

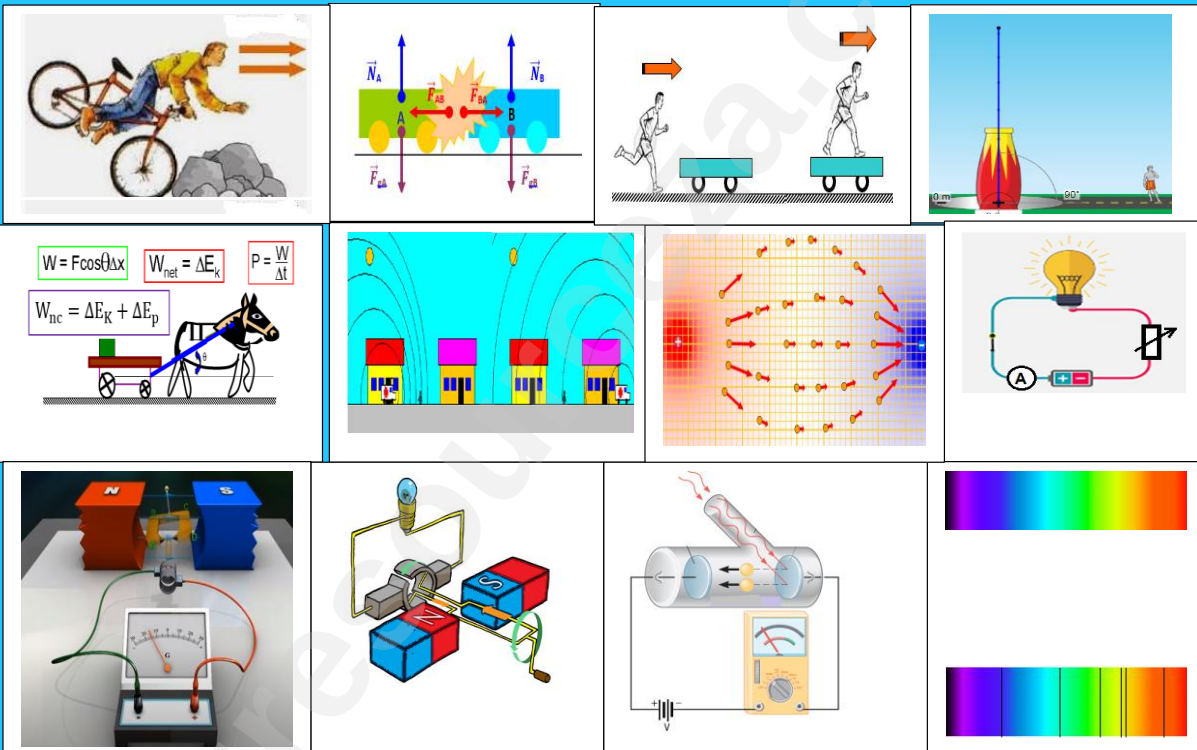


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NORTHERN CAPE DEPARTMENT OF EDUCATION
NOORD- KAAP DEPARTEMENT VAN ONDERWYS



PHYSICAL SCIENCES
FISIESE WETENSKAPPE
GRADE 12 / GRAAD 12



PHYSICS / FISIKA
WORKBOOK TEACHER'S GUIDE
WERKBOEK ONDERWYSESGIDS

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2020

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SOLUTIONS/OPLOSSINGS

TOPIC 1/ONDERWERP 1/MECHANICS/MEGANIKA

1.1. NEWTON'S LAWS AND APPLICATION OF NEWTON'S LAWS/NEWTON SE WETTE
EN TOEPASSING VAN NEWTON SE WETTE.

QUESTION 1/VRAAG 1

- | | | |
|------|-----|-----|
| 1.1 | B✓✓ | (2) |
| 1.2 | D✓✓ | (2) |
| 1.3 | B✓✓ | (2) |
| 1.4 | A✓✓ | (2) |
| 1.5 | A✓✓ | (2) |
| 1.6 | C✓✓ | (2) |
| 1.7 | B✓✓ | (2) |
| 1.8 | D✓✓ | (2) |
| 1.9 | C✓✓ | (2) |
| 1.10 | D✓✓ | (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
$T = mg$ ✓ $\therefore T = (2,5)(9,8)$ ✓ $= 24,5 \text{ N}$ ✓	$F_{\text{net}} = ma$ $T - mg = (2,5)(0)$ } ✓ $T - (2,5)(9,8)$ ✓ = 0 $T = 24,5 \text{ N}$ ✓	$F_{\text{net}} = ma$ $mg - T = (2,5)(0)$ } ✓ $(2,5)(9,8) - T$ ✓ = 0 $T = 24,5 \text{ N}$ ✓

(3)

- 2.1.3

POSITIVE MARKING FROM 2.1.2 POSITIEWE NASIEN VANAF 2.1.2 For mass M/ Vir mass M $f_s = \mu_s N$ ✓ $\therefore N = \frac{24,5}{0,2} = 122,5 \text{ N}$ ✓ $N = Mg = 122,5 \text{ N}$ <u>$M(9,8) = 122,5 \text{ N}$</u> ✓ $M = 12,5 \text{ kg}$ ✓	OR/OF $\mu_s N = \mu_s Mg$ $24,5 = (0,2) M(9,8)$ ✓ $M = 12,5 \text{ kg}$ ✓
--	--

(5)



2.1.4

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

$$f_k = \mu_k N$$

$$f_k = (0,15)(5)(9,8) \checkmark$$

$$= 7,35 \text{ N}$$

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

$$T - f_k = ma$$

$$T - 7,35 = 5a \checkmark$$

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

$$w - T = ma$$

$$(2,5)(9,8) - T = 2,5 a \checkmark$$

$$17,15 = 7,5 a$$

$$a = 2,29 \text{ m} \cdot \text{s}^{-2} \checkmark$$

(5)

2.2

$$F = G \frac{m_1 m_2}{r^2} \checkmark$$

$$F = \frac{(6,67 \times 10^{-11})(6,5 \times 10^{20})(90)}{(550 \times 10^3)^2} \checkmark$$

$$= 12,90 \text{ N} \checkmark (12,899 \text{ N})$$

(4)

OR/OF

$$g = \frac{Gm}{r^2} \checkmark$$

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

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

$$w = mg$$

$$= (90)(0,143 \dots) \checkmark$$

$$= 12,89 \text{ N} \checkmark (\text{downwards/afwaarts})$$

(4)

[19]



QUESTION3/VRAAG 3

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

3.1.1 $T - f = ma$

$T - \mu_k(mg) = ma \checkmark$

$T - (0,4)(5)(9,8) \checkmark = 5a \checkmark \dots\dots\dots(1)$

NOTE/LET WEL:

1 mark for any of the 2 formulae

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)

3.1.2 **POSITIVE MARKING FROM QUESTION 3.1.1**

POSITIEWE NASIEN VANAF VRAAG 3.1.1

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 3.1.1

POSITIEWE NASIEN VANAF VRAAG 3.1.1

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)

3.1.3 6 m ✓

(1)

3.2

- 3.2.1 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)

3.2.2 $F = \frac{Gm_1m_2}{r^2} \checkmark$

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

$$F_g = W = mg$$

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

$$= 637 \text{ N}$$

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

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

(6)

[18]

QUESTION 4/VRAAG 4

- 4.1 When a resultant/net force acts on an object, the object will accelerate in the (direction of the net/resultant force). The acceleration is directly proportional to the net force ✓ and inversely proportional to the mass ✓ of the object.

Wanneer 'n netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die netto krag teen 'n versnelling direk eweredig aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

OR/OF

The resultant/net force acting on the object is equal (is directly proportional to) to the rate of change of momentum of an object (in the direction of the force). ✓✓

Die resulterende/netto krag wat op 'n voorwerp inwerk, is gelyk aan (is direk eweredig aan) die tempo van verandering van momentum van die voorwerp (in die rigting van die netto krag).

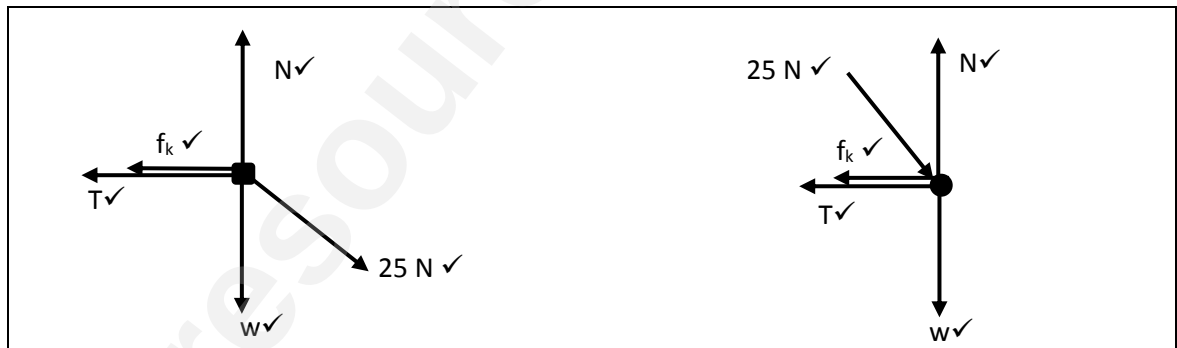
(2)

- 4.2

$$\begin{aligned} f_k &= \mu_k N \checkmark = \mu_k mg \\ &= (0,15)(3)(9,8) \checkmark \\ &= 4,41 \text{ N} \checkmark \end{aligned}$$

(3)

- 4.3



Accepted Labels/Aanvaarde benoemings	
w	F_g/F_w /force of Earth on block/weight/14,7 N/mg/gravitational force F_g/F_w /krag van Aarde op blok/gewig/14,7 N/mg/gravitasiekrag
N	F_N/F_{normal} /normal force F_N/F_{normaal} /normalekrag
T	Tension/ F_T Spanning/ F_T
f_k	$f_{\text{kinetic friction/kinetiesewrywing}}/f_t/w/f//F_{f/w}$ kinetic friction/kinetiesewrywing
25 N	$F_{\text{applied}}/F_A/F$ $F_{\text{toegepas}}/F_A/F$



4.4.1

OPTION 1/OPSIE 1 $f_k = \mu_k N = \mu_k(25 \sin 30^\circ + mg)$ $= 0,15[(25 \sin 30^\circ) \checkmark + (1,5)(9,8) \checkmark]$ $= 4,08 \text{ N} \checkmark$	OPTION 2/OPSIE 2 $f_k = \mu_k N = \mu_k(25 \cos 60^\circ + mg)$ $= 0,15[(25 \cos 60^\circ) \checkmark + (1,5)(9,8) \checkmark]$ $= 4,08 \text{ N} \checkmark$
---	---

(3)

4.4.2

POSITIVE MARKING FROM

QUESTION 4.2 AND QUESTION 4.4.1

POSITIEWE NASIEN VANAF VRAAG 4.2 EN VRAAG 4.4.1

OPTION 1/OPSIE 1

For the 1,5 kg block/ *Vir die 1,5 kg blok*

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

$$F_x + (-T) + (-f_k) = ma \quad \checkmark$$

$$25 \cos 30^\circ - T - f_k = 1,5a$$

$$(25 \cos 30^\circ - T) - 4,08 \square = 1,5a$$

$$17,571 - T = 1,5a \dots\dots\dots(1)$$

For the 3 kg block
Vir die 3 kg blok

$$T - f_k = 3a$$

$$T - 4,41 \square = 3a \dots\dots\dots(2)$$

$$13,161 = 4,5 a$$

$$a = 2,925 \text{ m} \cdot \text{s}^{-2}$$

$$T = 13,19 \text{ N} \checkmark \quad (13,17 \text{ N} - 13,19 \text{ N})$$

$\checkmark$ either one



OPTION 2/OPSIE 2	OPTION 3/OPSIE 3
For the 1,5 kg block/<i>Vir die 1,5 kg blok</i> $F_{\text{net}} = ma$ $F_x + (-T) + (-f_k) = ma$ } ✓ $25 \cos 30^\circ - T - f_k = 1,5a$ $(25 \cos 30^\circ - T) - 4,08 = 1,5a$ $17,571 - T = 1,5a \dots\dots\dots(1)$ For the 3 kg block <i>Vir die 3 kg blok</i> $T - f_k = 3a$ $T - 4,41 = 3a \dots\dots\dots(2)$ $35,142 - 2T = T - 4,41$ $T = 13,18 \text{ N} \checkmark$	For the 1,5 kg block/<i>Vir die 1,5 kg blok</i> $F_{\text{net}} = ma$ $F_x + (-T) + (-f_k) = ma$ } ✓ $25 \cos 30^\circ - T - f_k = 1,5a$ $(25 \cos 30^\circ - T) - 4,08 = 1,5a$ $17,571 - T = 1,5a \dots\dots\dots(1)$ $a = \frac{17,571 - T}{1,5}$ For the 3 kg block <i>Vir die 3 kg blok</i> $T - f_k = 3a$ $T - 4,41 = 3a \dots\dots\dots(2)$ $a = \frac{T - 4,41}{3}$ $\frac{17,571 - T}{1,5} = \frac{T - 4,41}{3}$ $T = 13,18 \text{ N} \square$

(5)
[18]

QUESTION 5/VRAAG 5

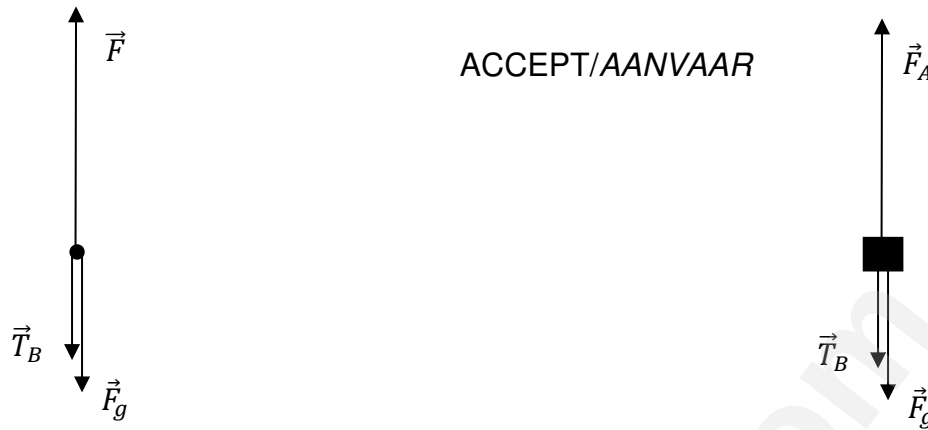
- 5.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force and the acceleration is directly proportional to the force ✓ and inversely proportional to the mass of the object. ✓

Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag teen 'n versnelling direk eweredig aan die krag ✓ *en omgekeerd eweredig aan die massa van die voorwerp.* ✓

(2)



5.2



Accepted labels/Aanvaarde benoemings		
F	F _{app} / F _A /applied force (accept T/tension) F _{toegepas} / F _T /toegepaste krag/(aanvaar T/spanning)	✓
F _g	w/F _w /weight/mg/gravitational force w/F _w /gewig/mg/gravitasiekrag	✓
T	F _T /Tension/Spanning	✓

Notes/Aantekeninge

- Marks awarded for label and arrow./Punt toegeken vir benoeming en pyltjie.
- Do not penalise for length of arrows since drawing is not to scale./Moenie vir die lengte van die pyltjies penaliseer nie aangesien die tekening nie volgens skaal is nie.
- Any other additional force(s)./Enige ander ekstra krag(te). Max/Maks $\frac{2}{3}$
- If force(s) do not make contact with body./Indien krag(te) nie met die voorwerp kontak maak nie: Max/Maks $\frac{2}{3}$
- Do not penalise if vector notation is not used./Moenie penaliseer indien vektor notasie nie gebruik is nie.

(3)

5.3.1 $\Sigma \vec{F}_y = \vec{0}$

$\vec{N} + \vec{F}_g = \vec{0}$

$N - F_g = 0$

$N = mg$

$N = 4,0 \times 9,8 \checkmark$

$N = 39,20 \text{ N} \checkmark$

✓Any one/Enige een

(3)



Note/Aantekening: Do not penalise if vectors notation is not used./Moenie penaliseer indien vektore notasie nie gebruik word nie.

5.3.2 **OPTION 1/OPSIE 1**

$$\Sigma \vec{F} = m\vec{a} \checkmark \quad \text{OR/OF} \quad \vec{F}_{\text{net}} = m\vec{a} \quad \text{OR/OF} \quad F_{\text{net}} = ma$$

Direction of motion as positive/Rigting van beweging as positief

Block A/Blok A

$$\vec{T} + \vec{f}_k = m_A \vec{a} \quad \text{OR/OF} \quad T + f_k = m_A a$$

$$T - f_k = m_A a$$

$$T - 11,76 = 4a \quad (1)$$

✓ Any one/Enige een

Block B/Blok B:

$$\vec{T} + \vec{F}_g + \vec{F} = m_B \vec{a} \quad \text{OR/OF} \quad T + F_g + F = m_B a$$

$$-T - F_{g(B)} + F = m_B a$$

$$-T - m_B g + F = m_B a$$

$$-T - (8)(9,8) + 96 = 8a$$

$$-T - 78,4 + 96 = 8a$$

$$-T + 17,6 = 8a \quad (2)$$

✓ Any one/Enige een

Solving (1) and (2)/Los (1) en (2) op:

$$T - 11,76 - T - (8)(9,8) + 96 = 4a + 8a$$

$$T - 11,76 - T - 78,4 + 96 = 12a$$

$$a = 0,49 \text{ m} \cdot \text{s}^{-2}$$

✓ Any one/Enige een

$$T - 11,76 = 4(0,49) \quad \checkmark \quad \text{OR/OF} \quad -T - 78,4 + 96 = 8(0,49)$$

$$T = 13,72 \text{ N} \quad \checkmark \quad \text{OR/OF} \quad T = 13,68 \text{ N} \quad \checkmark \quad \text{OR/OF} \quad T = 13,71 \text{ N} \quad \checkmark$$



OPTION 2/OPSIE 2

$$\Sigma \vec{F} = m\vec{a} \checkmark \quad \text{OR/OF} \quad \vec{F}_{\text{net}} = m\vec{a} \quad \text{OR/OF} \quad F_{\text{net}} = ma$$

Direction of motion as negative / *Rigting van beweging as negatief*

Block A / *Blok A*:

$$\vec{T} + \vec{f}_k = m_A \vec{a} \quad \text{OR/OF} \quad T + f_k = m_A a$$

$$-T + f_k = m_A a$$

$$-T + 11,76 = 4a \quad (1)$$

Block B / *Blok B*:

$$\vec{T} + \vec{F}_{g(B)} + \vec{F} = m_B \vec{a} \quad \text{OR/OF} \quad T + F_{g(B)} + F = m_B a$$

$$T + F_g - F = m_B a$$

$$T + m_B g - F = m_B a$$

$$T + (8)(9,8) - 96 = 8a$$

$$T + 78,4 - 96 = 8a \quad (2)$$

$$T - 17,6 = 8a$$

Solving 1 and 2 / *Los 1 en 2 op*:

$$-T + 11,76 + T + (8)(9,8) - 96 = 4a + 8a$$

$$-T + 11,76 + T + 78,4 - 96 = 12a$$

$$a = -0,49 \text{ m} \cdot \text{s}^{-2}$$

$$-T + 11,76 = 4(-0,49) \quad \checkmark \quad \text{OR/OF} \quad T + 78,4 - 96 = 8(-0,49)$$

$$T = 13,72 \text{ N} \checkmark$$

OPTION 3/OPSIE 3

$$\Sigma \vec{F} = m\vec{a} \checkmark \quad \text{OR/OF} \quad \vec{F}_{\text{net}} = m\vec{a} \quad \text{OR/OF} \quad F_{\text{net}} = ma$$

Direction of motion as positive / *Rigting van beweging as positief*



Block A/Blok A:

$$\vec{T} + \vec{f}_k = m_A \vec{a} \quad \text{OR/OF} \quad T + f_k = m_A a$$

$$T - f_k = m_A a$$

$$T - 11,76 = 4a$$

$$a = \frac{T - 11,76}{4} \quad (1)$$

Block B/Blok B:

$$\vec{T} + \vec{F}_g + \vec{F} = m_B \vec{a} \quad \text{OR/OF} \quad T + F_g + F = m_B a$$

$$-T - F_{g(B)} + F = m_B a$$

$$-T - m_B g + F = m_B a$$

$$-T - (8)(9,8) + 96 = 8a$$

$$-T - 78,4 + 96 = 8a \quad (2)$$

Substitute (1) into (2)/Vervang (1) in (2):

$$(-T - 78,4 + 96) \checkmark = 8 \left(\frac{T - 11,76}{4} \right) \checkmark$$

$$T = 13,71 \text{ N} \checkmark$$

OPTION 4/OPSIE 4

$$\Sigma \vec{F} = m \vec{a} \checkmark \quad \text{OR/OF} \quad \vec{F}_{\text{net}} = m \vec{a} \quad \text{OR/OF} \quad F_{\text{net}} = ma$$

Direction of motion as negative/Rigting van beweging as negatief

Block A/Blok A:

$$\vec{T} + \vec{f}_k = m_A \vec{a} \quad \text{OR/OF} \quad T + f_k = m_A a$$

$$-T + f_k = m_A a$$

$$-T + 11,76 = 4a$$

$$a = \frac{-T + 11,76}{4} \quad (1)$$

Block B/Blok B:



$$\vec{T} + \vec{F}_g + \vec{F} = m_B \vec{a} \quad \text{OR/OF } T + F_g + F = m_B a$$

$$+T + F_{g(B)} - F = m_B a$$

$$+T + m_B g - F = m_B a$$

$$+T + (8)(9,8) - 96 = 8a$$

$$+T + 78,4 - 96 = 8a \quad (2)$$

Substitute (1) into (2)/Vervang (1) in (2):

$$(+T + 78,4 - 96) \checkmark = 8 \left(\frac{-T + 11,76}{4} \right) \checkmark$$

$$T = 13,71 \text{ N} \checkmark$$

Note/Aantekening: Do not penalise if vector notation is not used./Moenie penaliseer indien vektornotasie nie gebruik is nie.

(6)

[14]

QUESTION 6/VRAAG 6

- 6.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force at an acceleration directly proportional to the force ✓ and inversely proportional to the mass ✓ of the object.

Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel teen 'n versnelling direk eweredig aan die krag ✓ en omgekeerd eweredig aan die massa ✓ van die voorwerp.

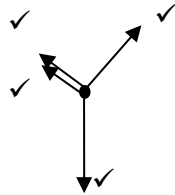
(2)



6.2

NB: Do not penalise if arrows omitted (vectors notation).

LW: Moenie penaliseer inden pyle uitgelaat is nie (vektornotasie)



(4)

6.3 Option 1/Opsie 1

$$\vec{F}_{net} = m\vec{a} \checkmark \text{ OR/OF } \sum \vec{F} = m\vec{a}$$

Block A/Blok A (In x direction/ In x rigting)

$$\vec{F}_{gx(A)} + \vec{f}_{f(A)} + \vec{F}_{BA} = m\vec{a}$$

$$F_{gx(A)} - f_{f(A)} - F_{BA} = ma$$

$$mg \sin \alpha - \mu_A N_A - F_{BA} = ma$$

✓ Anyone/ enigeen

Block A OR B /Blok A OF B (In y direction/ In y rigting)

$$\vec{F}_{net} = \vec{0} \checkmark \text{ OR/OF } \sum \vec{F} = \vec{0}$$

$$\vec{F}_{gy} + \vec{N} = \vec{0}$$

$$-F_{gy} + N = 0$$

$$N = F_{gy} = mg \cos \alpha$$

$$mg \sin \alpha - \mu_A mg \cos \alpha - F_{BA} = ma$$

✓ Anyone/ enigeen



Block B (In x direction/ In x rigting)

$$\left. \begin{aligned} \vec{F}_{gx(B)} + \vec{f}_{f(B)} + \vec{F}_{AB} &= m\vec{a} \\ F_{gx(B)} - f_{f(B)} + F_{AB} &= ma \\ mg \sin \alpha - \mu_B N_B + F_{AB} &= ma \\ mg \sin \alpha - \mu_B mg \cos \alpha + F_{AB} &= ma \end{aligned} \right\} \quad \checkmark \text{ Anyone/ enigeen}$$

Solving/ oplossing

$$mg \sin \alpha - \mu_A mg \cos \alpha - F_{BA} + mg \sin \alpha - \mu_B mg \cos \alpha + F_{AB} = ma + ma$$

$$a = g \sin 45^\circ - \frac{1}{2}(\mu_A + \mu_B)g \cos 45^\circ$$

$$a = (9,8) \sin 45^\circ \checkmark - \frac{1}{2}(0,01 + 1,0)(9,8) \cos 45^\circ \checkmark$$

$$a = + \checkmark 3,43 m \cdot s^{-2} \checkmark$$

OR/OF

$$a = 3,43 m \cdot s^{-2} \checkmark \text{ in the direction of motion/in die rigting van beweging} \checkmark$$

Option 2/Opsie 2

$$\vec{F}_{net} = m\vec{a} \checkmark \text{ OR/OF } \sum \vec{F} = m\vec{a}$$

Block A/Blok A (In x direction/ In x rigting)

$$\left. \begin{aligned} \vec{F}_{gx(A)} + \vec{f}_{f(A)} + \vec{F}_{BA} &= m\vec{a} \\ F_{gx(A)} - f_{f(A)} - F_{BA} &= ma \\ mg \sin \alpha - \mu_A N_A - F_{BA} &= ma \end{aligned} \right\} \quad \checkmark \text{ Anyone/ enigeen}$$

Block A OR B /Blok A OF B (In y direction/ In y rigting)

$$\left. \begin{aligned} \vec{F}_{net} &= \vec{0} \checkmark \text{ OR/OF } \sum \vec{F} = \vec{0} \\ \vec{F}_{gy} + \vec{N} &= \vec{0} \\ -F_{gy} + N &= 0 \\ N = F_{gy} &= mg \cos \alpha \end{aligned} \right\} \quad \checkmark \text{ Anyone/ enigeen}$$



$$mg \sin \alpha - \mu_A mg \cos \alpha - F_{BA} = ma$$

$$(0,2)(9,8) \sin 45^\circ - (0,01)(0,2)(9,8) \cos 45^\circ - F_{BA} = (0,2)a$$

$$1,386 - 0,01386 - F_{BA} = (0,2)a \quad \text{OR/OF} \quad 1,372 - F_{BA} = (0,2)a$$

✓ Anyone/ enigeen

Block B (In x direction / In x rigting)

$$\vec{F}_{gx(B)} + \vec{f}_{f(B)} + \vec{F}_{AB} = m\vec{a}$$

$$F_{gx(B)} - f_{f(B)} + F_{AB} = ma$$

$$mg \sin \alpha - \mu_B N_B + F_{AB} = ma$$

$$mg \sin \alpha - \mu_B mg \cos \alpha + F_{AB} = ma$$

✓ Anyone/ enigeen

$$(0,2)(9,8) \sin 45^\circ - (1,0)(0,2)(9,8) \cos 45^\circ + F_{AB} = (0,2)a$$

$$1,39 - 1,39 + F_{BA} = (0,2)a \quad \text{OR/OF} \quad 0 + F_{BA} = (0,2)a$$

✓ Anyone/ enigeen

Solving/ oplossing

$$1,372 - F_{BA} + 0 + F_{BA} = (0,2)a + (0,2)a$$

$$1,372 = (0,4)a$$

$$a = + \checkmark 3,43 \text{ m} \cdot \text{s}^{-2} \checkmark$$

OR/OF

$$a = 3,43 \text{ m} \cdot \text{s}^{-2} \checkmark \text{ in the direction of motion / in die rigting van beweging } \checkmark$$

Option 3/ Opsie 3

$$\vec{F}_{net} = m\vec{a} \checkmark \quad \text{OR/OF} \quad \sum \vec{F} = m\vec{a}$$

$$\vec{F}_{gx} + \vec{f}_{f1} + \vec{f}_{f2} = (m_A + m_B)\vec{a}$$

$$F_{gx} - f_{f1} - f_{f2} = (m_A + m_B)a$$

$$(m_A + m_B)g \sin \alpha - (\mu_A + \mu_B)N = (m_A + m_B)a$$

✓ Anyone/ enigeen



In y direction/ In y rigting

$$\vec{F}_{net} = \vec{0} \checkmark \text{ OR/OF } \sum \vec{F} = \vec{0}$$

$$\vec{F}_{gy} + \vec{N} = \vec{0}$$

$$-F_{gy} + N = 0$$

$$N = F_{gy} = mg \cos \alpha$$

✓ Anyone/ enigeen

$$m_A = m_B$$

$$m_A + m_B = 2m$$

$$2mg \sin \alpha - \mu_A mg \cos \alpha - \mu_B mg \cos \alpha = 2ma$$

$$g \sin \alpha - \frac{1}{2} \mu_A mg \cos \alpha - \frac{1}{2} \mu_B mg \cos \alpha = a$$

✓ Anyone/ enigeen

$$a = g \sin 45^\circ - \frac{1}{2} (\mu_A + \mu_B) g \cos 45^\circ$$

$$a = (9,8) \sin 45^\circ \checkmark - \frac{1}{2} (0,01 + 1,0) (9,8) \cos 45^\circ \checkmark$$

(8)

$$a = + \checkmark 3,43 m \cdot s^{-2} \checkmark$$

OR/OF

$$a = 3,43 m \cdot s^{-2} \checkmark \text{ in the direction of motion/in die rigting van beweging } \checkmark$$



6.4 **POSITIVE MARKING FROM 6.3/POSITIEWE NASIEN VANAF 6.3**
Option 1/Opsie 1

$$mg \sin \alpha - \mu_A mg \cos \alpha - F_{BA} = ma \checkmark$$

$$(0,2)(9,8) \sin 45^\circ - (0,01)(9,8) \cos 45^\circ - F_{BA} = (0,2)(3,43) \checkmark$$

$$F_{BA} = 0,69 \text{ N} \checkmark$$

Option 2/Opsie 2

$$mg \sin \alpha - \mu_B mg \cos \alpha + F_{AB} = ma \checkmark$$

$$(0,2)(9,8) \sin 45^\circ - (1,0)(0,2)(9,8) \cos 45^\circ + F_{AB} = (0,2)(3,43) \checkmark$$

$$F_{AB} = F_{BA} = 0,69 \text{ N} \checkmark$$

Option 3/Opsie 3

$$F_{BA} = \frac{1}{2} mg (\mu_B - \mu_A) \cos \alpha \checkmark$$

$$F_{BA} = \frac{1}{2} (0,2)(9,8)(1,0 - 0,01) \cos 45^\circ \checkmark$$

$$F_{BA} = 0,69 \text{ N} \checkmark$$

(3)

6.5 **Decreases** ✓

Acceleration of the blocks is directly proportional to gravitational acceleration (g) ✓

Acceleration due to gravity on the Moon is less than on the Earth ✓

Verminder

Versnelling van die blokke is direk eweredig aan gravitasieversnelling (g)

gravitasieversnelling op die Maan is kleiner as op die Earth

(3)

[20]



QUESTION 7/VRAAG 7

- 7.1 (When a net force, is applied to an object, it accelerates in the direction of the net force). The acceleration is directly proportional to the net force ✓ and inversely proportional to the mass of the object. ✓

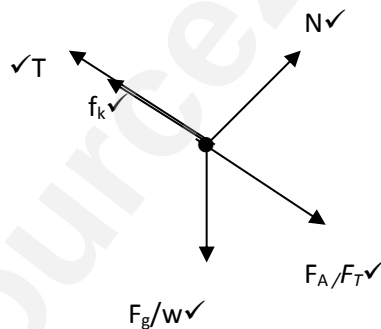
(Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die netto krag). Die versnelling is direk eweredig aan die netto krag ✓ en omgekeerd eweredig aan die massa van die voorwerp. ✓

ACCEPT/ AANVAAR

The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force. ✓✓

Die resulterende/netto krag wat op 'n voorwerp inwerk, is gelyk aan die tempo van verandering van momentum van die voorwerp in die rigting van die resulterende/netto krag. ✓✓

7.2



(2)

- 7.3 *Kinetic frictional force* is the force that opposes the motion of a moving object relative to a surface. ✓✓

Kinetiese wrywingskrag is die krag wat die beweging van 'n bewegende voorwerp relatief tot 'n oppervlak teenwerk. ✓✓

(5)

- 7.4.1 $f_k = \mu_k N$ ✓
In y direction/ In y rigting

$$\left. \begin{aligned} \sum \vec{F}_y &= \vec{0} \\ \vec{F}_{gy} + \vec{N} &= \vec{0} \\ -F_{gy} + N &= 0 \\ mg \cos 30^\circ - N &= 0 \\ f_k &= \mu_k mg \cos 30 \\ f_k &= 0.30[(3 \times 9.8 \times \cos 30)] \\ f_k &= 7.64 \text{ N} \end{aligned} \right\} \checkmark$$

(2)

(4)



7.4.2 Option 1/*Opsie 1*

3 kg block /blok

$$\left. \begin{aligned} \sum \vec{F} &= m\vec{a} \text{ OR/OF } \vec{F}_{net} = m\vec{a} \\ \vec{F}_A + \vec{F}_{gx} + \vec{T} + \vec{f}_f &= m_{3kg} \times \vec{a} \\ F_A + F_{gx} - T - f_f &= m_{3kg} \times a \end{aligned} \right\} \checkmark$$

$$F_A + mg \sin 30^\circ - T - f_f = m_{3kg} \times a$$

$$12 + 3 \times 9,8 \times \sin 30^\circ - T - 7,64 = 3a \checkmark \quad \text{OR/OF } 19,06 - T = 3a$$

10 kg block/blok

$$\left. \begin{aligned} \sum \vec{F} &= m\vec{a} \text{ OR/OF } \vec{F}_{net} = m\vec{a} \\ \vec{T} + \vec{f}_f &= m_{10kg} \times \vec{a} \\ T - f_f &= m_{10kg} \times a \end{aligned} \right\} \rightarrow \begin{array}{|l} \text{Mark is awarded only once for} \\ \text{this formula. /Punt word slegs} \\ \text{een keer toegeken vir hierdie} \\ \text{formule.} \end{array}$$

$$T - f_f = m_{10kg} \times a$$

$$T - 8 = 10a \checkmark$$

Solving /*Los op*

$$19,06 - T + T - 8 = 13a$$

$$a = 0,85 \text{ m} \cdot \text{s}^{-2}$$

$$T - 8 = 10(0,85) \checkmark \quad \text{OR/OF } 19,06 - T = 3(0,85)$$

$$T = 16,50 \text{ N } \checkmark \quad \text{OR/OF } T = 16,51 \text{ N}$$

(6)

7.5 LESS THAN ✓/*MINDER AS*

(1)

[20]

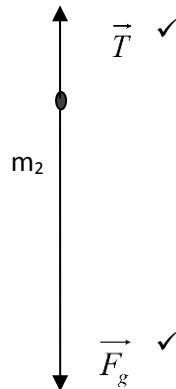


QUESTION 8/VRAAG 8 (NC/September 2014)

8.1

4 kg block/4 kg-blok

(2)



8.2

When a net force is applied to an object of mass m , it accelerates in the direction of the net force ✓. The acceleration is directly proportional to the net force and inversely proportional to the mass ✓.

