



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)**

FEBRUARY/MARCH/FEBRUARIE/MAART 2016

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 16 pages.
*Hierdie memorandum bestaan uit 16 bladsye.***

QUESTION 1/VRAAG 1

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

QUESTION 2/VRAAG 2

2.1 **For the 5 kg mass/Vir die 5 kg massa:**

2.1.1 $T - f = ma$
 $T - \mu_k(mg) = ma \checkmark$
 $T - (0,4)(5)(9,8) \checkmark = 5a \checkmark \dots\dots\dots(1)$

NOTE/LET WEL:
 1 mark for any of the 2 formulae
 1 punt vir enige van die 2 formules

For the 20 kg mass/Vir die 20 kg massa

$mg - T = ma$
 $20(9,8) - T = 20a \checkmark \dots\dots\dots(2)$

$176,4 = 25a \quad (1) + (2)$
 $\therefore a = 7,06 \text{ (7,056) m} \cdot \text{s}^{-2} \checkmark$

(5)

ACCEPT/AANVAAR (4 marks/4 punte)

$F_{\text{net}} = ma$
 $Mg - f = (M + m) a \checkmark$
 $[20(9,8) - (0,4)(5)(9,8)] \checkmark = 25a \checkmark$
 $\therefore a = 7,06 \text{ m} \cdot \text{s}^{-2} \checkmark$

(4)

2.1.2 **POSITIVE MARKING FROM QUESTION 2.1.1**

POSITIEWE NASIEN VANAF VRAAG 2.1.1

OPTION 1/OPSIE 1

$v_f^2 = v_i^2 + 2a\Delta y \checkmark$
 $= 0 \checkmark + (2)(7,056)(6) \checkmark$
 $v_f = 9,20 \text{ m} \cdot \text{s}^{-1} \checkmark$

POSITIVE MARKING FROM QUESTION 2.1.1

POSITIEWE NASIEN VANAF VRAAG 2.1.1

OPTION 2/OPSIE 2

The 5 kg mass travels as fast as the 20 kg mass
 Die 5 kg massa beweeg net so vinnig soos die 20 kg massa

$W_{\text{net}} = \Delta K \checkmark$
 $(5)(7,056)(6 \cos 0^\circ) \checkmark = \frac{1}{2}(5)(v_f^2 - 0) \checkmark$
 $v_f = 9,20 \text{ m} \cdot \text{s}^{-1} \checkmark$

OPTION 3/OPSIE 3

For the 20 kg mass/Vir die 20 kg massa

$W_{\text{net}} = \Delta K \checkmark$
 $Mg - T = Ma$
 $(20)(9,8) - T = (20)(7,056) \checkmark$
 $T = 54,88 \text{ N}$

$W_{\text{net}} = \Delta K$
 $W_T + W_g = \frac{1}{2}m(v_f^2 - v_i^2)$
 $(54,88)(6)(\cos 180) + 20(9,8)(6)(\cos 0) = \frac{1}{2}(20)(v_f^2 - 0) \checkmark$
 $v_f = 9,202 \text{ m} \cdot \text{s}^{-1} \checkmark$

OPTION 4/OPSIE 4

$$W_{nc} = \Delta K + \Delta U \checkmark$$

$$W_{nc} = f_k \Delta x \cos \theta = \mu_k N \Delta x \cos \theta = \Delta U + \Delta K$$

$$(0,4)(5)(9,8)(6) \cos 180^\circ \checkmark = (20)(9,8)(0 - 6) + \frac{1}{2} (25)(v_f^2 - 0) \checkmark$$

$$-117,6 = (20)(9,8)(-6) + \frac{1}{2} (25)(v_f^2 - 0)$$

$$v_f = 9,202 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(4)

2.1.3 6 m ✓

(1)

2.2

2.2.1 Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses ✓ and inversely proportional to the square of the distance between their centres. ✓

Elke liggaam in die heelal trek elke ander liggaam aan met 'n krag wat direk eweredig is aan die produk van hul massas ✓ en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul middelpunte. ✓

(2)

