basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA
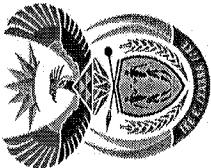
NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT

GRADE/GRAAD 12

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

NOVEMBER 2015
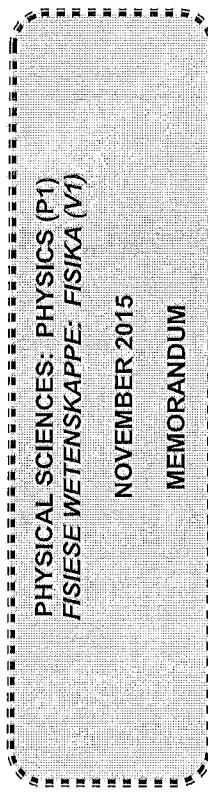
MEMORANDUM

MARKS/PUNTE: 150

This memorandum consists of 28 pages.
Hierdie memorandum bestaan uit 28 bladsye.

QUESTION 1/VRAAG 1

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

QUESTION 2/VRAAG 2

2.1.1 When body A exerts a force on body B, body B exerts a force of equal magnitude in the opposite direction on body A. ✓✓
Wanneer liggaam A 'n krag uitoefen op liggaam B, oefen liggaam B 'n krag van gelyke grootte in die teenoorgestelde rigting op liggaam A uit.

OR/OF

If body A exerts a force on body B, then body B exerts an equal ✓ and opposite✓ force on body A
Indien liggaam A 'n krag uitoefen op liggaam B, dan sal liggaam B 'n gelyke maar teenoorgestelde krag op liggaam A uitoefen   **(2)**

2.1.2 For 2,5 kg block/Vir 2,5 kg blok

	OR/OF	OR/OF
T = mg ✓	F_net = ma	F_net = ma
∴T = (2,5)(9,8)✓	T – mg = (2,5)(0) ✓	mg – T = (2,5)(0)
= 24,5 N ✓	T – (2,5)(9,8)✓ = 0	(2,5)(9,8) – T✓ = 0
	T = 24,5 N ✓	T = 24,5 N ✓

$T = mg$ ✓
$\therefore T = (2,5)(9,8)$ ✓
$= 24,5\ N$ ✓

(3)

2.1.3 **POSITIVE MARKING FROM 2.1.2**
POSITIEWE NASIEN VANAF 2.1.2

For mass M/Vir mass M

$f_s = \mu_s N$ ✓

	OR/OF
∴ N = $\frac{24,5}{0,2}$ ✓ = 122,5 N	$\mu_s N$✓ $= \mu_s Mg$
N = Mg = 122,5 N	$24,5$✓ $= (0,2)$✓ $M(9,8)$
M(9,8) = 122,5 N	M = 12,5 kg✓
M = 12,5 kg✓	

(5)

2.1.4 For the 5 kg block/Vir die 5 kg blok:

$f_k = \mu_k N$
$f_k = (0,15)(5)(9,8)$ ✓
$= 7,35\ N$

$F_{net} = ma$
$T - f_k = ma$ ✓
$T - 7,35 = 5a$ ✓

For the 2,5 kg block/Vir die 2,5 kg blok

$w - T = ma$
$(2,5)(9,8) - T = 2,5\ a$ ✓

$17,15 = 7,5\ a$
$a = 2,29\ m \cdot s^{-2}$ ✓

(5)

2.2

$F = G\frac{m_1 m_2}{r^2}$ ✓

$F = \frac{(6,67 \times 10^{-11})(6,55 \times 10^{20})(90)}{(550 \times 10^3)^2}$ ✓

$= 12,90\ N$✓ (12,899 N)

OR/OF

$g = \frac{Gm}{r^2}$ ✓

$g = \frac{(6,67 \times 10^{-11})(6,5 \times 10^{20})}{(550 \times 10^3)^2}$ ✓

$= 0,143...m \cdot s^{-2}$

$w = mg$
$= (90)(0,143..)$✓
$= 12,89\ N$✓ (downwards/afwaarts)

(4)

[19]

QUESTION 3/VRAAG 3

3.1.

OPTION 1/OPSIE 1
Upwards positive/Opwaarts positief:

$v_f = v_i + a\Delta t$ ✓
-16 ✓ $= 16 - 9,8(\Delta t)$ ✓
$\Delta t = 3,27\,s$ ✓

OPTION 2/OPSIE 2
Upwards positive/Opwaarts positief:

$v_f = v_i + a\Delta t$ ✓
To the top/By bopunt:
0 ✓ $= 16 - 9,8(\Delta t)$ ✓

$\Delta t = 1,63\,s$
Total time/Totale tyd = 1,63 x 2 = 3,26(7) s ✓

OPTION 3/OPSIE 3
Upwards positive/Opwaarts positief:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
0 ✓ $= 16\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$\Delta t(16 - 4,9\Delta t) = 0$
$\Delta t = 0$ or/of 3,27 s
Time taken/Tyd geneem = 3,27 s
(accept/aanvaar 3,26 s) ✓

OPTION 4/OPSIE 4
Upwards positive/Opwaarts positief:

$v_f^2 = v_i^2 + 2a\Delta y$
At highest point/By hoogste punt
$0 = 16^2 + 2(-9,8)\Delta y$ ✓
$\Delta y = 13,06\,m$
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$13,06 = 16\Delta t - 4,9\Delta t^2$ ✓
$\Delta t = 1,62$ or 1,65
Total time/Totale tyd = (1,62/1,65)x2
= 3,24 s ✓ or/of 3,3 s

(4)

Downwards positive/Afwaarts positief:

$v_f = v_i + a\Delta t$ ✓
16 ✓ $= -16 + 9,8(\Delta t)$ ✓
$\Delta t = 3,27\,s$ ✓

Downwards positive/Afwaarts positief:

$v_f = v_i + a\Delta t$ ✓
To the top/By bopunt:
0 ✓ $= -16 + 9,8(\Delta t)$ ✓
$\Delta t = 1,63s$
Total time/Totale tyd = 1,63 x 2 = 3,26(7) s ✓

Downwards positive/Afwaarts positief:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
0 ✓ $= -16\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓
$\Delta t(-16 + 4,9\Delta t) = 0$
$\Delta t = 0$ or/of 3,27 s
Time taken/Tyd geneem = 3,27 s
(accept/aanvaar 3,26 s) ✓

(4)

Downwards positive/Afwaarts positief:

$v_f^2 = v_i^2 + 2a\Delta y$
At highest point/By hoogste punt
$0 = (-16)^2 + 2(9,8)\Delta y$ ✓
$\Delta y = 13,06\,m$
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$13,06 = -16\Delta t + 4,9\Delta t^2$ ✓
$\Delta t = 1,62$ or 1,65
Total time/Totale tyd = (1,62/1,65) x 2
= 3,24 s ✓ or/of 3,3 s