Indien 'n netto krag op 'n voorwerp met massa m inwerk, sal dit in die rigting van die netto krag versnel. ✓ Die versnelling is direk eweredig aan die netto krag en omgekeerd eweredig aan die massa. ✓

OR/OF

When a net external force acts on an object of mass m , the acceleration that results is directly proportional to the net force and has a magnitude that is inversely proportional to the mass ✓. The direction is the same direction of the net force. ✓

Indien 'n netto eksterne krag op 'n voorwerp met massa m inwerk, is die versnelling wat veroorsaak word direk eweredig aan die netto krag en het dit 'n grootte wat omgekeerd eweredig is aan die massa. ✓ Die rigting is dieselfde as die rigting van die netto krag. ✓

OR/OF

If a resultant force acts on a body, it will cause the body to accelerate in the direction of the resultant force ✓. The acceleration of the body will be directly proportional to the resultant force and inversely proportional to the mass of the body. ✓

Indien 'n resultante krag op 'n liggaam inwerk, sal dit veroorsaak dat die liggaam versnel in die rigting van die resultante krag. ✓ Die versnelling van



die liggaam sal direk eweredig wees aan die resultante krag en omgekeerd eweredig aan die massa van die liggaam.

(2)

8.3.1 **Option 1/Opsie 1**

$$\Sigma \vec{F}_{net} = m\vec{a} \quad \checkmark$$

For the 2 kg block/2 kg blok (+ upwards/ opwaarts)

$$T - F_{g1} = m_1 a$$

$$T - m_1 g = m_1 a$$

$$T - 2 \times 9,8 = 2a \quad \checkmark$$

For the 4 kg block/4 kg-blok (+ downwards/afwaarts)

$$-T + m_2 g = m_2 a$$

$$-T + 4 \times 9,8 = m_2 a \quad \checkmark$$

Solving the system of equations/Los stelsel van vergelykings op

$$T - 2 \times 9,8 - T + 4 \times 9,8 = (2 + 4)a \quad \checkmark$$

$$2 \times 9,8 = 6a$$

$$a = + 3,27 \text{ m} \cdot \text{s}^{-2}$$

$$a = 3,27 \text{ m} \cdot \text{s}^{-2} \quad \checkmark$$

(5)

2.3.2 **Option 1/Opsie 1**

$$T = \left(\frac{2m_1 m_2}{m_1 + m_2} \right) g \quad \checkmark$$

$$T = \left(\frac{2 \times 2 \times 4}{2 + 4} \right) 9,8 \quad \checkmark$$

$$T = 26,13 \text{ N} \quad \checkmark$$

Option 2/Opsie 2

$$T - F_{g1} = m_1 a \quad \text{OR/OR} \quad T = m_1 (a + g) \quad \checkmark$$

$$T = 2 (3,27 + 9,8) \quad \checkmark$$

$$T = 26,14 \text{ N} \quad \checkmark$$



Option 3/Opsie 3

$$-T + m_2g = m_2a \quad \checkmark \quad \text{OR/OF} \quad -T = m_2a - m_2g \quad \text{OR} \quad T = -m_2a + m_2g$$

$$T = 4(-3,27 + 9,8) \checkmark$$

$$T = 26,12 \text{ N} \checkmark \quad (3)$$

8.4 Smaller than $\checkmark$ / *Kleiner as* $\checkmark$ (1)

[13]

QUESTION 9/VRAAG 9 (FS-NC September 2016.)

9.1 It is the force exerted by the surface on the object that opposes the motion of an object $\checkmark$ and which acts parallel to the surface $\checkmark$

Dit is die krag wat die oppervlak op die voorwerp uitoefen wat die beweging van 'n voorwerp teenstaan en wat parallel met die oppervlak werk.

(2)

9.2.1 $\tan 20^\circ = \frac{F_v}{F_H}$

$$F_v = (\tan 20^\circ)(38) \checkmark$$

$$= 13,83 \text{ N} \checkmark$$

(2)

9.2.2 POSITIVE MARKING FROM 9.2.1

POSITIEWE NASIEN VANAF 9.2.1

$$F_N = F_g - F_v$$

$$= (5)(9,8) \checkmark - 13,83 \checkmark$$

$$= 35,17 \text{ N} \checkmark$$

(3)

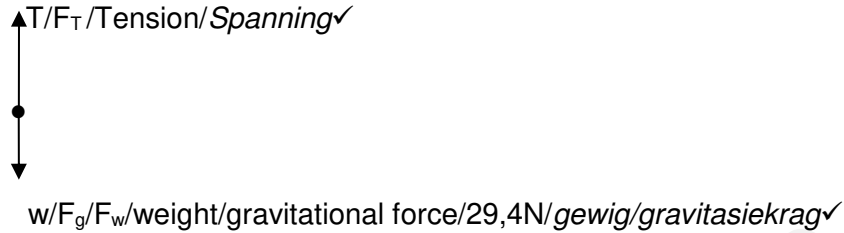
9.3 When a resultant force acts on an object the object will accelerate in the direction of the force at acceleration directly proportional to the force $\checkmark$ and inversely proportional to the mass of the object. $\checkmark$

Indien 'n resulterende krag op 'n voorwerp inwerk sal die voorwerp in die rigting van die krag versnel met 'n versnelling direk eweredig aan die grootte van die krag en omgekeerd eweredig aan die massa van die voorwerp.

(2)



9.4



(2)

9.5 **POSITIVE MARKING FROM 9.2.2**

POSITIEWE NASIEN VANAF 9.2.2

Option 1/Opsie 1

Left/upwards as positive:/Links/opwaarts as positief

5 kg block: $F_{net} = ma$ ✓

$$-T + F_H - f = ma$$

$$\underline{-T + 38 - (0,2)(35,17)} \checkmark = 5a \quad \boxed{1}$$

3 kg block : $-F_g + T = ma$

$$\underline{-(3)(9,8) + T} = 3a \quad \boxed{2}$$

Substitute 2 into 1/ Plaasvanger 2 in 1:

$$a = 0,196 \text{ m} \cdot \text{s}^{-2}$$

Substitute a into 2/ Plaasvanger a in 1

$$\begin{aligned} -29,4 + T &= (3)(0,196) \checkmark \\ T &= 29,99 \text{ N} \checkmark \end{aligned}$$

Option 2/Opsie 2

Right/downwards as positive:/Regs/afwaarts as positief

5 kg block/5-kg blok: $F_{net} = ma$ ✓

$$T - F_H + f = ma$$

$$\underline{T - 38 + (0,2)(35,17)} \checkmark = -5a \quad \boxed{1}$$

3 kg block/3-kg blok : $-F_g + T = ma$

$$\underline{-(3)(9,8) + T} = 3a \quad \boxed{2}$$



Substitute 2 into 1/ *Plaasvanger 2 in 1*:

$$a = 0,196 \text{ m} \cdot \text{s}^{-2}$$

Substitute a into 2/ *Plaasvanger a in 1*

$$29,4 - T = -(3)(0,196) \checkmark$$

$$T = 29,99 \text{ N} \checkmark$$

(6)

[17]

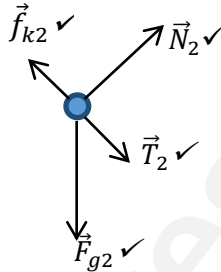
QUESTION 10/VRAAG 10

- 10.1 When a net force acts on an object, the object will accelerate in the direction of the net force and the acceleration is directly proportional to the net force ✓ and inversely proportional to the mass of the object. ✓

Indien 'n resulterende krag op 'n voorwerp inwerk sal die voorwerp in die rigting van die krag versnel met 'n versnelling direk eweredig aan die grootte van die krag en omgekeerd eweredig aan die massa van die voorwerp.

(2)

10.2



Block 2/Blok 2

(4)

10.3.1

$$\Sigma \vec{F} = m\vec{a} \checkmark$$

Block 1 in x direction (positive the incline):

$$\vec{F}_{gx1} + \vec{T}_1 + \vec{f}_{k1} = m_1 \vec{a}_1$$

$$F_{gx1} - T_1 - f_{k1} = m_1 \vec{a}_1$$

$$m_1 g \sin \theta - T_1 - f_{k1} = m_1 \vec{a}_1$$

$$(8)(9,8) \sin 30^\circ - T_1 - 16 = 8\vec{a}$$

$$23,2 - T_1 = 8\vec{a} \text{ (Equation 1)}$$

Any one ✓



Block 2 in x direction (positive the incline):

$$\begin{aligned}\vec{F}_{gx2} + \vec{T}_2 + \vec{f}_{k2} &= m_2 \vec{a}_2 \\ F_{gx2} + T_2 - f_{k2} &= m_2 \vec{a}_2 \\ m_2 g \sin \theta + T_2 - f_{k2} &= m_2 \vec{a}_2 \\ (16)(9,8) \sin 30^\circ + T_2 - 62 &= 16 \vec{a} \\ T_2 + 16,4 &= 16 \vec{a} \quad (\text{Equation 2})\end{aligned}$$

Any one ✓

Adding equation 1 and 2:

$$\begin{aligned}m_1 g \sin \theta - T_1 - f_{k1} + m_2 g \sin \theta + T_2 - f_{k2} &= m_1 \vec{a} + m_2 \vec{a} \\ (8)(9,8) \sin 30^\circ - T_1 - 16 + (16)(9,8) \sin 30^\circ + T_2 - 62 &= 8 \vec{a} + 16 \vec{a} \\ \checkmark &\end{aligned}$$

OR/OF

$$23,2 - T_1 + T_2 + 16,4 = 8 \vec{a} + 16 \vec{a}$$

$$\vec{a} = +1,65 \text{ m} \cdot \text{s}^{-2} \quad \checkmark$$

(6)

OR/OF

$$\vec{a} = 1,65 \text{ m} \cdot \text{s}^{-2} \quad \text{down the incline/ teen die helling af}$$

10.3.2 POSITIVE MARKING FROM QUESTION 10.3.1

POSITIEWE NASIEN VANAF 10.3.1

OPTION 1/OPSIE 1

Using equation 1 (down the incline positive)/ *Gebruik vergelyking 1 (afwaarts teen die helling positief):*

$$\begin{aligned}m_1 g \sin \theta - T - f_{k1} &= m_1 a_1 \\ (8)(9,8) \sin 30^\circ - T - 16 &= 8 a_1 \\ -T - 23,2 &= 8 a_1 \\ -T - 23,2 &= (8) (1,65) \quad \checkmark \\ -T &= 10 \text{ N} \\ T &= 10 \text{ N} \quad \checkmark\end{aligned}$$

✓Any one /Enige een

OPTION 2/OPSIE 2

Using equation 2 (down the incline positive)/ *Gebruik vergelyking 2 (afwaarts teen die helling positief):*

$$\begin{aligned}m_2 g \sin \theta + T - f_{k2} &= m_2 a_2 \\ (16)(9,8) \sin 30^\circ + T - 62 &= 16 a\end{aligned}$$

✓Any one/Enige een



$$T + 16,4 = 16\vec{a}$$

$$T + 16,4 = (16) \underline{(1,65)} \checkmark$$

$$78,4 + T - 62 = 26,4$$

$$T = +10 \text{ N}$$

$$T = 10 \text{ N} \checkmark$$

(3)

[15]



TOPIC 1/ONDERWERP 1/MECHANICS/MEGANIKA

1.2. MOMENTUM AND IMPULSE/ MOMENTUM EN IMPULS

QUESTION 1/VRAAG 1

(2)

1.1 B ✓✓

(2)

1.2 D ✓✓

(2)

1.3 A ✓✓

(2)

1.4 C ✓✓

(2)

1.5 B ✓✓

(2)

1.6 A ✓✓

(2)

1.7 D ✓✓

(2)

1.8 B ✓✓

(2)

1.9 A ✓✓

(2)

1.10 C ✓✓

(2)

[20]



QUESTION 2/VRAAG2

- 2.1. (Linear) momentum is the product of an object's mass and its velocity. ✓✓
 (Lineêre) momentum is die produk van 'n voorwerp se massa en sy snelheid. ✓✓(2)

2.2

OPTION 1/OPSIE 1

Let towards the wall be positive/Laat die rigting na die muur toe positief wees

$$\Delta \vec{p} = \vec{p}_f - \vec{p}_i \quad \checkmark \text{OR/OF} \quad \Delta \vec{p} = m\vec{v}_f - m\vec{v}_i$$

$$\Delta \vec{p} = [0,0585 \times (-6)] \checkmark - [0,0585 \times (+8)] \checkmark$$

$$\Delta \vec{p} = -0,351 - 0,468$$

$$\Delta \vec{p} = -\checkmark 0,819 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark$$

OR/OF

$$\Delta \vec{p} = 0,819 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark \text{ away from the wall/weg van die muur af} \checkmark$$

OPTION 2/OPSIE 2

Let towards the wall be negative/Laat die rigting na die muur toe negatief wees

$$\Delta \vec{p} = \vec{p}_f - \vec{p}_i \quad \checkmark \text{OR/OF} \quad \Delta \vec{p} = m\vec{v}_f - m\vec{v}_i$$

$$\Delta \vec{p} = [0,0585 \times (+6)] \checkmark - [0,0585 \times (-8)] \checkmark$$

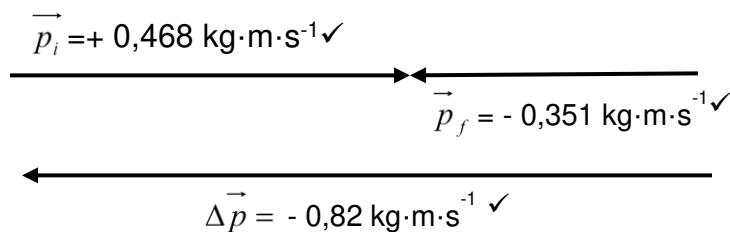
$$\Delta \vec{p} = +0,351 + 0,468$$

$$\Delta \vec{p} = +\checkmark 0,82 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark$$

OR/OF

$$\Delta \vec{p} = 0,82 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark \text{ away from the wall/weg van die muur af} \checkmark \quad (5)$$

2.3

(3)
[10]

QUESTION 3/VRAAG 3

3.1 The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force. ✓✓

Die resulterende/netto krag wat op 'n voorwerp inwerk, is gelyk aan die tempo van verandering van momentum van die voorwerp in die rigting van die resulterende/netto krag. ✓✓ (2)

3.2 $\vec{p}_f = m\vec{v}_f$ OR/OF $p_f = mv_f$ ✓

$$0.3 = 0.03\vec{v}_f \quad \checkmark$$

$$\vec{v}_f = 10 \text{ m} \cdot \text{s}^{-1} \text{ to the right/na regs} \checkmark \quad (3)$$

3.3 $\vec{F}_{net} = \frac{\Delta \vec{p}}{\Delta t}$ OR/OF $F_{net} = \frac{\Delta p}{\Delta t}$ OR/OF $\vec{F}_{net} = \frac{\vec{p}_f - \vec{p}_i}{t_f - t_i}$ Or/OF $F_{net} = \frac{p_f - p_i}{t_f - t_i}$ ✓

Positive to the right/positief na reg

$$\vec{F}_{net} = \frac{+0,3 - (+9)}{(6 \times 10^{-2} - 4 \times 10^{-2})} \checkmark$$

$$\vec{F}_{net} = \frac{-8,7}{2 \times 10^{-2}}$$

$$\vec{F}_{net} = -435 \text{ N} \checkmark$$

OR/OF

$$\vec{F}_{net} = 435 \text{ N} \checkmark \text{ to the left/na links} \checkmark \quad (5)$$

[10]

QUESTION 4/VRAAG 4

4.1 The total linear momentum of an isolated system remains constant (is conserved). ✓✓

Die totale lineêre momentum in 'n geïsoleerde sisteem bly konstant (behoue). ✓✓

(2)

4.2

Data

$$m_A = 200 \text{ g} = 0,20 \text{ kg}$$

$$m_B = 2 \text{ kg}$$

$$\vec{v}_{iA} = 20 \text{ m} \cdot \text{s}^{-1} \text{ to the right/na regs}$$

$$\vec{v}_{iB} = 0$$

$$\vec{v}_{fAB} = ?$$



Positive to the right/Positief na regs.

$$\sum \vec{p}_{before} = \sum \vec{p}_{after}$$

$$\begin{aligned}\vec{p}_{A(before)} + \vec{p}_{B(before)} &= \vec{p}_{A(after)} + \vec{p}_{B(after)} \\ m_A \vec{v}_{A(before)} + m_B \vec{v}_{B(before)} &= m_A \vec{v}_{A(after)} + m_B \vec{v}_{B(after)} \\ m_A \vec{v}_{A(before)} + m_B \vec{v}_{B(before)} &= \vec{v}_{fAB}(m_A + m_B) \\ [(0,2)(+20) + (2)(0)] \checkmark &= \vec{v}_{fAB}(0,2 + 2) \checkmark \\ 4 &= \vec{v}_{fAB}(2,2) \\ \vec{v}_{fAB} &= \frac{4}{2,2} \\ \vec{v}_{fAB} &= 1,82 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ to the right/na regs.} \checkmark\end{aligned}$$

✓ Any one/enigteen

(5)

3.3.

Data

$$m_A = 200 \text{ g} = 0,20 \text{ kg}$$

$$\vec{v}_{A(before)} = 20 \text{ m} \cdot \text{s}^{-1} \text{ to the right/na regs}$$

$$\vec{v}_{A(after)} = 1,82 \text{ m} \cdot \text{s}^{-1} \text{ to the right/na regs}$$

$$\vec{I} = \Delta \vec{p} \text{ OR /OF } \vec{J} = \Delta \vec{p} \text{ OR/OF Impulse/Impuls} = \Delta p$$

$$\vec{I} = \vec{p}_f - \vec{p}_i \text{ OR/OF } \vec{J} = \vec{p}_f - \vec{p}_i \text{ OR/OF Impulse/ Impuls} = p_f - p_i$$

✓ Any one/enigteen

$$\vec{I} = m\vec{v}_f - m\vec{v}_i \quad j = m\vec{v}_f - m\vec{v}_i \text{ OR/OF Impulse/Impuls} = m\vec{v}_f - m\vec{v}_i$$

$$\vec{I}/\vec{J}/\text{Impuls} = 0,2 \times 1,82 - 0,2 \times 20 \quad \checkmark$$

$$\vec{I}/\vec{J}/\text{Impuls} = 0,364 - 4 = -3,6 \text{ N} \cdot \text{s} \checkmark$$

$$\text{OR/OF } \vec{I}/\vec{J}/\text{Impuls} = 3,64 \text{ N} \cdot \text{s} \text{ to the left/na links} \checkmark$$

(3)

[10]

QUESTION 5/VRAAG 5

5.1. The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force. ✓✓

Die resulterende/netto krag wat op 'n voorwerp inwerk, is gelyk aan die tempo van verandering van momentum van die voorwerp in die rigting van die resulterende/netto krag. ✓✓

(2)



5.2

$$\vec{F}_{net}\Delta t = \Delta\vec{p} \text{ OR } \vec{F}_{net}\Delta t = m\vec{v}_f - m\vec{v}_{fi} \checkmark$$

$$-45 \text{ N}(0,2 \text{ s}) = 0,5 \text{ kg} \times \vec{v}_f - 0,5 \text{ kg} \times 4 \text{ m} \cdot \text{s}^{-1} \checkmark$$

$$-9 \text{ N} \cdot \text{s} = (0,5 \text{ kg})\vec{v}_f - 2 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$$

$\vec{v}_f = -14 \text{ m} \cdot \text{s}^{-1}$ opposite to its original direction (away from the foot)/in die rigting teenoorgesteld aan sy oorspronklike rigting (weg van die voet) ✓
(3)

5.3

$$\Delta\vec{p} = m\vec{v}_f - m\vec{v}_{fi} \checkmark$$

$$\Delta\vec{p} = 0,5 \text{ kg} \times (-14 \text{ m} \cdot \text{s}^{-1}) - 0,5 \text{ kg} \times 4 \text{ m} \cdot \text{s}^{-1} \checkmark$$

$$\Delta\vec{p} = -9 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark \text{ OR/OF } \Delta\vec{p} = 9 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \text{ away from the foot/ weg van die voet OR/OF}$$

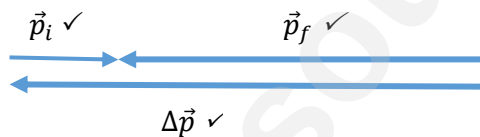
$$\Delta\vec{p} = \vec{J} = \text{impulse} \checkmark \text{ OR/OF } \Delta\vec{p} = \vec{F}_{net}\Delta t$$

$$\Delta\vec{p} = -45 \text{ N}(0,2 \text{ s}) \checkmark$$

$$\Delta\vec{p} = -9 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$$

$$\text{OR/OF } \Delta\vec{p} = 9 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \text{ away from the foot/ weg van die voet} \checkmark \quad (3)$$

5.4



(3)

[11]



QUESTION 6/ VRAAG 6

6.1 The total linear momentum of an isolated system✓ remains constant (is conserved).✓

Die totale lineêre momentum van 'n geïsoleerde sisteem ✓ bly konstant (bly behoue) . ✓

OR/OF

The total linear momentum of an isolated and closed system ✓ remains constant in magnitude and direction.✓

Die totale lineêre momentum van 'n geïsoleerde en geslote sisteem✓ bly konstant in grootte en rigting. ✓

OR/OF

If there is no external net force acting on a system of particles✓, the total linear momentum of the system is conserved. ✓

As daar geen eksterne netto krag uitgeoefen word op 'n sisteem van partikels✓, bly die totale lineêre momentum van die sisteem behoue.✓

OR/OF

The total linear momentum of an isolated/closed system✓ remains constant. ✓

Die totale lineêre momentum van 'n geïsoleerde / geslote sisteem ✓bly konstant. ✓

OR/OF

If the impulse of the external forces acting on a system is zero✓ the total linear momentum of the system does not change/remains constant. ✓

As die impuls van die eksterne kragte uitgeoefen op 'n sisteem nul✓ is, sal die totale lineêre momentum van die stelsel nie verander nie / konstant bly. ✓

OR/OF

In an isolated system the total linear momentum of a system before a collision/interaction✓ is equal to the total linear momentum of the system after the collision. ✓



In 'n geïsoleerde stelsel is die totale lineêre momentum van 'n sisteem voor 'n botsing / interaksie $\checkmark$ gelyk aan die totale lineêre momentum van die sisteem na die botsing. $\checkmark$

6.2

$$\begin{aligned}
 \Sigma \vec{F}_{ext} &= \vec{0} \\
 \Delta \vec{p}_{net} &= \vec{0} \\
 \vec{p}_{Tf} - \vec{p}_{Ti} &= \vec{0} \\
 \vec{p}_{Ti} &= \vec{p}_{Tf} \\
 \vec{p}_{iS} + \vec{p}_{iT} &= \vec{p}_{fS} + \vec{p}_{fT} \\
 m_S \vec{v}_{iS} + m_T \vec{v}_{iT} &= m_S \vec{v}_{fS} + m_T \vec{v}_{fT} \\
 m_S \vec{v}_{iS} + m_T \vec{v}_{iT} &= \vec{v}_{fST} (m_S + m_T) \\
 (1500)(10) + (1500)(0) &\checkmark = \vec{v}_{fST} (1500 + 1500) \checkmark \\
 \vec{v}_{fST} &= 5 \text{ m} \cdot \text{s}^{-1} \checkmark
 \end{aligned}
 \quad \left. \begin{array}{l} \\ \\ \\ \\ \\ \\ \end{array} \right\} \text{Any one } \checkmark$$

(4)

6.3

Option 1/Opsie 1:

$$\begin{aligned}
 \vec{F} &= \frac{\Delta \vec{p}}{\Delta t} \\
 \vec{F} &= \frac{m \Delta \vec{v}}{\Delta t} \\
 \vec{F} &= \frac{m(\vec{v}_f - \vec{v}_i)}{\Delta t} \\
 \vec{F} &= \frac{1500(5-0)}{0,08} \checkmark \\
 \vec{F} &= 93750 \text{ N } \checkmark
 \end{aligned}
 \quad \left. \begin{array}{l} \\ \\ \\ \end{array} \right\} \text{Any one } \checkmark / \text{ Enige een}$$

Yes, it can result in a fatal injury because the force is greater than 85000 N. $\checkmark$

Yes, it can result in a fatal injury because the force is greater than 85000 N. $\checkmark$

Option 2/Opsie 2:

$$\begin{aligned}
 \vec{F} &= \frac{\Delta \vec{p}}{\Delta t} \\
 \vec{F} &= \frac{m \Delta \vec{v}}{\Delta t} \\
 \vec{F} &= \frac{m(\vec{v}_f - \vec{v}_i)}{\Delta t} \\
 \vec{F} &= \frac{1500(10-5)}{0,08} \checkmark \\
 \vec{F} &= 93750 \text{ N } \checkmark
 \end{aligned}
 \quad \left. \begin{array}{l} \\ \\ \\ \end{array} \right\} \text{Any one } \checkmark / \text{ Enige een}$$

Yes, it can result in a fatal injury because the force is greater than 85000 N. $\checkmark$

Ja, dit kan lei tot ernstige beserings, want die kragte is groter as 85000 N. $\checkmark$



6.4

When the air bag inflates during the collision the contact time of the passenger or driver with the air bag is longer than without air bag ✓ and thus the force on the passenger or driver is reduced ✓ according to the equation $(F_{\text{net}} = \frac{\Delta p}{\Delta t})$, ✓ because Δp is constant for the collision.

Wanneer die lugsak opblaas tydens die botsing is die kontak tyd van die passasier en / of bestuurder met 'n lugsak langer as sonder 'n lugsak ✓ en gevolglik word die krag op die passasier en / of bestuurder verminder ✓

Volgens die vergelyking is: $(F_{\text{net}} = \frac{\Delta p}{\Delta t})$, ✓ want Δp is konstant vir die botsing.

QUESTION 7/VRAAG 7

- 7.1 Impulse is the product of the resultant/net force acting on an object and the time the resultant/net force acts on the object. ✓✓ (2)

Impuls is die produk van die resulterende/netto krag wat op 'n voorwerp inwerk en die tyd wat die resulterende/netto krag op die voorwerp inwerk.

- 7.2 3000 N ✓ (1)

- 7.3 Impulse of the force/ Impuls van die krag ✓ (1)

- 7.4 $I = F\Delta t$ OR/OF $J = F\Delta t$ } ✓ Any one/ Enige een (1)
 $I = \frac{1}{2}F_{\text{max}}\Delta t$ OR/OF $J = \frac{1}{2}F_{\text{max}}\Delta t$
 $I = \frac{1}{2}(3000)(6 \times 10^{-3})$ ✓
 $I = 9,00 \text{ N} \cdot \text{s}$
 $I = \Delta p = 9,00 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$ ✓ (3)

- 7.5 $\Delta \vec{p} = m(\vec{v}_f - \vec{v}_{fi})$ ✓ OR/OF $\Delta \vec{p} = m\vec{v}_f - m\vec{v}_{fi}$
 Positive towards the bat/ Positief teenoor die kolf
 $-9 = 0,16\vec{v}_f - (0,16)(20)$ ✓
 $\vec{v}_f = -36,25 \text{ m} \cdot \text{s}^{-1}$
 $v_f = 36,25 \text{ m} \cdot \text{s}^{-1}$ ✓ (3)

- 7.6 The cricket fielder draws his arms towards his body to lengthen the time ✓ while catching the ball. This will reduce the force ✓ acted upon him by the ball and therefore reduces the chances of getting



hurt. $F_{net} = \frac{\Delta p}{\Delta t}$ as Δp is constant ✓. By increasing time, the net force will decrease. (3)

Die krieketspeler trek sy arms in na sy liggaam om die tyd te verleng ✓

terwyl hy die bal vang. Dit sal die krag verminder ✓ wat die bal op die speler uitoefen en dus die kans verminder dat die speler seerkry. ✓

$F_{net} = \frac{\Delta p}{\Delta t}$ Δp is konstant ✓. Deur die tyd te verleng, sal die netto krag afneem.

