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]

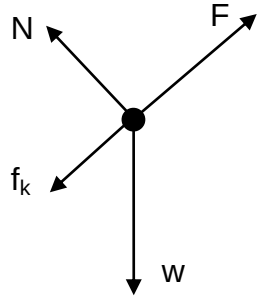
QUESTION 2/*VRAAG 2*

2.1

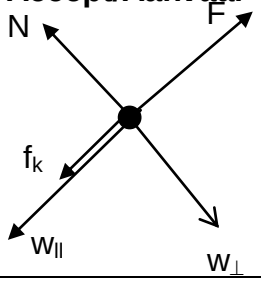
Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark. /*Indien enige van die onderstreepte sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.*

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)

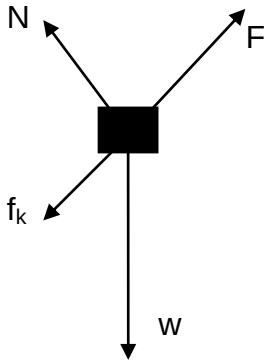
2.2



Accept/Aan*vaar*



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*

$F_{net} = ma$
$F + f_k + w_{||} = ma$
$F + (-f_k) + (-w_{||}) = ma$
$F - (f_k + w_{||}) = ma$
✓Any one/*Enige een*

$F - [18 + (20)(9,8)(\sin 30^o)]$ ✓ $= 0$ ✓
$F = 116$ N ✓

NOTE/*LET WEL*
$F_{net} = 0$ ✓✓
$F = f_k + w_{||}$ ✓✓

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

$W_{net} = \Delta E_k$ ✓
$F\Delta x\cos 0^o + f\Delta x\cos 180^o + w\Delta x\cos 120^o$ ✓$= 0$ ✓
$F\Delta x = 18\Delta x + (20)(9,8)\Delta x(0,5)$
$F = 116$ N ✓

NOTE/*LET WEL*
$W_{net} = 0$ ✓✓
$F\Delta x = f\Delta x + w\Delta x(0,5)$ ✓✓

(4)

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

116 N / $f + w_{||}$ ✓ 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

OPTION 1/*OPSIE 1*
Up the incline positive/*Teen skuinsvlak op positief*

$F_{net} = ma$
$-116 = 20a$ ✓
$a = -5,80$ m·s^{-2}

$v_f^2 = v_i^2 + 2a\Delta x$ ✓ $0 = (2)^2 + (2)(-5,8)\Delta x$✓ $\Delta x = 0,34$ m ✓	$v_f = v_i + \Delta t$ $0 = 2 + (-5,8)\Delta t$ $\Delta t = 0,34$ s **OR/*OF*** $F_{net}\Delta t = m(v_f - v_i)$ $(-116)\Delta t = (20)(0 - 2)$ $\Delta t = 0,34$ s $\Delta x = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= (2)(0,34) + \frac{1}{2}(-5,8)(0,34)^2$✓ $= 0,34$ m ✓	$v_f = v_i + \Delta t$ $0 = 2 + (-5,8)\Delta t$ $\Delta t = 0,34$ s **OR/*OF*** $F_{net}\Delta t = m(v_f - v_i)$ $(-116)\Delta t = (20)(0 - 2)$ $\Delta t = 0,34$ s $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\frac{2 + 0}{2}\right)0,34$ ✓ $= 0,34$ m ✓

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

$F_{net} = ma$
$116 = 20a$ ✓
$a = 5{,}80\ m\cdot s^{-2}$

$v_f^2 = v_i^2 + 2a\Delta x$ ✓ $0 = (-2)^2 + (2)(5{,}8)\Delta x$ ✓ $\Delta x = -0{,}34$ m Distance = 0,34 m ✓ *Afstand*	$v_f = v_i + a\Delta t$ $0 = -2 + (5{,}8)\Delta t$ $\Delta t = 0{,}34$ s **OR/*OF*** $F_{net}\Delta t = m(v_f - v_i)$ $(116)\Delta t = (20)(0 - (-2))$ $\Delta t = 0{,}34$ s $\Delta x = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= (-2)(0{,}34) + \frac{1}{2}(5{,}8)(0{,}34)^2$ ✓ $= -0{,}34$ m ✓ Distance/*Afstand* = 0,34 m ✓	$v_f = v_i + a\Delta t$ $0 = -2 + (5{,}8)\Delta t$ $\Delta t = 0{,}34$ s **OR/*OF*** $F_{net}\Delta t = m(v_f - v_i)$ $(116)\Delta t = (20)(0-(-2))$ $\Delta t = 0{,}34$ s $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $= \left(\frac{-2 + 0}{2}\right)0{,}34$ ✓ $= -0{,}34$ m ✓ Distance/*Afstand* = 0,34 m ✓

OPTION 2/*OPSIE 2*
$W_{net} = \Delta E_K$
$F_{net}\Delta x\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$ ✓Any one/*Enige een*
$(116)\Delta x\cos 180^o$ ✓$= \frac{1}{2}(20)(0^2 - 2^2)$ ✓
$\Delta x = 0{,}34$ m ✓

OPTION 3/*OPSIE 3*
$W_{net} = \Delta E_K$
$W_f + W_{wll} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$f\Delta x\cos\theta + (mg\sin 30^o)\Delta x\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$ ✓Any one/*Enige een*
$(18)\Delta x\cos 180^o + (20)(9{,}8)\sin 30^o\Delta x\cos 180^o$✓$= \frac{1}{2}(20)(0^2 - 2^2)$ ✓
$\Delta x = 0{,}34$ m ✓