2.2.2

$$F = \frac{Gm_1m_2}{r^2} \checkmark$$

On the mountain/Op die berg

$$F_g = \frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(65)}{(6,38 \times 10^6 + 6 \times 10^3)^2} \checkmark$$

$$= 627,2 \text{ N}$$

On the ground/Op die grond

$$F_g = W = mg$$

$$= (65 \times 9,8) \checkmark$$

$$= 637 \text{ N}$$

$$F_g = \frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(65)}{(6,38 \times 10^6)^2}$$

$$= 636,94 \text{ N}$$

$$\text{Difference/Verskil} = (637 - 627,2) \checkmark$$

$$= 9,8 \text{ N} \checkmark$$

(6)
[18]

QUESTION 3/VRAAG 3

3.1

3.1.1

OPTION 1/OPSIE 1**Upwards positive/Opwaarts positief:**

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

$$v_f^2 = (-2)^2 + 2(-9,8)(-45) \checkmark$$

$$v_f = 29,76 \text{ m}\cdot\text{s}^{-1} \checkmark$$

Downwards positive/Afwaarts positief:

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

$$v_f^2 = (2)^2 + 2(9,8)(45) \checkmark$$

$$v_f = 29,76 \text{ m}\cdot\text{s}^{-1} \checkmark \quad (29,77 \text{ m}\cdot\text{s}^{-1})$$

OPTION 2/OPSIE 2**Upwards positive/Opwaarts positief:**

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

for either equation/vir beide vergelykings

$$-45 = -2\Delta t + \frac{1}{2}(-9,8)\Delta t^2$$

$$-4,9\Delta t^2 - 2\Delta t + 45 = 0$$

$$4,9\Delta t^2 + 2\Delta t - 45 = 0 \checkmark$$

$$\Delta t = 2,83$$

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

$$v_f = 0 + (-9,8)(2,83)$$

$$v_f = -29,73 \text{ m s}^{-1} \checkmark$$

Downwards positive/Afwaarts positief:

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

for either equation/vir beide vergelykings

$$45 = 2\Delta t + \frac{1}{2}(9,8)\Delta t^2$$

$$4,9\Delta t^2 + 2\Delta t - 45 = 0 \checkmark$$

$$\Delta t = 2,83$$

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

$$v_f = 0 + (9,8)(2,83)$$

$$v_f = 29,73 \text{ m s}^{-1} \checkmark$$

OPTION 3/OPSIE 3**Downwards positive/Afwaarts positief:**

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

for either equation/vir beide vergelykings

$$45 = 2\Delta t + \frac{1}{2}(9,8)\Delta t^2$$

$$4,9\Delta t^2 + 2\Delta t - 45 = 0 \checkmark$$

$$\Delta t = 2,83$$

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

$$45 = \frac{2 + v_f}{2} \cdot 2,83$$

$$v_f = 29,80 \text{ m s}^{-1} \checkmark$$

Upwards positive/Opwaarts positief:

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

for either equation/vir beide vergelykings

$$-45 = -2\Delta t + \frac{1}{2}(-9,8)\Delta t^2$$

$$-4,9\Delta t^2 - 2\Delta t + 45 = 0$$

$$4,9\Delta t^2 + 2\Delta t - 45 = 0 \checkmark$$

$$\Delta t = 2,83$$

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

$$-45 = \frac{-2 + v_f}{2} \cdot 2,83 \checkmark$$

$$v_f = -29,80 \text{ m s}^{-1} \checkmark$$

OPTION 4/OPSIE 4

$$E_{\text{mech at top}} = E_{\text{mech at surface of water}}$$

$$\frac{1}{2} m v_i^2 + m g h_i = \frac{1}{2} m v_f^2 + m g h_f \checkmark$$

$$\frac{1}{2} (2)^2 + 9,8(45) = \frac{1}{2} v_f^2 + 0 \checkmark$$

$$v_f = 29,76 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 5/OPSIE 5

$$W_{\text{net}} = : \Delta K \checkmark$$

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

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

$$9,8(45) \cos 0 = \frac{1}{2} (v_f^2 - 2^2) \checkmark$$

$$v_f = 29,76 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(3)