[13]

QUESTION 8/VRAAG 8

8.1

OPTION 1/OPSIE 1

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

$$\Sigma p_i = \Sigma p_f$$

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

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

$$(3 + 0,02)(0) \checkmark = (3)(-1,4) + (0,02)v_{f2} \checkmark$$

$$v_{f2} = 210 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OR/OF

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

$$\Sigma p_i = \Sigma p_f$$

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

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

$$(3 + 0,02)(0) \checkmark = (3)(1,4) + (0,02)v_{f2} \checkmark$$

$$v_{f2} = -210 \text{ m} \cdot \text{s}^{-1}$$

(4)



$$\text{Speed/Speed} = 210 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OPTION 2/OPSIE 2

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

$$\Delta p_{\text{bullet}} = -\Delta p_{\text{block}} \checkmark$$

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

$$(0,02)(v_f - 0) \checkmark = -(3)(-1,4 - 0) \checkmark$$

$$\therefore v_i = 210 \text{ m}\cdot\text{s}^{-1} \checkmark$$

OR/OF

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

$$\Delta p_{\text{bullet}} = -\Delta p_{\text{block}} \checkmark$$

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

$$(0,02)(v_f - 0) \checkmark = -(3)(1,4 - 0) \checkmark$$

$$\therefore v_i = -210 \text{ m}\cdot\text{s}^{-1}$$

$$\text{Speed/Speed} = 210 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(4)

8.2

OPTION 1/OPSIE 1

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

$$0 = 210^2 + 2a(0,4) \checkmark$$

$$a = -55\,125 \text{ m}\cdot\text{s}^{-2}$$

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

$$= (0,02)(-55\,125) \checkmark$$

$$= -1\,102,5 \text{ N}$$

$$\text{Magnitude of force} = 1\,102,5 \text{ N} \checkmark$$

$$\text{Grootte van krag} = 1\,102,5 \text{ N}$$

OPTION 2/OPSIE 2

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

$$0,4 = \left(\frac{210 + 0}{2} \right) \Delta t \checkmark$$

$$\Delta t = 0,004 \text{ s (0,00381 s)}$$

$$F_{\text{net}} \Delta t = \Delta p = m \Delta v \checkmark$$

$$F_{\text{net}} = \frac{(0,02)(0 - 210)}{(0,004)} \checkmark$$

$$= -1\,050 \text{ N}$$

$$\text{Magnitude of force} = 1\,050 \text{ N} \checkmark$$

$$\text{Grootte van krag} = 1\,050 \text{ N}$$

$$(\text{Accept/Aanvaar: } 1102,5 \text{ N})$$

(5)



OPTION 3/OPSIE 3

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

$$0 = 210^2 + 2a(0,4) \checkmark$$

$$a = -55\,125 \text{ m}\cdot\text{s}^{-2}$$

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

$$0 = 210 - (55\,125)\Delta t$$

$$\Delta t = 0,004 \text{ s } (0,00381 \text{ s})$$

$$F_{\text{net}}\Delta t = \Delta p = m\Delta v \checkmark$$

$$F_{\text{net}} = \frac{(0,02)(0 - 210)}{(0,004)} \checkmark$$

$$= -1\,050 \text{ N}$$

Magnitude of force = 1 050 N ✓ (Accept/Aanvaar: 1 102,5 N)

Grootte van krag = 1 050 N

(5)

(5)

8.3 The same as/equal ✓
Dieselfde as/gelyk

(1)

[10]

QUESTION 9/VRAAG 9

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

(2)



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.

9.2

9.2.1 $\Sigma p_i = \Sigma p_f$ ✓

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$(m_1 + m_2) v_i = m_1 v_{1f} + m_2 v_{2f}$$

$$0 = (0,4) v_{1f} + 0,6 (4)$$
✓

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

$$= 6 \text{ m} \cdot \text{s}^{-1} \text{ to the left/na links}$$
✓

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)

9.2.2

OPTION 1/OPSIE 1

$$\Delta p = F_{\text{net}} \Delta t$$
✓

$$[(0,6)(4) - 0] = F_{\text{net}} (0,3)$$
✓

$$F_{\text{net}} = 8 \text{ N}$$
✓

OR/OF

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

$$0,6(4 - 0) = F_{\text{net}}(0,3)$$
✓

OPTION 2/OPSIE 2

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

$$4 = 0 + a(0,3)$$

$$a = 13,33 \text{ m} \cdot \text{s}^{-2}$$

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

$$= 0,6(13,33)$$

$$F_{\text{net}} = 8 \text{ N}$$
✓



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

(4)

9.3 No/Nee $\checkmark$

(1)

[11]

QUESTION 10 VRAAG 10

10.1 A system on which the resultant/net external force is zero / 'n Sisteem waarop die resulterende krag/netto eksterne krag nul is $\checkmark$

A system which excludes external forces / 'n Sisteem wat eksterne kragte uitlaat.

(1)

10.2.1 **OPTION 1/OPSIE 1**

$$p = mv \checkmark$$

$$30\,000 = (1\,500)v \checkmark$$

$$v = 20 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 2/OPSIE 2

$$\Delta p = mv_f - mv_i \square$$

$$0 = (1\,500)v_f - 30\,000 \square$$

$$v = 20 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(3)



10.2.2 **POSITIVE MARKING FROM QUESTION 10.2.1/POSITIEWE NASIEN VANAF VRAAG 10.2.1**

OPTION 1/OPSIE 1

$$\sum p_i = \sum p_f$$

} ✓

1 mark for any/1 punt vir enige

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$30\,000 + (900)(-15) \checkmark = 14\,000 + 900v_B \checkmark$$

$$\therefore v_B = 2,78 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ east/oos (Accept/Aanvaar: to the right/na regs)}$$

1 mark for any/1 punt vir enige

OPTION 2/OPSIE 2

$$\Delta p_A = -\Delta p_B$$

$$p_f - p_i = -(mv_f - mv_i)$$

$$14\,000 - 30\,000 \square = 900v_f - 900(-15) \square$$

$$v_f = 2,78 \text{ m} \cdot \text{s}^{-1} \square \text{ east/oos} \square \quad (\text{Accept/Aanvaar: to the right/na regs})$$

(5)

10.2.3 **OPTION 1/OPSIE 1**

$$\text{Slope/Helling} = \frac{\Delta p}{\Delta t} = F_{\text{net}} \checkmark$$

$$= \frac{(14\,000 - 30\,000)}{(20,2 - 20,1)} \checkmark$$

$$= -160\,000$$

$$F_{\text{net}} = 160\,000 \text{ N} \checkmark$$

OPTION 2/OPSIE 2

$$F_{\text{net}} \Delta t = \Delta p \checkmark$$

$$F_{\text{net}}(0,1) \checkmark = 14\,000 - 30\,000 \square \checkmark$$

$$F_{\text{net}} = -160\,000 \text{ N}$$

$$F_{\text{net}} = 160\,000 \text{ N} \checkmark$$



POSITIVE MARKING FROM QUESTION 10.2.2/POSITIEWE NASIEN VANAF VRAAG 10.2.2

OPTION 3/OPSIE 3

$$F_{\text{net}}\Delta t = \Delta p \checkmark$$

$$F_{\text{net}}(0,1)\checkmark = \underline{900[(2,78) - (-15)]}\checkmark$$

$$F_{\text{net}} = 160\,020\text{ N}$$

$$F_A = -F_B$$

$$F_{\text{net}} = 160\,020\text{ N} \checkmark$$

OPTION 4/OPSIE 4

$$p = mv$$

$$\underline{14\,000} = 1\,500v_f \checkmark$$

$$v_f = 9,33\text{ m}\cdot\text{s}^{-1}$$

$$F_{\text{net}} = \frac{m(v_f - v_i)}{\Delta t} \checkmark = \frac{1500(9,33 - 20)}{0,1} \checkmark$$

$$= -160\,050$$

$$= 160\,050\text{ N} \checkmark$$

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

$$\underline{9,33 = 20 + a(0,1)}$$

$$a = -106,7\text{ m}\cdot\text{s}^{-2}$$

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

$$= \underline{1\,500(-106,7)} \checkmark$$

$$F_{\text{net}} = -160\,050\text{ N}$$

$$F_{\text{net}} = 160\,050\text{ N} \checkmark$$

(4)

[13]

QUESTION 11/VRAAG 11

- 11.1 Momentum is the product of the mass and velocity of an object. $\checkmark\checkmark$
Momentum is die produk van die massa en snelheid van 'n voorwerp.

(2)



11.2 $\Delta p = 0 \checkmark$
 $F_{\text{net}} = \frac{\Delta p}{\Delta t} = 0 \checkmark$

OR/OF

$\Delta p = 0 \checkmark$
 $\Delta v = 0 \therefore a = 0 \therefore F_{\text{net}} = ma \checkmark$

OR/OF

Gradient of graph/ Gradiënt van grafiek = $\frac{\Delta p}{\Delta t} = F_{\text{net}} \checkmark$

Gradient of graph between/Gradient van grafiek tussen:
 $t = 10 \text{ s}$ and/en $20 \text{ s} = 0 \checkmark$

(2)

11.3

OPTION 1	OPTION 2
$F_{\text{net}} \Delta t = \Delta p \checkmark$ $= -120 - 50 \checkmark$ $= -170$ $\therefore F_{\text{net}} \Delta t = 170 \text{ N} \cdot \text{s} / \text{kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark$	$F_{\text{net}} = \frac{\Delta p}{\Delta t} \checkmark$ $= \frac{-120 - 50}{50 - 20}$ $\therefore F_{\text{net}} = -5,67$ $F_{\text{net}} \Delta t = (-5,67)(30) \checkmark$ $= -170$ $\therefore F_{\text{net}} \Delta t = 170 \text{ N} \cdot \text{s} / \text{kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark$

(3)

11.4

OPTION 1/ OPSIE 1	OPTION 2/OPSIE 2
$\Sigma p_i = \Sigma p_f \checkmark$ $-120 + 70 \checkmark = 50 + p_{\text{Bf}} \checkmark$ $\therefore p_{\text{Bf}} = -100$ $\therefore p_{\text{Bf}} = 100 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark$ west / wes $\checkmark$	$\Delta p_A = -\Delta p_B \checkmark$ $50 - (-120) \checkmark = -(p_{\text{Bf}} - 70) \checkmark$ $\therefore p_{\text{Bf}} = -100$ $\therefore p_{\text{Bf}} = 100 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark$ west / wes $\checkmark$
Other formulae/Ander formules: $m_1 v_{i1} + m_2 v_{i2} = m_1 v_{f1} + m_2 v_{f2}$ or $m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$ or $m_A v_{iA} + m_B v_{iB} = m_A v_{fA} + m_B v_{fB}$ $p_{\text{total before}} = p_{\text{total after}}$ Accept /Aanvaar: $p_{\text{before}} = p_{\text{after}}$ $p_i = p_f$	Notes/Aantekeninge: - If no formula/principle – Max. $\frac{4}{5}$ <i>Indien geen formule/beginsel –</i> <i>Maks. $\frac{4}{5}$</i> - Mark direction independently. <i>Sien rigting onafhanklik na.</i>

(5)

[12]



QUESTION12/VRAAG 12

12.1 Momentum is mass multiplied by velocity. ✓✓

OR

Momentum is a vector quantity equal to the product of the mass of the object and its velocity. ✓✓

Momentum is massa vermenigvuldig met snelheid. ✓✓

OF

Momentum is 'n vektorhoeveelheid wat gelyk is aan die produk van die massa van die voorwerp en sy snelheid. ✓✓

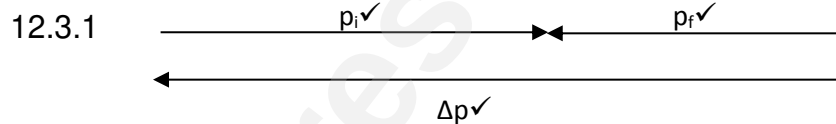
(2)

12.2 $p = m \times v$ ✓

$p = (0,156)(40,8)$ ✓

$p = 6,36 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$ ✓

(3)



(3)

12.3.2. Impulse/Impuls (J) = $\Delta p = m(v_f - v_i)$ ✓

$= 0,156(-35 - 40,8)$ ✓

$= 11,82 \text{ N} \cdot \text{s}$ ✓

(3)



12.3.3 POSITIVE MARKING FROM 12.3.2 / POSITIEWE NASIEN VAN 12.3.2

$$\text{Impulse/Impuls (J)/ } \Delta p = F_{\text{net}} \Delta t \checkmark$$

$$11,82 = F_{\text{net}} \times 1,2 \checkmark$$

$$F_{\text{net}} = 9,85 \text{ N} \checkmark$$

OR/OF

$$F_{\text{net}} = \frac{\Delta p}{\Delta t} \checkmark$$

$$F_{\text{net}} = \frac{11,82}{1,2} \checkmark$$

$$F_{\text{net}} = 9,85 \text{ N} \checkmark$$

(3)

- 12.4 The cricket fielder draws his arms towards his body to lengthen the time $\checkmark$ while catching the ball. This will reduce the force $\checkmark$ acted upon him by the ball

and therefore reduces the chances of getting hurt. $F_{\text{net}} = \frac{\Delta p}{\Delta t}$ as Δp is

constant $\checkmark$. By increasing time, the net force will decrease.

Die krieketspeler trek sy arms in na sy liggaam om die tyd te verleng $\checkmark$ terwyl hy die bal vang. Dit sal die krag verminder $\checkmark$ wat die bal op die speler

uitoefen en dus die kanse verminder dat die speler seerkry. $\checkmark$ $F_{\text{net}} = \frac{\Delta p}{\Delta t}$

Δp is konstant $\checkmark$. Deur die tyd te verleng, sal die netto krag afneem.

(3)

[17]



TOPIC 1/ONDERWERP 1/MECHANICS/MEGANIKA

1.3. VERTICAL PROJECTILE MOTION/VERTIKALE PROJEKTIEL BEWEGING

QUESTION 1/VRAAG 1

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

[20]

QUESTION 2/VRAAG 2

2.1.

<u>OPTION 1/OPSIE 1</u> Upwards positive/Opwaarts positief: $v_f = v_i + a\Delta t$ $-16 = 16 - 9,8(\Delta t)$ $\Delta t = 3,27s$	Downwards positive/Afwaarts positief: $v_f = v_i + a\Delta t$ $16 = -16 + 9,8(\Delta t)$ $\Delta t = 3,27s$
---	---

<u>OPTION 2/OPSIE 2</u> Upwards positive/Opwaarts positief: $v_f = v_i + a\Delta t$	Downwards positive/Afwaarts positief: $v_f = v_i + a\Delta t$
---	---



To the top/By bopunt: $0\checkmark = 16 - 9,8(\Delta t)\checkmark$ $\Delta t = 1,63\text{s}$ Total time/Totale tyd = $1,63 \times 2$ $= 3,26(7)\text{ s}\checkmark$	To the top/By bopunt: $0\checkmark = -16 + 9,8(\Delta t)\checkmark$ $\Delta t = 1,63\text{s}$ Total time/Totale tyd = $1,63 \times 2$ $= 3,26(7)\text{ s}\checkmark$
--	---

<u>OPTION 3/OPSIE 3</u> Upwards positive/Opwaarts positief: $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $0\checkmark = 16\Delta t + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$ $\Delta t(16 - 4,9\Delta t) = 0$ $\Delta t = 0 \text{ or/of } 3,27\text{ s}$ Time taken/Tyd geneem = $3,27\text{ s}$ (accept/aanvaar $3,26\text{ s}$) $\checkmark$	Downwards positive/Afwaarts positief: $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $0\checkmark = -16\Delta t + \frac{1}{2} (9,8) \Delta t^2 \checkmark$ $\Delta t(-16 + 4,9\Delta t) = 0$ $\Delta t = 0 \text{ or/of } 3,27\text{ s}$ Time taken/Tyd geneem = $3,27\text{ s}$ (accept/aanvaar $3,26\text{ s}$) $\checkmark$
--	---

<u>OPTION 4/OPSIE 4</u> Upwards positive/Opwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ At highest point/By hoogste punt $0 = 16^2 + 2(-9,8)\Delta y \checkmark$ $\Delta y = 13,06\text{ m}$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$	Downwards positive/Afwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ At highest point/By hoogste punt $0 = (-16)^2 + 2(9,8)\Delta y \checkmark$ $\Delta y = 13,06\text{ m}$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $13,06 = -16\Delta t + 4,9\Delta t^2 \checkmark$
--	---

(4)



$13,06 = 16\Delta t - 4,9\Delta t^2 \checkmark$ $\Delta t = 1,62 \text{ or } 1,65$ Total time/ <i>Totale tyd</i> = $(1,62/1,65) \times 2$ $= 3,24 \text{ s} \checkmark \text{ or/of } 3,3 \text{ s}$	$\Delta t = 1,62 \text{ or } 1,65$ Total time/ <i>Totale tyd</i> = $(1,62/1,65) \times 2$ $= 3,24 \text{ s} \checkmark \text{ or/of } 3,3 \text{ s}$
---	--

<u>OPTION 5/OPSIE 5</u>	
Upwards positive/Opwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ At highest point/ <i>By hoogste punt</i> $0 = 16^2 + 2(-9,8)\Delta y \checkmark$ $\Delta y = 13,06 \text{ m}$ $\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t \checkmark$ $13,06 = \left(\frac{0 + 16}{2} \right) \Delta t \checkmark$ $\Delta t = 1,63 \text{ s}$ Total time/ <i>totale tyd</i> = $3,26 \text{ s} \checkmark$	Downwards positive/Afwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y$ At highest point/ <i>By hoogste punt</i> $0 = (-16)^2 + 2(9,8)\Delta y \checkmark$ $\Delta y = -13,06 \text{ m}$ $\Delta y = \left(\frac{v_f + v_i}{2} \right) \Delta t \checkmark$ $-13,06 = \left(\frac{0 - 16}{2} \right) \Delta t \checkmark$ $\Delta t = 1,63 \text{ s}$ Total time/ <i>totale tyd</i> = $3,26 \text{ s} \checkmark$

<u>OPTION 6 /OPSIE 6</u>	
Upwards positive/Opwaarts positief: $F_{\text{net}} \Delta t = \Delta p \checkmark$ $mg \Delta t = m (v_f - v_i)$ $-9,8\Delta t \checkmark = \underline{(0 - 16)} \checkmark$	Downwards positive/Afwaarts positief: $F_{\text{net}} \Delta t = \Delta p \checkmark$ $mg \Delta t = m (v_f - v_i)$ $9,8\Delta t \checkmark = \underline{\{0 - (-16)\}} \checkmark$



$\Delta t = 1,63 \text{ s}$ Total time/ <i>Totale tyd</i> = $(1,63)(2)$ = $3,26 \text{ s} \checkmark$	$\Delta t = 1,63 \text{ s}$ Total time/ <i>Totale tyd</i> = $(1,63)(2)$ = $3,26 \text{ s} \checkmark$
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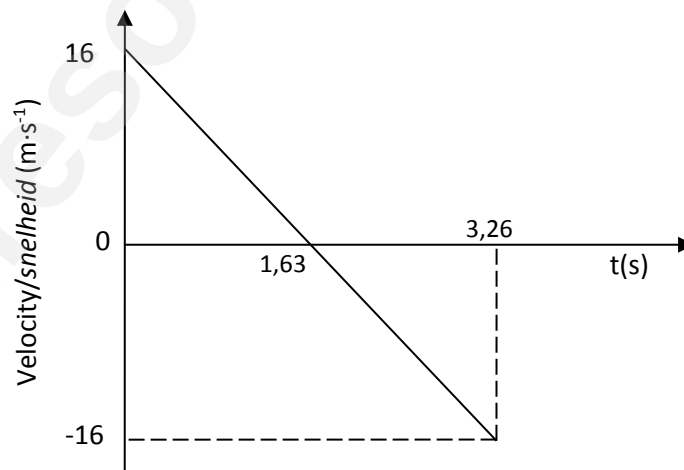
<u>OPTION 7 / OPSIE 7</u> Upwards positive/Opwaarts positief: $F_{\text{net}} \Delta t = \Delta p \checkmark$ $mg \Delta t = m (v_f - v_i)$ $-9,8 \Delta t \checkmark = [-16 - (+16)] \checkmark$ $\Delta t = 3,26 \text{ s}$ Total time/ <i>Totale tyd</i> = $3,26 \text{ s} \checkmark$	Downwards positive/Afwaarts positief: $F_{\text{net}} \Delta t = \Delta p \checkmark$ $mg \Delta t = m (v_f - v_i)$ $9,8 \Delta t \checkmark = [16 - (-16)] \checkmark$ $\Delta t = 3,26 \text{ s}$ Total time/ <i>Totale tyd</i> = $3,26 \text{ s} \checkmark$
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(4)

2.2

POSITIVE MARKING FROM 2.1./POSITIEWE NASIEN VANAF 2.1

Upwards positive/Opwaarts positief:

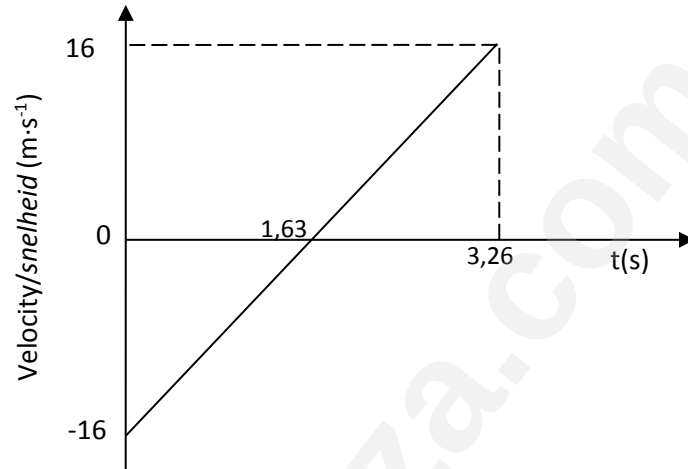


(3)



POSITIVE MARKING FROM 2.1./POSITIEWE NASIEN VANAF 2.1

Downwards positive/Afwaarts positief:



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

(3)



2.3

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)

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

$$\begin{aligned} y_A - 0 &= 16\Delta t + \frac{1}{2}(-9,8)\Delta t^2 \\ &= 16\Delta t - 4,9\Delta t^2 \checkmark \end{aligned}$$

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

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

$$\begin{aligned} y_B - 30 &= (v_i \Delta t + \frac{1}{2} a \Delta t^2) \\ y_B &= 30 - [-9(\Delta t - 1) + \frac{1}{2}(-9,8)(\Delta t - 1)^2] \checkmark \\ &= 34,1 + 0,8\Delta t - 4,9\Delta t^2 \checkmark \end{aligned}$$

$$y_A = y_B$$

$$\therefore 16\Delta t - 4,9\Delta t^2 = 34,1 + 0,8\Delta t - 4,9\Delta t^2$$

$$15,2\Delta t = 34,1$$

$$\Delta t = 2,24 \text{ s } \checkmark$$

$$\begin{aligned} y_A &= 16(2,24) - 4,9(2,24)^2 \\ &= 11,25 \text{ m } \checkmark \end{aligned}$$

(6)

Downwards positive/Afwaarts 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)

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

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

(6)



$$= -16\Delta t + 4,9\Delta t^2 \checkmark$$

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

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

$$y_B - 30 = - (v_i \Delta t + \frac{1}{2} a \Delta t^2)$$

$$y_B = 30 - [9(\Delta t - 1) + \frac{1}{2}(9,8)(\Delta t - 1)^2] \checkmark$$

$$= 34,1 + 0,8\Delta t - 4,9 \Delta t^2 \checkmark$$

$$y_A = y_B$$

$$16\Delta t - 4,9\Delta t^2 = 34,1 + 0,8\Delta t - 4,9\Delta t^2$$

$$15,2\Delta t = 34,1$$

$$\Delta t = 2,24 \text{ s} \checkmark$$

$$\Delta y_A = (- 16 (2,24) + 4,9(2,24)^2)$$

$$= 11,25 \text{ m} \checkmark$$

OPTION 2/OPSIE 2

Upwards positive/Opwaarts positief:

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

$$= 16\Delta t + \frac{1}{2}(-9,8)\Delta t^2$$

$$= 16\Delta t - 4,9\Delta t^2 \checkmark$$

$$\text{Distance travelled by ball A} = y_A = 16\Delta t - 4,9\Delta t^2$$

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

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

$$= 0,8\Delta t - 4,9\Delta t^2 + 4,1 \checkmark$$

(6)



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

$$y_A + (-y_B) = 30$$

$$16\Delta t - 4,9\Delta t^2 - (0,8\Delta t - 4,9\Delta t^2 + 4,1) = 30$$

$$15,2\Delta t = 34,1$$

$$\Delta t = 2,24 \text{ s} \checkmark$$

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

$$\begin{aligned} y_A &= 16(2,24) - 4,9(2,24)^2 \\ &= 11,25 \text{ m} \checkmark \end{aligned}$$

Downwards positive/ Afwaarts positief:

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

$$= -16\Delta t + \frac{1}{2}(9,8)\Delta t^2$$

$$= -16\Delta t + 4,9\Delta t^2 \checkmark$$

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

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

$$= -0,8\Delta t + 4,9\Delta t^2 - 4,1 \checkmark$$

$$(-y_A) + y_B = 30$$

$$-(-16\Delta t + 4,9\Delta t^2) - 0,8\Delta t + 4,9\Delta t^2 - 4,1 = 30$$

$$15,2\Delta t = 34,1$$

$$\Delta t = 2,24 \text{ s} \checkmark$$

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

$$\begin{aligned} \Delta y_A &= -16(2,24) + 4,9(2,24)^2 \\ &= -11,25 \text{ m} \end{aligned}$$

$$\therefore \text{Height of ball A/ Hoogte van bal A} = 11,25 \text{ m} \checkmark$$



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

$$\begin{aligned} v_f &= 16 + (-9,8)(1) \\ &= 6,2 \text{ m}\cdot\text{s}^{-1} \end{aligned}$$

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

$$\begin{aligned} \Delta y_A &= v_i\Delta t + \frac{1}{2} a\Delta t^2 \checkmark \\ &= (16)(1) + \frac{1}{2}(-9,8)1^2 \\ &= 11,1 \text{ m} \end{aligned}$$

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

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

For ball/Vir bal **B**,

$$\begin{aligned} \Delta y_B &= v_i\Delta t + \frac{1}{2} a\Delta t^2 \\ &= -9\Delta t + \frac{1}{2}(-9,8)\Delta t^2 \checkmark \end{aligned}$$

$$y_A + (-y_B) = (30 - 11,1) = 18,9$$

$$6,2\Delta t - 4,9\Delta t^2 - [-9\Delta t + \frac{1}{2}(-9,8)\Delta t^2] = 18,9$$

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

$$\Delta t = 1,24 \text{ s} \checkmark$$

The balls meet after/Die balle ontmoet na $(1,24 + 1) = 2,24 \text{ s} \checkmark$

$$\begin{aligned} \Delta y_A &= [6,2 (1,24) - 4,9 (1,24)^2] \\ &= 0,154 \text{ m} \end{aligned}$$

Meeting point/Ontmoetingspunt = $(11,1 + 0,154) = 11,25 \text{ m} \checkmark$ **OR/OF**

$$\begin{aligned} \Delta y &= (-9)(1,24) + \frac{1}{2} (-9,8)(1,24)^2 \checkmark \\ &= -18,69 \text{ m} \end{aligned}$$

Meeting point/Ontmoetingspunt = $(30 - 18,69) = 11,31 \text{ m} \checkmark$ 

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

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

$$= -6,2 \text{ ms}^{-1}$$

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

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

$$= (-16)(1) + \frac{1}{2}(9,8)(1)^2$$

$$= -11,1 \text{ m}$$

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

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

For ball/Vir bal **B**

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

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

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

$$6,2\Delta t - 4,9\Delta t^2 + [9\Delta t + \frac{1}{2}(9,8)\Delta t^2] = 18,9$$

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

$$\Delta t = 1,24 \text{ s} \checkmark$$

The balls meet after/Die balle ontmoet na $(1,24 + 1) = 2,24 \text{ s} \checkmark$

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

$$= -0,154 \text{ m}$$

$$\text{Meeting point/Ontmoetingspunt} = (-11,1 - 0,154) = 11,25 \text{ m} \checkmark$$

OR/OF

$$\Delta y = (9)(1,24) + \frac{1}{2}(9,8)(1,24)^2 \checkmark$$

$$= 18,69 \text{ m}$$

$$\text{Meeting point/Ontmoetingspunt} = (30 - 18,69) = 11,31 \text{ m} \checkmark$$

(6)

[13]



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

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

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

$$\Delta t = 2,83$$

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

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

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



<u>OPTION 3/OPSIE 3</u>	Upwards positive/Opwaarts positief:
Downwards positive/Afwaarts positief: $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ for either equation/vir beide vergelykings $45 = 2\Delta t + \frac{1}{2}(9,8)\Delta t^2$ $4,9 \Delta t^2 + 2\Delta t - 45 = 0 \checkmark$ $\Delta t = 2,83$ $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$ $45 = \frac{2 + v_f}{2} \cdot 2,83$ $v_f = 29,80 \text{ m s}^{-1} \checkmark$	$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ for either equation/vir beide vergelykings $-45 = -2\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ $-4,9 \Delta t^2 - 2\Delta t + 45 = 0$ $4,9 \Delta t^2 + 2\Delta t - 45 = 0 \checkmark$ $\Delta t = 2,83$ $\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t$ $-45 = \frac{-2 + v_f}{2} \cdot 2,83 \checkmark$ $v_f = -29,80 \text{ m s}^{-1} \checkmark$

<u>OPTION 4/OPSIE 4</u>
$E_{\text{mech at top}} = E_{\text{mech at surface of water}}$ $\frac{1}{2} m v_i^2 + m g h_i = \frac{1}{2} m v_f^2 + m g h_f \checkmark$ $\frac{1}{2} (2)^2 + 9,8(45) = \frac{1}{2} v_f^2 + 0 \checkmark$ $v_f = 29,76 \text{ m} \cdot \text{s}^{-1} \checkmark$

<u>OPTION 5/OPSIE 5</u>
$W_{\text{net}} = : \Delta K \checkmark$ $F_g \Delta h \cos \theta = \frac{1}{2} m (v_f^2 - v_i^2)$ $m g \Delta h \cos \theta = \frac{1}{2} m (v_f^2 - v_i^2)$

(3)



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

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

3.1.2

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**

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

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

$\therefore$ for ball/vir bal **B**

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

$\therefore$ 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

OPTION1/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**

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

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

$\therefore$ for ball/vir bal **B**

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

$\therefore$ 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 $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $-45 = -2\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ $-4,9 \Delta t^2 - 2\Delta t + 45 = 0$ $4,9 \Delta t^2 + 2\Delta t - 45 = 0$ $\Delta t = 2,83 \checkmark$ $\therefore$ for ball/vir bal B $\Delta t_B = 2,83 - 1 = 1,83 \text{ s } \checkmark$	Downwards positive/Afwaarts positief: $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $45 = 2\Delta t + \frac{1}{2}(9,8)\Delta t^2$ $4,9 \Delta t^2 + 2\Delta t - 45 = 0$ $\Delta t = 2,83 \checkmark$ $\therefore$ for ball/vir bal B $\Delta t_B = 2,83 - 1 = 1,83 \text{ s } \checkmark$
---	--

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

(3)



3.1.3

**POSITIVE MARKING FROM
3.2/POSITIEWE NASIEN VANAF 3.2****Upwards positive/Opwaarts positief:**

$$\Delta t_B = 1.83\text{s} \checkmark$$

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

$$-45 \checkmark = v_i (1,83) + \frac{1}{2} (-9.8)(1,83)^2 \checkmark$$

$$v_i = -15,62 \text{ m}\cdot\text{s}^{-1} \checkmark$$

Downwards**positive/Afwaarts positief:**

$$\Delta t_B = 1.83\text{s} \checkmark$$

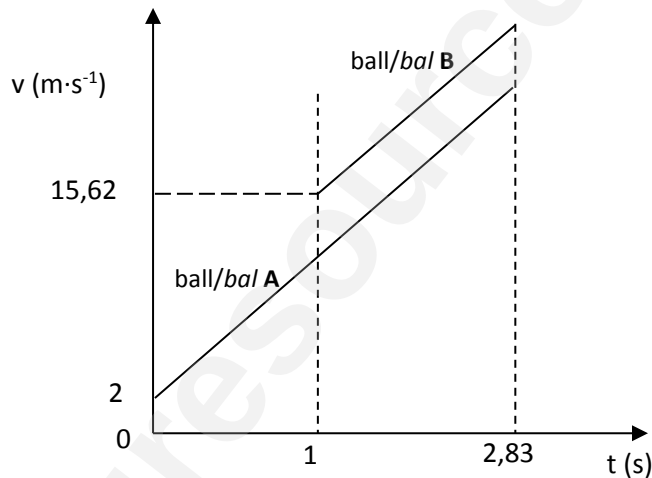
$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$45 \checkmark = v_i (1,83) + \frac{1}{2} (9.8)(1,83)^2 \checkmark$$

$$v_i = 15,62 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(5)

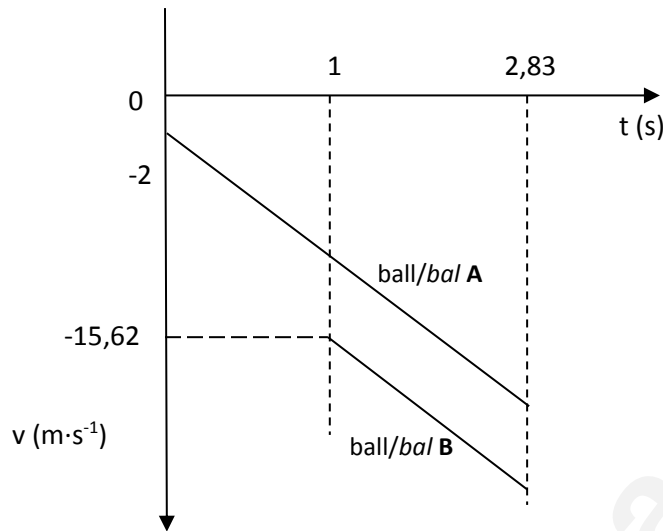
3.2

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 $2 \text{ m}\cdot\text{s}^{-1}$ 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	✓



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 motion of an object under the influence of gravity/weight/gravitational force only / Motion in which the only force acting is the gravitational force. ✓✓

Die beweging van 'n voorwerp slegs onder die invloed van swaartekrag/gewig gravitasiekrag.