OPTION 4/*OPSIE 4*
$W_{net} = \Delta E_K$
$W_f + W_w = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$f\Delta x\cos\theta + mg\Delta x\cos 120° = \frac{1}{2}m(v_f^2 - v_i^2)$ ✓Any one/*Enige een*
$(18)\Delta x\cos 180^o + (20)(9{,}8)\Delta x\cos 120^o$✓$= \frac{1}{2}(20)(0^2 - 2^2)$ ✓
$\Delta x = 0{,}34$ m ✓

OPTION 5/*OPSIE 5*
$W_{nc} = \Delta E_p + \Delta E_k$
$f\Delta x\cos\theta = mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_i^2)$ ✓Any one/*Enige een*
$18\Delta x\cos 180^o$✓ $= 20(9{,}8)\Delta x + \frac{1}{2}(20)(0^2 - 2^2)$ ✓
$-18\Delta x = 196\Delta x\sin 30^o - 40$
$\Delta x = 0{,}34$ m ✓

(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 $m \cdot s^{-2}$/is zero.
  Sy versnelling is nie 9,8 $m \cdot s^{-2}$/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*	**DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$\underline{(-62,68)^2 = v_i^2 + 2(-9,8)(-200)}$ ✓	$\underline{(62,68)^2 = v_i^2 + 2(9,8)(200)}$ ✓
$v_i = 2,96\ m \cdot s^{-1}$ ✓	$v_i = -2,96\ m \cdot s^{-1}$ $= 2,96\ m \cdot s^{-1}$ ✓

OPTION 2/*OPSIE 2*

$(E_{mech/meg})_{200\ m} = (E_{mech/meg})_{bottom/onder}$
$(E_P + E_K)_{200\ m} = (E_P + E_K)_{bottom/onder}$
$(mgh + ½\ mv^2)_{200\ m} = (mgh + ½\ mv^2)_{bottom/onder}$
} ✓Any one/*Enige een*

$\underline{m(9,8)(200) + ½m(v^2) = 0 + ½m(62,68)^2}$ ✓
$v_i = 2,96\ m \cdot s^{-1}$ ✓

NOTE/*LET WEL*
Mass may be omitted during substitution.
Massa mag uitgelaat word tydens vervanging.

OPTION 3/*OPSIE 3*

$W_{nc} = \Delta E_p + \Delta E_k$
$0 = mg(h_f - h_i) + ½m(v_f^2 - v_i^2)$
} ✓Any one/*Enige een*

$\underline{0 = m(9,8)(0 - 200) + ½m(62,68^2 - v_i^2)}$ ✓
$v_i = 2,96\ m \cdot s^{-1}$ ✓

NOTE/*LET WEL*
Mass may be omitted during substitution.
Massa mag uitgelaat word tydens vervanging.

OPTION 4/*OPSIE 4*

$W_{net} = \Delta E_k$
$F_{net}\Delta x\cos\theta = ½m(v_f^2 - v_i^2)$
$mg\Delta x\cos\theta = ½m(v_f^2 - v_i^2)$
} ✓Any one/*Enige een*

$\underline{m(9,8)(200) = + ½m(62,68^2 - v_i^2)}$ ✓
$v_i = 2,96\ m \cdot s^{-1}$ ✓

NOTE/*LET WEL*
Mass may be omitted during substitution.
Massa mag uitgelaat word tydens vervanging. (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** ✓
  *Formule om Δt van klip **A** te bereken*
- Substitution to calculate Δt of stone **A** ✓
  *Vervanging om Δt van klip **A** te bereken*
- 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***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$-62,68 = 2,96 + (-9,8)\Delta t$ ✓	$62,68 = -2,96 + 9,8\Delta t$ ✓
$\Delta t = 6,70$ s ✓ (6,698)	$\Delta t = 6,70$ s ✓ (6,698)
OPTION 2/*OPSIE 2*	
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + ½ a\Delta t^2$ ✓
$-200 = (2,96)\Delta t + ½ (-9,8)\Delta t^2$ ✓	$200 = (-2,96)\ \Delta t + ½ (9,8)\Delta t^2$ ✓
$\Delta t = 6,70$ s ✓ (6,697)	$\Delta t = 6,70$ s ✓ (6,697)
OPTION 3/*OPSIE 3*	
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓	$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$-200 = \left(\frac{+2,96 + (-62,68)}{2}\right)\Delta t$ ✓	$200 = \left(\frac{-2,96 + 62,68}{2}\right)\Delta t$ ✓
$\Delta t = 6,70$ s ✓ (6,698)	$\Delta t = 6,70$ s ✓ (6,698)
OPTION 4/*OPSIE 4*	
UPWARDS AS POSITIVE/ ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE/** ***AFWAARTS AS POSITIEF***
From 200 m upwards:	From 200 m upwards:
Vanaf 200 m opwaarts:	*Vanaf 200 m opwaarts*:
$v_f = v_i + a\Delta t$ ✓	$v = v_i + a\Delta t$ ✓
$0 = 2,96 + (-9,8)\Delta t$ ✓	$0 = -2,96 + (9,8)\Delta t$ ✓
$\Delta t = 0,3$ s (0,302)	$\Delta t = 0,3$ s (0,302)
From max h downwards:	From max h downwards:
Vanaf maks h afwaarts:	*Vanaf maks h afwaarts*:
$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$
$-62,68 = 0 + (-9,8)\Delta t$	$62,68 = 0 + (9,8)\Delta t$
$\Delta t = 6,40$ s (6,369)	$\Delta t = 6,40$ s (6,369)
$t_A = 0,3 + 6,40 = 6,7$ s ✓	$t_A = 0,3 + 6,40 = 6,7$ s ✓