3.1.2

**POSITIVE MARKING FROM 3.1
POSITIEWE NASIEN VANAF 3.1****OPTION 1/OPSIE 1****Upwards positive/Opwaarts positief:**

The balls hit the water at the same instant./Die balle tref die water gelyktydig

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

Ball/Bal A

$$-29,76 = -2 + (-9,8) \Delta t$$

$$\Delta t = 2,83 \text{ s} \checkmark$$

∴ for ball/vir bal B

$$\Delta t_B = 2,83 - 1 = 1,83 \text{ s}$$

∴ for ball/vir bal B

$$\Delta t_B = 2,83 - 1 = 1,83 \text{ s} \checkmark$$

**POSITIVE MARKING FROM 3.1
POSITIEWE NASIEN VANAF
3.1****OPTION 1/OPSIE 1****Downwards positive/Afwaarts positief**

The balls hit the water at the same instant./Die balle tref die water gelyktydig

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

Ball/Bal A

$$29,76 = 2 + (9,8) \Delta t$$

$$\Delta t = 2,83 \text{ s} \checkmark$$

∴ for ball/vir bal B

$$\Delta t_B = 2,83 - 1 = 1,83 \text{ s}$$

∴ for ball/vir bal B

$$\Delta t_B = 2,83 - 1 = 1,83 \text{ s} \checkmark$$

OPTION 2**Upwards positive/Opwaarts positief:**

Ball/Bal A

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

$$-45 = -2 \Delta t + \frac{1}{2} (-9,8) \Delta t^2$$

$$-4,9 \Delta t^2 - 2 \Delta t + 45 = 0$$

$$4,9 \Delta t^2 + 2 \Delta t - 45 = 0$$

$$\Delta t = 2,83 \checkmark$$

∴ for ball/vir bal B

$$\Delta t_B = 2,83 - 1 = 1,83 \text{ s} \checkmark$$

Downwards positive/Afwaarts positief:

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

$$45 = 2 \Delta t + \frac{1}{2} (9,8) \Delta t^2$$

$$4,9 \Delta t^2 + 2 \Delta t - 45 = 0$$

$$\Delta t = 2,83 \checkmark$$

∴ for ball/vir bal B

$$\Delta t_B = 2,83 - 1 = 1,83 \text{ s} \checkmark$$

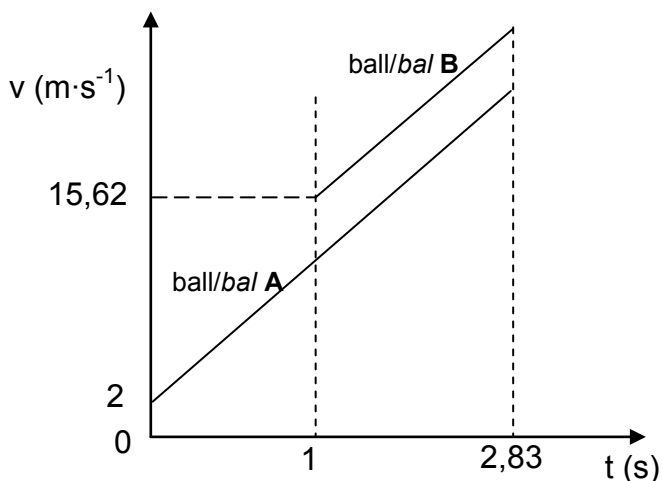
<p>OPTION 3 Downwards positive/Afwaarts positief: Ball/Bal A $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $45 = \frac{2 + 29,76}{2} \Delta t$ $\Delta t = 2,83 \checkmark$ $\therefore \text{for ball/vir bal B}$ $\Delta t_B = 2,83 - 1 = 1,83 \text{ s} \checkmark$</p>	<p>Upwards positive/Opwaarts positief: Ball/Bal A $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark$ $-45 = \frac{-2 - 29,76}{2} \Delta t$ $\Delta t = 2,83 \checkmark$ $\therefore \text{for ball/vir bal B}$ $\Delta t_B = 2,83 - 1 = 1,83 \text{ s} \checkmark$</p>
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(3)