Beweging waarin die enigste krag wat op die liggaam inwerk, die gravitasiekrag is.

(2)

4.2.1

<u>OPTION 1/OPSIE 1</u>	<u>OPTION 2/OPSIE 2</u>
Upwards positive/Opwaarts positief: $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $= 0^2 + (2)(-9,8)\checkmark(-20)\checkmark$ $v_f = 19,80 \text{ m}\cdot\text{s}^{-1} \square$ Downwards positive Afwaarts positief $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $= 0^2 + (2)(9,8)\square(20)\checkmark$ $v_f = 19,80 \text{ m}\cdot\text{s}^{-1}\checkmark$	Upwards positive/Opwaarts positief: $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $-20 = 0 + \frac{1}{2}(-9,8)\Delta t^2 \square$ $\Delta t = 2,02 \text{ s}$ $v_f = v_i + a\Delta t$ $= 0 + (-9,8)(2,02) \square$ $= -19,80 \text{ m}\cdot\text{s}^{-1}$ $= 19,80 \text{ m}\cdot\text{s}^{-1} \square$ Downwards positive Afwaarts positief $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ $20 = 0 + \frac{1}{2}(9,8)\Delta t^2 \checkmark$ $\Delta t = 2,02 \text{ s}$ $v_f = v_i + a\Delta t$ $= 0 + (9,8)(2,02) \square$ $= 19,80 \text{ m}\cdot\text{s}^{-1} \square$



<u>OPTION 3/OPSIE 3</u> $(E_{\text{mech}})_{\text{Top/Bo}} = (E_{\text{mech}})_{\text{Ground/Grond}}$ $(E_P + E_K)_{\text{Top}} = (E_P + E_K)_{\text{Bottom/Onder}}$ $(mgh + \frac{1}{2} mv^2)_{\text{Top/Bo}} = (mgh + \frac{1}{2} mv^2)_{\text{Bottom/Onder}}$ $(9,8)(20) + 0 \checkmark = (0 + \frac{1}{2} v_f^2) \checkmark$ $v_f = 19,80 \text{ m}\cdot\text{s}^{-1} \checkmark$	✓ 1 mark for any 1 punt vir enige
<u>OPTION 4/OPSIE 4</u> $W_{\text{nc}} = \Delta E_p + \Delta E_k \square$ $0 = mg\Delta h + \frac{1}{2} m\Delta v^2$ $0 \square = m(9,8)(0 - 20) + \frac{1}{2} m(v_f^2 - 0) \square$ $v_f = 19,80 \text{ m}\cdot\text{s}^{-1} \checkmark$	
<u>OPTION 5/OPSIE 5</u> $W_{\text{net}} = \Delta E_k \square$ $mg\Delta x \cos 0^\circ = \frac{1}{2} m(v_f^2 - 0)$ $m(9,8)(20)(1) \square = \frac{1}{2} mv_f^2 \square$ $v_f = 19,80 \text{ m}\cdot\text{s}^{-1} \checkmark$	

(4)

4.2.2

POSITIVE MARKING FROM QUESTION 4.2.1/POSITIEWE NASIEN VANAF VRAAG 4.2.1 <u>OPTION 1/OPSIE 1</u> <u>Downwards positive/Afwaarts positief</u> $v_f = v_i + a\Delta t \checkmark$ $19,80 = 0 + (9,8)\Delta t \checkmark$ $\Delta t = 2,02 \text{ s} \checkmark$ <u>Upwards positive/Opwaarts positief</u>
--



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

$$-19,80 = 0 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 2,02 \text{ s} \checkmark$$

OPTION 2/OPSIE 2

Upwards positive/Opwaarts positief:

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

$$-20 = 0 + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$$

$$\Delta t = 2,02 \text{ s} \checkmark$$

Downwards Positive/Afwaarts positief

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

$$20 = 0 + \frac{1}{2} (9,8) \Delta t^2 \checkmark$$

$$\Delta t = 2,02 \text{ s} \checkmark$$

OPTION 3/OPSIE 3

Downwards positive/Afwaarts positief:

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

$$20 = \left(\frac{0 + 19,80}{2} \right) (\Delta t) \checkmark$$

$$\Delta t = 2,02 \text{ s} \checkmark$$

Upwards positive/Opwaarts positief:

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

$$-20 = \left(\frac{0 - 19,80}{2} \right) (\Delta t) \checkmark$$

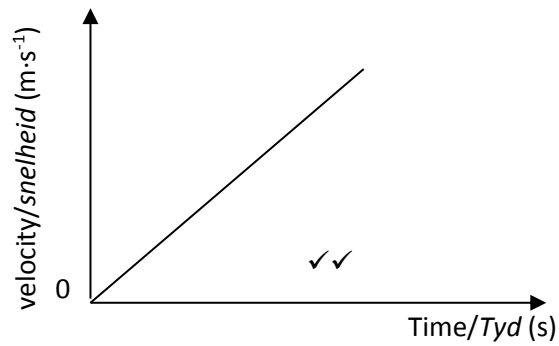
$$\Delta t = 2,02 \text{ s} \checkmark$$

(3)

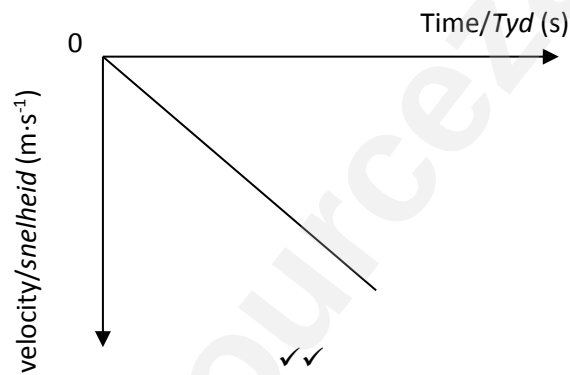


4.3

Downward positive/Afwaarts positief



Upward positive/Opwaarts positief



Notes/Aantekeninge

□ □	Straight line through the origin. <i>Reguitlyn deur die oorsprong</i>
-----	--

(2)

[11]



QUESTION 5

5.1 $9,8 \text{ m} \cdot \text{s}^{-2}$ ✓ downwards ✓ (2)

5.2 $0 \text{ m} \cdot \text{s}^{-1}$ ✓ (1)

5.3 **Option 1**

Positive downwards

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

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

$$v_i = 10,02 \text{ m} \cdot \text{s}^{-1} \text{ downwards} \quad \checkmark$$

OR

$$v_i = +10,02 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

Option 2

Positive upwards

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

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

$$v_i = 10,02 \text{ m} \cdot \text{s}^{-1} \text{ downwards} \quad \checkmark$$

OR

$$v_i = -10,02 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

(4)



5.4 POSITIVE MARKING FROM 3.3

Option 1

Upward positive

$$v_f^2 = v_i^2 + 2g\Delta y \quad \checkmark$$

$$\checkmark (-10,02)^2 = v_i^2 + 2(-9,8)3,4 \quad \checkmark$$

$$v_i = 12,92 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

Option 2

Downward positive

$$v_f^2 = v_i^2 + 2g\Delta y \quad \checkmark$$

$$\checkmark (10,02)^2 = v_i^2 + 2(9,8)(-3,4) \quad \checkmark$$

$$v_i = 12,92 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

Option 3*Positive downwards*

$$v_f^2 = v_i^2 + 2g\Delta y \quad \checkmark$$

$$\Delta y = H_{\max} = 1,2 + 2,2 + |\Delta y_1|$$

(Consider the motion from maximum height until it reaches the top of the window while the stone is moving down)

$$(10,02)^2 = 0^2 + 2(9,8)\Delta y_1 \quad \checkmark$$

$$\Delta y_1 = 5,12 \text{ m}$$

$$H_{\max} = \underline{1,2 + 2,2 + 5,12}$$



$$H_{\max} = 8,52 \text{ m}$$

From bottom to maximum height

$$(0)^2 = v_i^2 + 2 \times 9,8 \times (-8,52) \checkmark$$

$$v_i = 12,92 \text{ m} \cdot \text{s}^{-1} \checkmark$$

Option 4

Positive upwards

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

$$H_{\max} = 1,2 + 2,2 + |\Delta y|$$

$$(-10,02)^2 = 0^2 + 2(-9,8)\Delta y \checkmark$$

$$\Delta y = -5,12 \text{ m}$$

$$H_{\max} = 1,2 + 2,2 + 5,12$$

$$H_{\max} = 8,52 \text{ m}$$

$$(0)^2 = v_i^2 + 2 \times -9,8 \times 8,52 \checkmark$$

$$v_i = 12,92 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(4)

5.5

Option 1

Positive downwards

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

$$0 = -12,92 + (9,8)\Delta t \checkmark$$

$$\Delta t = 1,32 \text{ s} \checkmark$$

Option 2

Positive upwards



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

$$0 = 12,92 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 1,32 \text{ s} \checkmark$$

Option 3

Positive downwards

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

$$12,92 = 0 + (9,8)\Delta t \checkmark$$

$$\Delta t_{\text{up}} = \Delta t_{\text{down}}$$

$$\Delta t = 1,32 \text{ s} \checkmark$$

Option 4

Positive upwards

$$v = v_i + g\Delta t \checkmark$$

$$-12,92 = 0 + (-9,8)\Delta t \checkmark$$

$$\Delta t_{\text{up}} = \Delta t_{\text{down}}$$

$$\Delta t = 1,32 \text{ s} \checkmark$$

Option 5

Positive downwards

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

$$12,92 = -12,92 + (9,8)\Delta t \checkmark$$

$$\Delta t = 2,64 \text{ s}$$

$\therefore$ Time for upward motion is $2,64/2 = 1,32 \text{ s} \checkmark$

Option 6

Positive upwards

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

$$-12,92 = 12,92 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 2,64 \text{ s}$$

$\therefore$ Time for upward motion is $2,64/2 = 1,32 \text{ s} \checkmark$



Option 7

Positive upwards

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

$$8,52 = \left(\frac{12,92 + 0}{2} \right) \Delta t \checkmark$$

$$\Delta t = 1,32 \text{ s} \checkmark$$

Option 8

Positive downwards

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

$$-8,52 = \left(\frac{-12,92 + 0}{2} \right) \Delta t \checkmark$$

$$\Delta t = 1,32 \text{ s} \checkmark$$

Option 9

Positive upwards

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

$$8,52 = (12,92) \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$$

$$-4,9 \Delta t^2 + (12,92) \Delta t - 8,52 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\Delta t = 1,32 \text{ s} \checkmark$$



Option 10

Positive downwards

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

$$-8,52 = (-12,92) \Delta t + \frac{1}{2} (+9,8) \Delta t^2 \checkmark$$

$$4,9 \Delta t^2 + (-12,92) \Delta t + 8,52 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\Delta t = 1,32 \text{ s} \checkmark$$

Option 11

Positive upwards

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

$$0 = (12,92) \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$$

$$\Delta t = 1,32 \text{ s} \checkmark$$

Option 12

Positive downwards

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

$$0 = (-12,9) \Delta t + \frac{1}{2} (+9,8) \Delta t^2 \checkmark$$

$$\Delta t = 1,32 \text{ s} \checkmark$$



Option 13

Positive upwards

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

$$-8,52 = (0) \Delta t + \frac{1}{2} (-9,8) \Delta t^2 \checkmark$$

$$\Delta t = 1,32 \text{ s} \checkmark$$

Option 14

Positive downwards

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

$$8,52 = (0) \Delta t + \frac{1}{2} (+9,8) \Delta t^2 \checkmark$$

$$\Delta t = 1,32 \text{ s} \checkmark$$

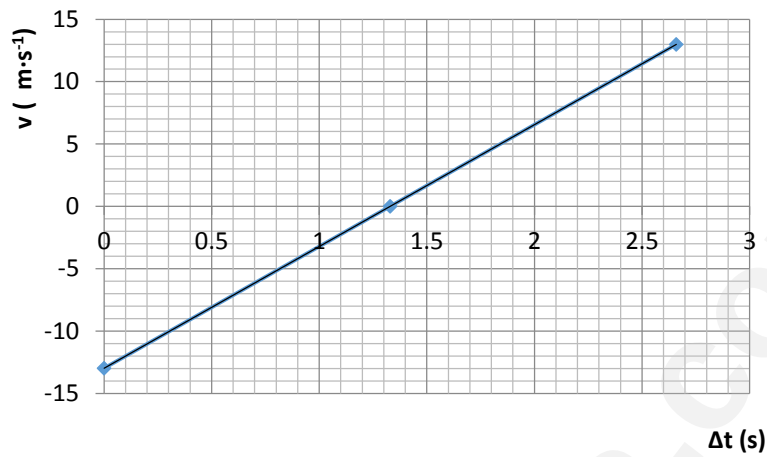
(3)



5.5

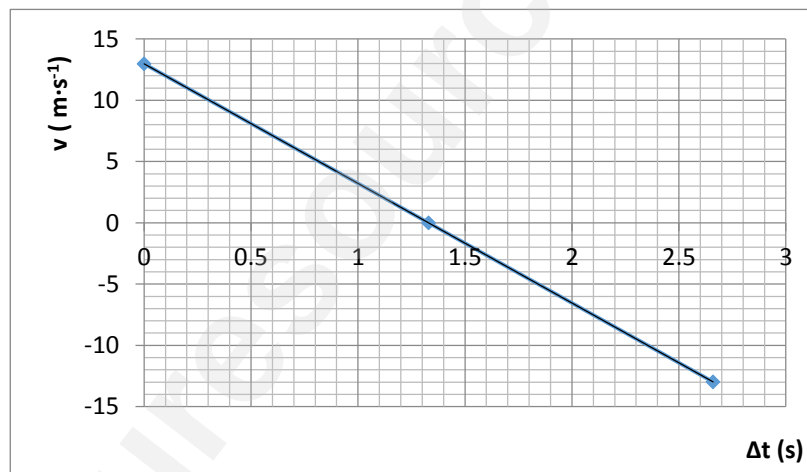
Option 1 (POSITIVE MARKING FROM 5.4 AND 5.5)

Positive downwards



Option 2

Positive upwards



Criteria for marking the graph	Marks
Correct shape	1
Graph starts at $-12.92 \text{ m}\cdot\text{s}^{-1}$ and ends at $+12.92 \text{ m}\cdot\text{s}^{-1}$ OR Graph starts at $+12.92 \text{ m}\cdot\text{s}^{-1}$ and ends at $-12.92 \text{ m}\cdot\text{s}^{-1}$	1
Graph ending at 2,64 s	1

(3)

[17]



QUESTION 6

- 6.1. The ball is considered as a projectile because the only force acting on it is the gravitational force therefore it moves in free fall. ✓✓

Die bal is 'n projektiel aangesien die enigste krag wat daarop inwerk, die van gravitasiekrag is en ondergaan die bald us vryval. (2)

- 6.2. The initial velocity is $10 \text{ m}\cdot\text{s}^{-1}$ ✓upwards✓ (2)

Die aanvanklike snelheid is $10 \text{ m}\cdot\text{s}^{-1}$ ✓opwaarts✓

- 6.3. The velocity of the ball when it hits the ground is $19.41 \text{ m}\cdot\text{s}^{-1}$ ✓downwards✓ (2)

Die snelheid van die bal wanneer dit die grond bereik is $19.41 \text{ m}\cdot\text{s}^{-1}$ ✓afwaarts✓

- 6.4. The gradient of the graph represents the acceleration of the ball (projectile)/gravitational acceleration (acceleration due to gravity). ✓ (1)

Die gradiënt van die grafiek stel die versnelling van die projektiel/bal voor (gravitasionele versnelling/ versnelling a.g.v. gravitasie)

6.5.

6.5.1

Option 1/Opsie 1

Upwards as positive/ opwaarts as positief

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

$$\Delta y = (+10)(3) + \frac{1}{2}(-9,8)(3^2) \checkmark$$

$$\Delta y = -14,1 \text{ m}$$

$$H = 14,1 \text{ m} \checkmark$$

Downwards as positive/ Afwaarts as positief

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

$$\Delta y = (-10)(3) + \frac{1}{2}(+9,8)(3^2) \checkmark$$

$$\Delta y = +14,10 \text{ m}$$



$$H=14,10 \text{ m} \checkmark$$

Option 2/Opsie 2

Positive upwards/ opwaarts as positief

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

$$\Delta y = \left(\frac{10 - 19,40}{2} \right) 3 \checkmark$$

$$\Delta y = -14,10 \text{ m}$$

$$H=14,10 \text{ m} \checkmark$$

Downwards as positive/ Afwaarts as positief

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

$$\Delta y = \left(\frac{-10 + 19,40}{2} \right) 3 \checkmark$$

$$\Delta y = +14,10 \text{ m}$$

$$H=14,10 \text{ m} \checkmark$$

(3)

6.5.2

Option 1/Opsie 1

Positive upwards/ opwaarts as positief

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

$$0 = v_i + (-9,8)(1,28) \checkmark$$

$$v_f = 12,54 \text{ m} \cdot \text{s}^{-1}$$

$$\text{Speed} = 12,54 \text{ m} \cdot \text{s}^{-1} \checkmark$$

Option 2/Opsie 2

Downwards as positive/ Afwaarts as positief

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

$$0 = v_i + (+9,8)(1,28) \checkmark$$

$$v_f = -12,54 \text{ m} \cdot \text{s}^{-1}$$

$$\text{Speed} = 12,54 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(3)

6.5.3

Option 1/Opsie 1

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

$$\Delta y = \left(\frac{-12,54 + 0}{2} \right) 1,28 \checkmark$$



$$\Delta y = -8,03 \text{ m}$$

$$H = 8,03 \text{ m} \checkmark$$

Option 2/Opsie 2

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

$$\Delta y = 12,54(1,28) + \frac{1}{2}(-9,8)(1,28)^2 \checkmark$$

$$\Delta y = 8,02 \text{ m} \checkmark$$

Option 3/Opsie 3

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

$$0 = (12,54)^2 + 2(-9,8)\Delta y \checkmark$$

$$\Delta y = 8,02 \text{ m} \quad \checkmark$$

(3)

6.6

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

$$\Delta y = 10(1,02) + \frac{1}{2}(-9,8)(1,02)^2$$

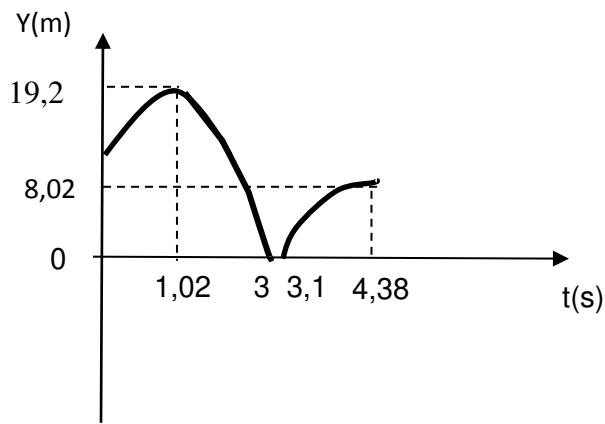
$$\Delta y = 5,1 \text{ m}$$

$$y_f = y_i + \Delta y$$

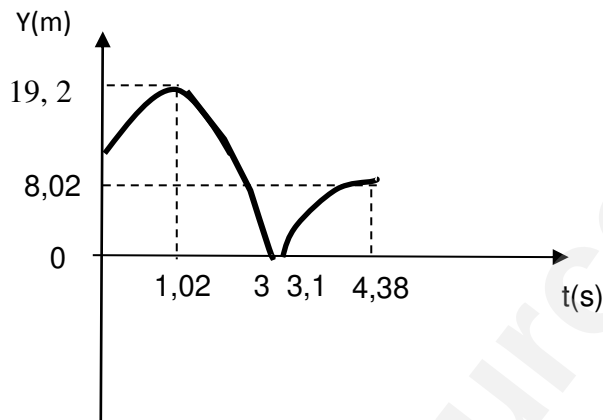
$$y_f = 14,1 + 5,1$$

$$y_f = 19,2 \text{ m}$$





OR/OF



Criteria/ <i>Kriteria</i>	Marks/ <i>Punte</i>
Correct shape from 0 s to 3 s. <i>Korrekte vorm van 0 s tot 3 s.</i>	✓
Correct shape from 3.1 s to 4,38 s. <i>Korrekte vorm van 3,1 s tot 4,38</i>	✓
The position of the projectile at 1,02 s. <i>Die posisie van die projektiel by 1, 02 s</i>	✓
The time the projectile reaches the projection point. <i>Die tyd geneem vir die bal om projeksiepoint te bereik</i>	✓
Position of the projectile at 4,38 s. <i>Posisie van die projektiel by 4,38 s.</i>	✓



QUESTION 7/VRAAG 7

7.1. $\vec{v}_f = \vec{v}_i + g\Delta t$ ✓

Ball A/ bal A

$\vec{v}_f = 0 - 9,8 \times 1,5$ ✓

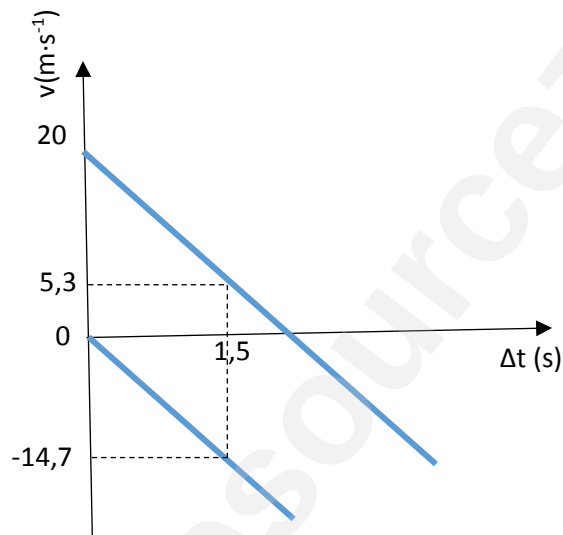
$\vec{v}_f = -14,7 \text{ m} \cdot \text{s}^{-1}$ ✓ OR/OF $\vec{v}_f = 14,7 \text{ m} \cdot \text{s}^{-1}$ downwards/ afwaarts ✓

Ball B/Bal B

$\vec{v}_f = 20 - 9,8 \times 1,5$ ✓

$\vec{v}_f = +5,3 \text{ m} \cdot \text{s}^{-1}$ ✓ OR/OF $\vec{v}_f = 5,3 \text{ m} \cdot \text{s}^{-1}$ upwards/ opwaarts ✓ (5)

2.2



Criteria for graph/Kriteria vir grafiek	Marks/Punte
Correct shape of A and B. <i>Korekte vorm van A en B.</i>	✓
Initial velocity of A and B correctly indicated as shown. <i>Beginsnelheid van A en B korrek aangedui soos getoon.</i>	✓
The velocity of the balls A and B at 1,5 s.	✓



Die snelheid van die balle A en B op 1,5 s.	
Time taken for the balls to pass each other.	✓
Tyd wat dit neem vir die balle om mekaar verby te gaan.	

(4)

7.3 Option 1/Opsie 1

$$\Delta \vec{y} = \vec{v}_i \Delta t + \frac{1}{2} \vec{g} \Delta t^2 \checkmark$$

$$\Delta \vec{y} = 0 \times 1,5 - \frac{1}{2} 9,8 \times (1,5)^2 \checkmark$$

$$\Delta \vec{y} = -11,025 \text{ m} \checkmark$$

OR/OF

$$\Delta \vec{y} = 11,025 \text{ m downwards/afwaarts} \checkmark$$

Option 2/Opsie 2

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

$$\Delta \vec{y} = \left(\frac{-14,7 - 0}{2} \right) 1,5 \checkmark$$

$$\Delta \vec{y} = -11,025 \text{ m} \checkmark$$

OR/OF

$$\Delta \vec{y} = 11,025 \text{ m downwards/afwaarts} \checkmark$$

Option 2/Opsie 2

$$\text{Area}(\Delta) = A = \frac{1}{2} b \times h \checkmark$$

$$\Delta \vec{y} = \left(\frac{-14,7 - 0}{2} \right) 1,5 \checkmark$$

$$\Delta \vec{y} = -11,025 \text{ m} \checkmark$$

OR/OF

$$\Delta \vec{y} = 11,025 \text{ m downwards/afwaarts} \checkmark$$

(3)

[12]



QUESTION 8/VRAAG 8

- 8.1. An object upon which the only force acting is the force of gravity. ✓✓
 'n voorwerp waarop die enigste krag wat daarop inwerk, die gravitasiekrag is. ✓✓ (2)
 8.2. Taking down as positive / Neem af as positief

$$\Delta \vec{x} = \vec{v}_i t + \frac{1}{2} \vec{g} t^2 \quad \checkmark$$

$$\frac{1}{2} \vec{g} t^2 + \vec{v}_i t - \Delta \vec{x} = 0$$

$$\frac{1}{2} (9,8) t^2 + (-10) t - (-1,5) = 0$$

$$\underbrace{(4,9)}_a \underbrace{t^2}_{x^2} + \underbrace{(-10)}_b \underbrace{t}_x + \underbrace{(1,5)}_c = 0 \quad \checkmark$$

$$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$t = \frac{-(-10) \pm \sqrt{(-10)^2 - 4(4,9)(1,5)}}{2(4,9)}$$

$$t = \frac{10 \pm \sqrt{70,6}}{9,8}$$

$$t = \frac{10 \pm 8,40238}{9,8}$$

$$t = 1,02041 \pm 0,857386$$

$$t = 0,16 \text{ s or } t = 1,88 \text{ s}$$

The ball passes through the point in the photograph at $t = 0,16 \text{ s}$ on the way up ✓
 and $t = 1,88 \text{ s}$ on the way down. ✓

Die bal beweeg deur die punt in die foto teen $t = 0,16 \text{ s}$ tydens die opwaartse beweging en $t = 1,88 \text{ s}$ tydens die afwaartse beweging. ✓

(4)

8.3. Down positieve/af positief

$$\vec{y}_f = \vec{y}_i + \vec{v}_i \Delta t + \frac{1}{2} \vec{g} \Delta t^2 \quad \checkmark$$

$$\vec{y}_f = 0 + (-10) \times (0,1) + \frac{1}{2} (9,8) (0,1)^2 \quad \checkmark$$

$$\vec{y}_f = (-1,0) + \frac{1}{2} (9,8) (0,01)$$

$$\vec{y}_f = (-1,0) + 0,049 = -0,951 \text{ m}$$

$$\vec{y}_f = 0,951 \text{ m} \quad \checkmark \text{ upwards/opwaarts}$$

Upwards positive/ opwaarts positief

$$\vec{y}_f = \vec{y}_i + \vec{v}_i \Delta t + \frac{1}{2} \vec{g} \Delta t^2 \quad \checkmark$$

$$\vec{y}_f = 0 + (10) \times (0,1) + \frac{1}{2} (-9,8) (0,1)^2 \quad \checkmark$$

$$\vec{y}_f = (1,0) + \frac{1}{2} (-9,8) (0,01)$$

$$\vec{y}_f = (1,0) + (-0,049) = 0,951 \text{ m}$$

$$\vec{y}_f = 0,951 \text{ m} \quad \checkmark \text{ upwards/opwaarts}$$

(4)

[10]



QUESTION 9/VRAAG 9

9.1 A projectile is an object upon which the only force acting is the force of gravity.
✓✓

'n Projektiel is 'n voorwerp waarop die enigste krag wat daarop inwerk, die gravitasiekrag is.

(2)

9.2.1 **OPTION 1/OPSIE 1**

Positive downwards/Positief afwaarts:

$$\vec{v}_f = \vec{v}_i + \vec{a}\Delta t \quad \checkmark \text{ OR/OF } \mathbf{v_f = v_i + a\Delta t}$$

$$245 = 0 + 9,8\Delta t \quad \checkmark$$

$$\Delta t = 25 \text{ s} \quad \checkmark$$

OPTION 2/OPSIE 2

Positive upwards/Positief opwaarts:

$$\vec{v}_f = \vec{v}_i + \vec{a}\Delta t \quad \checkmark \text{ OR/OF } \mathbf{v_f = v_i + a\Delta t}$$

$$-245 = 0 - 9,8\Delta t \quad \checkmark$$

$$\Delta t = 25 \text{ s} \quad \checkmark$$

OPTION 3/OPSIE 3

Positive downwards/Positief afwaarts:

$$\vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\Delta\vec{y}$$

$$(245)^2 = 0^2 + 2(9,8)\Delta y$$

$$\Delta\vec{y} = +3062,5 \text{ m}$$

$$\Delta\vec{y} = \left(\frac{\vec{v}_i + \vec{v}_f}{2}\right) \Delta t \quad \checkmark$$

$$3062,5 = \left(\frac{0 + 245}{2}\right) \Delta t \quad \checkmark$$

$$\Delta t = 25 \text{ s} \quad \checkmark$$

OPTION 4/OPSIE 4

Positive upwards/Positief opwaarts:

$$\vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\Delta\vec{y}$$

$$(-245)^2 = 0^2 + 2(-9,8)\Delta y$$

$$\Delta\vec{y} = -3062,5 \text{ m}$$

$$\Delta\vec{y} = \left(\frac{\vec{v}_i + \vec{v}_f}{2}\right) \Delta t \quad \checkmark$$

$$-3062,5 = \left(\frac{0 - 245}{2}\right) \Delta t \quad \checkmark$$

$$\Delta t = 25 \text{ s} \quad \checkmark$$

OPTION 5/OPSIE 5

Positive downwards/Positief afwaarts:

$$\vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\Delta\vec{y}$$

$$(245)^2 = 0^2 + 2(9,8)\Delta\vec{y}$$

$$\Delta\vec{y} = +3062,5 \text{ m}$$

$$\Delta\vec{y} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2 \quad \checkmark$$

$$3062,5 = (0 \times t) + \frac{1}{2}(9,8)\Delta t^2 \quad \checkmark$$



$$\Delta t = 25 \text{ s} \checkmark$$

OPTION 6/OPSIE 6

Positive upwards/Positief opwaarts:

$$\vec{v}_f^2 = \vec{v}_i^2 + 2\vec{a}\Delta\vec{y}$$

$$(-245)^2 = 0^2 + 2(-9,8)\Delta y$$

$$\Delta\vec{y} = -3062,5 \text{ m}$$

$$\Delta\vec{y} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2 \checkmark$$

$$-3062,5 = (0 \times t) + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$$

$$\Delta t = 25 \text{ s} \checkmark$$

Note/Aantekening: Do not penalise if vector notation is not used./Moenie penaliseer indien vektornotasie nie gebruik is nie.