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

(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 s ✓ (t_A – 5)
  Vervanging van t = 1,7 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*	**DOWNWARDS AS POSITIVE/ *AFWAARTS AS POSITIEF***
Stone B/*Klip B*:	**Stone B/*Klip B*:**
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= \underline{2,96(6,7 - 5) + \frac{1}{2}(-9,8)(6,7 - 5)^2}$ ✓ = -9,13 m (-9,09 to/*tot* -9,13) Distance travelled by stone **B**: 9,13 m *Afstand afgelê deur klip **B**: 9,13 m*	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= \underline{-2,96(6,7 - 5) + \frac{1}{2}(9,8)(6,7 - 5)^2}$ ✓ = 9,13 m (9,09 to/tot 9,13) Distance travelled by stone **B**: 9,13 m *Afstand afgelê deur klip **B**: 9,13 m*
Hot-air balloon/*Lugballon*	**Hot-air balloon/*Lugballon***
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ $= \underline{2,96(6,7 - 5)}$ ✓ + 0 = 5,03 m Distance travelled by hot-air balloon/ *Afstand afgelê deur lugballon:* 5,03 m	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ $= \underline{-2,96(6,7 - 5)}$ ✓ + 0 = -5,03 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*** = $\underline{9,13 + 5,03}$ ✓ = 14,16 m ✓ (14,11 - 14,16)	Distance between hot-air balloon and stone **B**/*Afstand tussen lugballon en klip **B*** = $\underline{9,13 + 5,03}$ ✓ = 14,16 m ✓ (14,11 - 14,16)

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OPTION 2/*OPSIE 2*
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
Stone B/*Klip B*:
$v_f = v_i + a\Delta t$
$= 2,96 + (-9,8)(6,70 \overset{\checkmark}{-} 5)$
$= -13,7\ m\cdot s^{-1}$
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$(-13,7)^2 = (2,96)^2 + 2(-9,8)\Delta y$ ✓
$\Delta y = -9,13$ m
Distance travelled by stone **B:** 9,13 m
*Afstand afgelê deur klip **B:** 9,13 m*

Hot-air balloon/*Lugballon*
$\Delta y = v_i\Delta t + ½\ a\Delta t^2$
$= -2,96(6,70 - 5) + 0$ ✓
$= -5,03$ m
Distance travelled by hot-air balloon/
Afstand afgelê deur lugballon: 5,03 m

Distance between hot-air balloon and stone **B**/*Afstand afgelê deur lugballon en klip **B*** = 9,13+ 5,03 ✓
= 14,16 m ✓ (14,11 - 14,16)

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DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
Stone B/*Klip B*:
$v_f = v_i + a\Delta t$
$= -2,96 + (9,8)(6,70 \overset{\checkmark}{-} 5)$
$= 13,7\ m\cdot s^{-1}$
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$(13,7)^2 = (-2,96)^2 + 2(9,8)\Delta y$ ✓
$\Delta y = 9,13$ m
Distance travelled by stone **B:** 9,13 m
*Afstand afgelê deur klip **B:** 9,13 m*

Hot-air balloon/*Lugballon*
$\Delta y = v_i\Delta t + ½\ a\Delta t^2$
$= -2,96(6,70 - 5) + 0$ ✓
$= -5,03$ m
Distance travelled by hot-air balloon/
Afstand afgelê deur lugballon: 5,03 m

Distance between hot-air balloon and stone **B**/*Afstand afgelê deur lugballon en klip **B*** = 9,13+ 5,03 ✓
= 14,16 m ✓ (14,11 - 14,16)

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OPTION 3/*OPSIE 3*
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
Stone B/*Klip B*:
$v_f = v_i + a\Delta t$
$= 2,96 + (-9,8)(6,70 \overset{\checkmark}{-} 5)$
$= -13,7\ m\cdot s^{-1}$
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$= \left(\frac{+2,96 + (-13,7)}{2}\right)(6,70 - 5)$ ✓
$= -9,13$ m
Distance travelled by stone **B:** 9,13 m
*Afstand afgelê deur klip **B:** 9,13 m*

Hot-air balloon/*Lugballon*
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= 2,96(6,70 - 5) + 0$ ✓
$= 5,03$ m
Distance travelled by hot-air balloon/
Afstand afgelê deur lugballon: 5,03 m

Distance between hot-air balloon and stone **B**/*Afstand afgelê deur lugballon en klip **B*** = 9,13 + 5,03 ✓
= 14,16 m ✓ (14,11 - 14,16)

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DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
Stone B/*Klip B*:
$v_f = v_i + a\Delta t$
$= -2,96 + (9,8)(6,70 \overset{\checkmark}{-} 5)$
$= 13,7\ m\cdot s^{-1}$
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$= \left(\frac{-2,96 + (13,7)}{2}\right)(6,70 - 5)$ ✓
$= 9,13$ m
Distance travelled by stone **B:** 9,13 m
*Afstand afgelê deur klip **B:** 9,13 m*

Hot-air balloon/*Lugballon*
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= -2,96(6,70 - 5) + 0$ ✓
$= -5,03$ m
Distance travelled by hot-air balloon/
Afstand afgelê deur lugballon: 5,03 m

Distance between hot-air balloon and stone **B**/*Afstand afgelê deur lugballon en klip **B*** = 9,13+ 5,03 ✓
= 14,16 m ✓ (14,11 - 14,16)