(4)

3.1

OPTION 5/OPSIE 5
Upwards positive/Opwaarts positief:

$v_f^2 = v_i^2 + 2a\Delta y$
At highest point/By hoogste punt
$0 = 16^2 + 2(-9,8)\Delta y$ ✓
$\Delta y = 13,06\,m$
$\Delta y = \left(\dfrac{v_f + v_i}{2}\right)\Delta t$ ✓
$13,06 = \left(\dfrac{0 + 16}{2}\right)\Delta t$ ✓

$\Delta t = 1,63\,s$
Total time/Totale tyd = 3,26 s ✓

OPTION 6/OPSIE 6
Upwards positive/Opwaarts positief:

$F_{net}\,\Delta t = \Delta p$ ✓
$mg\,\Delta t = m(v_f - v_i)$
$-9,8\Delta t$ ✓ $= [0 - 16]$ ✓
$\Delta t = 1,63\,s$
Total time/Totale tyd = (1,63)(2) ✓
= 3,26 s ✓

OPTION 7/OPSIE 7
Upwards positive/Opwaarts positief:

$F_{net}\,\Delta t = \Delta p$ ✓
$mg\,\Delta t = m(v_f - v_i)$
$-9,8\Delta t$ ✓ $= [-16 - (+16)]$ ✓
$\Delta t = 3,26\,s$
Total time/Totale tyd = 3,26 s ✓

(4)

Downwards positive/Afwaarts positief:

$v_f^2 = v_i^2 + 2a\Delta y$
At highest point/By hoogste punt
$0 = (-16)^2 + 2(9,8)\Delta y$ ✓
$\Delta y = -13,06\,m$
$\Delta y = \left(\dfrac{v_f + v_i}{2}\right)\Delta t$ ✓
$-13,06 = \left(\dfrac{0 - 16}{2}\right)\Delta t$ ✓

$\Delta t = 1,63\,s$
Total time/totale tyd = 3,26 s ✓

(4)

Downwards positive/Afwaarts positief:

$F_{net}\,\Delta t = \Delta p$ ✓
$mg\,\Delta t = m(v_f - v_i)$
$9,8\Delta t$ ✓ $= [0 - (-16)]$ ✓
$\Delta t = 1,63\,s$
Total time/Totale tyd = (1,63)(2)
= 3,26 s ✓

Downwards positive/Afwaarts positief:

$F_{net}\,\Delta t = \Delta p$ ✓
$mg\,\Delta t = m(v_f - v_i)$
$9,8\Delta t$ ✓ $= [16 - (-16)]$ ✓
$\Delta t = 3,26\,s$
Total time/Totale tyd = 3,26 s ✓

(4)

3.2   POSITIVE MARKING FROM 3.1/POSITIEWE NASIEN VANAF 3.1
Upwards positive/Opwaarts positief:
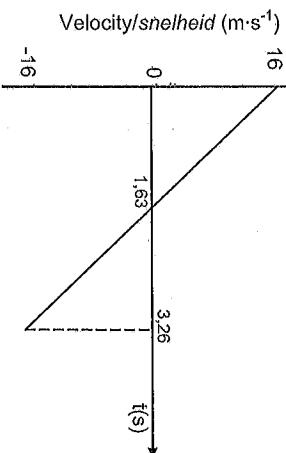
3.2   POSITIVE MARKING FROM 3.2/POSITIEWE NASIEN VANAF 3.2
Downwards positive/Afwaarts positief:

(3)

Criteria for graph/Kriteria vir grafiek	Marks/Punte
Correct shape for line extending beyond t = 1,63 s. Korrekte vorm vir lyn verleng verby t = 1,63 s	✓
Initial velocity correctly indicated as shown. Beginsnelheid korrek aangedui soos getoon.	✓
Time to reach maximum height and time to return to the ground correctly shown. Tyd om maksimum hoogte te bereik en om na die grond terug te keer.	✓
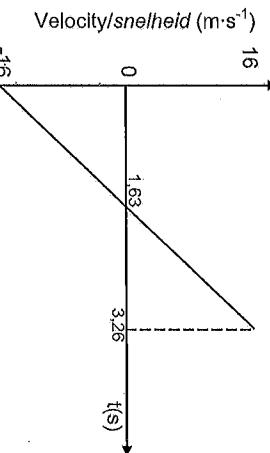
(3)

3.3   **OPTION 1 / OPSIE 1**
Upwards positive/Opwaarts positief:
Take y_A as height of ball A from the ground. (no penalising)/Neem y_A as hoogte van bal A vanaf die grond. (geen penalisering)

$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
$y_A - 0 = 16 \Delta t + \frac{1}{2}(-9,8) \Delta t^2$
$= 16 \Delta t - 4,9 \Delta t^2$ ✓

Take y_B as height of ball B from the ground./Neem y_B as hoogte van bal B vanaf die grond.

$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$
$y_B - 30 = (v_i \Delta t + \frac{1}{2} a \Delta t^2)$
$y_B - 30 = [-9(\Delta t -1) + \frac{1}{2}(-9,8)(\Delta t -1)^2$ ✓
$= 34,1 + 0,8 \Delta t - 4,9 \Delta t^2$ ✓

$y_A = y_B$
$\therefore 16 \Delta t - 4,9 \Delta t^2 = 34,1 + 0,8 \Delta t - 4,9 \Delta t^2$
$15,2 \Delta t = 34,1$
$\Delta t = 2,24$ s ✓
$y_A = 16(2,24) - 4,9(2,24)^2$
$= 11,25$ m ✓

Downwards positive/Afwaarts positief:
Take y_A as height of ball A from the ground./Neem y_A as hoogte van bal A vanaf die grond. (geen penalisering)

$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
$y_A - 0 = -16 \Delta t + \frac{1}{2}(9,8) \Delta t^2$
$= -16 \Delta t + 4,9 \Delta t^2$ ✓

Take y_B as height of ball B from the ground/Neem y_B as hoogte van bal B vanaf die grond.