(3)

9.2.2 **POSITIVE MARKING FROM 3.2.1/POSITIEWE NASIEN VANAF 3.2.1****OPTION 1/OPSIE 1**

Positive downwards/Positief afwaarts:

$$\Delta\vec{y} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2 \text{ OR/OF } \Delta\vec{y} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2$$

$$\vec{v}_{iA}\Delta t_A + \frac{1}{2}\vec{a}\Delta t_A^2 = \vec{v}_{iB}\Delta t_B + \frac{1}{2}\vec{a}\Delta t_B^2$$

✓ Any one/Enige een

$$0(25) + \frac{1}{2}(+9,8)(25)^2 \checkmark = \vec{v}_{iB}(20) + \frac{1}{2}(+9,8)(20)^2 \checkmark$$

$$\vec{v}_{iB} = 55,13 \text{ m}\cdot\text{s}^{-1} \text{ downwards/afwaarts } \checkmark \text{ OR/OF } \vec{v}_{iB} = +55,13 \text{ m}\cdot\text{s}^{-1}$$

OPTION 2/OPSIE 2

Positive upwards/Positief opwaarts:

$$\Delta\vec{y} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2 \text{ OR/OF } \Delta\vec{y} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2$$

$$\vec{v}_{iA}\Delta t_A + \frac{1}{2}\vec{a}\Delta t_A^2 = \vec{v}_{iB}\Delta t_B + \frac{1}{2}\vec{a}\Delta t_B^2$$

✓ Any one/Enige een

$$0(25) + \frac{1}{2}(-9,8)(25)^2 \checkmark = \vec{v}_{iB}(20) + \frac{1}{2}(-9,8)(20)^2 \checkmark$$

$$\vec{v}_{iB} = 55,13 \text{ m}\cdot\text{s}^{-1} \text{ downwards/afwaarts } \checkmark \text{ OR/OF } \vec{v}_{iB} = -55,13 \text{ m}\cdot\text{s}^{-1}$$

OPTION 3/OPSIE 3

Positive downwards/Positief afwaarts:

$$\Delta\vec{y} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2 \checkmark \text{ OR/OF } \Delta\vec{y} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2$$

$$\Delta\vec{y}_A = 0(25) + \frac{1}{2}(+9,8)(25)^2 \checkmark$$

$$\Delta\vec{y}_A = +3062,5 \text{ m}$$

$$+3062,5 = \vec{v}_{iB}(20) + \frac{1}{2}(+9,8)(20)^2 \checkmark$$

$$\vec{v}_{iB} = 55,13 \text{ m}\cdot\text{s}^{-1} \text{ downwards/afwaarts } \checkmark \text{ OR/OF } \vec{v}_{iB} = +55,13 \text{ m}\cdot\text{s}^{-1}$$



OPTION 4/OPSIE 4

Positive upwards/Positief opwaarts:

$$\Delta \vec{y} = \vec{v}_i \Delta t + \frac{1}{2} \vec{a} \Delta t^2 \quad \checkmark \text{ OR/OF } \Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$\Delta \vec{y}_A = 0(25) + \frac{1}{2} (-9,8)(25)^2 \quad \checkmark$$

$$\Delta \vec{y}_A = -3062,5 \text{ m}$$

$$-3062,5 = \vec{v}_{iB}(20) + \frac{1}{2} (-9,8)(20)^2 \quad \checkmark$$

$$\vec{v}_{iB} = 55,13 \text{ m} \cdot \text{s}^{-1} \text{ downwards/afwaarts } \checkmark \text{ OR/OF } \vec{v}_{iB} = -55,13 \text{ m} \cdot \text{s}^{-1}$$

OPTION 5/OPSIE 5

Positive downwards/Positief afwaarts:

$$\Delta \vec{y} = \vec{v}_i \Delta t + \frac{1}{2} \vec{a} \Delta t^2 \quad \text{OR/OF } \Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$\left(\frac{\vec{v}_i + \vec{v}_f}{2} \right) \Delta t = \vec{v}_{iB} \Delta t_B + \frac{1}{2} \vec{a} \Delta t_B^2$$

$$\left(\frac{0 + 245}{2} \right) (25) \checkmark = \vec{v}_{iB}(20) + \frac{1}{2} (+9,8)(20)^2 \quad \checkmark$$

$$\vec{v}_{iB} = 55,13 \text{ m} \cdot \text{s}^{-1} \text{ downwards/afwaarts } \checkmark \text{ OR/OF } \vec{v}_{iB} = +55,13 \text{ m} \cdot \text{s}^{-1}$$

✓ Any one/Enige een

OPTION 6/OPSIE 6

Positive upwards/Positief opwaarts:

$$\Delta \vec{y} = \vec{v}_i \Delta t + \frac{1}{2} \vec{a} \Delta t^2 \quad \text{OR/OF } \Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$\left(\frac{\vec{v}_i + \vec{v}_f}{2} \right) \Delta t = \vec{v}_{iB} \Delta t_B + \frac{1}{2} \vec{a} \Delta t_B^2$$

$$\left(\frac{0 - 245}{2} \right) (25) \checkmark = \vec{v}_{iB}(20) + \frac{1}{2} (-9,8)(20)^2 \quad \checkmark$$

$$\vec{v}_{iB} = 55,13 \text{ m} \cdot \text{s}^{-1} \text{ downwards/afwaarts } \checkmark \text{ OR/OF } \vec{v}_{iB} = -55,13 \text{ m} \cdot \text{s}^{-1}$$

✓ Any one/Enige een

OPTION 7/OPSIE 7

Positive downwards/Positief afwaarts:

$$\Delta \vec{y} = \vec{v}_i \Delta t + \frac{1}{2} \vec{a} \Delta t^2 \quad \text{OR/OF } \Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$\frac{\vec{v}_f^2 - \vec{v}_i^2}{2a} = \vec{v}_{iB} \Delta t_B + \frac{1}{2} \vec{a} \Delta t_B^2$$

$$\frac{(245)^2 - 0^2}{2(9,8)} \checkmark = \vec{v}_{iB}(20) + \frac{1}{2} (+9,8)(20)^2 \quad \checkmark$$

$$\vec{v}_{iB} = 55,13 \text{ m} \cdot \text{s}^{-1} \text{ downwards/afwaarts } \checkmark \text{ OR/OF } \vec{v}_{iB} = +55,13 \text{ m} \cdot \text{s}^{-1}$$

✓ Any one/Enige een

OPTION 8/OPSIE 8

Positive upwards/Positief opwaarts:

$$\Delta \vec{y} = \vec{v}_i \Delta t + \frac{1}{2} \vec{a} \Delta t^2 \quad \text{OR/OR} \quad \Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$\frac{\vec{v}_f^2 - \vec{v}_i^2}{2a} = \vec{v}_i \Delta t + \frac{1}{2} \vec{a} \Delta t^2$$

$$\frac{(-245)^2 - 0^2}{2(-9,8)} \checkmark = \vec{v}_{iB}(20) + \frac{1}{2}(-9,8)(20)^2 \checkmark$$

✓ Any one/Enige een

$$\vec{v}_{iB} = 55,13 \text{ m} \cdot \text{s}^{-1} \text{ downwards/afwaarts} \checkmark \quad \text{OR/OR} \quad \vec{v}_{iB} = -55,13 \text{ m} \cdot \text{s}^{-1}$$

(4)

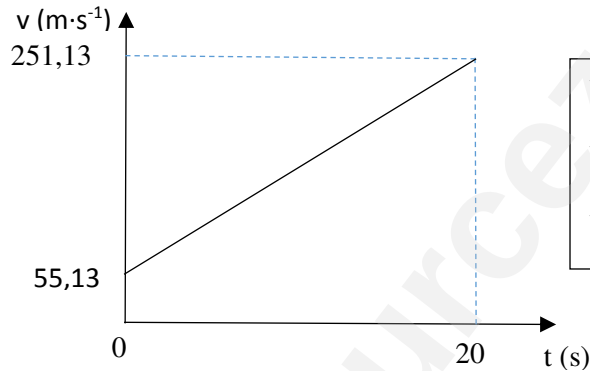
Note/Aantekening: Do not penalise if vector notation is not used./Moenie penaliseer indien vektorenotasie nie gebruik is nie.

9.3

POSITIVE MARKING FROM 8.2.2/POSITIEWE NASIEN VANAF 8.2.2

OPTION 1/ OPSIE 1

Positive downwards/Positief afwaarts:



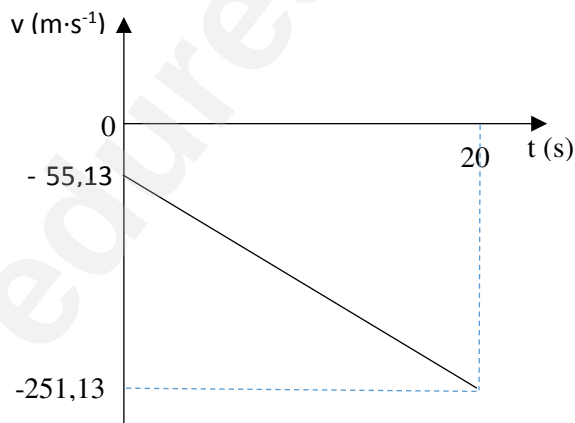
$$\vec{v}_f = \vec{v}_i + a \Delta t$$

$$\vec{v}_f = 55,13 + 9,8(20)$$

$$\vec{v}_f = 251,13 \text{ m} \cdot \text{s}^{-1}$$

OPTION 2/ OPSIE 2

Positive upwards/Positief opwaarts:



$$\vec{v}_f = \vec{v}_i + a \Delta t$$

$$\vec{v}_f = -55,13 - 9,8(20)$$

$$\vec{v}_f = -251,13 \text{ m} \cdot \text{s}^{-1}$$



Criteria for marking the graph/ <i>Kriteria vir die nasien van die grafiek.</i>	Marks/ <i>Punte</i>
Initial velocity/ <i>Aanvanklike snelheid</i>	✓
Final velocity/ <i>Finale snelheid</i>	✓
Time taken for object B to reach object A / <i>Tyd geneem deur voorwerp B om voorwerp A te bereik.</i>	✓
Correct shape/ <i>Korrekte vorm.</i>	✓

(4)
[13]

QUESTION 10 / VRAAG 10

10.1.1 $4,9 \text{ m} \cdot \text{s}^{-1}$ upwards/*opwaarts*✓

(1)

10.1.2 $0,5 \text{ s}$ ✓

(1)

10.1.3 $1,5 \text{ s}$ ✓

(1)

10.2 OPTION 1/OPSIE 1

Positive upwards/*Positief opwaarts*

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

$$v_f = 4,9 + (-9,8)(0,3) \checkmark$$

$$v_f = 1,96 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(3)

OPTION 2/OPSIE 2

Positive downwards/*Positief afwaarts*

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

$$v_f = (-4,9) + (+9,8)(0,3) \checkmark$$

$$v_f = 1,96 \text{ m} \cdot \text{s}^{-1} \checkmark$$

10.3 Option 1/Opsie1



Velocity lost/*Snelheid verloor* = 10 %

$$= (10 \div 100)(9,8) \checkmark$$

$$= 0,98 \text{ m} \cdot \text{s}^{-1}$$

Velocity with which the ball leaves the ground/*Snelheid waarmee die bal die grond verlaat* = $9,8 - 0,98 \checkmark$

$$= 8,82 \text{ m} \cdot \text{s}^{-1} \text{ upwards/opwaarts}$$

Positive upwards/*Positief opwaarts*

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

$$0^2 = (8,82)^2 + 2(-9,8)\Delta y \checkmark$$

$$\Delta y = 3,97 \text{ m} \checkmark$$

Option 2/Opsie 2

Velocity lost/*Snelheid verloor* = 10 %

$$= (10 \div 100)(9,8) \checkmark$$

$$= 0,98 \text{ m} \cdot \text{s}^{-1}$$

Velocity with which the ball leaves the ground/*Snelheid waarmee die bal die grond verlaat* = $9,8 - 0,98 \checkmark$

$$= 8,82 \text{ m} \cdot \text{s}^{-1} \text{ upwards/opwaarts}$$

Positive downwards/*Positief afwaarts*

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

$$0^2 = (-8,82)^2 + 2(+9,8)\Delta y \checkmark$$

$$\Delta y = 3,97 \text{ m} \checkmark \text{ above the ground/bo die grond.}$$

Option 3/Opsie 3

Velocity lost/*Snelheid verloor* = 10 %

$$= (10 \div 100)(9,8) \checkmark$$

$$= 0,98 \text{ m} \cdot \text{s}^{-1}$$



Velocity with which the ball leaves the ground/ *Snelheid waarmee die bal die grond verlaat* = $9,8 - 0,98\checkmark$

$$= 8,82 \text{ m} \cdot \text{s}^{-1} \text{ upwards/opwaarts}$$

Positive upwards/Positief opwaarts

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

$$0 = (8,82) + (-9,8)\Delta t$$

$$\Delta t = 0,9 \text{ s}$$

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

$$\Delta y = \left(\frac{8,82 + v_f}{2} \right) 0,9\checkmark$$

$$\Delta y = 3,97 \text{ m}$$

$$\Delta y = 3,97 \text{ m} \checkmark \text{ above the ground/bo die grond.}$$

Option 4/Opsie 4

Velocity lost/*Snelheid verloor* = 10 %

$$= (10 \div 100)(9,8)\checkmark$$

$$= 0,98 \text{ m} \cdot \text{s}^{-1}$$

Velocity with which the ball leaves the ground/ *Snelheid waarmee die bal die grond verlaat* = $9,8 - 0,98\checkmark$

$$= 8,82 \text{ m} \cdot \text{s}^{-1} \text{ upwards/opwaarts}$$

Positive downwards/Positief afwaarts

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

$$0 = (-8,82) + (+9,8)\Delta t$$

$$\Delta t = 0,9 \text{ s}$$

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

$$\Delta y = \left(\frac{-8,82 + v_f}{2} \right) 0,9\checkmark$$



$$\Delta y = -3,97 \text{ m}$$

$$\Delta y = 3,97 \text{ m} \checkmark \text{ above the ground/bo die grond.}$$

Option 5/Opsie 5

$$\text{Velocity lost/Snelheid verloor} = 10 \%$$

$$= (10 \div 100)(9,8) \checkmark$$

$$= 0,98 \text{ m} \cdot \text{s}^{-1}$$

$$\text{Velocity with which the ball leaves the ground/ Snelheid waarmee die bal die grond verlaat} = 9,8 - 0,98 \checkmark$$

$$= 8,82 \text{ m} \cdot \text{s}^{-1} \text{ upwards/opwaarts}$$

$$\text{Positive upwards/Positief opwaarts}$$

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

$$0 = (8,82) + (-9,8)\Delta t$$

$$\Delta t = 0,9 \text{ s}$$

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

$$\Delta y = (8,82)\Delta t + \frac{1}{2}(-9,8)(0,9)^2 \checkmark$$

$$\Delta y = 3,97 \text{ m}$$

$$\Delta y = 3,97 \text{ m} \checkmark \text{ above the ground/bo die grond.}$$

Option 6/Opsie 6

$$\text{Velocity lost/Snelheid verloor} = 10 \%$$

$$= (10 \div 100)(9,8) \checkmark = 0,98 \text{ m} \cdot \text{s}^{-1}$$

$$\text{Velocity with which the ball leaves the ground/ Snelheid waarmee die bal die grond verlaat} = 9,8 - 0,98 \checkmark$$

$$= 8,82 \text{ m} \cdot \text{s}^{-1} \text{ upwards/opwaarts}$$

$$\text{Positive downwards/Positief afwaarts}$$

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



$$0 = (-8,82) + (+9,8)\Delta t$$

$$\Delta t = 0,9 \text{ s}$$

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

$$\Delta y = (-8,82)\Delta t + \frac{1}{2} (+9,8)(0,9)^2 \checkmark$$

$$\Delta y = -3,97 \text{ m}$$

$$\Delta y = 3,97 \text{ m} \checkmark \text{ above the ground/bo die grond.}$$

(5)

[11]



TOPIC 1/ONDERWERP 1/MECHANICS/MEGANIKA

1.4. WORK-ENERGY AND POWER/WERK, ENERGIE EN DRYWING.

QUESTION 1/VRAAG 1

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

[20]



QUESTION 2/VRAAG 2

- 2.1 The total mechanical energy (sum of gravitational potential energy and kinetic energy) in an isolated system remains constant. ✓✓ (2 or 0)

Die totale meganiese energie (som van gravitasie- potensiële energie en kinetiese energie) in 'n geslote sisteem bly konstant.

(2)

- 2.2 Non-conservative/nie-konserwatiewe ✓

A non-conservative force as a force for which the work done in moving an object between two points depends on the path taken. ✓

'n nie-konserwatiewe krag as 'n krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, afhanklik is van die roete wat gevolg word.

(2)

- 2.3 **OPTION 1/OPSIE 1**

$$W = F\Delta x \cos \theta$$

$$W = mg\Delta x \cos \theta$$

$$W = (1)(9,8)(240 + 0,2) \cos 0^\circ \checkmark$$

$$W = 2353,96 \text{ J} \checkmark$$

} Any One /Enigeeen ✓

OPTION 2/OPSIE 2

$$W = -\Delta E_p$$

$$W = -(E_{pf} - E_{pi})$$

$$W = -(mgh_f - mgh_i)$$

$$W = (1)(9,8)(0) - (1)(9,8)(240 + 0,2) \checkmark$$

$$W = 2353,96 \text{ J} \checkmark$$

} Any One /Enigeeen ✓

(3)



2.4

$$\begin{aligned}
 \Delta E_m &= 0 \\
 E_{Mi} &= E_{Mf} \\
 E_{Ki} + E_{Pi} &= E_{Kf} + E_{Pf} \\
 \frac{1}{2}mv_i^2 + mgh_i &= \frac{1}{2}mv_f^2 + mgh_f \\
 mgh_i &= \frac{1}{2}mv_f^2
 \end{aligned}$$

Any one/Enige een ✓

$$0 + (1)(9,8)(2,40) = \frac{1}{2}v_f^2 + 0$$

$$v = \sqrt{2353,96}$$

$$v = 68,59 \text{ m} \cdot \text{s}^{-1}$$

(4)

2.5

The work done on an object by a net force is equal to the change in the object's kinetic energy ✓✓ (2 or 0)

Die arbeid verrig op 'n voorwerp deur 'n nettokrag is gelyk aan die verandering in kinetiese energie van die voorwerp.

(2)

2.6

OPTION 1/OPSIE 1

$$W_{\text{non-conservative}} = \Delta E_K + \Delta E_p$$

$$f \Delta x \cos \theta = (E_{Kf} - E_{Ki}) + (E_{Pf} - E_{Pi})$$

$$f \Delta x \cos 180 = \left(\frac{mv_f^2}{2} - \frac{mv_i^2}{2} \right) + (mgh_f - mgh_i)$$

$$f(0,2) \cos 180 = \left(\frac{1 \times 0^2}{2} - \frac{1 \times (68,59)^2}{2} \right) + (1 \times 9,8 \times (-0,2) - 1 \times 9,8 \times 0)$$

$$f = 11771,27 \text{ N}$$

Any one/Enige een ✓

OPTION 2/OPSIE 2

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

$$f \Delta x \cos 180^\circ + Fg \Delta x \cos 0^\circ = E_{Kf} - E_{Ki}$$

$$f \Delta x \cos 180^\circ + mg \Delta x \cos 0^\circ = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$f \times 0,2 \times (-1) + (1)(9,8)(0,2)(1) = \frac{1}{2}(1)0 - \frac{1}{2}(1)(68,59)^2$$

$$f = 11771,27 \text{ N}$$

Any one/Enige een ✓

(5)

[18]

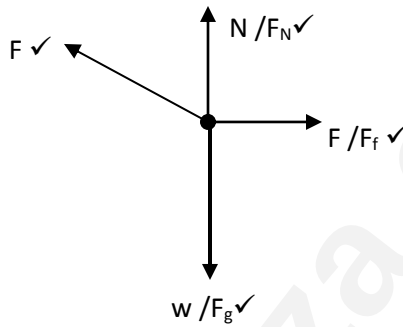


QUESTION 3/VRAAG 3

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

3.2 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)

3.3



3.4 $F \sin 20^\circ + N = mg$ ✓

$$N = mg - F \sin 20^\circ$$

$$W_{fk} = f_k \Delta x \cos \theta = \mu_k N \Delta x \cos \theta$$
 ✓

$$= \mu_k (mg - F \sin 20^\circ) (3) \cos \theta$$

$$= (0,2)[200(9,8) - F \sin 20^\circ] (3) \cos 180^\circ$$
 ✓

$$= (-1176 + 0,205 F) \text{ J}$$
 ✓

3.5 $W_{\text{tot}} = [W_g] + W_f + W_F$ ✓

$$0 = [0] + [(-1176 + 0,205 F)] + [F (\cos 20^\circ) (3) (\cos 0^\circ)]$$
 ✓

$$F = 388,88 \text{ N}$$
 ✓

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 4/VRAAG 4

- 4.1 Power is the rate at which work is done or energy is expended. ✓✓ (2 or 0)
Drywing is die tempo waarteenarbeidverrig of energieverbruik word. (2)

- 4.2 Gravitational force✓/Gravitasiekrag

A conservative force is a force for which the work done in moving an object between two points is independent of the path taken. ✓
 'n konserwatiewekrag is 'n krag waarvoor die arbeidverrig om 'n voorwerp tussen twee punte te beweeg, onafhanklik is van die roete wat gevolg word (2)

- 4.3 $\Sigma \vec{F}_{net} = m\vec{a}$ **OR/OF** $\Sigma \vec{F}_{net} = 0$
- $$\vec{T} + \vec{f} + \vec{F}_g = 0$$
- $$T - f - F_g = 0$$
- $$T - f - mg = 0$$
- Any one/ Enigeeen ✓
- $$T - 4 \times 10^3 \checkmark - (1,8 \times 10^3 \times 9,8) \checkmark = 0$$
- $$T = 2,16 \times 10^4 N$$
- $$P = Fv \checkmark$$
- $$P = 2,16 \times 10^4 \times 3 \checkmark$$
- $$P = 6,48 \times 10^4 W \checkmark$$

(6)

[10]

QUESTION 5/VRAAG 5

- 5.1.1 $E_k/K = \frac{1}{2} mv^2 \checkmark$
 $= \frac{1}{2} (2)(4,95)^2 \checkmark$
 $= 24,50 J \checkmark$

(3)



5.1.2

POSITIVE MARKING FROM QUESTION 5.1.1/POSITIEWE NASIEN VANAF**5.1.1****OPTION 1/OPSIE 1**

$$E_{\text{mech before}} = E_{\text{mech after}}$$

$$[(E_{\text{mech}})_{\text{bob}} + (E_{\text{mech}})_{\text{block}}]_{\text{before/voor}} = [(E_{\text{mech}})_{\text{Block}} + (E_{\text{mech}})_{\text{bob}}]_{\text{after/na}}$$

$$(mgh + \frac{1}{2}mv^2)_{\text{before/voor}} = (mgh + \frac{1}{2}mv^2)_{\text{after/na}}$$

$$(5)(9,8)h + 0 + 0 = 5(9,8)\frac{1}{4}h + 0 + 24,50$$

$$h = 0,67 \text{ m} \checkmark$$

Any one/

Enige een ✓

OPTION 2/OPSIE 2

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

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

$$-\Delta E_p = \Delta E_k$$

$$-[(5)(9,8)(\frac{1}{4}h) - (5)(9,8)h] = 24,50$$

$$h = 0,67 \text{ m}$$

Any one/

Enige een ✓

OPTION 3/OPSIE 3

$$\text{Loss } E_p \text{ bob} = \text{Gain in } E_k \text{ of block}$$

$$mg(\frac{3}{4}h) = 24,5$$

$$(5)(9,8)(\frac{3}{4}h) = 24,5$$

$$h = 0,67 \text{ m}$$

OPTION 4 /OPSIE 4Before/Voor

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

$$(5)(9,8)h + 0 = (5)(9,8)h_o + \frac{1}{2}(5)v^2$$

$$v_i^2 = 19,6h - 19,6h_o$$

After/Na

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

$$(5)(9,8)h_o + \frac{1}{2}(5)v_i^2 = (5)(9,8)(\frac{1}{4}h) + 0$$

$$v_i^2 = 4,9h - 19,6h_o$$

(4)



$E_{\text{mech/meg}}$ before collision/voor botsing = $E_{\text{mech/meg}}$ after collision/na botsing

$$\frac{1}{2} m v_i^2(\text{bob/skietlood}) + 0 = \frac{1}{2} m v_f^2(\text{bob/skietlood}) + \frac{1}{2} m v^2(\text{block/blok})$$

$$\frac{1}{2} (5)(19,6h - 19,6h_0) = \frac{1}{2} (5)(4,9h - 19,6h_0) + 24,5$$

$$h = 0,67 \text{ m}$$

- 5.2 The net/total work done on an object is equal to the change in the object's kinetic energy

Die netto/totale arbeid op 'n voorwerp verrig is gelyk aan die verandering in die kinetiese energie van die voorwerp.

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/netto krag is gelyk aan die voorwerp se verandering in kinetiese energie.

(2)

- 5.3

OPTION 1/OPSIE 1

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

$$W_f + mg\Delta y \cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$$

$$W_f + (2)(9,8)(0,5)\cos 180^\circ \checkmark = \frac{1}{2} (2)(2^2 - 4,95^2) \checkmark$$

$$W_f = -10,7 \text{ J} \checkmark$$

OPTION 2/OPSIE 2

$$W_{\text{nc}} = \Delta E_K + \Delta U$$

$$W_{\text{nc}} = \Delta E_K + \Delta E_P$$

Any one/ Enige een

$$W_f = \frac{1}{2} (2)(2^2 - 4,95^2) \checkmark + (2)(9,8)(0,5-0) \checkmark$$

$$= -10,7 \text{ J} \checkmark$$

(4)

[13]

QUESTION 6/VAAG 6

- 6.1 A *conservative force* is a force for which the work done in moving an object between two points is independent of the path taken. ✓✓

'n konserwatiewe krag is 'n krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, onafhanklik is van die roete wat gevolg word.



(2)

6.2 Negative/Negatief✓

The angle between the tension force and the direction of the displacement is 180° and the cosine of 180° is minus one (-1). ✓

Die hoek tussen die spanningkrag en die rigting van die verplasing is 180° en die cosinus van 180° is minus een (-1)

(2)

6.3 OPTION 1/OPSIE 1

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

$$W_f + W_{T1} + W_{T2} = (E_{kf} - E_{ki}) + (E_{pf} - E_{pi})$$

$$f_f \Delta x \cos 180^\circ + T_1 \Delta x \cos 0^\circ + T_2 \Delta x \cos 180^\circ = \frac{1}{2} (m_1 + m_2) v_f^2 - 0 + (0 - m_1 g h_i)$$

$$f_f \Delta x \cos 180^\circ = \frac{1}{2} (m_1 + m_2) v_f^2 - 0 + (0 - m_2 g h_i)$$

$$\mu_k N \Delta x \cos 180^\circ = \frac{1}{2} (m_1 + m_2) v_f^2 - 0 + (0 - m_2 g h_i)$$

$$\mu_k m_1 g \Delta x \cos 180^\circ = \frac{1}{2} (m_1 + m_2) v_f^2 - 0 + (0 - m_2 g h_i)$$

✓ Any one/

Enige een

$$[(\mu_k)(2,40)(9,8)(0,50)(-1)] \checkmark = \left[\frac{1}{2} (2,40 + 1,80) \right] (0,95)^2 \checkmark - (1,80)(9,8)(0,5) \checkmark$$

$$(\mu_k)(-11,76) = 1,90 - 8,82$$

$$(\mu_k)(-11,76) = -6,92$$

$$(\mu_k) = 0,59 \checkmark$$

OPTION 2/OPSIE 2

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

$$W_f + W_{T1} + W_{T2} + W_g = (E_{kf} - E_{ki})$$

$$f_{f1} \Delta x \cos 180^\circ + f_{g2} \Delta x \cos 0^\circ = \frac{1}{2} (m_1 + m_2) v_f^2 - 0$$

✓ Any one/Enige een✓



$$f_f \Delta x \cos 180^\circ + m_2 g \Delta x \cos 0^\circ = \left(\frac{1}{2} m_1 + m_1 \right) v_f^2 - 0$$

$$\mu N \Delta x \cos 180^\circ + m_2 g \Delta x = \frac{1}{2} (m_1 + m_1) v_f^2 - 0$$

$$\mu m_1 g \Delta x (-1) + m_2 g d = \frac{1}{2} (m_1 + m_1) v_f^2 - 0$$

$$[(\mu_k)(2,40)(9,8)(0,50)(-1)] \checkmark + 8,82 \checkmark = \left[\frac{1}{2} (2,40 + 1,80) \right] (0,95)^2 \checkmark$$

$$(\mu_k)(-11,76) = 1,90 - 8,82$$

$$(\mu_k)(-11,76) = -6,92 (\mu_k) = 0,59 \checkmark \quad (5)$$

[9]

QUESTION 7/VRAAG 7

7.1 A non-conservative force is a force for which the work done in moving an object between two points depends on the path taken. ✓✓

'n Nie-konserwatiwew krag is 'n krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, afhankelijk is van die roete wat gevolg word. ✓✓

(2 or 0) (2)

$$7.2 \quad P = \frac{W_{nc}}{\Delta t} = \frac{\Delta E_k + \Delta E_p}{\Delta t} \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} \text{Any one/Enige een} \checkmark$$

$$= \frac{\left(\frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \right) + (mgh_f - mgh_i)}{\Delta t}$$

$$= \frac{\left[\frac{1}{2} (87) (2,1)^2 - 0 \right] \checkmark + [(87) (9,8) (35) - 0] \checkmark}{60 \checkmark}$$

$$= 500,55 \text{ W } \checkmark \quad (5)$$

[7]

QUESTION 8/VRAAG 8

8.1 The net (total) work (done on an object/particle) is equal to ✓ the change in kinetic energy (of the object/particle). ✓

Die netto(totale) werk (verrig op 'n voorwerp/deeltjie) is gelyk aan ✓ die verandering in kinetiese energie (van die voorwerp/deeltjie). ✓

OR/OF



The work done by the resultant/net force (on an object/particle) is equal to ✓ the change in kinetic energy (of the object/particle) ✓
 Die werk verrig deur die resultante/netto krag (op 'n voorwerp/deeltjie) is gelyk aan ✓ die verandering in kinetiese energie (van die voorwerp/deeltjie). ✓

(2)

8.2

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

OR/OF

$$W_{\text{fr}} + W_A + W_g + W_N = \Delta E_K$$

OR/OF

✓ Any one/Enige een

$$F_f \Delta x \cos 180^\circ + F \Delta x \cos 30^\circ + F_g \Delta x \cos 90^\circ + N \Delta x \cos 90^\circ = \frac{mv_f^2}{2} - \frac{mv_i^2}{2}$$

$$\checkmark \underline{160,02 \Delta x (-1)} + \checkmark \underline{(191,7) \Delta x (\cos 30^\circ)} + 0 + 0 = \frac{600(3)^2}{2} - \frac{600(0)^2}{2} \checkmark$$

$$(-160,02 + 166,017...) \Delta x = 2700$$

$$(5,997...) \Delta x = 2700$$

$$\Delta x = 450,22 \text{ m} \checkmark$$

(5)

8.3

OPTION 1/OPSIE 1

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

OR/OF

$$P = \frac{F \Delta x \cos 30^\circ}{\Delta t}$$

✓ Any one/Enige een

$$5 \text{ minutes} = 300 \text{ s}$$

$$P = \frac{191,7 \times 450,22 \times 0,866}{300} \checkmark$$

$$P = 249,14 \text{ W} \checkmark$$

OPTION 2/OPSIE 2

$$P = F v \checkmark$$

$$P = \underline{191,7 \cos 30^\circ} \left(\frac{3+0}{2} \right) \checkmark$$

(3)



$$P = 249,03 \text{ W} \checkmark$$

8.4 Greater than ✓

The horizontal component (of the force)/ force in direction of the motion will be greater. ✓

Groter as ✓

Die horisontale komponent (van die krag)/krag in die rigting van die beweging sal groter wees. ✓

OR/OF

The work done will be greater. ✓

Die werk verrig sal groter wees. ✓

OR/OF

As θ decreases, $\cos \theta$ increases. ✓

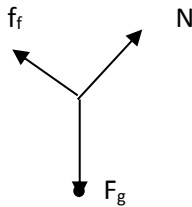
Soos θ kleiner word, sal $\cos \theta$ groter word. ✓

(2)

[12]

QUESTION 9

9.1



9.2

Energy is not conserved because there is a non-conservative force (friction force) acting on the block.