</td>
</tr>
</table>

OPTION 4/*OPSIE 4*	
UPWARDS POSITIVE/ *OPWAARTS POSITIEF*:	**DOWNWARDS POSITIVE/ *AFWAARTS POSITIEF:***
Stone B/*Klip B*:	**Stone B/*Klip B*:**
$v_f = v_i + a\Delta t$ $= 2,96 + (-9,8)(6,70 - 5)$ ✓ $= -13,7\ m\cdot s^{-1}$	$v_f = v_i + a\Delta t$ $= -2,96 + (9,8)(6,70 - 5)$ ✓ $= 13,7\ m\cdot s^{-1}$
Balloon's height after 5 s: 214,8 m *Ballon se hoogte na 5 s: 214,8 m*	Balloon's height after 5 s: 214,8 m *Ballon se hoogte na 5 s: 214,8 m*
$E_{mech/meg})_{214,8\ m} = (E_{mech/meg})_{1,7\ s}$ $(E_P + E_K)_{214,8\ m} = (E_P + E_K)_{1,7\ s}$ ✓ $(mgh + ½\ mv^2) = (mgh + ½\ mv^2)_{1,7s}$ $\underline{(9,8)(214,9) + ½(2,96)^2} =$ $\underline{(9,8)h + ½(13,7)^2}$ ✓ $\therefore h = 205,67\ m$	$(E_{mech/meg})_{214,8\ m} = (E_{mech/meg})_{1,7\ s}$ $(E_P + E_K)_{214,8\ m} = (E_P + E_K)_{1,7\ s}$ ✓ $(mgh + ½\ mv^2) = (mgh + ½\ mv^2)_{1,7s}$ $\underline{(9,8)(214,8) + ½(2,96)^2} =$ $\underline{(9,8)h + ½(13,7)^2}$ ✓ $\therefore h = 205,67\ m$
Distance travelled by stone **B/** *Afstand afgelê deur klip **B**:* 214,8 – 205,67 = 9,13 m	Distance travelled by stone **B/** *Afstand afgelê deur klip **B**:* 214,8 – 205,67 = 9,13 m
Hot-air balloon/*Lugballon*	**Hot-air balloon/*Lugballon***
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= \underline{2,96(6,70 - 5)}$ ✓ + 0 $= 5,03\ m$	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $= \underline{-2,96(6,70 - 5)}$ ✓ + 0 $= -5,03\ m$
Distance travelled by hot-air balloon/ *Afstand afgelê deur lugballon:* 5,03 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***: $\underline{9,13 + 5,03}$ ✓ = 14,16 m ✓ (14,11 to/*tot* 14,16)	Distance between hot-air balloon and stone **B**/*Afstand tussen lugballon en klip **B***: 9,13 + 5,03 ✓ = 14,16 m ✓ (14,11 to/*tot* 14,16)

<table>
<tr>
<td><u>OPTION 5/OPSIE 5</u>
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
<u>Stone B/Klip B:</u>
$v_f = v_i + a\Delta t$
$= 2,96 + (-9,8)(6,70 \overset{\checkmark}{-} 5)$
$= -13,7\ m\cdot s^{-1}$
$W_{net} = \Delta E_K$ ✓
$F_{net}\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$= \frac{1}{2}m(v_f^2 - v_i^2)$
$(9,8)\Delta h\cos 0° = \underline{\frac{1}{2}(13,7^2 - 2,96^2)}$ ✓
$\Delta h = 9,13$ m

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

<u>Hot-air balloon/Lugballon</u>
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= \underline{2,96(6,70 - 5)}$ ✓ + 0
$= 5,03$ 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: $\underline{9,13 + 5,03}$ ✓ = 14,16 m ✓
(14,11 to/tot 14,16)</td>
<td><u>DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF</u>
<u>Stone B/Klip B</u>:
$v_f = v_i + a\Delta t$
$= -2,96 + (9,8)(6,70 \overset{\checkmark}{-} 5)$
$= 13,7\ m\cdot s^{-1}$
$W_{net} = \Delta E_K$ ✓
$F_{net}\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$= \frac{1}{2}m(v_f^2 - v_i^2)$
$(9,8)\Delta h\cos 0° = \underline{\frac{1}{2}(13,7^2 - 2,96^2)}$ ✓
$\Delta h = 9,13$ m

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

<u>Hot-air balloon/Lugballon</u>
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= \underline{-2,96(6,70 - 5)}$ ✓ + 0
$= -5,03$ m
Distance travelled by hot-air balloon/
Afstand afgelê deur lugballon: 5,03 m

