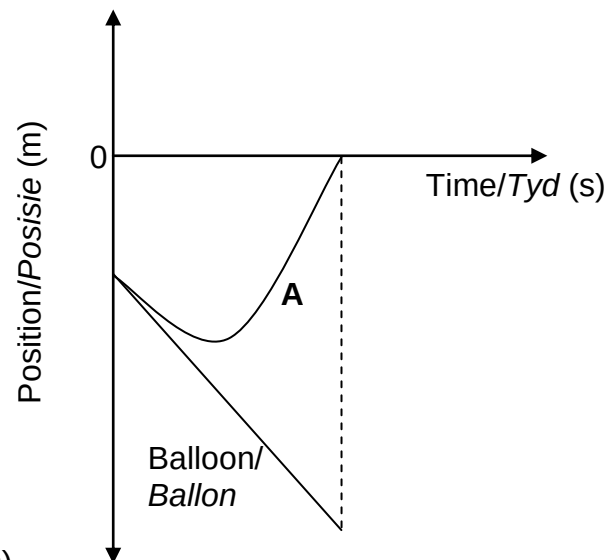
(6)

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

$$\sum E_{Ki} = \sum E_{Kf}$$

$$\frac{1}{2}m_1v_{i1}^2 + \frac{1}{2}m_2v_{i2}^2 = \frac{1}{2}m_1v_{f1}^2 + \frac{1}{2}m_2v_{f2}^2 \quad \left. \begin{array}{l} \checkmark \text{ Any one/Enige een} \\ \frac{1}{2}m_xv_{ix}^2 + \frac{1}{2}m_yv_{iy}^2 = \frac{1}{2}m_xv_{fx}^2 + \frac{1}{2}m_yv_{fy}^2 \end{array} \right\}$$

$$\frac{1}{2}(10)(2)^2 + \frac{1}{2}(2)v_{iy}^2 \checkmark = 0 + 36 \checkmark$$

$$v_y = \pm 4 \text{ m} \cdot \text{s}^{-1}$$

$$v_y = 4 \text{ m} \cdot \text{s}^{-1} \checkmark \quad \text{west/wes} \checkmark$$

ACCEPT/AANVAAR: left/links

OPTION 2/OPSIE 2

$$E_{Ki} = \frac{1}{2} m_Y v_f^2$$

$$36 = \frac{1}{2} (2) v_f^2$$

$$v_f = 6 \text{ m} \cdot \text{s}^{-1}$$

$$\sum p_i = \sum p_f$$

$$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$$

$$m_xv_{xi} + m_yv_{yi} = m_xv_{xf} + m_yv_{yf}$$

$$(10)(2) + (2)v_{y-} \checkmark = 0 + (2)(6) \checkmark$$

$$v_y = -4 \text{ m} \cdot \text{s}^{-1}$$

$$v_y = 4 \text{ m} \cdot \text{s}^{-1} \checkmark \quad \text{west/wes} \checkmark$$

ACCEPT/AANVAAR: left/links

OPTION 3/OPSIE 3

$$E_{Ki} = \frac{1}{2} m_Y v_f^2$$

$$36 = \frac{1}{2} (2) v_f^2$$

$$v_f = 6 \text{ m} \cdot \text{s}^{-1}$$

$$\Delta p_x = -\Delta p_y$$

$$m_x(v_{xf} - v_{xi}) = -m_y(v_{yf} - v_{yi}) \quad \left. \begin{array}{l} \checkmark \text{ Any one/Enige een} \\ (10)(0 - 2) \checkmark = -(2)(6 - v_y) \checkmark \end{array} \right\}$$

$$(10)(0 - 2) \checkmark = -(2)(6 - v_y) \checkmark$$

$$v_{yf} = -4 \text{ m} \cdot \text{s}^{-1}$$

$$v_y = 4 \text{ m} \cdot \text{s}^{-1} \checkmark \quad \text{west/wes} \checkmark$$

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

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

OPTION 5/OPSIE 5

WEST POSITIVE/WES POSITIEF:

For X/Vir X:

$$\begin{aligned} v_f &= v_i + a\Delta t & v_f^2 &= v_i^2 + 2a\Delta x & \Delta x &= \left(\frac{v_f + v_i}{2} \right) \Delta t \\ 0 &= -2 + a(0,1) & 0 &= (-2)^2 + 2(20)\Delta x & &= \left(\frac{0 + (-2)}{2} \right) (0,1) \\ a &= 20 \text{ m}\cdot\text{s}^{-2} & \Delta x &= -0,10 \text{ m} & &= -0,10 \text{ m} \end{aligned}$$

$$\begin{aligned} W_{\text{net}} &= \Delta E_k \checkmark \\ F_{\text{net}}\Delta x \cos\theta &= \frac{1}{2} m(v_f^2 - v_i^2) \\ F_{\text{net}}(0,1)\cos 180^\circ &= \frac{1}{2} (10)(0^2 - 2^2) \checkmark \end{aligned}$$