<p>3.1.3 POSITIVE MARKING FROM 3.2/POSITIEWE NASIEN VANAF 3.2 Upwards positive/Opwaarts positief: $\Delta t_B = 1,83 \text{ s} \checkmark$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $-45 \checkmark = v_i (1,83) + \frac{1}{2} (-9,8)(1,83)^2 \checkmark$ $v_i = -15,62 \text{ m} \cdot \text{s}^{-1} \checkmark$</p>	<p>Downwards positive/Afwaarts positief: $\Delta t_B = 1,83 \text{ s} \checkmark$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $45 \checkmark = v_i (1,83) + \frac{1}{2} (9,8)(1,83)^2 \checkmark$ $v_i = 15,62 \text{ m} \cdot \text{s}^{-1} \checkmark$</p>
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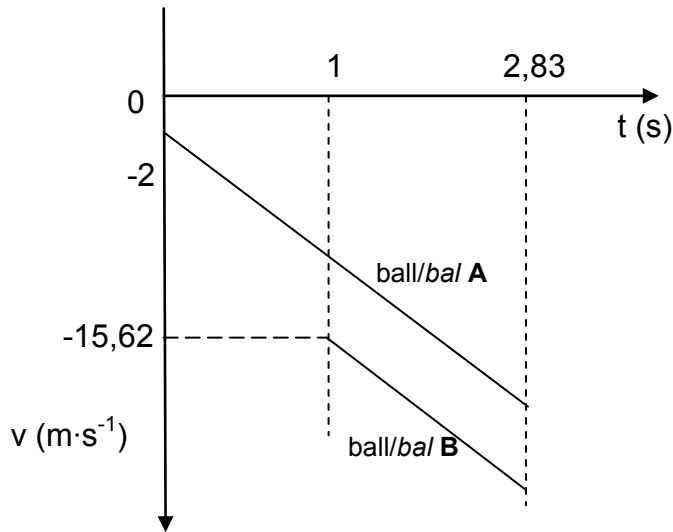
(5)

3.2
POSITIVE MARKING FROM 3.1.2; 3.1.3/POSITIEWE NASIEN VANAF 3.1.2; 3.1.3
CONSIDER MOTION DOWNWARD AS POSITIVE/BESKOU BEWEGING AFWAARTS AS POSITIEF



CRITERIA FOR MARKING/KRITERIA VIR NASIEN	
1 mark for each initial velocity shown/1 punt vir elke beginsnelheid aangedui (For/Vir A 2 m·s ⁻¹ for/vir B 15,62 m·s ⁻¹)	✓✓
Time of release of ball/Tyd van vrystelling van bal B t = 1s	✓
Time of flight for both balls must be indicated as same on time axis/Vlugtyd van beide balle moet op dieselfde tydas aangetoon word (2,83 s)	✓
Shape: Lines must be parallel or nearly so/Vorm: Lyne moet parallel of amper parallel wees	✓

CONSIDER MOTION UPWARD AS POSITIVE/BESKOU OPWAARTSE BEWEGING AS POSITIEF



CRITERIA FOR MARKING/KRITERIA VIR NASIEN	
1 mark for each initial velocity shown/1 punt vir elke beginsnelheid aangedui (For/Vir A $-2 \text{ m}\cdot\text{s}^{-1}$ for/vir B $-15,62 \text{ m}\cdot\text{s}^{-1}$)	✓✓
Time of release of ball/Tyd van vrystelling van bal B $t= 1\text{ s}$	✓
Time of flight for both balls must be indicated as same on time axis/Vlugtyd van beide balle moet op dieselfde tyd as aangetoon word (2,83 s)	✓
Shape: Lines must be parallel or nearly so/Vorm: Lyne moet parallel of amper parallel wees	✓

(5)
[16]

QUESTION 4/VRAAG 4

4.1 The total linear momentum in a closed system ✓ remains constant./is conserved ✓ Die totale lineêre momentum in 'n geslote stelsel ✓ bly konstant/bly behoue. ✓

OR/OF

In a closed/isolated system, the total momentum before a collision is equal to the total momentum after the collision. // In 'n geslote/geïsoleerde stelsel is die totale momentum voor 'n botsing gelyk aan die totale momentum na die botsing. (2)

4.2

4.2.1 $\sum p_i = \sum p_f$ ✓
 $m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$
 $(m_1 + m_2) v_i = m_1 v_{1f} + m_2 v_{2f}$

0 ✓ = $(0,4)v_{1f} + 0,6(4)$ ✓
 $v_{1f} = -6 \text{ m} \cdot \text{s}^{-1}$
 = $6 \text{ m} \cdot \text{s}^{-1}$ to the left/na links ✓