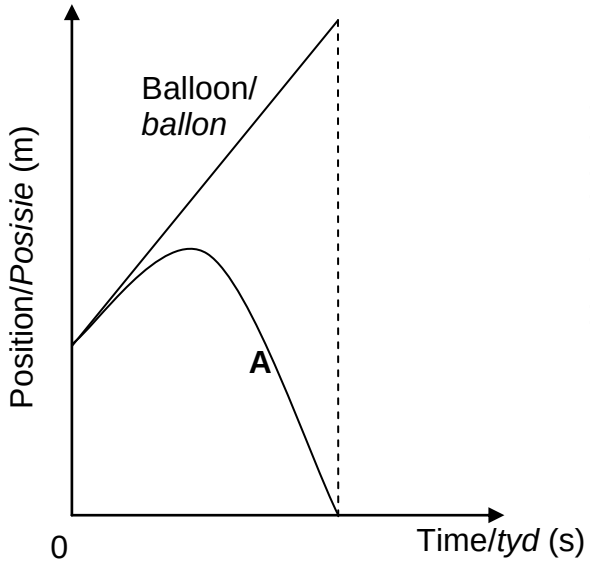
Distance between hot-air balloon and stone B/Afstand tussen lugballon en klip B: 9,13+ 5,03 ✓ = 14,16 m ✓
(14,11 to/tot 14,16)</td>
</tr>
<tr>
<td colspan="2"><u>OPTION 6/OPSIE 6</u>
Using relative velocities/Deur relatiewe snelhede te gebruik:</td>
</tr>
<tr>
<td>UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= (\overset{\checkmark}{2,96} - \overset{\checkmark}{2,96})(1,7) + \frac{1}{2}(-9,8)(\overset{\checkmark}{1,7})^2$
$= -14,16$ m
Distance between hot-air balloon and stone B/Afstand tussen lugballon en klip B: 14,16 m ✓</td>
<td>DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= (\overset{\checkmark}{2,96} - \overset{\checkmark}{2,96})(1,7) + \frac{1}{2}(9,8)(\overset{\checkmark}{1,7})^2$
$= 14,16$ m ✓</td>
</tr>
</table>

OPTION 7/*OPSIE 7*
UPWARDS AS POSITIVE/
OPWAARTS AS POSITIEF
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$= \underline{(2,96)(1,7) + \frac{1}{2}(-9,8)(1,7)^2}$ ✓ ✓
$= -9,13$ m
Distance travelled by stone **B:** 9,13 m
*Afstand afgelê deur klip **B:** 9,13 m*

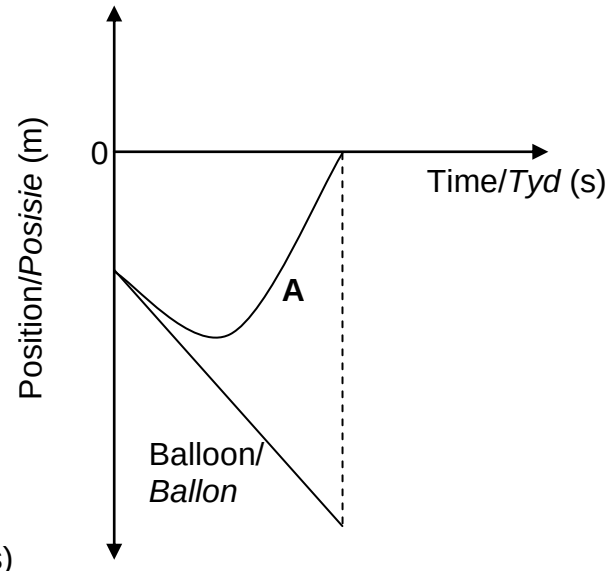
DOWNWARDS AS POSITIVE/
AFWAARTS AS POSITIEF
$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$= \underline{(-2,96)(1,7) + \frac{1}{2}(9,8)(1,7)^2}$ ✓ ✓
$= 9,13$ m

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 ✓
$v_y = \pm 4\ m\cdot s^{-1}$
$v_y = 4\ m\cdot s^{-1}$ ✓ west/*wes* ✓ **ACCEPT/*AANVAAR:*** left/*links*

OPTION 2/*OPSIE 2*

$E_{Ki} = \frac{1}{2}\ m_Yv_f^2$
$36 = \frac{1}{2}\ (2)\ v_f^2$
$v_f = 6\ m\cdot s^{-1}$

$\sum p_i = \sum p_f$
$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$
$m_xv_{xi} + m_yv_{yi} = m_Xv_{xf} + m_yv_{yf}$
✓Any one/*Enige een*

(10)(2) + (2)v_y ✓ = 0 + (2)(6) ✓
$v_y = -4\ m\cdot s^{-1}$
$v_y = 4\ m\cdot s^{-1}$ ✓ west/*wes*✓ **ACCEPT/*AANVAAR***: left/*links*

OPTION 3/*OPSIE 3*

$E_{Ki} = \frac{1}{2}\ m_Yv_f^2$
$36 = \frac{1}{2}\ (2)\ v_f^2$
$v_f = 6\ m\cdot s^{-1}$

$\Delta p_X = -\Delta p_Y$
$m_x(v_{Xf} - v_{Xi}) = -\ m_Y(v_{Yf} - v_{Yi})$
✓Any one/*Enige een*

(10)(0 – 2)✓ = -(2)(6 – v_Y) ✓
$v_{Yf} = -4\ m\cdot s^{-1}$
$v_y = 4\ m\cdot s^{-1}$ ✓ 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