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

OPTION 6/OPSIE 6

EAST POSITIVE/OOS POSITIEF:

For Y/Vir Y:

$$\begin{aligned} v_f &= v_i + a\Delta t & v_f^2 &= v_i^2 + 2a\Delta x & \Delta x &= \left(\frac{v_f + v_i}{2} \right) \Delta t \\ 6 &= -4 + a(0,1) & (6)^2 &= (-4)^2 + 2(100)\Delta x & &= \left(\frac{6 - 4}{2} \right) (0,1) \\ a &= 100 \text{ m}\cdot\text{s}^{-2} & \Delta x &= 0,10 \text{ m} & &= 0,10 \text{ m} \end{aligned}$$

$$\begin{aligned} W_{\text{net}} &= \Delta E_k \checkmark \\ F_{\text{net}}\Delta x \cos\theta &= \frac{1}{2} m(v_f^2 - v_i^2) \\ F_{\text{net}}(0,1)\cos 0^\circ &= \frac{1}{2} (2)(6^2 - (-4)^2) \checkmark \end{aligned}$$

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

OPTION 6/OPSIE 6

WEST POSITIVE/WES POSITIEF:

For Y/Vir Y:

$$\begin{aligned} v_f &= v_i + a\Delta t & v_f^2 &= v_i^2 + 2a\Delta x & \Delta x &= \left(\frac{v_f + v_i}{2} \right) \Delta t \\ -6 &= 4 + a(0,1) & (-6)^2 &= (4)^2 + 2(-100)\Delta x & &= \left(\frac{-6 + 4}{2} \right) (0,1) \\ a &= -100 \text{ m}\cdot\text{s}^{-2} & \Delta x &= -0,10 \text{ m} & &= -0,10 \text{ m} \end{aligned}$$

$$\begin{aligned} W_{\text{net}} &= \Delta E_k \checkmark \\ F_{\text{net}}\Delta x \cos\theta &= \frac{1}{2} m(v_f^2 - v_i^2) \\ F_{\text{net}}(0,1)\cos 0^\circ &= \frac{1}{2} (2)((-6)^2 - (4)^2) \checkmark \\ F_{\text{net}} &= 200 \text{ N} \checkmark \end{aligned}$$

(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 bewegingsvergelykings gebruik word. Maks 1/3 vir korrekte antwoord.

OPTION 1/OPSIE 1

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

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

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

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

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

} ✓ Any one/Enige een

OPTION 2/OPSIE 2

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

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

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

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

} ✓ Any one/Enige een

(3)

5.3

POSITIVE MARKING FROM QUESTION 5.2.

POSITIEWE NASIEN VANAF VRAAG 5.2.

OPTION 1/OPSIE 1

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

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

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

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

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

$$f = 8,2 \text{ N} \quad \checkmark$$

} ✓ Any one/Enige een

OPTION 2/OPSIE 2

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

(4)

5.4

LEFT NEGATIVE/LINKS NEGATIEF

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

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

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

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)

6.2

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 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

OPTION 1/OPSIE 1

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR } f_L = \frac{v}{v - v_s} f_s \checkmark$$

$$f_L = \frac{v}{\lambda_L} \checkmark$$

$$= \frac{340}{0,5 - 0,05} \checkmark$$

$$= \frac{340}{0,45}$$

$$= 755,56 \text{ Hz}$$

$$755,56 = \left(\frac{340 + 0}{340 - v_s} \right) 680 \checkmark$$

$$v_s = 34 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (33,67 - 34,04)$$

OPTION 2/OPSIE 2

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR } f_L = \frac{v}{v - v_s} f_s \checkmark$$

$$\frac{v}{\lambda_L} = \left(\frac{v + 0}{v - v_s} \right) f_s$$

$$\left(\frac{340}{0,5 - 0,05} \right) = \left(\frac{340 + 0}{340 - v_s} \right) 680 \checkmark$$

$$\frac{340}{0,45} = \left(\frac{340 + 0}{340 - v_s} \right) 680$$

$$v_s = 34 \text{ m} \cdot \text{s}^{-1} \checkmark \quad (33,67 - 34,04)$$

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.