NOTE: Mark for final answer to be forfeited if direction is not given/
LET WEL: Punt vir finale antwoord word verbeur indien rigting nie gegee word nie. (4)

4.2.2

<p><u>OPTION 1/OPSIE 1</u> $\Delta p = F_{\text{net}} \Delta t$ ✓ $[(0,6)(4) - 0]$ ✓ = $F_{\text{net}} (0,3)$ ✓ $F_{\text{net}} = 8 \text{ N}$ ✓</p> <p><u>OR/OF</u> $m(v_f - v_i) = F_{\text{net}} \Delta t$ ✓ $0,6(4 - 0)$ ✓ = $F_{\text{net}}(0,3)$ ✓ $F_{\text{net}} = 8 \text{ N}$ ✓</p>	<p><u>OPTION 2/OPSIE 2</u> $v_f = v_i + a \Delta t$ $4 = 0 + a(0,3)$ $a = 13,33 \text{ m} \cdot \text{s}^{-2}$</p> <p>$F_{\text{net}} = ma$ $= 0,6(13,33)$ $F_{\text{net}} = 8 \text{ N}$ ✓</p>
<p><u>OPTION 3/OPSIE 3</u> $\Delta p = F_{\text{net}} \Delta t$ ✓ $[(0,4)(6) - 0]$ ✓ = $F_{\text{net}} (0,3)$ ✓ $F_{\text{net}} = 8 \text{ N}$ ✓</p> <p><u>OR/OF</u> $m(v_f - v_i) = F_{\text{net}} \Delta t$ ✓ $0,4(6 - 0)$ ✓ = $F_{\text{net}}(0,3)$ ✓ $F_{\text{net}} = 8 \text{ N}$ ✓</p>	<p><u>OPTION 4/OPSIE 4</u> $v_f = v_i + a \Delta t$ $6 = 0 + a(0,3)$ $a = 20 \text{ m} \cdot \text{s}^{-2}$</p> <p>$F_{\text{net}} = ma$ $= 0,4(20)$ $F_{\text{net}} = 8 \text{ N}$ ✓</p>

4.3 No/Nee ✓

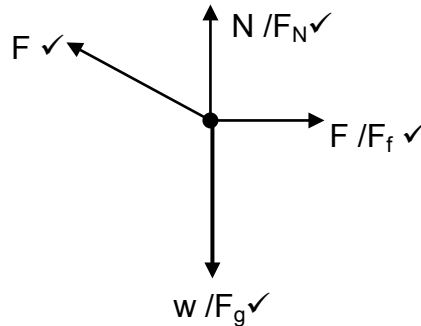
(1)
[11]

QUESTION 5/VRAAG 5

5.1 It is a ratio of two forces ✓ (hence units cancel out)./Dit is 'n verhouding van twee kragte ✓ (dus word eenhede uitgekansleer) (1)

5.2 The net work done on an object is equal ✓ to the change in kinetic energy of the object ✓ /Die netto arbeid wat op 'n voorwerp verrig word, is gelyk ✓ aan die verandering in kinetiese energie van die voorwerp ✓ (2)

5.3



(4)

5.4 $F \sin 20^\circ + N = mg$ ✓
 $N = mg - F \sin 20^\circ$

$$\begin{aligned}
 W_{fk} &= f_k \Delta x \cos \theta = \mu_k N \Delta x \cos \theta \checkmark \\
 &= \mu_k (mg - F \sin 20^\circ) (3) \cos \theta \\
 &= \underline{(0,2)[200(9,8) - F \sin 20^\circ] (3) \cos 180^\circ} \checkmark \\
 &= (-1176 + 0,205 F) \text{ J} \checkmark
 \end{aligned}$$

(4)

5.5 $W_{tot} = [W_g] + W_f + W_F$ ✓
 $0 \checkmark = [0] + [(-1176 + 0,205 F)] + [F (\cos 20^\circ) (3) (\cos 0^\circ)] \checkmark$
 $F = 388,88 \text{ N} \checkmark$

NOTE: Do not penalise if value of W_g is not indicated/

LET WEL: Moenie penaliseer indien die waarde van W_g nie aangedui word nie.