$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$
$y_B - 30 = -(v_i \Delta t + \frac{1}{2} a \Delta t^2)$
$y_B = 30 - [9(\Delta t -1) + \frac{1}{2}(9,8)(\Delta t -1)^2$ ✓
$= 34,1 + 0,8 \Delta t - 4,9 \Delta t^2$ ✓

$y_A = y_B$
$16 \Delta t - 4,9 \Delta t^2 = 34,1 + 0,8 \Delta t - 4,9 \Delta t^2$
$15,2 \Delta t = 34,1$
$\Delta t = 2,24$ s ✓
$\Delta y_A = (-16 (2,24) + 4,9(2,24)^2)$
$= 11,25$ m ✓

(6)

3.3

OPTION 2/OPSIE 2
Upwards positive/Opwaarts positief:

$\Delta y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$= 16\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓
$= 16\Delta t - 4,9\Delta t^2$ ✓

Distance travelled by ball A = $y_A = 16\Delta t - 4,9\Delta t^2$
$\Delta y_B = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$= -9(\Delta t - 1) + \frac{1}{2}(-9,8)(\Delta t - 1)^2$ ✓
$= 0,8\Delta t - 4,9\Delta t^2 + 4,1$ ✓

Distance travelled by ball B = $y_B = 0,8\Delta t - 4,9\Delta t^2 + 4,1$

$y_A + (-y_B) = 30$
$16\Delta t - 4,9\Delta t^2 - (0,8\Delta t - 4,9\Delta t^2 + 4,1) = 30$
$15,2\Delta t = 34,1$
$\Delta t = 2,24$ s ✓

$\therefore \Delta y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$y_A = 16 (2,24) - 4,9(2,24)^2$
$= 11,25$ m ✓

(6)

3.3

Downwards positive/Afwaarts positief:
$y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$= -16\Delta t + \frac{1}{2}(9,8)\Delta t^2$
$= -16\Delta t + 4,9\Delta t^2$ ✓

$y_B = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$= 9(\Delta t - 1) + \frac{1}{2}(9,8)(\Delta t - 1)^2$ ✓
$= - 0,8\Delta t + 4,9\Delta t^2 - 4,1$ ✓

$(-y_A) + y_B = 30$
$-(-16\Delta t + 4,9\Delta t^2) - 0,8\Delta t + 4,9\Delta t^2 - 4,1 = 30$
$15,2\Delta t = 34,1$
$\Delta t = 2,24$ s ✓

$\therefore \Delta y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$\Delta y_A = -16 (2,24) + 4,9(2,24)^2$
$= - 11,25$ m

$\therefore$ Height of ball A/Hoogte van bal A = 11,25 m ✓

(6)

OPTION 3/OPSIE 3
Upwards positive/Opwaarts positief:
$v_f = v_i + a\Delta t$
After 1 s, speed of ball A/Spoed van bal A na 1 s
$v_f = 16 + (-9,8)(1)$
$= 6,2$ m·s^{-1}

Distance travelled by ball A in 1 s/Afstand deur bal A afgelê in 1 s
$\Delta y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$= (16)(1) + \frac{1}{2}(-9,8)1^2$
$= 11,1$ m

For ball A, after 1 s/Vir bal A na 1 s
$\Delta y_A = 6,2\Delta t - 4,9\Delta t^2$ ✓

For ball/Vir bal **B,**
$\Delta y_B = v_i\Delta t + \frac{1}{2} a\Delta t^2$
$= -9\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓

$y_A + (-y_B) = (30 - 11,1) = 18,9$
$6,2\Delta t - 4,9\Delta t^2 - [-9\Delta t + \frac{1}{2}(-9,8)\Delta t^2] = 18,9$
$15,2\Delta t = 18,9$
$\Delta t = 1,24$ s ✓

The balls meet after/Die balle ontmoet na (1,24 +1) = 2,24 s ✓
$\Delta y_A = [6,2 (1,24) - 4,9 (1,24)^2]$
$= 0,154$ m
Meeting point/Ontmoetingspunt = (11,1 + 0,154) = 11,25 m ✓

OR/OF
$\Delta y = (-9)(1,24) + \frac{1}{2} (-9,8)(1,24)^2$ ✓
$= -18,69$ m
Meeting point/Ontmoetingspunt = (30 -18,69) = 11,31 m ✓

(6)

Downwards positive/Afwaarts positief:

$v_f = v_i + a\Delta t$

After 1 s, speed of ball A/Spoed van bal A na 1 s

$v_f = -16 + (9,8)(1)$

$= -6,2$ ms⁻¹

Distance travelled by ball A in 1 s/Afstand deur bal A afgelê in 1 s

$\Delta y_A = v_i\Delta t + ½\, a\Delta t^2$ ✓

$= (-16)(1) + ½(9,8)(1)^2$

$= -11,1$ m

For ball A, after 1 s/Vir bal A na 1 s

$\Delta y_A = -6,2\Delta t + 4,9\Delta t^2$ ✓

For ball/Vir bal **B**

$\Delta y_B = v_i\Delta t + ½\, a\Delta t^2$

$= 9\Delta t + ½(9,8)\Delta t^2$ ✓

$-\Delta y_A + \Delta y_B = 18,9$

$6,2\Delta t - 4,9\Delta t^2 + [9\Delta t + ½(9,8)\Delta t^2] = 18,9$

$15,2\Delta t = 18,9$

$\Delta t = 1,24$ s ✓

The balls meet after/Die balle ontmoet na (1,24 +1) = 2,24 s ✓

$\Delta y_A = -6,2 (1,24) + 4,9 (1,24)^2$

$= -0,154$ m

Meeting point/Ontmoetingspunt = (-11,1 - 0,154) = 11,25 m✓

OR/OF

$\Delta y = (9)(1,24) + ½ (9,8)(1,24)^2$ ✓

$= 18,69$ m

Meeting point/Ontmoetingspunt = (30 -18,69) = 11,31 m✓

(6)
[13]

QUESTION 4/VRAAG 4

4.1   <u>**OPTION 1/OPSIE 1**</u>

Take motion to the right as positive/Neem beweging na regs as positief.

$\Sigma p_i = \Sigma p_f$

$(m_1 + m_2)v_i = m_1v_{f1} + m_2v_{f2}$

$(3 + 0,02)(0) = (3)(-1,4) + (0,02)\, v_{f2}$ ✓   [Any one/Enige een]

$v_{f2} = 210$ m·s⁻¹ ✓

OR/OF

$\Sigma p_i = \Sigma p_f$

$(m_1 + m_2)v_i = m_1v_{f1} + m_2v_{f2}$

$(m_1+m_2)v_i = m_1v_{f1} + m_2v_{f2}$

$(3 + 0,02)(0) = (3)(1,4) + (0,02)\, v_{f2}$ ✓   [Any one/Enige een]

$v_{f2} = -210$ m·s⁻¹

Speed/Spoed = 210 m·s⁻¹ ✓

(4)

<u>**OPTION 2/OPSIE 2**</u>

Take motion to the right as positive/Neem beweging na regs as positief.