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

$$= \frac{-195 \times 10^{-6}}{-1,6 \times 10^{-19}} \checkmark$$

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

(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

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

$$= \frac{(9 \times 10^9)(195 \times 10^{-6})}{(0,5)^2} \checkmark$$

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

(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 elektrostatische kragte ✓
- Final answer/Finale antwoord: $1,11 \times 10^{-7} \text{ C}$ ✓ ($1,106 \times 10^{-7} \text{ C}$)

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

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

$$1,38 = \left(+ \frac{(9 \times 10^9)(195 \times 10^{-6})q_2}{(0,03)^2} \right) + \left(- \frac{(9 \times 10^9)(195 \times 10^{-6})q_2}{(0,05)^2} \right) \checkmark$$

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

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: $1,11 \times 10^{-7} \text{ C}$ ✓ ($1,106 \times 10^{-7} \text{ C}$)

$$E = \frac{F}{q} = \frac{1,38}{195 \times 10^{-6}}$$

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

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

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

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

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

(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

$$P = I^2 R \checkmark$$

$$5,76 = (1,2^2) R \checkmark$$

$$R = 4 \Omega \checkmark$$

OPTION 2/OPSIE 2

$$P = VI$$

$$5,76 = V(1,2)$$

$$V = 4,8 \text{ V}$$

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

$$5,76 = \frac{(4,8)^2}{R} \checkmark$$

$$R = 4 \Omega \checkmark$$

$$V = IR \checkmark$$

$$4,8 = (1,2) R \checkmark$$

$$R = 4 \Omega \checkmark$$

(3)

8.4 POSITIVE MARKING FROM QUESTION 8.3

POSITIEWE NASIEN VANAF VRAAG 8.3

OPTION 1/OPSIE 1

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{8,4} \checkmark$$

$$R_p = 3,5 \Omega$$

$$R_T = 3,5 + 4 \checkmark$$

$$= 7,5 \Omega \checkmark$$

OPTION 2/OPSIE 2

$$R_p = \frac{R_1 R_2}{R_1 + R_2}$$

$$R_p = \frac{(6)(8,4)}{6 + 8,4} \checkmark$$

$$R_p = 3,5 \Omega$$

$$R_T = 3,5 + 4 \checkmark$$

$$= 7,5 \Omega \checkmark$$

(3)

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

CALCULATE V_p/BEREKEN V_p Marking criteria/Nasienkriteria	CALCULATE V_2/BEREKEN V_2 Marking criteria/Nasienkriteria
- Formula/Formule: $V = IR$ ✓ - Substitution to calculate V_p / Vervanging om V_p te bereken. ✓	- Substitution to calculate I_{branch} or ratio of R_{branch} /Vervanging om I_{tak} of verhouding van R_{tak} te bereken. ✓ - Substitution to calculate V_2 / Vervanging om V_2 te bereken. ✓ - Final Answer/Finale antwoord: 3 V ✓
OPTION 1/OPSIE 1 $V_p = IR$ $= (1,2)(3,5)$ ✓ $= 4,2 \text{ V}$	$I = \frac{V}{R}$ $= \frac{4,2}{8,4}$ ✓ $= 0,5 \text{ A}$ $V_2 = IR$ ✓ $= (0,5)(6)$ ✓ $= 3 \text{ V}$ ✓ OR/OF $R_{2,4} : R_6 = 2,4 : 6$ ✓ $= 2 : 5$ $V_{2,4} : V_6 = 1,2 : 3$ ✓✓ $V_2 = 3 \text{ V}$ ✓
OPTION 2/OPSIE 2 $P_x = VI$ $5,76 = V(1,2)$ $V_x = 4,8 \text{ V}$ $I_{6\Omega} = \frac{8,4}{14,4} \times 1,2$ $= 0,7 \text{ A}$ $V_{6\Omega} = IR$ ✓ $= (0,7)(6)$ ✓ $= 4,2 \text{ V}$	
OPTION 3/OPSIE 3 $\mathcal{E} = I(R + r)$ $12 = 1,2(7,5 + r)$ $r = 2,5 \Omega$ $V_p = 12 - 1,2(2,5 + 4)$ ✓ = 4,2 V	
CALCULATION OF $I_{8,4\Omega}$ AND V_2/BEREKENING VAN $I_{8,4\Omega}$ EN V_2 OPTION 4/OPSIE 4 $I_{8,4\Omega} = \left(\frac{6}{14,4}\right)(1,2)$ OR/OF $\left(\frac{3,5}{8,4}\right)(1,2)$ $= 0,5 \text{ A}$ ✓✓ $V_2 = IR$ ✓ $= (0,5)(6)$ ✓ $= 3 \text{ V}$ ✓	
OPTION 5/OPSIE 5 $V_x = IR$ $= (1,2)(4)$ $= 4,8 \text{ V}$ $V_{\text{ext}} = IR_{\text{ext}}$ $= (1,2)(7,5)$ $= 9 \text{ V}$ $V_p = 9 - 4,8$ ✓ = 4,2 V $V_{8,4\Omega} = IR$ $4,2 = I(8,4)$ ✓ $I = 0,5 \text{ A}$ $V_2 = IR$ ✓ $= (0,5)(6)$ ✓ $= 3 \text{ V}$ ✓	