<table>
<tr>
<td><u>OPTION 1/OPSIE 1</u>
EAST POSITIVE/OOS POSITIEF:
For Y/Vir Y:
$F_{net}\Delta t = \Delta p$ } ✓Any one/
$F_{net}\Delta t = m(v_f - v_i)$ } Enige een
$\underline{F_{net}\ (0,1) = 2\{6 - (-4)\}}$ ✓
$F_{net} = 200$ N ✓</td>
<td>WEST POSITIVE/WES POSITIEF:
For Y/Vir Y:
$F_{net}\Delta t = \Delta p$ } ✓Any one/
$F_{net}\Delta t = m(v_f - v_i)$ } Enige een
$\underline{F_{net}\ (0,1) = 2(-6 - 4)}$ ✓
$F_{net} = -200$ N
$F_{net} = 200$ N ✓</td>
</tr>
<tr>
<td><u>OPTION 2/OPSIE 2</u>
EAST POSITIVE/OOS POSITIEF:
For X/Vir X:
$F_{net}\Delta t = \Delta p$ } ✓Any one/
$F_{net}\Delta t = m(v_f - v_i)$ } Enige een
$\underline{F_{net}\ (0,1) = 10(0 - 2)}$ ✓
$F_{net} = -200$ N
$F_{net} = 200$ N ✓</td>
<td>WEST POSITIVE/WES POSITIEF
For X/Vir X:
$F_{net}\Delta t = \Delta p$ } ✓Any one/
$F_{net}\Delta t = m(v_f - v_i)$ } Enige een
$\underline{F_{net}\ (0,1) = 10\{0 - (-2)\}}$ ✓
$F_{net} = 200$ N ✓</td>
</tr>
<tr>
<td><u>OPTION 3/OPSIE 3</u>
EAST POSITIVE/OOS POSITIEF:
For Y/Vir Y:
$v_f = v_i + a\Delta t$
$6 = -4 + a(0,1)$
$a = 100\ m\cdot s^{-2}$
$F_{net} = ma$ ✓
$= \underline{2(100)}$ ✓
$= 200$ N ✓</td>
<td>WEST POSITIVE/WES POSITIEF
For Y/Vir Y:
$v_f = v_i + a\Delta t$
$-6 = 4 + a(0,1)$
$a = -100\ m\cdot s^{-2}$
$F_{net} = ma$ ✓
$= \underline{2(-100)}$ ✓
$= -200$ N
$F_{net} = 200$ N ✓</td>
</tr>
<tr>
<td><u>OPTION 4/OPSIE 4</u>
EAST POSITIVE/OOS POSITIEF:
For X/Vir X:
$v_f = v_i + a\Delta t$
$0 = 2 + a(0,1)$
$a = -20\ m\cdot s^{-2}$
$F_{net} = ma$ ✓
$= \underline{10(-20)}$ ✓
$= -200$ N
$F_{net} = 200$ N ✓</td>
<td>WEST POSITIVE/WES POSITIEF
For X/Vir X:
$v_f = v_i + a\Delta t$
$0 = -2 + a(0,1)$
$a = 20\ m\cdot s^{-2}$
$F_{net} = ma$ ✓
$= \underline{10(20)}$ ✓
$F_{net} = 200$ N ✓</td>
</tr>
<tr>
<td colspan="2"><u>OPTION 5/OPSIE 5</u>
EAST POSITIVE/OOS POSITIEF:
For X/Vir X:
$v_f = v_i + a\Delta t$ $\quad v_f^2 = v_i^2 + 2a\Delta x$ $\quad \Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$
$0 = 2 + a(0,1)$ $\quad 0 = (2)^2 + 2(-20)\Delta x$ $\quad = \left(\frac{0+2}{2}\right)(0,1)$
$a = -20\ m\cdot s^{-2}$ $\quad \Delta x = 0,10$ m $\quad = 0,10$ m
$W_{net} = \Delta E_k$ ✓
$F_{net}\Delta x\cos\theta = ½\ m(v_f^2 - v_i^2)$
$\underline{F_{net}(0,1)\cos 180^o = ½\ (10)(0^2 - 2^2)}$ ✓
$F_{net} = 200$ N ✓</td>
</tr>
</table>

OPTION 5/*OPSIE 5*
WEST POSITIVE/*WES POSITIEF*:
For **X**/*Vir **X**:*

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

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

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

$W_{net} = \Delta E_k$ ✓
$F_{net}\Delta x\cos\theta = ½\ m(v_f^2 - v_i^2)$
$F_{net}(0,1)\cos180° = ½\ (10)(0^2 - 2^2)$ ✓
$F_{net} = 200\ N$ ✓

OPTION 6/*OPSIE 6*
EAST POSITIVE/*OOS POSITIEF*:
For **Y**/*Vir **Y**:*

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

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

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

$W_{net} = \Delta E_k$ ✓
$F_{net}\Delta x\cos\theta = ½\ m(v_f^2 - v_i^2)$
$F_{net}(0,1)\cos0° = ½\ (2)(6^2 - (-4)^2)$ ✓
$F_{net} = 200\ N$ ✓

OPTION 6/*OPSIE 6*
WEST POSITIVE/*WES POSITIEF*:
For **Y**/*Vir **Y**:*

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

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

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

$W_{net} = \Delta E_k$ ✓
$F_{net}\Delta x\cos\theta = ½\ m(v_f^2 - v_i^2)$
$F_{net}(0,1)\cos0° = ½\ (2)((-6)^2 - (4)^2)$ ✓
$F_{net} = 200\ N$ ✓

(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/*OPSIE1*
$E_{P/mech\ top/meg\ bo} = E_{Q/mech\ ground\ /meg\ grond}$
$(E_p + E_k)_{P/top/bo} = (E_p + E_k)_{Q/bottom/onder}$
$(mgh + ½mv^2)_{P/top/bo} = (mgh + ½mv^2)_{Q/bottom/onder}$
✓Any one/*Enige een*
$(2)(9,8)(5) + 0 = 0 + ½(2)v_f^2$ ✓
$v_f = 9,90\ m\cdot s^{-1}$ ✓ (9,899)

OPTION 2/*OPSIE2*
$\Delta E_p + \Delta E_K = 0$
$(mgh_f - mgh_i) + ½m(v_f^2 - v_i^2) = 0$
✓Any one/*Enige een*
$0 - (2)(9,8)(5) + ½(2)(v_f^2 - 0)$ ✓ = 0
$v_f = 9,90\ m\cdot s^{-1}$ ✓ (9,899) (3)