$\Delta p_{bullet} = -\Delta p_{block}$ ✓

$m(v_f - v_i) = - m(v_f - v_i)$

$(0,02)(v_f - 0) = -(3)(-1,4 - 0)$ ✓

∴ $v_f = 210$ m·s⁻¹ ✓

OR/OF

Take motion to the left as positive/Neem beweging na links as positief

$\Delta p_{bullet} = -\Delta p_{block}$ ✓

$m(v_f - v_i) = - m(v_f - v_i)$

$(0,02)(v_f - 0) = -(3)(1,4 - 0)$ ✓

∴ $v_f = -210$ m·s⁻¹

Speed/Spoed = 210 m·s⁻¹ ✓

(4)

4.2

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$v_f^2 = v_i^2 + 2a\Delta x$ ✓ $0 = 210^2 + 2a(0,4)$ ✓ $a = -55\ 125\ m \cdot s^{-2}$ $F_{net} = ma$ ✓ $= (0,02)(-55\ 125)$ ✓ $= -1\ 102,5\ N$ Magnitude of force = 1 102,5 N ✓ Grootte van krag = 1 102,5 N	$\Delta x = \left(\dfrac{v_i + v_f}{2}\right)\Delta t$ ✓ $0,4 = \left(\dfrac{210 + 0}{2}\right)\Delta t$ ✓ $\Delta t = 0,004\ s\ (0,00381s)$ $F_{net}\Delta t = \Delta p = m\Delta v$ ✓ $F_{net} = \dfrac{(0,02)(0-210)}{(0,004)}$ ✓ $= -1\ 050\ N$ Magnitude of force = 1 050 N ✓ Grootte van krag = 1 050 N (Accept/Aanvaar. 1102,5 N)

OPTION 3/OPSIE 3
$v_f^2 = v_i^2 + 2a\Delta x$ ✓ $0 = 210^2 + 2a(0,4)$ ✓ $a = -55\ 125\ m\ s^{-2}$ $v_f = v_i + a\Delta t$ $0 = 210 - (55\ 125)\Delta t$ $\Delta t = 0,004\ s\ (0,00381\ s)$ $F_{net}\Delta t = \Delta p = m\Delta v$ ✓ $F_{net} = \dfrac{(0,02)(0-210)}{(0,004)}$ ✓ $= -1\ 050\ N$ Magnitude of force = 1 050 N ✓ (Accept/Aanvaar. 1 102,5 N)   Grootte van krag = 1 050 N

OPTION 4/OPSIE 4
$W_{net} = \Delta K$ $F_{net}\Delta x cos\theta = \Delta K = \frac{1}{2}m(v_i^2 - v_f^2)$ ✓ $F_{net}(0,4)$ ✓$cos180° = \frac{1}{2}(0,02)(0^2 - 210^2)$ ✓ } ✓ $F_{net} = 1\ 102,5\ N$ ✓   **OR/OF** $W_{nc} = \Delta E_p + \Delta E_k$ $F_{net}\Delta x cos\theta = 0 + \frac{1}{2}m(v_i^2 - v_f^2)$ ✓ } ✓ $F_{net}(0,4)$ ✓$cos180° = \frac{1}{2}(0,02)(0^2 - 210^2)$ ✓ $F_{net} = 1\ 102,5\ N$ ✓

Any one/Enige een

(5)

4.3 The same as/equal ✓
Dieselfde as/gelyk

(1)
[10]

QUESTION 5/VRAAG 5

5.1

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$v_{ave} = \dfrac{800}{75}$ ✓ $= 10,67 m \cdot s^{-1}$ ✓ $P_{ave} = Fv_{ave}$ ✓ $P_{ave} = (240)(10,67)$ $= 2\ 560,8\ W\ (2,56\ kW)$ ✓	$v_{ave} = \dfrac{800}{75}$ ✓ $= 10,67 m \cdot s^{-1}$ ∴Distance covered in 1s = 10,67m ∴W(Work done in 1 s) = $F\Delta x cos\theta$ ✓ $= (240)(10,67)(1)$ $= 2\ 560,8\ J\ s^{-1}$ ✓ ∴ $P_{ave} = 2\ 560,8\ W\ (2,56\ kW)$ ✓

OPTION 3/OPSIE 3	OPTION 4/OPSIE 4
$P = \dfrac{W}{\Delta t}$ ✓ $= \dfrac{F\Delta x cos\theta}{\Delta t}$ $= \dfrac{(240)(800)cos0°}{75}$ ✓ $= 2\ 560\ W$ ✓	$P = \dfrac{W}{\Delta t}$ ✓ $= \dfrac{F\Delta x cos\theta}{\Delta t}$ $= \dfrac{(240)(10,67)cos0°}{1}$ ✓ $= 2\ 560\ W$ ✓

(3)

5.2

(5)

Accepted labels/Aanvaarde benoemings		
w	F_g / F_w / weight / mg / gravitational force/2 940 N F_g / F_w / gewig / mg / gravitasiekrag	
f	$F_{friction}$ / F_f / friction /294 N /f_k $F_{wrywing}$ / F_w / wrywing/294 N /f_k	
N	F_N / F_{normal} / normal force F_N / $F_{normaal}$ / normaalkrag	
F_D	$F_{Applied/toegepas}$/350 N/Average driving force $F_{driving/dtykrag}$/350/Gemiddelde aandrywingskrag	

5.3 The net/total work done on an object is equal✓ to the change in the object's kinetic energy. ✓
Die netto/totale arbeid verrig op 'n voorwerp is gevk aan die verandering in die voorwerp se kinetiese energie.
OR/OF
The work done on an object by a resultant/net force is equal✓ to the change in the object's kinetic energy. ✓
Die arbeid verrig op 'n voorwerp deur 'n resulterende krag is gelyk aan die verandering in die voorwerp se kinetiese energie.

(4)

(2)

5.4

OPTION 1/OPSIE 1
$W_{nc} = \Delta U + \Delta K$ ✓
$W_f + W_D = \Delta U + \Delta K$
$f\Delta x \cos\theta + F_D\Delta x \cos\theta = mg(h_f - h_i) + \frac{1}{2}(m)(v_f^2 - v_i^2)$
$(294)(450)(\cos180°)$✓ $+ (350)(450)\cos0°$✓ $= (300)(9,8)(5 - 0)$✓ $+ \frac{1}{2}(300)(v_f^2 - 0)$✓
$v_f = 8,37 \text{ m·s}^{-1}$✓

OPTION 2/OPSIE 2
$W_{net} = \Delta K$✓
$W_f + W_g + W_f + W_N$
$= (F_D\Delta x \cos\theta) + (mg \sin\alpha)\Delta x \cos\theta) + (f\Delta x \cos\theta) + 0$
$= [350(450)](\cos\theta)$✓ $+ (300)(9,8)\dfrac{5}{450}(450)(\cos180°)$✓ $+$
$294(450)(\cos180°)$✓
$= 157\,500 - 14\,700 - 132\,300$
$= 10\,500 \text{ J}$

$W_{net} = \Delta K$
$10\,500 = \frac{1}{2}(300)(v_f^2 - 0)$ ✓
$v_f = 8,37 \text{ m·s}^{-1}$ ✓