(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

OPTION 1/OPSIE 1

$$V_{\text{rms/wgk}} = \frac{V_{\text{max/maks}}}{\sqrt{2}}$$

$$= \frac{100}{\sqrt{2}} \checkmark$$

$$= 70,71 \text{ V}$$

$$I_{\text{rms/wgk}} = \frac{V_{\text{rms/wgk}}}{R} \checkmark$$

$$= \frac{70,71}{25} \checkmark$$

$$= 2,83 \text{ A} \checkmark$$

ACCEPT/AANVAAR

If subscripts omitted in $V = IR$

Indien onderskrifte uitgelaat is in $V = IR$

OPTION 2/OPSIE 2

$$I_{\text{max/maks}} = \frac{V_{\text{max/maks}}}{R}$$

$$= \frac{100}{25} \checkmark$$

$$= 4 \text{ A}$$

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

$$= \frac{4}{\sqrt{2}} \checkmark$$

$$= 2,83 \text{ A} \checkmark$$

OPTION 3/OPSIE 3

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

$$= \frac{100^2}{25} \checkmark = 200 \text{ W}$$

$$P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$$

$$200 = \left(\frac{100}{\sqrt{2}} \right) I_{\text{rms}} \checkmark$$

$$I_{\text{rms}} = 2,83 \text{ A} \checkmark$$

(4)

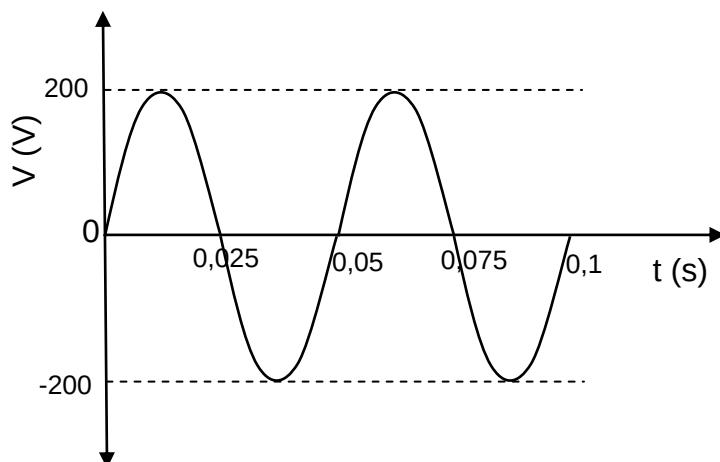
9.5

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

OPTION 1/OPSIE 1 $P_{\text{ave/gem}} = \frac{V_{\text{rms/wgk}}^2}{R} \checkmark$ $= \frac{70,71^2}{25} \checkmark$ $= 200,00 \text{ W } \checkmark (200 \text{ W})$	OPTION 2/OPSIE 2 $P_{\text{ave}} = V_{\text{rms}} I_{\text{rms}} \checkmark$ $= (70,71)(2,83) \checkmark$ $= 200,11 \text{ W } \checkmark$	OPTION 3/OPSIE 3 $P_{\text{ave/gem}} = I_{\text{rms/wgk}}^2 R \checkmark$ $= (2,83)^2 (25) \checkmark$ $= 200,22 \text{ W } \checkmark$
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 $\checkmark$
2 golwe
- Period of wave is 0,05 s $\checkmark$
Periode van golf is 0,05 s
- Amplitude = 200 V $\checkmark$

(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**
 $m = \frac{1}{h} \checkmark$
 $\frac{f_x - 10,4 \times 10^{14} \checkmark}{23,01 \times 10^{-19} - 0 \checkmark} = \frac{1}{6,63 \times 10^{-34} \checkmark}$
 $f_x = 4,51 \times 10^{15} \text{ (Hz)} \checkmark (45,1 \times 10^{14} \text{ Hz})$
- OPTION 3/OPSIE 3**
 $E = W_o + E_{k(max)} \checkmark$
 $hf = hf_o + E_{k(max)}$
 $6,63 \times 10^{-34} f_x \checkmark = (6,63 \times 10^{-34})(10,40 \times 10^{14}) \checkmark + 23,01 \times 10^{-19} \checkmark$
 $f_x = 4,51 \times 10^{15} \text{ (Hz)} \checkmark (45,1 \times 10^{14} \text{ Hz})$ (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