(4)

[15]

QUESTION 6/VRAAG 6

6.1 $v = f\lambda$ ✓
 $= (222 \times 10^3)(1,5 \times 10^{-3})$ ✓
 $= 333 \text{ m}\cdot\text{s}^{-1}$ ✓ (3)

6.2
6.2.1 Towards the bat/Na die vlermuis toe ✓ (1)

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

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \text{ OR/OF } f_L = \frac{v}{v - v_s} f_s \quad \checkmark$$
$$230,3 = \frac{333}{333 - v_s} (222) \quad \checkmark$$
$$76689,9 - 230,3 v_s = 73\,926$$
$$v = 12 \text{ m}\cdot\text{s}^{-1} \quad \checkmark \quad (\text{towards bat/na die vlermuis toe})$$

Notes/Notas:

- Any other Doppler formula, e.g./Enige ander Doppler-formule, bv.:
$$f_L = \frac{v - v_L}{v - v_s} - \text{Max./Maks. } \frac{3}{4}$$
- Marking rule 1.5: No penalisation if zero substitutions are omitted./Nasienreël 1.5: Geen penalisering indien nulvervangings uitgelaat is nie.

(6)
[10]

QUESTION 7/VRAAG 7

7.1 The magnitude of the charges are equal ✓ / The balls repel each other with the same/identical force or force of equal magnitude ✓ / Die grootte van die ladings is gelyk ✓ / Die balle stoot mekaar af met dieselfde/identiese kragte of krag van dieselfde grootte. ✓ (1)

7.2 The electrostatic force of attraction between two point charges is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between them. ✓ / Die elektrostatische aantrekkingskrag tussen twee puntladings is direk eweredig aan die produk van die ladings ✓ en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. ✓ (2)

7.3
7.3.1 $T \cos 20^\circ = w$ ✓
 $= mg$
 $= (0,1)(9,8)$ ✓ = 0,98 N
 $\therefore T = 1,04 \text{ N}$ ✓ (3)

7.3.2 **POSITIVE MARKING FROM 7.3/POSITIEWE NASIEN VANAF 7.3**

$$F_{\text{electrostatic/elektrostaties}} = T \sin 20^\circ \checkmark$$

$$\frac{kQ_1 Q_2}{r^2} \checkmark = (1,04) \sin 20^\circ$$

$$\frac{kQ_1 Q_2}{r^2} = 0,356$$

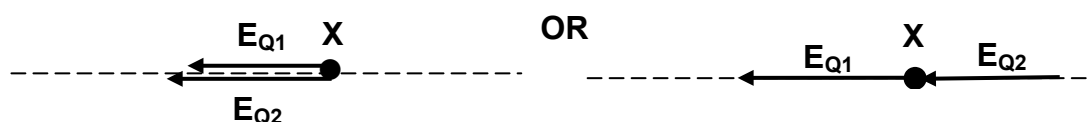
$$\frac{(9 \times 10^9)(250 \times 10^{-9})(250 \times 10^{-9})}{r^2} \checkmark = 0,356 \checkmark$$

$$\therefore r = 0,0397 \text{ m} \checkmark$$

(5)
[11]

QUESTION 8/VRAAG 8

8.1



Vectors E_{Q1} and E_{Q2} in the same direction $\checkmark \checkmark$ / Vektore E_{Q1} en E_{Q2} in dieselfde rigting $\checkmark \checkmark$

Correct drawing of vectors E_{Q1} and E_{Q2} $\checkmark \checkmark$ / Korrekte tekening van vektore E_{Q1} en E_{Q2} $\checkmark \checkmark$

The fields due to the two charges add up because they come from the same direction. Hence the field cannot be zero. / Die velde as gevolg van die twee ladings word bymekaar getel omdat hulle uit dieselfde rigting inwerk. Die veld kan dus nie nul wees nie.