OR/OF
$\alpha = \sin^{-1}\dfrac{5}{450}$
$= 0,64°$

(6)

OPTION 3/OPSIE 3
$W_{net} = W_D + W_g + W_f + W_N$
$= (F_D\Delta x \cos\theta) + mg\Delta x \cos\theta) + f\Delta x \cos\theta + 0$
$W_{net} = (350)(450)(\cos0°)$✓ $+(300)(9,8)(450)\cos(90 + 0,64)$ ✓$+294(450)(\cos180°)$✓
$= 157\,500 - 14\,777,74 - 13\,2300$
$= 10\,430,51 \text{ J}$

$W_{net} = \Delta K$✓
$10\,430.51 = \frac{1}{2}(300)(v_f^2 - 0)$✓
$v_f = 8,34 \text{ m·s}^{-1}$ ✓

OR/OF
$\alpha = \sin^{-1}\dfrac{5}{450}$
$= 0,64°$

(6)

OPTION 4/OPSIE 4
$F_{net} = F_D + (-mg\sin\alpha) +(-f)$
$= 350$ ✓$+[-(300)(9,8)\sin0,64°]$✓ $+ (-294)$✓
$= 23,16 \text{ N}$

$W_{net} = F_{net} \Delta x \cos\theta$
$= (23,16)(450) \cos0°$
$= 10\,422 \text{ J}$

$W_{net} = \Delta K$ ✓
$10\,422 = \frac{1}{2}(300)(v_f^2 - 0)$✓
$v_f = 8,34 \text{ m·s}^{-1}$ ✓

OR/OF
$F_{net} = 350$ ✓$- (300)(9,8)\sin0,64°$✓ $- 294$✓
$= 350 - 32,84 - 294$
$= 23,16 \text{ N}$

(6)
[15]

QUESTION 6/VRAAG 6

6.1.1 Frequency (of sound detected by the listener (observer))✓
Frekwensie van klank deur luisteraar (waarnemer) waargeneem (1)

6.1.2 The apparent change in frequency or pitch of 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 (of toonhoogte) van die klank deur 'n luisteraar waargeneem omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klankvoortplanting het. (2)

6.1.3 Away/*Weg van*✓
Detected frequency of source decreases✓
Waargenome frekwensie van bron neem af (2)

6.1.4

OPTION 1/OPSIE 1
EXPERIMENT/EKSPERIMENT 2
$f_L = \dfrac{v \pm v_L}{v \pm v_s}f_s$ ✓ OR/OF $f_L = \dfrac{v}{v + v_s}f_s$ ✓
$874 = \dfrac{v}{v + 10}$✓ (900) ✓
$v = 336,15 \text{ m·s}^{-1}$✓   (Accept/*Aanvaar*: 336,15 m·s⁻¹ – 323,33 m·s⁻¹)

EXPERIMENT/EKSPERIMENT 3
$f_L = \dfrac{v \pm v_L}{v \pm v_s}f_s$ ✓ OR/OF $f_L = \dfrac{v}{v + v_s}f_s$ ✓
$850 = \dfrac{v}{v + 20}$ ✓(900) ✓
$v = 340 \text{ m·s}^{-1}$✓   (Accept/*Aanvaar*: 313,33 m·s⁻¹ – 340 m·s⁻¹)

EXPERIMENT/EKSPERIMENT 4
$f_L = \dfrac{v \pm v_L}{v \pm v_s}f_s$ ✓ OR/OF $f_L = \dfrac{v}{v + v_s}f_s$ ✓
$827 = \dfrac{v}{v + 30}$ ✓(900) ✓
$v = 339,86 \text{ m·s}^{-1}$✓   (Accept/*Aanvaar*: 339,86 m·s⁻¹ – 345 m·s⁻¹)

(5)

OPTION 2/OPSIE 2

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

Experiment/Eksperiment 2 and/en 3

$$\frac{874(v+10)\checkmark}{v} = \frac{850(v+20)}{v}\checkmark \qquad \checkmark \text{ both frequencies / beide frekwensies}$$

$$874v + 8740 = 850v + 1700$$

$$\therefore v = 344,17 \text{ m·s}^{-1} \checkmark$$

Experiment/Eksperiment 2 and/en 4

$$\frac{874(v+10)\checkmark}{v} = \frac{827(v+30)}{v}\checkmark \qquad \checkmark \text{ both frequencies / beide frekwensies}$$

$$874v + 8740 = 827v + 24810$$

$$\therefore v = 341,91 \text{ m·s}^{-1} \checkmark$$

Experiment/Eksperiment 3 and/en 4

$$\frac{850(v+20)\checkmark}{v} = \frac{827(v+30)}{v}\checkmark \qquad \checkmark \text{ both frequencies / beide frekwensies}$$

$$850v + 1700 = 827v + 24810$$

$$\therefore v = 339,57 \text{ m·s}^{-1} \checkmark$$

(5)

6.2 Away from the Earth/Weg vanaf die aarde✓

(1)

[11]

QUESTION 7/VRAAG 7

7.1

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

$$n = \frac{0,5 \times 10^{-6}}{1,6 \times 10^{-19}} \checkmark$$

$$n = 3,13 \times 10^{12} \checkmark \text{ electrons/elektrone}$$

(3)
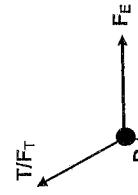
7.2

Accepted labels/Aanvaarde benoemings	
w	F_g / F_w / weight / mg / gravitational force
	F_g / F_w/ gewig / mg / gravitasiekrag
T	F_T / tension
	F_T / spanning
F_E	Electrostatic force/F_C/ Coulombic force/F_Q /F_{RPPR}
	Elektrostiesekrag / Coulombkrag / F_Q /F_{RPPR}

(3)

7.3 The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the (magnitudes of the) charges and inversely proportional to the square of the distance (r) between them. ✓✓
Die grootte van die elektrostatiese krag wat deur een puntlading (Q_1) op 'n ander puntlading (Q_2)uitgeoefen word, is direk eweredig aan die produk van die (groottes van die) ladings en omgekeerd eweredig aam die kwadraat van die afstand (r) tussen hulle.