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

OPTION 1/*OPSIE 1*
$W_{net} = \Delta E_K$
$W_f = ½mv_f^2 - ½mv_i^2$
$W_N + W_f + W_w = ½mv_f^2 - ½mv_i^2$
$f\Delta x\cos\theta = ½m(v_f^2 - v_i^2)$
✓Any one/*Enige een*
$f(10)\cos 180°$ ✓$= ½(2)(4^2 - 9,90^2)$ ✓
$f = 8,2$ N ✓

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta E_K + \Delta E_p$
$W_f = ½mv_f^2 - ½mv_i^2$
$W_N + W_f = ½mv_f^2 - ½mv_i^2$
$f\Delta x\cos\theta = ½m(v_f^2 - v_i^2) + mg(h_f - h_i)$ ✓Any one/*Enige een*
$f(10)\cos180°$ ✓$= ½(2)(4^2 - 9{,}90^2) + 0$ ✓
$f = 8{,}2$ N ✓ (4)

5.4

LEFT NEGATIVE/*LINKS NEGATIEF*

$F_{net}\Delta t = \Delta p$
$F_{net}\Delta t = mv_f - mv_i$
$F_{net}\Delta t = m(v_f - v_i)$ ✓Any one/*Enige een*
$-14 = 2(v_f - 4)$ ✓
$v_f = -3\ m\cdot s^{-1}$

ACCEPT/*AANVAAR*
Impulse/*Impuls* = mΔv

$\Delta E_K = ½mv_f^2 - ½mv_i^2$ ✓
$= ½(2)[(-3)^2 - 4^2]$ ✓
$= -7$ J ✓

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

ACCEPT/AANVAAR
$\Delta E_K = ½mv_f^2 - ½mv_i^2$ ✓
$= ½(2)[(0)^2 - (-3)^2]$ ✓
$= -9$ J ✓

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

RIGHT NEGATIVE/*REGS NEGATIEF*

$F_{net}\Delta t = \Delta p$
$F_{net}\Delta t = mv_f - mv_i$
$F_{net}\Delta t = m(v_f - v_i)$ ✓Any one/*Enige een*
$14 = 2(v_f - (-4))$ ✓
$v_f = 3\ m\cdot s^{-1}$

ACCEPT/*AANVAAR*
Impulse/*Impuls* = mΔv

$\Delta E_K = ½mv_f^2 - ½mv_i^2$ ✓
$= ½(2)[(3)^2 - (-4)^2]$ ✓
$= -7$ J ✓

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

ACCEPT/*AANVAAR*
$\Delta E_K = ½mv_f^2 - ½mv_i^2$ ✓
$= ½(2)[(0)^2 - (-3)^2]$ ✓
$= -9$ J ✓

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

(5)
[14]

QUESTION 6/*VRAAG 6*

6.1 $v = f\lambda$ ✓
$340 = 680\lambda$ ✓
$\lambda = 0,5$ 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*

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

$f_L = \frac{v}{\lambda_L}$
$= \frac{340}{0,5 - 0,05}$ ✓
$= \frac{340}{0,45}$
$= 755,56$ Hz

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

$v_s = 34$ m·s^{-1} ✓ (33,67 - 34,04)

OPTION 2/*OPSIE 2*

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

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

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

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

$v_s = 34$ m·s^{-1} ✓ (33,67 - 34,04)

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

(5)
[12]

QUESTION 7/*VRAAG 7*

7.1.1 Added/*Toegevoeg* ✓ (1)

7.1.2

NOTE/*LET WEL*
Ignore signs of the charges./ *Ignoreer tekens van die ladings.*

$n = \frac{Q}{q_e}$ ✓

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

= 1,22 x 10^{13} ✓ (1,21875 x 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 $E = \frac{kQ}{r^2}$ ✓

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

= 7,02 x 10^4 N·C^{-1} ✓ (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 x 10^{-7} C ✓ (1,106 x 10^{-7} C)

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

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

$1{,}38 = \left(+\frac{(9\times10^9)(1{,}95\times10^{-6})q_2}{(0{,}03)^2}\right) + \left(\checkmark -\frac{(9\times10^9)(1{,}95\times10^{-6})q_2}{(0{,}05)^2}\right)\checkmark$

q_2 = 1,11 x 10^{-7} C ✓ (1,106 x 10^{-7} C)

OPTION 2/*OPSIE 2*

Marking criteria/*Nasienkriteria*:

- $E = \frac{kQ}{r^2}$ ✓
- Correct substitution of 7,08 x 10^5 N·C^{-1}/*Korrekte substitusie van 7,08 x10^5 N·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 x 10^{-7} C ✓ (1,106 x 10^{-7} C)

$E = \frac{F}{q} = \frac{1{,}38}{1{,}95\times10^{-6}}$

= 7,08 x 10^5 N·C^{-1} (707692,30)

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

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

$= \left(+\frac{(9\times10^9)q_2}{(0{,}03)^2}\right) + \left(\checkmark -\frac{(9\times10^9)q_1}{(0{,}05)^2}\right)\checkmark$

q_2 = 1,11 x 10^{-7} C ✓ (1,106 x 10^{-7} 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*

$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$
$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{8,4}$ ✓
$R_p = 3,5\ \Omega$
$R_T = 3,5 + 4$ ✓
$= 7,5\ \Omega$ ✓