(4)

8.2 $E = k \frac{Q}{r^2} \checkmark$

$$E_{-2,5\mu\text{C}} = k \frac{Q}{r^2} = \frac{(9 \times 10^9)(2,5 \times 10^{-6})}{(0,3)^2} \checkmark = 250\,000 \text{ N.C}^{-1} \text{ to the left/na links}$$

$$E_{6\mu\text{C}} = k \frac{Q}{r^2} = \frac{(9 \times 10^9)(6 \times 10^{-6})}{(1,3)^2} \checkmark = 31\,952,66 \text{ N.C}^{-1} \text{ to the left/na links}$$

$$\begin{aligned} E_P &= E_{6\mu\text{C}} + E_{-2,5\mu\text{C}} \checkmark \\ &= 31\,952,66 + 250\,000 \\ &= 281\,952,66 \text{ N.C}^{-1} \checkmark \text{ to the left/na links} \checkmark \end{aligned}$$

(6)
[10]

QUESTION 9/VRAAG 9

9.1

9.1.1 $V = IR \checkmark$
 $= (0,2)(4+8) \checkmark$
 $= 2,4 \text{ V} \checkmark$

(3)

9.1.2 **POSITIVE MARKING FROM QUESTION 9.1.1/POSITIEWE NASIEN VANAF VRAAG 9.1.1**

$V = IR$ $2,4 = I_2(2) \checkmark$ $I_{2\Omega} = 1,2 \text{ A} \checkmark$ $I_T = I_2 + 0,2 \text{ A} \checkmark$ $= 1,4 \text{ A} \checkmark$	OR $I_2 = 6 \times 0,2 \checkmark$ $I_2 = 1,2 \text{ A} \checkmark$ $I_T = I_2 + 0,2 \checkmark$ $= 1,4 \text{ A} \checkmark$
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(4)

9.1.3 **POSITIVE MARKING FROM QUESTION 9.1.2/POSITIEWE NASIEN VANAF VRAAG 9.1.2**

OPTION 2/OPSIE 2 $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$ $\frac{1}{R_p} = \frac{1}{12} + \frac{1}{2} \checkmark$ $R_p = 1,72 \Omega \checkmark$ $\varepsilon = I(R+r) \checkmark$ $= 1,4(1,72 + 0,5) \checkmark$ $= 3,11 \text{ V} \checkmark$	OR/OF $R_p = \frac{R_1 R_2}{R_1 + R_2} \checkmark$ $R_p = \frac{(12)(2)}{12 + 2} \checkmark$ $= 1,71 \Omega \checkmark$ $\varepsilon = I(R+r) \checkmark$ $= 1,4(1,71 + 0,5) \checkmark$ $= 3,09 \text{ V} \checkmark$
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OPTION 2/OPSIE 2 $V_{int} = Ir \checkmark$ $= (1,4)(0,5) \checkmark$ $= 0,7 \text{ V} \checkmark$ $\varepsilon = V_{ext/eks} + V_{int} \checkmark$ $= 2,4 + 0,7 \checkmark$ $= 3,1 \text{ V} \checkmark$

(5)

9.2 Removing the 2 Ω resistor increases the total resistance of the circuit. ✓ Thus the total current decreases, decreasing the V_{int} (V_{lost}). ✓ Therefore the voltmeter reading increases. ✓ *Wanneer die 2 Ω-resistor verwyder word, verhoog dit die totale weerstand van die kring. ✓ Dus verklein die totale stroom, wat die V_{int} ($V_{verloor}$) verlaag. ✓ Dus verhoog die voltmeterlesing V.* ✓

(3)

[15]

QUESTION 10/VRAAG 10

10.1

10.1.1 North pole/Noordpool✓

(1)

10.1.2 Q to P✓

(1)

10.2

10.2.1 **OPTION 1/OPSIE 1**

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

$$I_{\text{rms}} = \frac{8}{\sqrt{2}} \checkmark$$

$$= 5,66 \text{ A}$$

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

$$220 = (5,66)R \checkmark$$

$$R = 38,87 \Omega \checkmark$$

(5)

OPTION 2/OPSIE 2

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

$$220 = \frac{V_{\text{max}}}{\sqrt{2}} \checkmark$$

$$V_{\text{max}} = 311,12 \text{ V}$$

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

$$311,12 = (8)R \checkmark$$

$$R = 38,89 \Omega \checkmark$$

10.2.2 **POSITIVE MARKING FROM QUESTION 10.4.1/POSITIEWE NASIEN
VANAF VRAAG 10.4.1**

OPTION 1/OPSIE 1

$$P_{\text{average}} = V_{\text{rms}} I_{\text{rms}} \checkmark$$
$$= (220)(5,66) \checkmark$$
$$= 1\,245,2 \text{ W}$$

$$P = \frac{W}{\Delta t} \checkmark$$

$$1\,245,2 = \frac{W}{7200} \checkmark$$

$$W = 8\,965\,440 \text{ J} \checkmark$$

$$P_{\text{average}} = I_{\text{rms}}^2 R$$
$$= (5,66)^2(38,89)$$
$$= 1\,245,86$$
$$E = Pt$$
$$= (1\,245,86)(7200)$$
$$= 8\,970\,192 \text{ J}$$