(2)

7.4

OPTION 1/OPSIE 1

$F_E = k\dfrac{Q_1 Q_2}{r^2}$ ✓

$T\sin\theta/(T\cos\theta) = F_E$

∴ $T\sin7°/(T\cos83°)$✓ = $\dfrac{(9×10^9)(0,5×10^{-6})(0,9×10^{-6})}{(0,2)^2}$✓

∴T = 0,83 N✓   (Accept/Aanvaar 0,82 N)

  (5)

OPTION 2/OPSIE 2

$F_E = \dfrac{kQ_1Q_2}{r^2}$✓

= $\dfrac{(9×10^9)(0,5×10^{-6})(0,9×10^{-6})}{(0,2)^2}$ ✓

= 0,101 N

$\tan7° = \dfrac{T_x}{T_Y} = \dfrac{0,101}{T_Y}$ ✓

$T_Y = 0,823$

$T = \sqrt{T_x^2 + T_Y^2} = \sqrt{(0,101)^2 + (0,823)^2} = 0,83\,N$ ✓ ✓

  (5)

OPTION 3/OPSIE 3

$F = \dfrac{kQ_1Q_2}{r^2}$✓ = $\dfrac{(9×10^9)(0,5×10^{-6})(0,9×10^{-6})}{(0,2)^2}$✓ = 0,101 N

$\dfrac{F_E}{\sin7°} = \dfrac{T}{\sin90°}$

$\dfrac{0,101}{\sin7°} = \dfrac{T}{\sin90°}$ ✓

T = 0,83 N ✓

  (5)

  [13]

QUESTION 8/VRAAG 8

8.1

$E_x = E_2 + E_{(-8)}$✓

= $\dfrac{kQ_2}{r^2} + \dfrac{kQ_{-8}}{r^2}$✓   ✓correct equation /korrekte vergelyking

= $\dfrac{(9×10^9)(2×10^{-5})}{(0,25)^2}$✓ + $\dfrac{(9×10^9)(8×10^{-6})}{(0,15)^2}$✓

= $2,88 × 10^6 + 3,2 × 10^6$

= $6,08 × 10^6$ N·C^{-1} ✓ to the east/na oos ✓

OR/OF

$E = k\dfrac{Q}{r^2}$✓

$E_2 = \dfrac{(9×10^9)(2×10^{-5})}{(0,25)^2}$ ✓

= $2,88× 10^6$ NC^{-1} to the east/na oos

$E_{-8} = \dfrac{(9×10^9)(8×10^{-6})}{(0,15)^2}$✓

= $3,2 ×10^6$ N·C^{-1} to the east/na oos

$E_x = E_2 + E_{(-8)}$

= $(2,88 × 10^6 + 3,2 × 10^6)$✓

= $6,08 × 10^6$ N·C^{-1} ✓ to the east/na oos✓

  (6)

8.2

OPTION 1/OPSIE 1

$F_E = QE$✓

= $(-2× 10^{-9})(6,08 × 10^6)$✓

= $-12,16 × 10^{-3}$

= $1,22 × 10^{-2}$ N✓ to the west/na wes✓

  (4)

OPTION 2/OPSIE 2

$F_{(-2)Q1} = qE_{(2)}$✓

= $(2× 10^{-9}) (2,88× 10^6)$

= $5,76 × 10^{-3}$ N to the west/na wes

$F_{(-2)Q2} = qE_{(8)}$

= $(2× 10^{-9})(3,2 × 10^6)$

= $6,4 × 10^{-3}$ N to the west/na wes

$F_{net} = 5,76 × 10^{-3} + 6,4 × 10^{-3}$✓

= $1,22 × 10^{-2}$ N✓ to the west/na wes✓

  (4)

OPTION 3/OPSIE 3

$F = k\dfrac{Q_1Q_2}{r^2}$ ✓

$F_{(-2)2} = \dfrac{(9\times10^9)(2\times10^{-9})(2\times10^{-5})}{(0,25)^2}$

$= 5,76 \times 10^{-3}$ N to the west/na wes

$F_{(-2)(-8)} = \dfrac{(9\times10^9)(2\times10^{-9})(8\times10^{-6})}{(0,15)^2}$

$= 6,4 \times10^{-3}$ N to the west/na wes

$F_{net} = (5,76 \times10^{-3} + 6,4 \times 10^{-3})$ ✓

$= 1,22 \times 10^{-2}$ N ✓to the west/na wes ✓

(4)

8.3 $2,44 \times 10^{-2}$ N✓   (1) [11]

QUESTION 9/VRAAG 9

9.1   The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature. (provided temperature and all other physical conditions are constant) ✓✓
Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur (mits temperatuur en alle fisiese toestande konstant bly)
OR/OF

The current in a conductor is directly proportional to the potential difference across the conductor, provided temperature and all other physical conditions are constant ✓✓
Die stroom in 'n geleier is direk eweredig aan die potensiaalverskil oor 'n geleier by konstante temperatuur mits temperatuur en alle fisiese toestande konstant bly

(2)

9.2   **OPTION 1/OPSIE 1**

V = IR✓

$V_8 = (0,5)(8)$✓ = 4 V

$V_8 = V_{16}$

∴ $V_{16} = 4$ V

$I_{16} = \dfrac{V}{R} = \dfrac{4}{16} = 0,25$ A

$I_{tot//} = A_1 = (0,5 + 0,25)$ ✓ = 0,75 A✓

OPTION 2/OPSIE 2

V = IR✓

$V_8 = (0,5)(8)$ ✓ = 4 V

$\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$

$= \dfrac{1}{8} + \dfrac{1}{16}$ ✓

$R = 5,33$ Ω

$I_{tot//} = \dfrac{4}{5,33}$

$A_1 = 0,75$ A✓

(4)

OPTION 3/OPSIE 3

$I_1R_1 = I_2R_2$ ✓

$(0,5)(8) = I_{16}(16)$ ✓

$I_{16} = \dfrac{(8)(0,5)}{16} = 0,25$ A

$I_{tot//} = A_1 = (0,5 + 0,25)$ ✓ = 0,75 A✓

OPTION 4/OPSIE 4

$2R_{8Ω} = R_{16Ω}$ ✓

∴ $I_{R16} = ½\, I_{R8}$ ✓

∴ $I_{R16} = ½ (0,5) = 0,25$ A

$A_1 = (0,5 + 0,25)$ ✓ = 0,75 A✓

(4)

9.3   **OPTION 1/OPSIE 1**

V = IR

$V_{20Ω} = (0,75)(20)$ ✓ = 15 V

$V_{//tot} = (15 + 4)$ ✓ = 19 V

$V_R = 19$ V

P = VI✓

12 = (19)I ✓

$I_R = A_2 = 0,63$ A✓

OPTION 2/OPSIE 2

$\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2} = \dfrac{1}{8} + \dfrac{1}{16}$ ✓

$R_{//} = 5,33$ Ω

$R_{//} + R_{20} = (5,33 + 20)$ ✓ = 25,33Ω

$V_{//tot} = I(R_{//} + R_{20})$

$= (0,75)(25,33)$

$= 19$ V

P = VI

12✓ = I(19) ✓

$I_R = A_2 = 0,63$ A✓

OPTION 3/OPSIE 3

V = IR

$V_{20Ω} = (0,75)(20)$ ✓ = 15 V

$V_{//tot} = (15 + 4)$ ✓ = 19 V

$V_R = 19$ V

$P = \dfrac{V^2}{R}$

$12 = \dfrac{(19)^2}{R}$

$R = 30,08$ Ω

$P = I^2R$✓

$12 = I^2(30,08)$✓

$I = 0,63$ A✓

OR/OF

$R = \dfrac{R_1R_2}{R_1 + R_2} = \dfrac{8\times16}{8+16}$ ✓ = 5,33 Ω

(5)