Energie bly nie behoue nie.

Daar is 'n nie-konserwatiewe krag (wrywingskrag) wat op die blok inwerk.

OR

The mechanical energy is not conserved because the system is not closed/isolated, friction force is acting (external force/non-conservative).

OF



Die meganiese energie bly nie behoue nie. Die sisteem is nie 'n geslote sisteem/ geïsoleerde sisteem nie; Wrywingskrag (eksterne krag/ nie-konserwatiewe krag werk in.

OR

$$E_M = E_k + E_p$$

$$E_{Mi} = 0 + mgh_i = 20 \times 9,8 \times 2,45 = 480,2 \text{ J}$$

$$E_{Mf} = \frac{mv^2}{2} + 0 = \frac{20 \times (4)^2}{2}$$

$$E_{Mf} = 160 \text{ J}$$

$$\text{Then } E_{Mf} < E_{Mi}$$

Mechanical energy is not conserved. Final mechanical energy smaller than initial mechanical energy, energy is dissipated due to friction.

OF

$$E_M = E_k + E_p$$

$$E_{Mi} = 0 + mgh_i = 20 \times 9,8 \times 2,45 = 480,2 \text{ J}$$

$$E_{Mf} = \frac{mv^2}{2} + 0 = \frac{20 \times (4)^2}{2}$$

$$E_{Mf} = 160 \text{ J}$$

$$\text{Then } E_{Mf} < E_{Mi}$$

Die meganiese energie bly nie behoue nie.

Finale meganiese energie is kleiner as die aanvanklike meganiese energie;

Energie word omgeskakel as gevolg van wrywing.



9.3 $W_{\text{non con}} = \Delta E_M$

$$W_{\text{fr}} = \Delta E_M$$

$$W_{\text{fr}} = E_{Mf} - E_{Mo}$$

$$W_{\text{fr}} = (E_p + E_K) - (E_{Po} + E_{Ko})$$

$$W_{\text{fr}} = E_K - E_{Po}$$

$$W_{\text{fr}} = \frac{mv^2}{2} - mgh$$

$$W_{\text{fr}} = \frac{20 \times (4)^2}{2} - 20 \times 9,8 \times 2,45$$

$$W_{\text{fr}} = \frac{20 \times 16}{2} - 20 \times 9,8 \times 2,45$$

$$W_{\text{fr}} = 160 - 480,2$$

$$W_{\text{fr}} = -320,2 \text{ J}$$

9.4 $W_f = F_f \Delta x \cos 180^\circ$

$$-320,2 = F_f (4,9) (-1)$$

$$F_f = 65,35 \text{ N}$$



9.5

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

$$W_{\text{net}} = E_{kf} - E_{ki}$$

$$W_{\text{net}} = E_{kf} - 0$$

$$W_{\text{net}} = \frac{mv^2}{2}$$

$$W_{\text{net}} = \frac{20x(4)^2}{2}$$

$$W_{\text{net}} = 160 \text{ J}$$

9.6.1

$$9.61. \Delta E_K = E_{Kf} - E_{Ki}$$

$$\Delta E_K = \frac{mv_f^2}{2} - \frac{mv_i^2}{2}$$

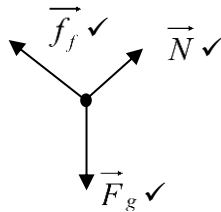
$$\Delta E_K = \frac{20 \times 0^2}{2} - \frac{20(4)^2}{2}$$

$$\Delta E_K = -160 \text{ J}$$



QUESTION 10

10.1



(3)

10.2

$$\left. \begin{aligned} f_f &= \mu N \\ f_f &= \mu mg \cos 30^\circ \end{aligned} \right\} \checkmark$$

$$f_f = \frac{0,737 \times 0,80 \times 9,8 \times 0,866}{1} \checkmark$$

$$f_f = 5,00 \text{ N} \checkmark$$

(3)

10.3

The net (total) work (done on an object/particle) is equal to✓ the change in kinetic energy (of the object/particle).✓

Die netto (totale) arbeid / werk verrig (op 'n voorwerp / deeltjies) is gelyk aan✓ die verandering in kinetiese energie ✓ (van die voorwerp / deeltjie).

OR/OF

The work done by the resultant/net force (on an object/particle) is equal to✓ the change in kinetic energy✓ (of the object/particle).

Die arbeid / werk verrig deur die resulterende / netto krag (op 'n voorwerp / deeltjie) is gelyk aan✓ die verandering in kinetiese energie ✓ (van die voorwerp / deeltjie).

(2)



10.4

$$\left. \begin{aligned} W_{net} &= \Delta E_K \\ W_g + W_{fr} &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ mg\Delta x \cos 60^\circ + f_f \Delta x \cos 180^\circ &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \end{aligned} \right\} \checkmark \text{Any one/Enige een}$$

$$\underline{0,80 \times 9,8 \times \Delta x \times 0,5} + \underline{5 \Delta x (-1)} = \underline{\frac{1}{2} \times 0,80 \times (0)_f^2 - \frac{1}{2} \times 0,80 \times (2)^2}$$

$$\Delta x = 1.48 \text{ m} \checkmark$$

(5)

10.5 EQUAL TO/GELYK AAN ✓

$$\left. \begin{aligned} W_g + W_{fr} &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ mg\Delta x \cos \beta + \mu mg\Delta x \cos \alpha &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\ \Delta x(g \cos \beta + \mu g \cos \alpha) &= \frac{1}{2}v_f^2 - \frac{1}{2}v_i^2 \\ \Delta x &= \left(\frac{v_f^2 - v_i^2}{2(g \sin \alpha + \mu g \cos \alpha)} \right) \end{aligned} \right\} \checkmark \text{Any one/Enige een}$$

The distance covered does not depend on the mass of the object. ✓

Die afstand afgelê is onafhanklik van die massa van die voorwerp.

OR/OF

EQUAL TO /GELYK AAN ✓

$$\left. \begin{aligned} F_{net} &= m \left(\frac{v_f^2 - v_i^2}{2\Delta x} \right) \\ mg \sin \alpha + \mu mg \cos \alpha &= m \left(\frac{v_f^2 - v_i^2}{2\Delta x} \right) \\ \Delta x &= \left(\frac{v_f^2 - v_i^2}{2(g \sin \alpha + \mu g \cos \alpha)} \right) \end{aligned} \right\} \checkmark \text{Any one Enige een}$$

The distance covered does not depend on the mass of the object. ✓

Die afstand afgelê is onafhanklik van die massa van die voorwerp.

(3)

[16]



**TOPIC 2/ONDERWERP 2 – WAVES, SOUND AND LIGHT/ GOLWE,
KLANK & LIG**

2.1. DOPPLER EFFECT/DOPPLER EFFEK

QUESTION 1/VRAAG 1

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

[20]



QUESTION 2/VRAAG 2

2.1.1 Frequency (of sound detected by the listener (observer))✓

Frekwensie van klank deur luisteraar (waarnemer) waargeneem (1)

2.1.2 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)

2.1.3 Away/Weg van✓

Detected frequency of source decreases✓

Waargenome frekwensie van bron neem af (2)

2.1.4

OPTION 1/OPSIE 1

EXPERIMENT/EKSPERIMENT 2

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

$$874 = \frac{v}{v + 10} (900) \quad \checkmark$$

$$v = 336,15 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \quad (\text{Accept/Aanvaar : } 336,15 \text{ m} \cdot \text{s}^{-1} - 323,33 \text{ m} \cdot \text{s}^{-1}) \quad (5)$$

EXPERIMENT/EKSPERIMENT 3

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

$$850 = \frac{v}{v + 20} (900) \quad \checkmark$$

$$v = 340 \text{ m} \cdot \text{s}^{-1} \quad \checkmark \quad (\text{Accept/Aanvaar : } 313,33 \text{ m} \cdot \text{s}^{-1} - 340 \text{ m} \cdot \text{s}^{-1}) \quad (5)$$



EXPERIMENT 4/EKSPERIMENT 4

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

$$827 = \frac{v}{v + 30} (900) \quad \checkmark$$

$$v = 339,86 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

(Accept/Aanvaar : $339,86 \text{ m} \cdot \text{s}^{-1} - 345 \text{ m} \cdot \text{s}^{-1}$)

(5)

OPTION 2/OPSIE 2

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

Experiment/Eksperiment 2 and/en 3

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

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

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

Experiment/Eksperiment 2 and/en 4

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

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

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

Experiment/Eksperiment 3 and/en 4

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

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

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

(5)

2.2 Away from the Earth/Weg vanaf die aarde ✓

(1)

[11]



QUESTION 3/VRAAG 3

3.1 $v = f\lambda$ ✓

$$= (222 \times 10^3)(1,5 \times 10^{-3}) \checkmark$$

$$= 333 \text{ m.s}^{-1} \checkmark$$

(3)

3.2

3.2.1 Towards the bat/*Na die vlermuis toe* ✓

(1)

3.2.2 **POSITIVE MARKING FROM QUESTION 3.1/POSITIEWE NASIEN VANAF VRAAG 3.1**

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

$$230,3 = \frac{333}{333 - v_s} (222) \checkmark$$

$$76689,9 - 230,3 v_s = 73\,926$$

$$v = 12 \text{ m.s}^{-1} \checkmark \quad (\text{towards bat/na die vlermuis toe})$$

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 4/VRAAG 4

- 4.1.1 It is the (apparent) change in frequency (or pitch) of the sound (detected by a listener) because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓

Dit is die verandering in frekwensie (of toonhoogte) van die klank (waargeneem deur 'n luisteraar) omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium van klankvoortplanting 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)

- 4.1.2 $v = f\lambda$ □

$$340 = f(0,28) \quad \square$$

$$f_s = 1\,214,29 \text{ Hz} \quad \square \quad (3)$$

- 4.1.3 **POSITIVE MARKING FROM QUESTION 4.1.2/POSITIEWE NASIEN VANAF VRAAG 4.1.2**

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \text{OR/OF} \quad f_L = \frac{v \pm v_L}{v \pm v_s} \times \frac{v}{\lambda_s} \quad \text{OR/OF} \quad f_L = \frac{v}{v - v_s} f_s \quad \text{OR/OF} \quad f_L = \frac{f_s}{1 - \frac{v_s}{v}} \quad \checkmark$$

$$f_L = \left(\frac{340}{340 - 30}\right) 1214,29 \checkmark \quad \text{OR/OF} \quad f_L = \left(\frac{340}{340 - 30}\right) \times \frac{340}{0,28} \quad \text{OR/OF} \quad f_L = \frac{1214,29}{1 - \frac{30}{340}}$$

$$= 1\,331,80 \text{ Hz} \checkmark \quad (1\,331,80 \text{ Hz} - 1\,335,72 \text{ Hz}) \quad (5)$$

- 4.1.4 Decreases/Verlaag ✓ (1)

- 4.2 The spectral lines of the star are/should be shifted towards the lower frequency ✓ end, which is the red end (red shift) of the spectrum. ✓

Die spektraallyne van die van die ster is verskuif na die laer frekwensie ent, wat die rooi ent van die spektrum is. (2)

[13]



QUESTION 5/VRAAG 5

5.1 $v = f\lambda$ ✓

$340 = f(0,71)$ ✓

$f = 478,87 \text{ Hz}$ ✓

The frequency of the sound detected by the person (listener) is smaller than the frequency of the source ($f_L < f_S$), therefore the train is moving away from the listener. ✓

Die frekwensie van die klank waargeneem deur die persoon (luisteraar) is kleiner as die frekwensie van die bron ($f_L < f_S$), dus beweeg die trein weg van die luisteraar. ✓

(4)

5.2 The change in pitch or frequency of the sound detected by an observer ✓ because of the sound source and the observer having different velocities with respect to the medium of sound propagation. ✓

Die verandering in toonhoogte of frekwensie van klank waargeneem deur 'n waarnemer ✓ as gevolg van die klankbron en waarnemer wat verskillende snelhede het relatief tot die medium van klankvoortplanting. ✓

OR/OF

The Doppler effect is the change in the observed frequency of a wave ✓ when the source or the detector moves relative to the transmitting medium. ✓

Die Doppler effek is die verandering in die waargenome frekwensie van 'n golf ✓ wanneer die bron of die waarnemer relatief tot die voortplantingsmedium beweeg. ✓

OR/OF

The (apparent) change in the frequency of a wave ✓ when there is a relative motion between the source of the wave and an observer. ✓

Die (skynbare) verandering in die frekwensie van 'n golf ✓ wanneer daar 'n relatiewe beweging tussen die bron van die golf en die waarnemer is. ✓

(2)



5.3 **POSITIVE MARKING FROM 5.1/POSITIEWE NASIEN VAN 5.1**
Option 1/Opsie 1

$$f_l = \left(\frac{v_{\text{sound/klank}} \pm v_{\text{listener/luisteraar}}}{v_{\text{sound/klank}} \pm v_{\text{source/bron}}} \right) f_s \checkmark$$

$$\checkmark 478,87 = \left(\frac{340 + 0}{340 + v_{\text{source/bron}}} \right) \checkmark \times 555 \checkmark$$

$$V_s = 54,05 \text{ m} \cdot \text{s}^{-1} \checkmark$$

Option 2/Opsie 2

$$f_l = \left(\frac{v_{\text{sound/klank}}}{v_{\text{sound/klank}} \pm v_{\text{source/bron}}} \right) f_s \checkmark$$

$$\checkmark 478,87 = \left(\frac{340}{340 + v_{\text{source/bron}}} \right) \checkmark 555 \checkmark$$

$$V_s = 54,05 \text{ m} \cdot \text{s}^{-1} \checkmark$$

Option 3/Opsie 3

$$f_L = \frac{f_s}{1 + \frac{v_s}{v}} \checkmark$$

$$\checkmark 478,87 = \frac{555}{1 + \frac{v_s}{340}} \checkmark$$

$$v_s = 54,05 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(5)

5.4 **ANY TWO**

To find the rate of blood flow (Doppler scanning) ✓

To see the unborn child (Ultra sound scanning) ✓

To hear the heart of a foetus (Ultra sound scanning) ✓

ENIGE TWEE

Om die tempo van bloedvloei te bepaal (Dopplerskandering) ✓

Om ongebore babas waar te neem (Ultraklankskandering) ✓

Om na die hartklop van 'n fetus te luister (Ultraklankskandering) ✓

(2)



- 5.5 The universe is expanding. ✓ ✓
Die heelal sit (dy) uit. ✓ ✓

(2)

[15]

QUESTION 6/VRAAG 6

- 6.1 Doppler effect is the change in frequency (or pitch) of the sound detected by a listener ✓ because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓

Doppler-effek is die verandering in frekwensie (of toonhoogte) van die klank waargeneem deur 'n luisteraar ✓ omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium waarin die klank voortgeplant word, het. ✓

OR/OF

The change in the observed frequency ✓ when there is relative motion between the source and the observer. ✓

Die verandering in die waargenome frekwensie ✓ as daar relatiewe beweging tussen die klankbron en die luisteraar is. ✓

(2)

- 6.2 For the same (constant) speed of sound ✓ the frequency of sound is inversely proportional to the wave length ✓ and as the locomotive approaches the listener (girl) the sound waves emitted by the whistle are compressed ✓ in front of the locomotive therefore the observed frequency is higher.

Vir dieselfde (konstante) spoed van klank ✓ is die frekwensie van klank omgekeerd eweredig aan die golflengte ✓ en as die lokomotief die luisteraar nader, word die klankgolwe wat deur die fluit uitgegee word, saamgepers aan ✓ die voorkant van die lokomotief, en is die waargenome frekwensie hoër.

(3)

- 6.3 EQUAL TO/GELYK AAN ✓

The driver of the locomotive is at rest relative to the source of sound. ✓

Die bestuurder van die lokomotief beweeg nie relatief tot van die bron van klank nie.

OR/OF

No relative motion between the train driver and locomotive. ✓



Geen relatiewe beweging tussen drywer en lokomotief nie.

(2)

6.4 OPTION 1/OPSIE 1

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

$$1836 \checkmark = \left(\frac{340}{340 + v_s} \right) \checkmark 2000 \quad \checkmark$$

$$v_s = 30,37 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 2/OPSIE 2

$$f_L = \left(\frac{v \pm v_L}{v \pm v_s} \right) f_s \quad \checkmark \text{ OR/OF } f_L = \left(\frac{v}{v - v_s} \right) f_s$$

$$2196,2 \checkmark = \left(\frac{340}{340 - v_s} \right) \checkmark 2000 \quad \checkmark$$

$$v_s = 30,37 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 3/OPSIE 3

$$f_L = \frac{f_s}{1 + \frac{v_s}{v}} \quad \checkmark$$

$$1836 \checkmark = \frac{2000 \checkmark}{1 + \frac{v_s}{340}} \quad \checkmark$$

$$v_s = 30,37 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 4/OPSIE 4

$$f_L = \frac{f_s}{1 + \frac{v_s}{v}} \quad \checkmark$$

$$2196,2 \checkmark = \frac{2000 \checkmark}{1 - \frac{v_s}{340}} \quad \checkmark$$

$$v_s = 30,37 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(5)



6.5 **ANY ONE**✓

- It is used (in flow meters) in medical science to measure:
 - the speed and direction (velocity) of blood flow.
 - movement of the heart of a foetus.
- To find the rate of blood flow (Doppler scanning)
- To see the unborn child (Ultra sound scanning)
- To hear the heart of a foetus (Ultra sound scanning)
- It is used in medical sonography to generate images (and sounds) of flowing blood.
- To detect blood clotting (Doppler ultrasound test)

ENIGE EEN

- *Dit word (in vloeimeters) gebruik in mediese wetenskap om die volgende te meet:*
 - *Die spoed en rigting (snelheid) van bloedvloei.*
 - *Beweging van 'n fetus se hart.*
- *Om die tempo van bloedvloei te meet (Doppler skandering)*
- *Om 'n ongebore baba te sien (Ultraklankskandering)*
- *Om die hart van 'n fetus te hoor (Ultraklankskandering)*
- *Dit word gebruik in mediese sonografie om beelde (en klanke) te vorm van vloeiende bloed.*
- *Om vorming van bloedklonte op te spoor. (Doppler- ultraklamktoets)*

(1)

[13]



QUESTION 7/ VRAAG 7

- 7.1 The Doppler effect is the change in frequency (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 Doppler-effek is die verandering in frekwensie (toonhoogte) van klank soos waargeneem deur die luisteraar omdat die klankbron en die luisteraar verskillende snelhede besit (relatief tot die medium wat die klank voortbring)

OR/ OF

The Doppler effect is the change in the observed frequency of a wave ✓ when the source or the detector moves relative to the transmitting medium. ✓

Die Doppler-effek is die verandering in die waargenome frekwensie van 'n golf wanneer die bron of die waarnemer beweeg relatief tot die medium wat die klank dra.

(2)

7.2 **OPTION 1/ OPSIE 1**

$$f_L = \left(\frac{v \pm v_L}{v \pm v_s} \right) f_s \checkmark$$

$$1\,000 \checkmark = \left(\frac{340}{340 - v_s} \right) \checkmark (930) \checkmark$$

$$V_s = 23,80 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 2/ OPSIE 2

$$f_L = \left(\frac{v}{v - v_s} \right) f_s \checkmark$$

$$1\,000 \checkmark = \left(\frac{340}{340 - v_s} \right) \checkmark (930) \checkmark$$

$$V_s = 23,80 \text{ m} \cdot \text{s}^{-1} \checkmark$$



OPTION 3/ OPSIE 3

$$f_L = \frac{f_s}{1 \pm \frac{v_s}{v}} \quad \checkmark \quad \text{OR} \quad f_L = \frac{f_s}{1 - \frac{v_s}{v}} \quad \checkmark$$

$$\checkmark 1000 = \frac{930}{1 - \frac{v_s}{340}} \quad \checkmark$$

$$v_s = 23,80 \text{ m} \cdot \text{s}^{-1} \quad \checkmark$$

(5)

7.3. Increases ✓ / Toeneem

(2)

The compressions behind the ambulance are further apart than when it was approaching ✓.

Die verdunnings agter die ambulans is verder van mekaar as die verdigtings toe die ambulans die luisteraar nader.

7.4.1. The stars are moving away ✓

Die sterre beweeg weg van die aarde

The spectral lines in the diagrams are shifted towards the red end/red shifted). ✓

Die spektrumlyne in die diagramme het verskuif na die rooi ent/rooi verskuiwing.

(2)

7.4.2. The Universe is expanding. ✓

(1)

Die heelal is besig om uit te sit.

[12]



QUESTION 8/VRAAG 8

- 8.1 Doppler effect is the change in frequency (or pitch) 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 Doppler-effek is die verandering in frekwensie (toonhoogte) van klank soos waargeneem deur die luisteraar omdat die klankbron en die luisteraar verskillende snelhede besit (relatief tot die medium wat die klank voortbring) (2)

- 8.2 Lower/ Laer ✓

Speed of sound is constant ✓, frequency detected (by the observer) is higher ✓ wevelenghts is inversely propotional to frequency. ✓
Die spoed van die klank is konstant, die frekwensie waargeneem (deur die waarnemer) is hoër, die golflengte is omgekeerd eweredig aan die frekwensie. (4)

- 8.3 $f_L = \left(\frac{v \pm v_L}{v \pm v_s}\right) f_s$ ✓ **OR/OF** $f_L = \left(\frac{v}{v \pm v_s}\right) f_s$

Appraching:

$$f_L = \left(\frac{343}{343-40}\right) 320 \text{ ✓}$$

$$f_L = 362,24 \text{ Hz}$$

Any One/ Enigeeen ✓

Moving away:

$$f_L = \left(\frac{343}{343+40}\right) 320 \text{ ✓}$$

$$f_L = 287,58 \text{ Hz}$$

Thus, the frequency shift that occurs as the train passes is:

$$\Delta f_L = f_{\text{recede}} - f_{\text{approach}}$$

$$\Delta f_L = 287,58 - 362,24$$

$$\Delta f_L = -75,66 \text{ Hz} \text{ ✓ OR/OF } \Delta f_L = 75,66 \text{ Hz}$$

Any One/ Enigeeen ✓



(6)

- 8.4 The star is movin away from the Erath ✓ because the spectrum shows a shift towards the red end, which is a lower frequenecy ✓
Die ster beweeg van die aarde af weg omdat die spektrum 'n verskuiwing toon na die rooi einde, wat 'n laer frekwensie is.

(2)

8.5 **ANY ONE/ENIGE EEN**

Doppler flow meter/*Doppler-vloimeter*

Measuring foetal heartbeat/ Meet van fetale hartslag

Measure speed of blood flow/Meet spoed van bloedvloei

Ultrasound/ Ultraklank

Sonar

Radar (for speeding/vir jaag)

(1)

[15]

QUESTION 9

- 9.1. Greater than✓ / hoër as
 When the police car approaches the listener:
- the sound waves emitted by the car's siren are compressed in front of the car;✓ more sound waves reach the listener per second✓ and the pitch (frequency) appears to be higher than the sound emitted by the source (the police car's siren). ✓

Toe die polisie motor nader aan die luisteraar kom :

- *die klank golwe uitgestraal word deur die motor se sirene is saamgeperste in*
- *en✓ meer klankgolwe bereik die luisteraar per second✓ voorkant van die motor , die helling (frekwensie) blyk te hoër is as die klank wat deur die wees*
- *✓bron (die polisie die motor se sirene) .*

(4)



9.2 Doppler effect✓/Doppler-effek

(3)

Doppler effect is the change in frequency (or pitch) of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓

Doppler-effek is die verandering in frekwensie (of toonhoogte) van die klank waargeneem deur 'n luisteraar is omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium waarin die klank voortgeplant word, het. ✓

9.3 **OPTION 1/OPSIE 1**

$$f_l = \left(\frac{v_{\text{sound}} \pm v_{\text{listener}}}{v_{\text{sound}} \pm v_{\text{source}}} \right) f_s \quad \checkmark \quad f_l = \left(\frac{v_{\text{klank}} \pm v_{\text{luisteraar}}}{v_{\text{sklank}} \pm v_{\text{bron}}} \right) f_s$$

$$f_l = \left(\frac{340 + 0}{340 - 30} \right) \checkmark \times 620 \checkmark$$

$$f_L = 680 \text{ Hz} \checkmark$$

OPTION 2/OPSIE 2

$$f_L = \frac{f_s}{1 - \frac{v_s}{v}} \checkmark$$

$$f_l = \frac{620}{1 - \frac{30}{340}} \checkmark \checkmark$$

$$f_L = 680 \text{ Hz} \checkmark$$

(4)

9.4 Lower tha✓/ laer as✓

(1)

9.5 The star is moving away the earth. ✓
Die ster beweeg weg van die aarde ✓

The spectral lines in diagram 2 are shifted towards the red end/red shifted). ✓
Die spektrumlyne in diagram 2 het verskuif na die rooi ent/rooi verskuiwing. ✓

2)

[14]



QUESTION 10 /VRAAG 10

10.1 Lower Than✓, ship A is moving away from the observer✓ (2)
Laer as,✓ skip A beweeg weg van die waarnemer✓

$$10.2 \quad \frac{95}{100} \times 500 \checkmark$$

$$= 475 \text{ Hz } \checkmark \quad (2)$$

10.3 Doppler effect. ✓

It is the change in frequency (or pitch) of the sound detected by a listener✓ because the sound source and the listener have different velocities relative to the medium of sound propagation.✓

Doppler-effek✓

Dit is die verandering in frekwensie (of toonhoogte) van die klank waargeneem deur 'n luisteraar✓ is omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium waarin die klank voortgeplant word, het. ✓ (3)

10.4 For ship A/ Vir skip A

$$f_l = \left(\frac{v_{\text{sound}} \pm v_{\text{listener}}}{v_{\text{sound}} \pm v_{\text{source}}} \right) f_s \checkmark$$

$$475 = \left(\frac{340}{340 + V_s} \right) \times 500 \checkmark$$

$$V_s = 17,90 \text{ m} \cdot \text{s}^{-1} \checkmark$$

$$v = \frac{\Delta x}{t}$$

$$17,90 = \frac{\Delta x}{(2 \times 60)} \checkmark$$

$$\Delta x = 2147,40 \text{ m}$$

For Ship B/ Vir skip B

$$f_l = \left(\frac{v_{\text{sound}} \pm v_{\text{listener}}}{v_{\text{sound}} \pm v_{\text{source}}} \right) f_s$$

$$450 = \left(\frac{340}{340 + V_s} \right) \times 500 \checkmark$$

$$V_s = 37,78 \text{ ms}^{-1} \checkmark$$

$$v = \frac{\Delta x}{t}$$

$$37,78 = \frac{\Delta x}{(2 \times 60)} \checkmark$$

$$\Delta x = 4533,34 \text{ m}$$

Distance between ships A and B/Afstand tussen skepe A en B = 2147,40 + 4533,34 ✓

$$= 6680,74 \text{ m} \checkmark \quad (9)$$

10.5 Moving away✓, the spectral lines are red shifted. ✓ (2)

Beweeg weg✓, die spektrumlyne is rooi verskuiwing✓



TOPIC 3/ONDERWERP 3 – ELECTRICITY AND MAGNETISM/ELEKTRISITEIT & MAGNETISME**3.1. ELECTROSTATICS/ELEKTROSTATIKA****QUESTION 1/VRAAG 1**

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

[20]

QUESTION 2/VRAAG 2

2.1

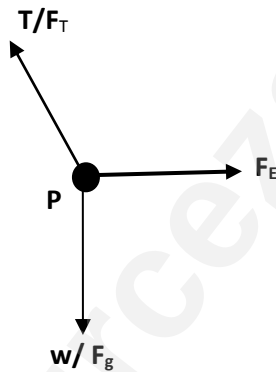
$$n = \frac{Q}{e} \checkmark$$

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

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

(3)

2.2



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 $/F_{RP/PR}$ Elektrostiesekrag / Coulombkrag / $F_Q / F_{RP/PR}$

(3)



- 2.3 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 aan die kwadraat van die afstand (r) tussen hulle.