(5)

OPTION 2/OPSIE 2

$$P_{\text{average}} = I_{\text{rms}}^2 R \checkmark$$
$$= (5,66)^2 (38,87) \checkmark$$
$$= 1\,245,22 \text{ W} \checkmark$$
$$1245,22 = \frac{W}{7200} \checkmark$$
$$W = 8\,965\,584 \text{ J} \checkmark$$

OPTION 3/OPSIE 3

$$P_{\text{average}} = \frac{V_{\text{rms}}^2}{R} \checkmark$$
$$P_{\text{average}} = \frac{220^2}{38,87} \checkmark$$
$$= 1245,18 \text{ W}$$
$$P = \frac{W}{\Delta t} \checkmark$$
$$1245,18 = \frac{W}{7200} \checkmark$$
$$W = 8\,965\,296 \text{ J} \checkmark$$

$$P_{\text{average}} = \frac{V_{\text{rms}}^2}{R}$$
$$P_{\text{average}} = \frac{220^2}{38,89}$$
$$= 1244,54 \text{ W}$$
$$E = Pt$$
$$= (1244,54)(7200)$$
$$= 8960688 \text{ J}$$

OPTION 3/OPSIE 3

$$W = I_{\text{rms}}^2 R \Delta t$$
$$= \left(\frac{I_{\text{max}}}{\sqrt{2}} \right)^2 R \Delta t$$
$$= \left(\frac{8}{\sqrt{2}} \right)^2 (38,87)(7200)$$
$$W = 8\,965\,296 \text{ J} \checkmark$$

(5)
[12]

QUESTION 11/VRAAG 11

11.1 It is the minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓/Dit is die minimum energie wat 'n elektron in die metaal benodig om elektrone uit die metaaloppervlak vry te stel. ✓ (2)

11.2 Frequency/Intensity ✓/Frekwensie/Intensiteit (1)

11.3 The minimum frequency required to remove an electron from the surface of the metal ✓/Die minimum frekwensie benodig om 'n elektron vanaf die oppervlak van die metaal te verwyder ✓ (2)

**11.4 POSITIVE MARKING FROM QUESTION 11.4/
 POSITIEWE NASIEN VANAF VRAAG 11.4**

$$\left. \begin{aligned} E &= W_0 + E_k \\ hf &= hf_0 + E_k \end{aligned} \right\} \text{✓ Any one/Enige een}$$

$$(6,63 \times 10^{-34})(6,50 \times 10^{14}) \checkmark = (6,63 \times 10^{-34})(5,001 \times 10^{14}) \checkmark + \frac{1}{2}(9,11 \times 10^{-31})v^2 \checkmark$$

$$\therefore v = 4,67 \times 10^5 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OR/OF

$$\left. \begin{aligned} E_k &= E_{\text{light}} - W_0 \\ &= hf_{\text{light}} - hf_0 \end{aligned} \right\} \text{✓ Any one/Enige een}$$

$$= (6,63 \times 10^{-34})(6,50 \times 10^{14} - 5,001 \times 10^{14}) \checkmark$$

$$= 9,94 \times 10^{-20} \text{ J}$$

$$E_k = \frac{1}{2}mv^2 \checkmark$$

$$v = \sqrt{\frac{2E_k}{m}} = \sqrt{\frac{(2)(9,94 \times 10^{-20})}{9,11 \times 10^{-31}}} \checkmark$$

$$v = 4,67 \times 10^5 \text{ m}\cdot\text{s}^{-1} \checkmark \quad (5)$$

11.5 The photocurrent is directly proportional to the intensity of the incident light. ✓✓/Die fotostroom is direk eweredig aan die intensiteit van die invallende lig. ✓✓ (2)
[12]

TOTAL/TOTAAL: 150