9.4

OPTION 1/OPSIE 1

$(\varepsilon) = I(R + r)$ ✓
$= V_{terminal} + V_{int}$
$= 19 + (0,75 + 0,63)(1)$ ✓
$= 20,38\ V$ ✓

OPTION 2/OPSIE 2

$V_{int} = Ir$
$= (0,75 + 0,63)(1)$ ✓
$= 1,38\ V$
$\varepsilon = V_{terminal} + V_{int}$ ✓
$= 19 + 1,38$
$= 20,38\ V$ ✓✓

(3)

OPTION 3/OPSIE 3

$R = \dfrac{V}{I} = \dfrac{19}{0,63} = 30,16\ \Omega$

$\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} = \dfrac{1}{30,16} + \dfrac{1}{25,33}$ $\therefore R_p = 13,77\ \Omega$

$\varepsilon = I(R + r)$ ✓
$= (1,38)(13,77 + 1)$ ✓
$= 20,38\ V$ ✓

[14]

QUESTION 10/VRAAG10

10.1.1   Move the bar magnet very quickly✓
up and down inside the coil ✓
*Beweeg die staafmagneet baie vinnig
op en af binne in die spoel.*

(2)

10.1.2   Electromagnetic induction/Elektromagnetiese induksie ✓

(1)

10.1.3   Commutator/kommutator / split rings/spleetringe ✓

(1)

10.2.1

OPTION 1/OPSIE 1

$P_{average} = \dfrac{V^2_{rms}}{R}$ ✓
$= \dfrac{220^2}{40,33}$ ✓
$= 1\ 200,10\ W\ (J \cdot s^{-1})$ ✓

OPTION 2/OPSIE 2

$I_{rms} = \dfrac{V_{rms}}{R}$ ✓
$= \dfrac{220}{40,33}$ ✓
$= 5,45\ A$

$P_{average} = I^2_{rms}R$
$= (5,45^2)(40,33)$ ✓
$= 1\ 197,9\ W$ **OR/OF** $1\ 200,10\ W$ ✓

OPTION 3/OPSIE 3

$I_{rms} = \dfrac{V_{rms}}{R}$ ✓
$= \dfrac{220}{40,33}$ ✓
$= 5,45\ A$

$P_{average} = V_{rms}\ I_{rms}$
$= (220)(5,45)$ ✓
$= 1\ 199\ W$ **or/of** $1\ 200,10\ W$ ✓

(4)

OPTION 1/OPSIE 1

$W = \dfrac{V^2_{rms}}{R}\Delta t$ ✓
$= \dfrac{220^2}{40,33}$ (1) ✓
$= 1200,10\ J$ ✓

OPTION 2/OPSIE 2

$I_{rms} = \dfrac{V_{rms}}{R}$ ✓
$= \dfrac{220}{40,33}$ ✓
$= 5,45\ A$

$W = I^2_{rms}R\Delta t$
$= (5,45^2)(40,33)(1)$ ✓
$= 1\ 197,9\ J$ **OR/OF** $1\ 200,10\ J$ ✓

OPTION 3/OPSIE 3

$I_{rms} = \dfrac{V_{rms}}{R}$ ✓
$= \dfrac{220}{40,33}$ ✓
$= 5,45\ A$

$W = V_{rms}\ I_{rms}\ \Delta t$
$= (220)(5,45)(1)$ ✓
$= 1\ 199\ J$ **or/of** $1\ 200,10\ J$ ✓

(4)

QUESTION 11/VRAAG 11

11.1   It is the process whereby electrons are ejected from a metal surface when light (of suitable frequency) is incident on it. ✓✓
Dit is die proses waartydens elektrone vanaf 'n metaaloppervlak vrygestel word wanneer van geskikte frekwensie daarop inval✓✓   (2)

11.2

Graph of/*Grafiek van* $E_{k(max/maks)}$ vs $\frac{1}{\lambda}$

$\frac{1}{\lambda} \times 10^6 \ (m^{-1})$

$E_{k(max)} \times (10^{-19} \ J)$

10.2.2

OPTION 1/OPSIE 1

$V_{rms} = \dfrac{V_{max}}{\sqrt{2}}$

$220 = \dfrac{V_{max}}{\sqrt{2}}$

$V_{max} = 311,13 \ V$

$I_{max} = \dfrac{V_{max}}{R} = \dfrac{311,13}{40,33}$ ✓

$= 7,71 \ A$ ✓

OR/OF

$P_{ave} = \dfrac{V_{max}I_{max}}{2}$

$1200,1 = \dfrac{(311,13)I_{max}}{2}$
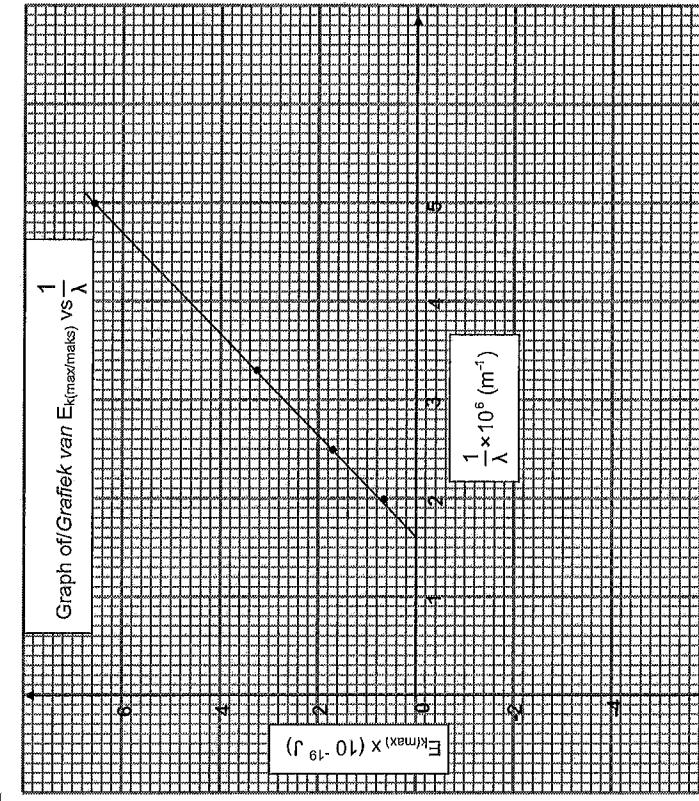
$I_{max} = 7,71 \ A$ (3)