OPTION 2/*OPSIE 2*

$R_p = \frac{R_1R_2}{R_1 + R_2}$
$R_p = \frac{(6)(8,4)}{6 + 8,4}$ ✓
$R_p = 3,5\ \Omega$
$R_T = 3,5 + 4$ ✓
$= 7,5\ \Omega$ ✓

(3)

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

CALCULATE V_P/*BEREKEN V_P*	**CALCULATE V_2/*BEREKEN V_2***
Marking criteria/*Nasienkriteria*	**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*

$V_p = IR$
$= (1,2)(3,5)$ ✓
$= 4,2$ V

$I = \frac{V}{R}$
$= \frac{4,2}{8,4}$ ✓
$= 0,5$ A

$V_2 = IR$ ✓
$= (0,5)(6)$ ✓
$= 3$ V ✓

OPTION 2/*OPSIE 2*

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

$I_{6\,\Omega} = \frac{8,4}{14,4} \times 1,2$
$= 0,7$ A

$V_{6\,\Omega} = IR$
$= (0,7)(6)$ ✓
$= 4,2$ V

OR/*OF*

OPTION 3/*OPSIE 3*

$\varepsilon = I(R + r)$
$12 = 1,2(7,5 + r)$
$r = 2,5\ \Omega$
$V_p = 12 - 1,2(2,5 + 4)$ ✓$= 4,2$ V

$R_{2,4} : R_6 = 2,4 : 6$ ✓
$= 2 : 5$
$V_{2,4} : V_6 = 1,2 : 3$ ✓✓
$V_2 = 3$ 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*** $\left(\frac{3,5}{8,4}\right)(1,2)$
$= 0,5$ A ✓✓
$V_2 = IR$ ✓
$= (0,5)(6)$ ✓
$= 3$ V ✓

OPTION 5/*OPSIE 5*

$V_x = IR$
$= (1,2)(4)$
$= 4,8$ V

$V_{ext} = IR_{ext}$
$= (1,2)(7,5)$
$= 9$ V

$V_p = 9 - 4,8$✓ $= 4,2$ V

$V_{8,4\Omega} = IR$
$4,2 = I(8,4)$✓
$I = 0,5$ A

$V_2 = IR$ ✓
$= (0,5)(6)$ ✓
$= 3$ 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*	**OPTION 2/*OPSIE 2***	**OPTION 3/*OPSIE 3***
$V_{rms/wgk} = \frac{V_{max/maks}}{\sqrt{2}}$ $= \frac{100}{\sqrt{2}}$ ✓ $= 70{,}71$ V $I_{rms/wgk} = \frac{V_{rms/wgk}}{R}$ ✓ $= \frac{70{,}71}{25}$ ✓ $= 2{,}83$ A ✓ **ACCEPT/*AANVAAR*** If subscipts omitted in V = IR *Indien onderskrifte uitgelaat is in V = IR*	$I_{max/maks} = \frac{V_{max/maks}}{R}$ $= \frac{100}{25}$ ✓ $= 4$ A $I_{rms/wgk} = \frac{I_{max/maks}}{\sqrt{2}}$ ✓ $= \frac{4}{\sqrt{2}}$ ✓ $= 2{,}83$ A ✓	$P_{ave} = \frac{V_{rms}^2}{R}$ $= \frac{\frac{100^2}{\sqrt{2}}}{25}$ ✓ $= 200$ W $P_{ave} = V_{rms}I_{rms}$ ✓ $200 = \left(\frac{100}{\sqrt{2}}\right) I_{rms}$ ✓ $I_{rms} = 2{,}83$ A ✓

(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***
$P_{ave/gem} = \frac{V^2_{rms/wgk}}{R}$ ✓ $= \frac{70{,}71^2}{25}$ ✓ = 200,00 W ✓ (200 W)	$P_{ave} = V_{rms}I_{rms}$ ✓ = (70,71)(2,83) ✓ = 200,11 W ✓	$P_{ave/gem} = I^2_{rms/wgk}R$ ✓ = $(2{,}83)^2(25)$ ✓ = 200,22 W ✓

OPTION 4/*OPSIE 4*

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

$2{,}83 = \frac{I_{max}}{\sqrt{2}}$

$I_{max/maks}$ = 4 A

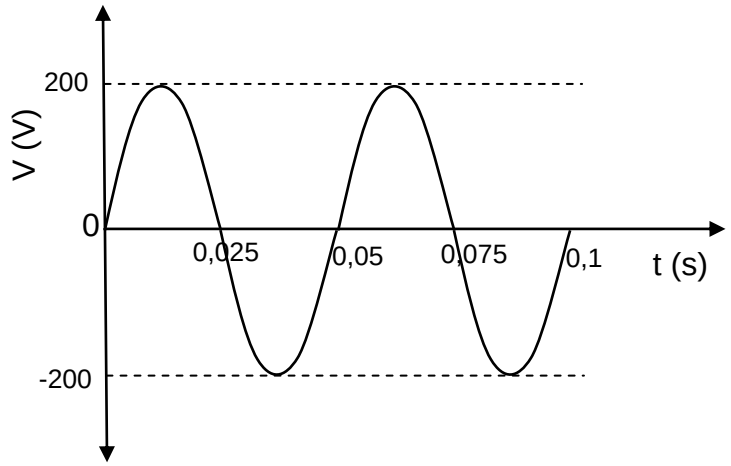
$P_{ave/gem} = \frac{V_{max/maks}I_{max/maks}}{2}$ ✓

$= \frac{(100)(4)}{2}$ ✓

= 200 W ✓

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

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

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