(2)

2.4

OPTION 1/OPSIE 1

$$F_E = k \frac{Q_1 Q_2}{r^2} \checkmark$$

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

$$\therefore T \sin 7^\circ / (T \cos 83^\circ) \checkmark = \frac{(9 \times 10^9)(0,5 \times 10^{-6})(0,9 \times 10^{-6})}{(0,2)^2} \checkmark$$

$$\therefore T = 0,83 \text{ N} \checkmark \quad (\text{Accept/Aanvaar } 0,82 \text{ N})$$

(5)

OPTION 2/OPSIE 2

$$F_E = \frac{k Q_1 Q_2}{r^2} \checkmark$$

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

$$= 0,101 \text{ N}$$

$$\tan 7^\circ = \frac{T_x}{T_y} = \frac{0,101}{T_y} \checkmark$$

$$T_y = 0,823 \text{ N}$$

$$T = \sqrt{T_x^2 + T_y^2} = \sqrt{(0,101)^2 + (0,823)^2} = 0,83 \text{ N} \checkmark$$

(5)



OPTION 3/OPSIE 3

$$F = \frac{kQ_1Q_2}{r^2} \checkmark = \frac{(9 \times 10^9)(0,5 \times 10^{-6})(0,9 \times 10^{-6})}{(0,2)^2} \checkmark = 0,101 \text{ N}$$

$$\frac{F_E}{\sin 7^\circ} = \frac{T}{\sin 90^\circ}$$

$$\frac{0,101}{\sin 7^\circ} = \frac{T}{\sin 90^\circ} \checkmark$$

$$T = 0,83 \text{ N} \checkmark$$

(5)

[13]

QUESTION 3/VRAAG 3

3.1 $E_X = E_2 + E_{(-8)} \checkmark$

$$= \frac{kQ_2}{r^2} + \frac{kQ_{-8}}{r^2} \quad \checkmark \text{correct equation / korrekte vergelyking}$$

$$= \frac{(9 \times 10^9)(2 \times 10^{-5})}{(0,25)^2} \checkmark + \frac{(9 \times 10^9)(8 \times 10^{-6})}{(0,15)^2} \checkmark$$

$$= 2,88 \times 10^6 + 3,2 \times 10^6$$

$$= 6,08 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark \text{ to the east/na oos} \checkmark$$

OR/OF

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

$$E_2 = \frac{(9 \times 10^9)(2 \times 10^{-5})}{(0,25)^2} \checkmark$$

$$= 2,88 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ to the east/na oos}$$

$$E_{-8} = \frac{(9 \times 10^9)(8 \times 10^{-6})}{(0,15)^2} \checkmark$$

$$= 3,2 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ to the east/na oos}$$

(6)



$$\begin{aligned}
 E_x &= E_2 + E_{(-8)} \\
 &= (2,88 \times 10^6 + 3,2 \times 10^6) \checkmark \\
 &= \underline{6,08 \times 10^6 \text{ N}\cdot\text{C}^{-1}} \checkmark \text{ to the east/na oos} \checkmark
 \end{aligned}$$

3.2

OPTION 1/OPSIE 1

$$\begin{aligned}
 F_E &= QE \checkmark \\
 &= (-2 \times 10^{-9}) (6,08 \times 10^6) \checkmark \\
 &= -12,16 \times 10^{-3} \text{ N} \\
 &= 1,22 \times 10^{-2} \text{ N} \checkmark \text{ to the west/na wes} \checkmark
 \end{aligned}$$

(4)

OPTION 2/OPSIE 2

$$\begin{aligned}
 F_{(-2)Q1} &= qE_{(2)} \checkmark \\
 &= (2 \times 10^{-9}) (2,88 \times 10^6) \\
 &= 5,76 \times 10^{-3} \text{ N to the west/na wes}
 \end{aligned}$$

$$\begin{aligned}
 F_{(-2)Q2} &= qE_{(8)} \\
 &= (2 \times 10^{-9}) (3,2 \times 10^6) \\
 &= 6,4 \times 10^{-3} \text{ N to the west/na wes}
 \end{aligned}$$

$$\begin{aligned}
 F_{\text{net}} &= \underline{5,76 \times 10^{-3} + 6,4 \times 10^{-3}} \checkmark \\
 &= 1,22 \times 10^{-2} \text{ N} \checkmark \text{ to the west/na wes} \checkmark
 \end{aligned}$$

(4)



OPTION 3/OPSIE 3

$$F = k \frac{Q_1 Q_2}{r^2} \checkmark$$

$$F_{(-2)2} = \frac{(9 \times 10^9)(2 \times 10^{-9})(2 \times 10^{-5})}{(0,25)^2}$$

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

$$F_{(-2)(-8)} = \frac{(9 \times 10^9)(2 \times 10^{-9})(8 \times 10^{-6})}{(0,15)^2}$$

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

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

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

(4)

3.3 $2,44 \times 10^{-2} \text{ N} \checkmark$

(1)

[11]

QUESTION 4/VRAAG 4

4.1 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)

4.2 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)



4.3

4.3.1 $T \cos 20^\circ = w \checkmark$

$= mg$

$= (0,1)(9,8) \checkmark = 0,98 \text{ N}$

$\therefore T = 1,04 \text{ N} \checkmark$

(3)

4.3.2 **POSITIVE MARKING FROM 4.3.1/POSITIEWE NASIEN VANAF 4.3.1**

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

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

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

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

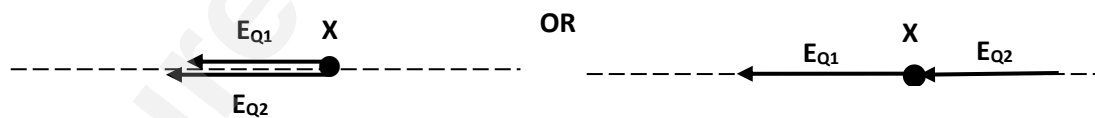
$\therefore r = 0,0397 \text{ m} \checkmark$

(5)

[11]

QUESTION 5/VRAAG 5

5.1



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)



5.2

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

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

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

$$E_P = E_{6\mu C} + E_{-2,5\mu C} \checkmark$$

$$= 31\,952,66 + 250\,000$$

$$= 281\,952,66 \text{ N.C}^{-1} \checkmark \text{ to the left/na links} \checkmark$$

(6)

[10]

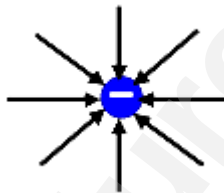
QUESTION 6/VRAAG 6

6.1 The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point. $\checkmark\checkmark$ (2 or 0)

Die elektriese veld by 'n punt is die elektrostatiese krag wat per eenheidspositiewe-lading wat by daardie punt geplaas is, ondervind word.

(2)

6.2



Spape (radial)/ *Vorm (radiaal)*) $\checkmark$

Correct direction/ *Korrekte rigting* $\checkmark$

(2)

6.3 At N. $\checkmark$

The distance from N to the point charge is smaller than the distance from M to the point charge $\checkmark$ and the electric field at a point due to a point charge is inversely proportional to the square distance between the point and the charge ($E \propto \frac{1}{r^2}$) $\checkmark$

Op N



Die afstand van Nna die puntlading is kleiner die afstandvanafMna die puntladingen die elektriese veld by 'n punt as gevolg van 'n puntlading is omgekeerdeweredigaan die kwadraatvan die afstandtussen die punt en die lading($E \propto \frac{1}{r^2}$).

(3)

- 6.4.1 The magnitude of the electrostatic force exerted by one point charge on another point charge is directly proportional to the product (of the magnitudes) of the charges✓ and inversely proportional to the square of the distance between them.✓

Die grootte van die elektrostatiese krag wat eenpuntlading op 'n anderpuntladinguitoefen, is direkeweredigaan die produk van die groottes van die ladings enomgekeerdeweredigaan die kwadraat van die afstandtussen hulle.

(2)

6.4.2 $F_{AB} = \frac{KQ_A Q_B}{r^2}$ ✓

$$F_{AB} = \frac{9 \times 10^9 \times (4 \times 10^{-6} \times (8 \times 10^{-6}))}{(3)^2}$$
✓

$F_{AB} = 0,032 \text{ N}$.✓ Towards point charge A

(4)

6.4.3



OPTION 1/ OPSIE 1

Positive towards point charge A:

$$E = K \frac{Q}{r^2}$$
✓

$$E_A = 9 \times 10^9 \frac{(4 \times 10^{-6})}{1^2}$$
✓

$$E_A = 3,6 \times 10^4 \text{ N} \cdot \text{C}^{-1}$$



$$E_B = 9 \times 10^9 \frac{(8 \times 10^{-6})}{4^2} \checkmark$$

$$E_B = 4,5 \times 10^3 \text{ N} \cdot \text{C}^{-1}$$

$$\vec{E}_{\text{net}} = \vec{E}_A + \vec{E}_B$$

$$E_{\text{net}} = E_A - E_B$$

$$E_{\text{net}} = 3,6 \times 10^4 - 4,5 \times 10^3 \checkmark$$

$$E_{\text{net}} = +3,15 \times 10^4 \text{ N} \cdot \text{C}^{-1} \checkmark$$

OR/OF

$$E_{\text{net}} = 3,15 \times 10^4 \text{ N} \cdot \text{C}^{-1} \text{ towards charge A}$$

OPTION 2/OPSIE 2

Positive towards point charge B:

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

$$E_A = 9 \times 10^9 \frac{(4 \times 10^{-6})}{1^2} \checkmark$$

$$E_A = 3,6 \times 10^4 \text{ N} \cdot \text{C}^{-1}$$

$$E_B = 9 \times 10^9 \frac{(8 \times 10^{-6})}{4^2} \checkmark$$

$$E_B = 4,5 \times 10^3 \text{ N} \cdot \text{C}^{-1}$$

$$\vec{E}_{\text{net}} = \vec{E}_A + \vec{E}_B$$

$$E_{\text{net}} = E_A - E_B$$

$$E_{\text{net}} = -3,6 \times 10^4 + 4,5 \times 10^3 \checkmark$$

$$E_{\text{net}} = -3,15 \times 10^4 \checkmark$$

OR/OF

$$E_{\text{net}} = 3,15 \times 10^4 \text{ N} \cdot \text{C}^{-1} \text{ towards charge A} \checkmark$$

(5)

[18]



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QUESTION 7/VRAAG 7

- 7.1.1 The (magnitude of the) electrostatic force exerted by one (point) charge on another is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between their (centres) them. ✓

Die (grootte) van die elektrostatiese krag wat een (punt) lading op 'n ander uitoefen, is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte.

(2)

- 7.1.2 F_E /Electrostatic force/*Elektrostatiese krag* ✓

(1)

- 7.1.3 The electrostatic force is inversely proportional to the square of the distance between the charges ✓

Die elektrostatiese krag is omgekeerd eweredig aan die kwadraat van die afstand tussen die ladings

OR/OF

The electrostatic force is directly proportional to the inverse of the square of the distance between the charged spheres (charges). □

Die elektrostatiese krag is direk eweredig aan omgekeerde van die kwadraat van die afstand tussen die gelaaide sfere (ladings).

OR/OF

$$F \propto \frac{1}{r^2} \square$$

OR/OF

They are inversely proportional to each other /Hulle is omgekeerd eweredig aan mekaar

(1)



7.1.4

OPTION 1/OPSIE 1

1 mark for using slope/

$$\text{Slope/Helling} = \frac{\Delta F_E}{\Delta \frac{1}{r^2}} = \frac{(0,027 - 0)}{(5,6 - 0)} \checkmark$$

$$= 4,82 \times 10^{-3} \text{ N} \cdot \text{m}^2 \quad (4,76 \times 10^{-3} - 5 \times 10^{-3})$$

$$\text{Slope/Helling} = F_E r^2 = kQ_1 Q_2 = kQ^2 \checkmark$$

$$4,82 \times 10^{-3} \checkmark = \underline{9 \times 10^9 Q^2} \checkmark$$

$$\therefore Q = 7,32 \times 10^{-7} \text{ C} \checkmark$$

OPTION 2/OPSIE 2

Accept any pair of points on the line/Aanvaar enige paar punte op die lyn

$$F = \frac{kQ_1 Q_2}{r^2} \square$$

$$() \square = \frac{(9 \times 10^9) Q^2}{()} \checkmark \checkmark$$

$$Q = 7,32 \times 10^{-7} \text{ C} \square \square \square (7,32 \times 10^{-7} - 7,45 \times 10^{-7} \text{ C})$$

Examples/Voorbeelde

$$(0,005) \square = \frac{(9 \times 10^9) Q^2}{(1)} \checkmark \checkmark$$

$$Q = 7,45 \times 10^{-7} \text{ C} \square$$

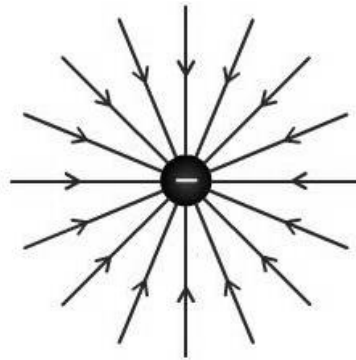
$$(0,027) \square = \frac{(9 \times 10^9) Q^2}{\left(\frac{1}{5,6}\right)} \checkmark \checkmark$$

$$Q = 7,32 \times 10^{-7} \text{ C} \square$$

(6)



7.2.1



Criteria for drawing electric field: <i>Kriteria vir teken van elektriese veld:</i>	Marks/Punte
Direction / <i>Rigting</i>	✓
Field lines radially inward / <i>Veldlyne radiaal inwaarts</i>	✓

7.2.2

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

Take right as positive / *Neem regs as positief*

$$E_{PA} = \frac{(9 \times 10^9)(0,75 \times 10^{-6})}{(0,09)^2} \checkmark$$

$$= 8,33 \times 10^5 \text{ N} \cdot \text{C}^{-1} \text{ to the left / na links}$$

$$E_{PB} = \frac{(9 \times 10^9)(0,8 \times 10^{-6})}{(0,03)^2} \checkmark$$

$$= 8 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ to the left / na links}$$

$$E_{\text{net}} = E_{PA} + E_{PB}$$

$$= [-8,33 \times 10^5 + (-8 \times 10^6)] \square \square$$

$$= -8,83 \times 10^6$$

$$= 8,83 \times 10^6 \text{ N} \cdot \text{C}^{-1} \checkmark$$

1 mark for the addition of same signs/
 1 mark for the addition of same signs/

(5)



Take left as positive/Neem links as positief

$$E_{PA} = \frac{(9 \times 10^9)(0,75 \times 10^{-6})}{(0,09)^2} \checkmark$$

$$= 8,33 \times 10^5 \text{ N} \cdot \text{C}^{-1} \text{ to the left/na links}$$

$$E_{PB} = \frac{(9 \times 10^9)(0,8 \times 10^{-6})}{(0,03)^2} \checkmark$$

$$= 8 \times 10^6 \text{ N} \cdot \text{C}^{-1} \text{ to the left/na links}$$

$$E_{\text{net}} = E_{PA} + E_{PB}$$

$$= (8,33 \times 10^5 + 8 \times 10^6) \square \square$$

$$= 8,83 \times 10^6 \text{ N} \cdot \text{C}^{-1} \square$$

1 mark for the addition of same signs/

[17]

QUESTION 87/VRAAG 8

8.1.

Coulomb's law states that the magnitude of the electrostatic force between two point charges is directly proportional to the product of the magnitudes of the charges✓ and inversely proportional to the square of the distance between them✓.

Coulomb se wet stel dat die grootte van die elektrostatiese krag tussen twee puntladings direk eweredig is aan die produk van die groottes van die ladings✓ en omgekeerd eweredig is aan die kwadraat van die afstand tussen hulle. ✓

OR/OF

The attractive or repulsive force exerted by one point charge on another is directly proportional to the product of the charges✓ and inversely proportional to the square of the distance between them✓.

Die aantrekkende of afstotende krag wat uitgeoefen word deur een puntlading op 'n ander is direk eweredig aan die produk van die ladings✓ en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. ✓

OR/OF

Coulomb's law states that the force of attraction or repulsion between two charges is directly proportional to the product of the charges✓ and inversely proportional to the square of the distance between their centres. ✓



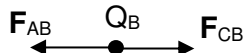
Coulomb se wet stel dat die krag van aantrekking of afstoting tussen twee ladings, direk eweredig is aan die produk van die ladings ✓ en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle middelpunte. ✓

(2)

8.2 Equal to ✓ / Gelyk aan ✓

(1)

8.3 Option 1/Opsie 1



Charge C must be positive. ✓

Lading C moet positief wees. ✓

$$\vec{F}_{net} = \vec{F}_{AB} + \vec{F}_{CB} \quad \checkmark \text{OR/OF Positive to the right/ Positief na regs} \quad 0 = -F_{AB} + F_{CB}$$

OR/OF

$$F_{AB} = F_{CB}$$

From the sketch we see that/van die skets sien ons dat $r_{AB} + r_{CB} = r_{AC}$

$$\frac{kq_A q_B}{r_{AB}^2} = \frac{kq_A q_B}{r_{CB}^2} \quad \checkmark$$

$$q_1 r_{CB}^2 = q_3 r_{AB}^2$$

$$(5 \times 10^{-6})(5 \times 10^{-2})^2 \checkmark = Q_C (15 \times 10^{-2})^2 \checkmark$$

$$(5 \times 10^{-6})(25 \times 10^{-4}) = Q_C (225 \times 10^{-4})$$

$$(125 \times 10^{-10}) = Q_C (225 \times 10^{-4})$$

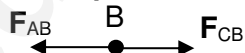
$$Q_C = 5,56 \times 10^{-7} \text{ C}$$

$$Q_C = nq_e \quad \checkmark$$

$$5,56 \times 10^{-7} = n (1,6 \times 10^{-19}) \quad \checkmark$$

$$n = 3,475 \times 10^{12} \text{ protons/protone} \quad \checkmark$$

Option 2/Opsie 2



Charge C must be positive. ✓

Lading C moet positief wees. ✓

$$\vec{F}_{net} = \vec{F}_{AB} + \vec{F}_{CB} \quad \checkmark \text{OR/OF Positive to the right/ Positief na regs} \quad 0 = -F_{AB} + F_{CB}$$

$$F_{AB} = F_{CB}$$

From the sketch we see that/van die skets sien ons dat $r_{AB} + r_{CB} = r_{AC}$



$$F_{AB} = \frac{kQ_B Q_C}{r_{CB}^2} \checkmark$$

$$6 \checkmark = \frac{9 \times 10^9 (3 \times 10^{-6}) Q_C}{(0,05)^2} \checkmark$$

$$Q_C = 5,56 \times 10^{-7} \text{ C} \checkmark$$

$$Q_C = nq_e \checkmark$$

$$5,56 \times 10^{-7} = n (1,6 \times 10^{-19}) \checkmark$$

$$n = 3,475 \times 10^{12} \text{ protons/protone} \checkmark$$

(8)

[11]

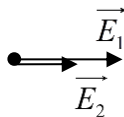
QUESTION 9/VRAAG 9

- 9.1 The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point. ✓

Die elektriese veld by 'n punt is die elektrostatische krag ondervind per eenheids positiewe lading by die punt. ✓

(2)

9.2



Positive to the right/ Positief na regs

$$E_{net} = E_1 + E_2 \checkmark$$

$$E_{net} = \frac{KQ_1}{r_1^2} + \frac{KQ_2}{r_2^2} \checkmark$$

$$E_{net} = \frac{(9 \times 10^9)(5 \times 10^{-6})}{(0,5)^2} \checkmark + \frac{(9 \times 10^9)(3 \times 10^{-6})}{(0,5)^2} \checkmark$$

$$E_{net} = 180000 + 108000$$

$$E_{net} = 2,88 \times 10^5 \text{ N} \cdot \text{C}^{-1} \checkmark \text{ to the right/ na regs} \checkmark$$

OR/OF

$$E_{net} = +2,88 \times 10^5 \text{ N} \cdot \text{C}^{-1} \checkmark \checkmark$$

(6)

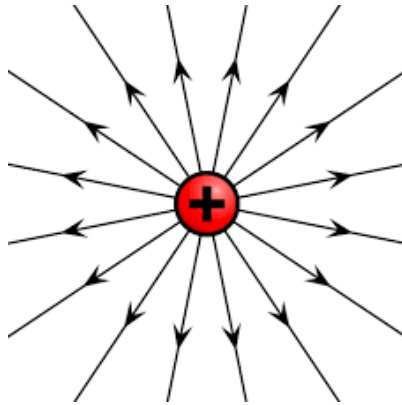


QUESTION 10 / VRAAG 10

- 10.1 The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point. ✓✓

Die elektriese veld by 'n punt is die elektrostatiese krag wat per eenheidspositiewe-lading wat by daardie punt geplaas is, ondervind word. (2)

10.2



Shape (radial)/Vorm (radiaal)✓

Correct direction/Korrekte rigting✓

(2)

- 10.3 At M.✓

The distance from M to the point charge is smaller than the distance from N to the point charge✓ and the electric field at a point due to a point charge is inversely proportional to the square distance between the point and the charge ($E \propto \frac{1}{r^2}$) ✓

Op M

Die afstand van M na die puntlading is kleiner die afstand vanaf N na die puntlading en die elektriese veld by 'n punt as gevolg van 'n puntlading is omgekeerd eweredig aan die kwadraat van die afstand tussen die punt en die lading ($E \propto \frac{1}{r^2}$). (3)

- 10.4.1 The magnitude of the electrostatic force exerted by one point charge on another point charge is directly proportional to the product (of the magnitudes) of the charges✓ and inversely proportional to the square of the distance between them.✓



Die grootte van die elektrostatische krag wat een puntlading op 'n ander puntlading uitoefen, is direk eweredig aan die produk van die groottes van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.

(2)

$$10.4.2 \quad F_{AB} = \frac{KQ_A Q_B}{r^2} \checkmark$$

$$F_{AB} = \frac{9 \times 10^9 \times 4,36 \times 10^{-6} \times 7 \times 10^{-6}}{(0,232)^2} \checkmark$$

$$F_{AB} = 5,10 \text{ N} \checkmark$$

(4)

10.4.3 Option 1/Opsie 1

$$E_A - E_B = 0 \checkmark \text{ OR/OF } E_A = E_B$$

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

$$\frac{KQ_A}{r_A^2} = \frac{KQ_B}{r_B^2}$$

$$\frac{Q_A}{r_A^2} = \frac{Q_B}{r_B^2}$$

$$\frac{4,36 \times 10^{-6}}{x^2} \checkmark = \frac{7 \times 10^{-6}}{(0,232+x)^2} \checkmark$$

OR/OF

$$\sqrt{\frac{4,36 \times 10^{-6}}{x^2}} \checkmark = \sqrt{\frac{7 \times 10^{-6}}{(0,232+x)^2}} \checkmark$$

OR/OF

$$\frac{\sqrt{4,36 \times 10^{-6}}}{x} \checkmark = \frac{\sqrt{7 \times 10^{-6}}}{0,232 + x} \checkmark$$

OR/OF

$$x(\sqrt{7 \times 10^{-6}}) \checkmark = 0,232\sqrt{4,36 \times 10^{-6}} + x\sqrt{4,36 \times 10^{-6}} \checkmark$$



$x = 0,87 \text{ m}$ on the left side of charged sphere A/aan die linkerkant van gelaaiide sfeer. ✓

Option 2/Opsie 2

$$E_A - E_B = 0 \checkmark \text{ OR/OF } E_A = E_B$$

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

$$\frac{KQ_A}{r_A^2} = \frac{KQ_B}{r_B^2}$$

$$\frac{Q_A}{r_A^2} = \frac{Q_B}{r_B^2}$$

$$\frac{4,36 \times 10^{-6}}{x^2} \checkmark = \frac{7 \times 10^{-6}}{(0,232 + x)^2} \checkmark$$

$$\frac{4,36 \times 10^{-6}}{x^2} = \frac{7 \times 10^{-6}}{0,054 + 0,464x + x^2}$$

$$4,36 \times 10^{-6}x^2 + 2,03 \times 10^{-6}x + 0,24 \times 10^{-6} = 7 \times 10^{-6}x^2$$

$$7 \times 10^{-6}x^2 - 4,36 \times 10^{-6}x^2 - 2,03 \times 10^{-6}x - 0,24 \times 10^{-6} = 0$$

$$2,64 \times 10^{-6}x^2 - 2,03 \times 10^{-6}x - 0,24 \times 10^{-6} = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} =$$

$$\frac{-2,03 \times 10^{-6} \pm \sqrt{(-2,03 \times 10^{-6})^2 - 4(2,64 \times 10^{-6})(-0,24 \times 10^{-6})}}{2 \times 2,64 \times 10^{-6}}$$

$x = 0,87 \text{ m}$ on the left side of charged sphere A aan die linkerkant van gelaaiide sfeer. ✓

(5)

[18]



TOPIC 3/ONDERWERP 3 – ELECTRICITY AND MAGNETISM/ELEKTRISITEIT & MAGNETISME

3.2. ELECTRIC CIRCUITS/ ELEKTRIESE STROOMBANE

QUESTION 1/VRAAG 1

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

[20]



QUESTION 2/VRAAG 2

2.1 10 V✓ (1)

2.2.1 $R_{\text{ext/eks}} = R_x + R_{\text{parallel}}$ ✓ **OR/OF** $R_{\text{ext/eks}} = R_x + \left(\frac{R_1 R_2}{R_2 + R_1} \right)$ $R_{\text{ext/eks}} = \frac{V}{I}$ ✓
 $\frac{1}{R_{\text{parallel}}} = \frac{1}{R_1} + \frac{1}{R_2}$ $R_{\text{ext/eks}} = \frac{8}{1}$ ✓
 $\frac{1}{R} = \frac{1}{2} + \frac{1}{4}$ ✓ $R_{\text{ext/eks}} = 8 \Omega$
 $R_{\text{parallel}} = 1,33 \Omega$
 $8 = R_x + 1,33$ ✓
 $R_x = 8 - 1,33 = 6,67 \Omega$ ✓ (7)

2.2.2 $V_{\text{int}} = I r$ ✓
 $10 - 8 = 1 r$ ✓
 $r = 2 \Omega$ ✓
OR/OF
 $\text{Emf/emk} = V_{\text{ext/eks}} + I r$ ✓
 $10 = 8 + 1 r$ ✓
 $r = 2 \Omega$ ✓
OR/OF
 $V_{\text{int}} = I r$ ✓
 $2 = 1 \times r$ ✓
 $r = 2 \Omega$ ✓ (3)

2.3 INCREASES ✓
 Total resistance increases. ✓
 Current in the circuit decreases ✓
 Lost volts ($I r$) decreases and according to the equation ($V_{\text{ext}} = \varepsilon - I r$) the voltage increases ✓.
TOENEEM ✓
Totale weerstand neem toe. ✓
Stroomsterkte in die baan neem af. ✓
Verlore volts ($I r$) neem af en volgens die vergelyking ($V_{\text{eks}} = \varepsilon - I r$) sal die voltmeterlesing toeneem. ✓

(4)

[15]



QUESTION 3/VRAAG 3

- 3.1 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)

3.2

<u>OPTION 1/OPSIE 1</u>	<u>OPTION 2/OPSIE 2</u>
$V = IR✓$	$V = IR✓$
$V_8 = (0,5)(8)✓ = 4 \text{ V}$	$V_8 = (0,5)(8) ✓ = 4 \text{ V}$
$V_8 = V_{16}$	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$
$\therefore V_{16} = 4 \text{ V}$	$= \frac{1}{8} + \frac{1}{16}✓$
$I_{16} = \frac{V}{R} = \frac{4}{16} = 0,25 \text{ A}$	$R = 5,33 \Omega$
$I_{tot//} = A_1 = (0,5 + 0,25) ✓ = 0,75 \text{ A}✓$	$I_{tot//} = \frac{4}{5,33}$
	$A_1 = 0,75 \text{ A}✓$

(4)



<u>OPTION 3/OPSIE 3</u>	<u>OPTION 4/OPSIE 4</u>
$I_1 R_1 = I_2 R_2 \checkmark$ $(0,5)(8) = I_{16}(16) \checkmark$ $I_{16} = \frac{(8)(0,5)}{16} = 0,25 \text{ A}$ $I_{\text{tot}} = A_1 = (0,5 + 0,25) \checkmark = 0,75 \text{ A} \checkmark$	$2R_{8\Omega} = R_{16\Omega} \checkmark$ $\therefore I_{R16} = \frac{1}{2} I_{R8} \checkmark$ $\therefore I_{R16} = \frac{1}{2} (0,5) = 0,25 \text{ A}$ $A_1 = (0,5 + 0,25) \checkmark = 0,75 \text{ A} \checkmark$

(4)

3.3

<u>OPTION 1/OPSIE 1</u>
$V = IR$ $V_{20\Omega} = (0,75)(20) \checkmark = 15 \text{ V}$ $V_{\text{tot}} = (15 + 4) \checkmark = 19 \text{ V}$ $V_R = 19 \text{ V}$ $P = VI \checkmark$ $12 = (19)I \checkmark$ $I_R = A_2 = 0,63 \text{ A} \checkmark$

(5)

<u>OPTION 2/OPSIE 2</u>
$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{8} + \frac{1}{16} \checkmark$ $R_{//} = 5,33 \Omega$ $R_{//} + R_{20} = (5,33 + 20) \checkmark = 25,33\Omega$ $V_{\text{tot}} = I(R_{//} + R_{20})$ $= (0,75)(25,33)$

OR/OF

$$R = \frac{R_1 R_2}{R_1 + R_2} = \frac{8 \times 16}{8 + 16} \checkmark = 5,33 \Omega$$

(5)



$= 19 \text{ V}$ $P = VI$ $12\checkmark = I(19) \checkmark$ $I_R = A_2 = 0,63 \text{ A}\checkmark$
<u>OPTION 3/OPSIE 3</u> $V = IR$ $V_{20\Omega} = (0,75)(20) \checkmark = 15 \text{ V}$ $V_{\text{tot}} = (15 + 4) \checkmark = 19 \text{ V}$ $V_R = 19 \text{ V}$ $P = \frac{V^2}{R}$ $12 = \frac{(19)^2}{R}$ $R = 30,08 \Omega$ $P = I^2 R \checkmark$ $12 = I^2(30,08) \checkmark$ $I = 0,63 \text{ A}\checkmark$

(5)

3.4

<u>OPTION 1/OPSIE 1</u>	<u>OPTION 2/OPSIE 2</u>
$(\varepsilon) = I(R + r) \checkmark$ $= V_{\text{terminal}} + V_{\text{int}}$ $= 19 + (0,75 + 0,63)(1) \checkmark$ $= 20,38 \text{ V}\checkmark$	$V_{\text{int}} = Ir$ $= (0,75 + 0,63)(1) \checkmark$ $= 1,38 \text{ V}$ $\varepsilon = V_{\text{terminal}} + V_{\text{int}} \checkmark$ $= 19 + 1,38$

(3)



$$= 20,38 \text{ V } \checkmark$$

OPTION 3/OPSIE 3

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

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

$$I_{\text{tot}} = 0,63 + 0,75 = 1,38 \text{ A}$$

$$\begin{aligned} \varepsilon &= I(R + r) \checkmark \\ &= (1,38)(13,77 + 1) \checkmark \\ &= 20,38 \text{ V} \checkmark \end{aligned}$$

[14]

QUESTION 4/VRAAG 4

4.1

4.1.1 $V = IR \checkmark$

$$= (0,2)(4+8) \checkmark$$

$$= 2,4 \text{ V} \checkmark$$

(3)

4.1.2 **POSITIVE MARKING FROM QUESTION 4.1.1/POSITIEWE NASIEN VANAF VRAAG 4.1.1**

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

(4)



4.1.3

$= 1,4 \text{ A} \checkmark$	$= 1,4 \text{ A} \checkmark$
------------------------------	------------------------------

POSITIVE MARKING FROM QUESTION 4.1.2/POSITIEWE NASIEN VANAF VRAAG 4.1.2

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

OPTION 2/OPSIE 2 $V_{\text{int}} = Ir \checkmark$ $= (1,4)(0,5)$ $= 0,7 \text{ V} \checkmark$ $\varepsilon = V_{\text{ext/eks}} + V_{\text{int}} \checkmark$ $= 2,4 + 0,7 \checkmark$ $= 3,1 \text{ V} \checkmark$
--

(5)

4.2

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

(3)

[15]

3.4

OPTION 1/OPSIE 1 $(\varepsilon) = I(R + r) \checkmark$ $= V_{\text{terminal}} + V_{\text{int}}$	OPTION 2/OPSIE 2 $V_{\text{int}} = Ir$ $= (0,75 + 0,63)(1) \checkmark$
---	--

(3)



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

OPTION 3/OPSIE 3

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

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

$$I_{\text{tot}} = 0,63 + 0,75 = 1,38 \text{ A}$$

$$\begin{aligned} \varepsilon &= I(R + r) \checkmark \\ &= (1,38)(13,77 + 1) \checkmark \\ &= 20,38 \text{ V} \checkmark \end{aligned}$$

[14]

QUESTION 5/ VRAAG 5

- 5.1 When current flows through a voltage source (battery/generator) a resistance to current flow arises ✓ due to the resistance of the materials (chemicals/conductors) from which the source is made. ✓

Wanneer stroom deur 'n volt-kragbron (battery/generator) vloei, ontstaan 'n weerstand teen stroomvloei as gevolg van die weerstand van die materiaal (chemikaleë/ geleiers) waarvan die bron gemaak is.