OPTION 2/OPSIE 2

$P_{average} = V_{rms}I_{rms}$ ✓

$1200,1 = (220)I_{rms}$ ✓

$I_{rms} = 5,455 \ A$

$I_{max} = \sqrt{2}(5,455) \qquad (7,715 \ A)$

$= 7,71 \ A$ ✓   (3)

OPTION 3/OPSIE 3

$P_{average} = I_{rms}^2 R$ ✓

$1200,1 = I_{rms}^2 (40,33)$ ✓

$I_{rms} = 5,455 \ A$

$I_{max} = \sqrt{2} I_{rms}$

$= \sqrt{2}(5,455)$

$= 7,71 \ A$ ✓   (3)

OPTION 4/OPSIE 4

$V_{rms} = I_{rms}R$ ✓

$220 = I_{rms}(40,33)$ ✓

$I_{rms} = 5,455 \ A$

$I_{max} = \sqrt{2} I_{rms}$

$= \sqrt{2}(5,455)$

$= 7,71 \ A$ ✓   (3)
          [11]

11.3.1

OPTION 1/OPSIE 1
$\dfrac{1}{\lambda} = 16 \times 10^6 \text{ m}^{-1}$ ✓
$f_o = c \dfrac{1}{\lambda}$ ✓
$= (3 \times 10^8)(1,6 \times 10^6)$ ✓
$= 4,8 \times 10^{14} \text{ Hz}$ ✓ **(Accept/Aanvaar** $4,8 \times 10^{14}$ Hz to/tot $5,1 \times 10^{14}$ Hz)
OPTION 2/OPSIE 2
By extrapolation: y-intercept $= -W_o$/Deur ekstrapolasie : y-afsnit $= -W_o$
$W_o = hf_o$ ✓
$3,2 \times 10^{-19}$ ✓ $= (6,63 \times 10^{-34})f_o$ ✓
$f_o = 4,8 \times 10^{14} \text{ Hz}$ ✓ **(Accept/Aanvaar** $4,8 \times 10^{14}$ Hz to/tot $4,83 \times 10^{14}$ Hz)
OPTION 3/OPSIE 3 (Points from the graph/ Punte vanaf grafiek)
$\dfrac{hc}{\lambda_o} = hf_o + E_{k(max)}$ ✓
$E = W_o + E_{k(max)}$
$(6,63 \times 10^{-34})(3 \times 10^8)(16 \times 10^6)$ ✓ $= (6,63 \times 10^{-34})f_o + 0$ ✓
$f_o = 4,8 \times 10^{14} \text{ Hz}$ ✓
OR/OF
$(6,63 \times 10^{-34})(3 \times 10^8)(5 \times 10^6) = (6,63 \times 10^{-34})f_o + 6,6 \times 10^{-19}$
$f_o = 4,92 \times 10^{14} \text{ Hz}$
OR/OF
$(6,63 \times 10^{-34})(3 \times 10^8)(3,3 \times 10^6) = (6,63 \times 10^{-34})f_o + 3,3 \times 10^{-19}$
$f_o = 4,8 \times 10^{14} \text{ Hz}$
OR/OF
$(6,63 \times 10^{-34})(3 \times 10^8)(2,5 \times 10^6) = (6,63 \times 10^{-34})f_o + 1,7 \times 10^{-19}$
$f_o = 4,94 \times 10^{14} \text{ Hz}$
OR/OF
$(6,63 \times 10^{-34})(3 \times 10^8)(2,2 \times 10^6) = (6,63 \times 10^{-34})f_o + 0,7 \times 10^{-19}$
$f_o = 5,54 \times 10^{14} \text{ Hz}$

(4)

11.3.2

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$hc = $ Gradient/ *Helling* ✓	$W_o = $ y intercept/afsnit ✓
$= \dfrac{\Delta y}{\Delta x}$	$= 3,2 \times 10^{-19} \text{ J}$
$= \dfrac{6,6 \times 10^{-19}}{(5-1,6) \times 10^6}$ ✓	**Accept /Aanvaar** $3,2 \times 10^{-19}$ J to/tot $3,4 \times 10^{-19}$ J)
$= 1,941 \times 10^{-25}$ (J·m)	$W_o = hf_o$
$h = \dfrac{\text{gradient / helling}}{c}$	$3,2 \times 10^{-19}$ ✓ $= h(4,8 \times 10^{14})$ ✓
$h = \dfrac{1,941 \times 10^{-25}}{3 \times 10^8}$ ✓	$h = 6,66 \times 10^{-34}$ J·s ✓
$= 6,47 \times 10^{-34}$ J·s ✓	**Accept /Aanvaar** $6,66 \times 10^{-34}$ J·s to/tot $7,08 \times 10^{-34}$ J·s)

OPTION 3/OPSIE 3	OPTION 4/OPSIE 4
(Points from the graph / *Punte vanaf grafiek*)	$W_o = \dfrac{hc}{\lambda_o}$ or / of $W_o = hc \dfrac{1}{\lambda_o}$
$\dfrac{hc}{\lambda} = W_o + K_{max} = 3,2 \times 10^{-19}$ ✓ $+ 6,6 \times 10^{-19}$ ✓	$3,2 \times 10^{-19}$ ✓ $= h(3 \times 10^8)(1,6 \times 10^6)$ ✓
$h = \dfrac{9,8 \times 10^{-19}}{(3 \times 10^8)(5 \times 10^6)}$ ✓ $= 6,53 \times 10^{-34}$ J·s	$h = 6,66 \times 10^{-34}$ J·s ✓
OR/OF	
$\dfrac{hc}{\lambda} = W_o + K_{max} = 3,2 \times 10^{-19}$ ✓ $+ 3,3 \times 10^{-19}$ ✓	
$h = \dfrac{6,5 \times 10^{-19}}{(3 \times 10^8)(3,3 \times 10^6)}$ ✓ $= 6,57 \times 10^{-34}$ J·s	
OR/OF	
$\dfrac{hc}{\lambda} = W_o + K_{max} = 3,2 \times 10^{-19}$ ✓ $+ 1,7 \times 10^{-19}$	
$h = \dfrac{4,7 \times 10^{-19}}{(3 \times 10^8)(2,5 \times 10^6)}$ ✓ $= 6,27 \times 10^{-34}$ J·s	
OR/OF	
$\dfrac{hc}{\lambda} = W_o + K_{max} = 3,2 \times 10^{-19}$ ✓ $+ 0,7 \times 10^{-19}$ ✓	
$h = \dfrac{3,9 \times 10^{-19}}{(3 \times 10^8)(2 \times 10^6)}$ ✓ $= 6,5 \times 10^{-34}$ J·s	

(4)
[13]

TOTAL/TOTAAL: 150

(4)