OR/OF

Internal resistance is the resistance offered to the electron flow ✓ by the electrolyte/medium of the cell/generator. ✓

Interne weerstand is die weerstand gebied teen die vloei van elektrone deur die elektroliet/ medium van die sel/ generator. (2)

5. 2

$$\varepsilon = V_{\text{ext}} + Ir \checkmark$$



$$6 = V_{\text{ext}} + I(0,10)$$

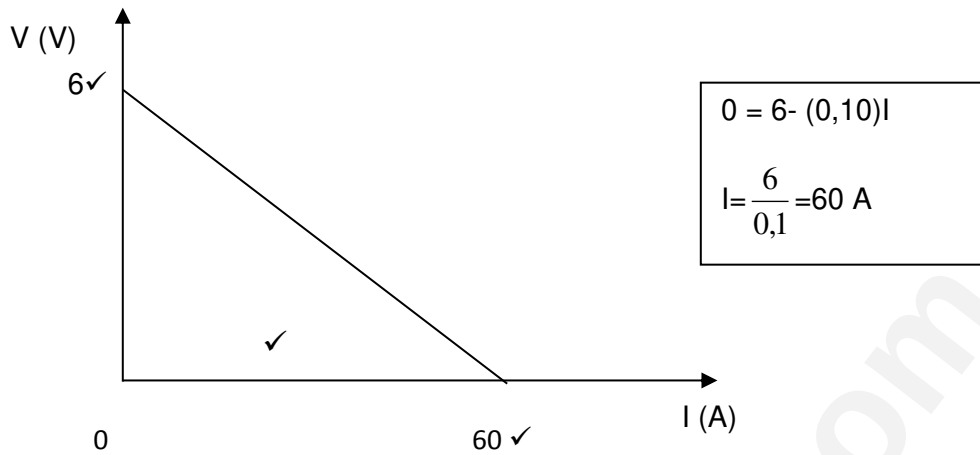
$$V_{\text{ext}} = 6 - (0,10)I \checkmark$$

(2)

eduresourceza.com



5.3



(3)

5.4

5.4.1 **OPTION 1/ OPSIE 1**

OPTION 2/ OPSIE 2

$$W = I^2 R \Delta t \checkmark$$

$$W_4 = I^2 R \Delta t \checkmark = 40$$

$$\frac{W_4}{W_R} = \frac{I^2 R_4 \Delta t}{I^2 R \Delta t^2}$$

$$I^2(4)\Delta t = 40 \checkmark$$

$$\frac{40}{60} \checkmark = \frac{I^2(4)\Delta t}{I^2 R \Delta t} \checkmark$$

$$R = 6 \Omega \checkmark$$

$$W_R = \left(\frac{10}{\Delta t}\right) R \Delta t = 60 \checkmark$$

$$R = 6 \Omega \checkmark$$

(4)

5.4.2 **POSITIVE MARKING FROM QUESTION 5.4.1/ POSITIEWE NASIEN VANAF VRAAG 5.4.1**

OPTION 1/ OPSIE 1

OPTION 2/ OPSIE 2

$$\varepsilon = I(R+r) \checkmark$$

$$\varepsilon = I(R+r) \checkmark$$

$$6 = I(4+6) + 0,10 \checkmark$$

$$6 = I(10) + 0,10 \checkmark$$

$$I = 0,59 \text{ A} \checkmark$$

$$I = 0,59 \text{ A} \checkmark$$

(3)



5.4.3 POSITIVE MARKING FROM QUESTION 5.4.1 and 5.4.2

POSITIEWE NASIEN VANAF VRAAG 5.4.1 en 5.4.2

OPTION 1 / OPSIE 1

$$\varepsilon = V_{\text{ext}} + Ir \checkmark$$

$$6 = V_{\text{ext}} + (0,59)(0,10) \checkmark$$

$$V_{\text{ext}} = 5,94 \text{ V} \checkmark$$

OPTION 2 / OPSIE 2

$$V = IR_{\text{ext}} \checkmark$$

$$= (0,59)(10) \checkmark$$

$$= 5,9 \text{ V} \checkmark$$

(3)

5.5 DECREASE ✓

Total resistance of the circuit decreases ✓

Current increases ✓

$V_{\text{internal resistance}}$ increases ✓

V_{ext} (voltmeter reading) decreases ($V_{\text{ext}} = \varepsilon - V_{\text{int}}$)

AFNEEM

Totale weerstand van die stroombaan neem af

Stroom neem toe

$V_{\text{interne weerstand}}$ neem toe

V_{eks} (voltmeterlesing) neem af ($V_{\text{eks}} = \varepsilon - V_{\text{int}}$)

(4)

[21]



QUESTION 6 / VRAAG 6

6.1

The potential difference across a conductor is directly proportional to the current in the conductor✓ at constant temperature. ✓

Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier✓ by konstante temperatuur✓.

(2)

6.2

$$R = \frac{V}{I} \checkmark$$

$$R = \frac{12.9}{1.5} \checkmark$$

$$R = 8.6 \, \Omega \checkmark$$

(3)

6.3 **POSITIVE MARKING FROM QUESTION 6.2**

POSITIEWE NASIEN VAN VRAAG 6.2

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_s} \checkmark$$

$$\frac{1}{R_T} = \frac{1}{8.6} + \frac{1}{(4+5)} \checkmark$$

$$\frac{1}{R_T} = \frac{88}{387}$$

$$R_T = 4.4 \, \Omega \checkmark$$

(3)

6.4 **POSITIVE MARKING FROM QUESTION 6.3**

POSITIEWE NASIEN VAN VRAAG 6.3

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$R = \frac{V}{I} \checkmark$ $4.4 = \frac{12.9}{I} \checkmark$ $I = 2.93 \, A$ $r = \frac{V}{I}$ $r = \frac{15-12.9}{2.93} \checkmark$ $r = 0.72 \, \Omega \checkmark$	$R = \frac{V}{I} \checkmark$ $4.4 = \frac{12.9}{I} \checkmark$ $I = 2.93 \, A$ $\varepsilon = I(R + r)$ $15 = 2.93(4.4 + r) \checkmark$ $r = 0.72 \, \Omega \checkmark$



OPTION 3/OPSIE 3	OPTION 4/OPSIE 4
$R = \frac{V}{I} \checkmark$ $9 = \frac{12.9}{I} \checkmark$ $I = 1.43 \text{ A}$ $I = 1.5 + 1.43$ $I = 2.93 \text{ A}$ $r = \frac{V}{I}$ $r = \frac{15-12.9}{2.93} \checkmark$ $r = 0,72 \Omega \checkmark$	$R = \frac{V}{I} \checkmark$ $9 = \frac{12.9}{I} \checkmark$ $I = 1.43 \text{ A}$ $I = 1.5 + 1.43$ $I = 2.93 \text{ A}$ $\varepsilon = I(R + r)$ $15 = 2.93(4.4 + r) \checkmark$ $r = 0,72 \Omega \checkmark$

(4)
[12]



QUESTION 7 / VRAAG 7

7.1

Any TWO✓✓

Electromotive force

1. Electromotive force transmits current both inside and outside the cell.
2. Electromotive force emf is the cause.
3. Electromotive force is always greater than potential difference.
4. Electromotive force creates potential difference in the entire circuit.
5. Electromotive force does not depend on the resistance of the circuit.
6. Electromotive force remains constant.
7. The part of the circuit where electrical energy is created from any other energy then that part contains the source of Electromotive force.

Potential difference

1. Potential difference current transfers between any two points in the circuit.
2. Potential difference is the result.
3. Potential difference is always less than electromotive force.
4. Potential difference takes place between any two points in the circuit.
5. Potential difference of two points depends on the resistance of those points.
6. It does not remain constant.
7. Potential difference exists in the part of the circuit where electrical potential energy is transformed into another form of energy

ENIGE TWEE

Elektromotoriese krag

1. Elektromotoriese krag stuur stroom binne en buite die sel.
2. Elektromotoriese krag emk is die oorsaak.
3. Elektromotoriese krag is altyd groter as potensiaalverskil.
4. Elektromotoriese krag skep potensiaalverskil die hele kring.
5. Elektromotoriese krag is nie afhanklik van die weerstand van die stroombaan nie.
6. Elektromotoriese krag bly konstant.
7. Die deel van die stroombaan waar elektriese energie geskep word van enige ander energie, daardie deel is die bron van elektromotoriese krag.

Moontlike verskil

1. Potensiaalverskil stroom word tussen enige twee punte in die kring.
2. Potensiaalverskil is die resultaat.
3. Potensiaalverskil is altyd minder as elektromotoriese krag.
4. Potensiaalverskil vind plaas tussen enige twee punte in die kring oogedra.

(2)



5. Potensiaalverskil van twee punte hang af van die weerstand van die punte.
6. Dit bly nie konstant nie.
7. Potensiaalverskil bestaan in die deel van die stroombaan waar elektriese potensiele energie omskep word in 'n ander vorm van energie

7.2 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature. ✓✓.

Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur.

OR/OF

The current in a conductor is directly proportional to the potential difference across the conductor at constant temperature. ✓✓

Die stroom in 'n geleier is direk eweredig aan die potensiaalverskil oor die geleier by konstante temperatuur.

(2)

7.3 **OPSION 1/OPSIE 1**

$$I_2 = \frac{V_2}{R_2} \checkmark$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \checkmark \text{ OR/OF } R_{eq} = \frac{R}{3}$$

$$V_1 = V_2 = V_3 = V$$

$$V_2 = IR_{eq} = I \frac{R}{3}$$

$$I_2 = \frac{I \frac{R}{3}}{R} = \frac{I}{3} \checkmark$$

$$I_2 = \frac{3}{3} = 1 \text{ A} \checkmark$$



OPTION 2/OPSIE 2

OR/OF

Since resistors are in parallel and are equal✓, the main current will divide equally.✓

Aangesien resistors parallel en gelyk is, sal die hoofstroom eweredig verdeel

$$I_2 = \frac{1}{3} I_{\text{main/hoof}}$$

$$I_2 = \frac{1}{3} \times 3 \checkmark$$

$$I_2 = 1 \text{ A} \checkmark \quad (4)$$

7.4 $V_{\text{ext}} = \varepsilon - V_i \checkmark$

$$V_{\text{ext}} = 12 \checkmark - (3 \times 0,4) \checkmark$$

$$V_{\text{ext}} = 10,8 \text{ V} \checkmark \quad (4)$$

7.5.1 Decreases/Afneem✓ (1)

7.5.2 Increases/Neem toe✓

The resistor is now connected in series then total resistance increases✓, emf is constant then current decreases✓, drop of potential in the battery decreases✓ and according to $V_{\text{ext}} = \varepsilon - V_i$ terminal potential increases.

Die resistor word nou in serie verbind, dan word die totale weerstand verhoog, emk is konstant as huidige afname, daling van potensiaal in die battery neem af en volgens $V_{\text{ext}} = \varepsilon - V_i$ terminale potensiaal toeneem.

(4)

[17]



QUESTION 8/VRAAG 8

- 8.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature. ✓✓ (2 or 0)

Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur. (2 of 0)

OR/OF

The current in a conductor is directly proportional to the potential difference across the conductor at constant temperature. ✓✓ (2 or 0)

Die stroom in 'n geleier is direk eweredig aan die potensiaalverskil oor die geleier by konstante temperatuur. (2 of 0)

(2)

8.2.1 **OPTION 1/OPSIE 1**

$$R_{234} = R_2 + \left(\frac{R_3 R_4}{R_3 + R_4} \right) \checkmark = 10 + \left(\frac{10 \times 10}{10 + 10} \right) \checkmark = 15 \, \Omega$$

R_1 and/en R_{234} are/is in parallel

$$R_{1234} = \frac{R_1 \times R_{234}}{R_1 + R_{234}} \text{ OR/OF } \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_{p2}}$$

$$R_{1234} = \frac{15 \times 15}{15 + 15} \checkmark \text{ OR/OF } \frac{1}{R_{eq}} = \frac{1}{15} + \frac{1}{15}$$

$$R_{1234} = 7,5 \, \Omega$$

$$I = \frac{\varepsilon}{R+r} \checkmark \text{ OR/OF } (\text{emf/emk}) \varepsilon = I(R+r)$$

$$I = \frac{12}{7,5 + 0,5} \checkmark \text{ OR/OF } 12 = I(7,5 + 0,5) \checkmark$$

$$I = 1,5 \, \text{A} \checkmark$$



OPTION 2/OPSIE 2

R_3 and/en R_4 are/is in parallel

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

$$\frac{1}{R_{34}} = \frac{1}{10} + \frac{1}{10}$$

Any one✓/Enige een

$$R_{34} = 5 \Omega$$

R_2 and R_{34} are in series/ R_2 en R_{34} is in serie

$$R_{234} = R_2 + R_{34}$$

$$R_{234} = 10 + 5$$

Any one✓/Enige een

$$R_{234} = 15 \Omega$$

R_1 and/en R_{234} are/is in parallel

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_{p2}}$$

$$\frac{1}{R_{eq}} = \frac{1}{15} + \frac{1}{15} \checkmark$$

$$R_{1234} = 7,5 \Omega$$

$$I = \frac{\varepsilon}{R+r} \checkmark \text{ OR/OF } (\text{emf/emk}) \varepsilon = I(R+r)$$

$$I = \frac{12}{7,5+0,5} \checkmark \text{ OR/OF } 12 = I(7,5+0,5) \checkmark$$

$$I = 1,5 \text{ A} \checkmark$$

OPTION 3/OPSIE 3

R_3 and/en R_4 are/is in parallel

$$R_{34} = \frac{R_3 \times R_4}{R_3 + R_4}$$

$$R_{34} = \frac{10 \times 10}{10 + 10}$$

Any one✓/Enige een

$$R_{34} = 5 \Omega$$



R_2 and R_{34} are in series/ R_2 en R_{34} is in serie

$$R_{234} = R_2 + R_{34} \quad \left. \vphantom{R_{234} = R_2 + R_{34}} \right\} \begin{array}{l} \text{Any one} \checkmark / \text{Enige een} \end{array}$$

$$R_{234} = 10 + 5$$

$$R_{234} = 15 \, \Omega$$

R_1 and/en R_{234} are/is in parallel

$$R_{1234} = \frac{R_1 \times R_{234}}{R_1 + R_{234}}$$

$$R_{1234} = \frac{15 \times 15}{15 + 15} \checkmark$$

$$R_{1234} = 7,5 \, \Omega$$

$$I = \frac{\varepsilon}{R+r} \checkmark \text{ OR/OF } (\text{emf/emk}) \varepsilon = I(R+r)$$

$$I = \frac{12}{7,5 + 0,5} \checkmark \text{ OR/OF } 12 = I(7,5 + 0,5) \checkmark$$

$$I = 1,5 \, \text{A} \checkmark$$

OPTION 4/OPSIE 4

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_{p2}} \checkmark$$

$$R_T = R_p = \left(\frac{1}{15} \checkmark + \frac{1}{10 + \left(\frac{1}{10} + \frac{1}{10} \right)^{-1}} \checkmark \right)^{-1} = 7,5 \, \Omega$$

$$I = \frac{\varepsilon}{R+r} \checkmark \text{ OR/OF } (\text{emf/emk}) \varepsilon = I(R+r)$$

(6)

$$I = \frac{12}{7,5 + 0,5} \checkmark \text{ OR/OF } 12 = I(7,5 + 0,5) \checkmark$$

$$I = 1,5 \, \text{A} \checkmark$$

8.2.2 POSITIVE MARKING FROM 8.2.1/POSITIEWE NASIEN VANAF 8.2.1.

OPTION 1/OPSIE 1

$$I_T = I_1 + I_2$$

$$I_1 = I_2$$

$$I_T = 2I$$



$$1,5 = 2I \checkmark$$

$$I = 0,75 \text{ A}$$

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

$$P = (0,75)^2 15 \checkmark$$

$$P = 8,44 \text{ W} \checkmark$$

OPTION 2/OPSIE 2

$$I_T = I_1 + I_2$$

$$I_1 = I_2$$

$$I_T = 2I$$

$$1,5 = 2I \checkmark$$

$$I = 0,75 \text{ A}$$

$$V = IR$$

$$V = (0,75)(15)$$

$$V = 11,25 \text{ V}$$

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

$$P = \frac{(11,25)^2}{15} \checkmark$$

$$P = 8,44 \text{ W} \checkmark$$

✓ Both/Beide

OPTION 3/OPSIE 3

$$I_T = I_1 + I_2$$

$$I_1 = I_2$$

$$I_T = 2I$$

$$1,5 = 2I \checkmark$$

$$I = 0,75 \text{ A}$$

$$V = IR$$

$$V = (0,75)(15)$$

$$V = 11,25 \text{ V}$$

$$P = VI$$

$$P = 11,25 \times 0,75 \checkmark$$

$$P = 8,44 \text{ W} \checkmark$$

✓ Both/Beide

(4)



8.2.3 POSITIVE MARKING FROM 8.2.1/POSITIEWE NASIEN VANAF 8.2.1.

OPTION 1/OPSIE 1

$$I_2 = I_3 + I_4$$

$$I_3 = I_4$$

$$I_2 = 2I_3$$

$$0,75 = 2I$$

$$I = 0,375 \text{ A}$$

$$V = IR \checkmark$$

$$V = (0,375)(10) \checkmark$$

$$V = 3,75 \text{ V} \checkmark$$

OPTION 2/OPSIE 2

$$I_T = I_1 + I_2$$

$$I_1 = I_2$$

$$I_T = 2I$$

$$1,5 = 2I \checkmark$$

$$I_2 = I_{34} = 0,75 \text{ A}$$

$$V = IR \checkmark$$

$$V = (0,75)(5) \checkmark$$

$$V = 3,75 \text{ V} \checkmark$$

(3)

8.3.1 DECREASES/AFNEEM ✓



Emf is constant therefore current is inversely proportional to total resistance.
 ✓ External resistance increases therefore total resistance increases ✓, hence current decreases.

Emk is konstant, daarom is die stroom omgekeerd eweredig aan totale weerstand. Eksterne weerstand neem toe dus neem totale weerstand toe, en stroom neem af. (3)

8.3.2 INCREASES/TOENEEM ✓

Total current decreases ✓ then less drop in potential (voltage drop) in the internal resistance and emf is constant ✓ therefore according to $V = \varepsilon - Ir$ terminal potential increases.

Totale stroom neem af, dus minder afname in potensiaal oor die interne weerstand en emk is konstante, en volgens $V = \varepsilon - Ir$ sal die terminale potensiaal verhoog. (3)

[21]

QUESTION 9/VRAAG 9

9.1 0 ✓ ✓ (2)

9.2 $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ OR/OF $R_p = \frac{R_1 R_2}{R_1 + R_2}$ ✓

$\frac{1}{3} + \frac{1}{6}$ ✓ $= \frac{3 \times 6}{6 + 3}$ ✓ $= 2 \Omega$ ✓

$R_p = 2 \Omega$ ✓

$R_T = 2 + 1$ ✓

$= 3 \Omega$ ✓ (5)

9.3 $I = \frac{V}{R}$ ✓ $= \frac{9}{3}$ ✓ $= 3A$ ✓

Emf / emk = $I(R+r)$ ✓ OR/OF $V_{\text{lost}} = Ir$ ✓

$12 = 3(3+r)$ ✓ $3 = 3 \times r$ ✓ (6)

$r = 1 \Omega$ ✓ $r = 1 \Omega$ ✓



9.4 **OPTION 1/ OPSIE 1**

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

$$= 3^2 \checkmark \times 1 \checkmark = 9 \text{ W } \checkmark$$

OPTION 2/ OPSIE 2

$$V = IR \checkmark = 3 \times 1 \checkmark = 3 \text{ V}$$

$$P = VI = 3 \times 3 \checkmark = 9 \text{ W } \checkmark$$

OPTION 3/ OPSIE 3

$$P = \frac{V^2}{R} \checkmark = \frac{3^2}{1} = 9 \text{ W } \checkmark$$

(4)

9.5 **OPTION 1/ OPSIE 1**

$$W = I^2 R \Delta t \checkmark = 3^2 \checkmark \times 1 \checkmark \times 20 \checkmark = 180 \text{ J } \checkmark$$

OPTION 2/ OPSIE 2

$$W = \frac{V^2 \Delta t}{R} \checkmark$$

$$= \frac{3^2 \times 20 \checkmark}{1} = 180 \text{ J } \checkmark$$

OPTION 3/ OPSIE 3

$$W = VI \Delta t \checkmark = 3 \times 3 \checkmark \times 20 \checkmark = 180 \text{ J } \checkmark$$

(4)

[21]



QUESTION 10/VRAAG 10

- 10.1 Zero/ nul. (1)
- 10.2 12 V (1)
- 10.3 $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$
 $\frac{1}{R_{eq}} = \frac{1}{6} + \frac{1}{4} \checkmark$
 $\frac{1}{R_{eq}} = \frac{2+3}{12} = \frac{5}{12}$ (3)
 $R_{eq} = 2,4 \Omega \checkmark$
- 10.4 $V = I \cdot R \checkmark$ (3)
 $V = 3 A \times 2,4 \Omega \checkmark$
 $V = 7,2 V \checkmark$
- 10.5 $V_{lost} = I r \checkmark$ (3)
 $12 - 10 = 3r \checkmark$
 $r = 0,67 \Omega \checkmark$
 Or
 $emf = V_{ext} + I r \checkmark$
 $12 = 10 + 3r \checkmark$
 $r = 0,67 \Omega \checkmark$
- 10.6 $V_{ext} = I \cdot R \checkmark$ (3)
 $10 = 3 R_t \checkmark$
 $R_{ext} = 3,33 \Omega \checkmark$
- 10.7 If the bulb of 6Ω is burnt out the resistance of the circuit increases then the reading of the ammeter decreases $\checkmark$ because the current strength decreases due to the increasing of the external resistance $\checkmark$, but the reading of the voltmeter increases $\checkmark$ because the lost volts also decreases but the emf of the battery is constant according to $V = \epsilon - V_{lost} = \epsilon - I r \checkmark$
As die gloeilamp van 6Ω uitbrand, sal die weerstand in die stroombaan toeneem en die lesing op die ammeter afneem $\checkmark$ want die stroomsterkte neem af as gevolg van die toename van die eksterne weerstand $\checkmark$, maar die voltmeterlesing sal toeneem $\checkmark$ want die verlore volts neem ook af, maar die emk van die battery bly konstant volgens $V = \epsilon - V_{verlore} = \epsilon - I r \checkmark$ (4)

[18]



QUESTION 11/VRAAG 11

- 11.1.1 (Maximum) energy provided (work done) by a battery per coulomb/unit charge passing through it ✓✓

Energie verskaf (arbeid verrig) deur 'n battery per coulomb/eenheid lading wat daardeur vloei. (2)

- 11.1.2 12 (V)✓ (1)

- 11.1.3 0 (V) / Zero/nul □ (1)

- 11.1.4 $\varepsilon = I(R + r)$ } ✓

$$\varepsilon = V_{\text{ext}} + V_{\text{int}}$$

$$12 = 11,7 + Ir$$

$$0,3 = I_{\text{tot}}(0,2) \quad \checkmark$$

$$I_{\text{tot}} = 1,5 \text{ A} \quad \checkmark$$

OR/OF

$$V = IR \quad \checkmark \quad (\text{Accept/Aanvaar: } V_{\text{lost}} = Ir)$$

$$0,3 = I_{\text{tot}}(0,2) \quad \checkmark$$

$$I_{\text{tot}} = 1,5 \text{ A} \quad \checkmark$$

(3)

- 11.1.5

OPTION 1/OPSIE 1

$$\left. \begin{aligned} \frac{1}{R_{//}} &= \frac{1}{R_1} + \frac{1}{R_2} \\ \frac{1}{R} &= \frac{1}{10} + \frac{1}{15} \end{aligned} \right\} \quad \checkmark \text{Any one}$$

OPTION 2/OPSIE 2

$$\left. \begin{aligned} R_{||} &= \frac{R_1 R_2}{R_1 + R_2} \\ &= \frac{(10)(15)}{10 + 15} \end{aligned} \right\} \quad \checkmark \text{Any one}$$

(2)



11.1.6

$R = 6 \Omega \checkmark$	$= 6 \Omega \checkmark$
POSITIVE MARKING FROM QUESTIONS 11.1.4 AND 11.1.5/POSITIEWE NASIEN VANAF VRAE 11.1.4 EN 11.1.5 <u>OPTION 1/OPSIE 1</u>	
$V = IR \square$ $11,7 \square = \underline{1,5(6 + R)} \square$ $R = 1,8 \Omega \square$	OR/OF $V = IR \square$ $\underline{11,7 = 1,5R} \square$ $R = 7,8 \Omega$ $\downarrow$ $R_R = 7,8 - 6 \square \square$ $= 1,8 \Omega \square$

<u>OPTION 2/OPSIE 2</u> $\varepsilon = I(R + r) \square$ $\underline{12 = 1,5(R + 0,2)} \square$ $R = 7,8 \Omega$ $\downarrow$ $R_R = 7,8 - 6 \square \square$ $= 1,8 \Omega \square$	
<u>OPTION 3/OPSIE 3</u> $V_{ } = IR_{ }$ $= (6)(1,5) \checkmark$ $= 9 \text{ V}$	

(4)



$$V_R = IR \quad \square$$

$$(11,7 - 9) = (1,5)R \checkmark$$

$$R = 1,8 \, \Omega \checkmark$$

11.2.1 $P_{\text{ave/gemid}} = Fv_{\text{ave/gemid}} \checkmark = mg(v_{\text{ave/gemid}})$

$$= (0,35)(9,8)(0,4) \checkmark$$

$$= 1,37 \, \text{W} \checkmark$$

OR/OF

$$P = \frac{W_{\text{nc}}}{\Delta t} \square = \frac{\Delta E_k + \Delta E_p}{\Delta t} = \frac{0 + (0,35)(9,8)(0,4 - 0)}{1} \square = 1,37 \, \text{W} \square$$

OR/OF

$$P = \frac{W}{\Delta t} \square = \frac{E_p}{\Delta t} = \frac{(0,35)(9,8)(0,4)}{1} \square = 1,37 \, \text{W} \square$$

(3)

11.2.2 **POSITIVE MARKING FROM QUESTION 11.2.1/POSITIEWE NASIEN VANAF VRAAG 11.2.1**

OPTION 1/OPSIE 1

$$P = VI$$

$$1,37 = (3)I \checkmark$$

$$I = 0,46 \, \text{A}$$

$$\mathcal{E} = V_{\text{ext}} + V_{\text{int}}$$

$$= V_T + V_X + V_{\text{int}}$$

$$12 = V_T + 3 + (0,2)(0,46) \checkmark$$

$$V_T = 8,91 \, \text{V}$$

✓ Any one

OPTION 2/OPSIE 2

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

$$1,37 = \frac{3^2}{R} \square$$

$$R = 6,57 \, \Omega$$

$$P = VI$$

$$1,37 = (3)I \checkmark$$

✓ Any one



$V_T = IR_T$ $8,91 = (0,46)R_T \square$ $R_T = 19,37 \Omega \checkmark$	$I = 0,46 \text{ A}$ $\varepsilon = I(R + r)$ $12 = 0,46(6,57 + R_T + 0,2) \square$ $R_T = 19,38 \Omega \square$
---	---

OPTION 3/OPSIE 3

$$P = VI \square$$

$$1,37 = (3)I \checkmark$$

$$I = 0,46 \text{ A}$$

$$P_{\text{tot}} = P_r + P_{\text{motor}} + P_T$$

$$(12)(0,46) \square = (0,46)^2(0,2) + 1,37 + (0,46)^2 R_T \square$$

$$R_T = 19,41 \Omega \square$$

OR/OF

$$P = VI \square$$

$$1,37 = (3)I \checkmark$$

$$I = 0,46 \text{ A}$$

$$P_{\text{tot}} = P_r + P_{\text{motor}} + P_T$$

$$(12)(0,46) = (0,46)^2(0,2) + 1,37 + P_T \square$$



$$P_T = 4,07 \text{ W}$$

$$P = I^2 R$$

$$4,07 = (0,46)^2 R_T \quad \square$$

$$R_T = 19,49 \, \Omega \quad \checkmark$$

OPTION 4/OPSIE 4

$$P = VI$$

$$1,37 = (3)I \quad \square$$

$$I = 0,46 \text{ A}$$

✓ Any one

$$\varepsilon = I(R + r)$$

$$12 = (0,46)(R + 0,2) \quad \square$$

$$R = 25,87 \, \Omega$$

$$V = IR$$

$$3 = (0,46)R \quad \square$$

$$R = 6,52 \, \Omega$$

$$R_T = 25,87 - 6,52$$

$$= 19,35 \, \Omega \quad \square$$

$$P = I^2 R$$

$$1,37 = (0,46)^2 R \quad \square$$

$$R = 6,47 \, \Omega$$

$$R_T = 25,87 - 6,47$$

$$= 19,4 \, \Omega \quad \square$$

$$P_{\text{motor}} = \frac{V^2}{R}$$

$$1,37 = \frac{3^2}{R} \quad \square$$

$$R = 6,56 \, \Omega$$

$$R_T = 25,87 - 6,56$$

$$= 19,31 \, \Omega \quad \square$$

(5)

[21]



TOPIC 3/ONDERWERP 3 – ELECTRICITY AND MAGNETISM/ELEKTRISITEIT & MAGNETISME

3.3. ELECTRODYNAMICS /ELEKTRODINAMIKA

QUESTION 1/VRAAG 1

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

[20]



QUESTION 2/ VRAAG 2

2.1 DC Generator✓

Mechanical energy to electrical energy✓

GS Generator

Meganiese energie na elektriese energie

(2)

2.2 To make the direction of the (induced) current to be the same in every half cycle/half turn✓✓

Om die (geïnduseerde) stroom se rigting dieselfde te hou tydens elke halfsiklus/ halwe rotasie

OR

To keep the (induced) current unidirectional✓✓

Om die (geïnduseerde) stroom in een rigting te laat vloei

(2)

2.3 Graph A✓/ Grafiek A

DC generator becomes an AC generator✓/ *GS generator word 'n WS-generator*

Voltage changes the polarity in every half cycle. ✓/ *Spanning verander die polariteit in elke halwe siklus*

(3)



$$2.4 \quad P_{\text{avg/gem}} = \frac{V_{\text{rms/wgk}}^2}{R} \checkmark$$

$$P_{\text{avg/gem}} = \frac{\left(\frac{V_{\text{max/maks}}}{\sqrt{2}}\right)^2}{R}$$

$$6 = \frac{\left(\frac{12}{\sqrt{2}}\right)^2}{R} \checkmark$$

$$R = 12 \, \Omega$$

$$P_{\text{avg/gem}} = \frac{V_{\text{rms/wgk}}^2}{R} \checkmark$$

$$P_{\text{avg}} = \frac{\left(\frac{V_{\text{max/maks}}}{\sqrt{2}}\right)^2}{R}$$

$$6 = \frac{\left(\frac{12}{\sqrt{2}}\right)^2}{R} \checkmark$$

$$R = 12 \, \Omega$$

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

$$V_{\text{rms/wgk}} = I_{\text{rmsTot/wgk tot}} R_T \checkmark$$

$$I_{\text{rms/wgk}} = \frac{\left(\frac{V_{\text{max/maks}}}{\sqrt{2}}\right)^2}{R}$$

$$\frac{V_{\text{rms/wgk}}}{\sqrt{2}} = I_{\text{rms Total/wgk tot}} \cdot \left(\frac{R}{2}\right)$$

$$= \frac{\left(\frac{12}{\sqrt{2}}\right)^2}{12}$$

$$\frac{12}{\sqrt{2}} = I_{\text{rms/wgk}} \cdot \left(\frac{12}{2}\right) \checkmark$$

$$I_{\text{rms/wgk}} = 0,71$$

$$I_{\text{rms Total/wgk totaal}} = 2 \times (0,71) \checkmark$$

$$I_{\text{rms Total/wgk tot}} = 1,42 \, \text{A} \checkmark$$

$$= 1,42 \, \text{A} \checkmark$$

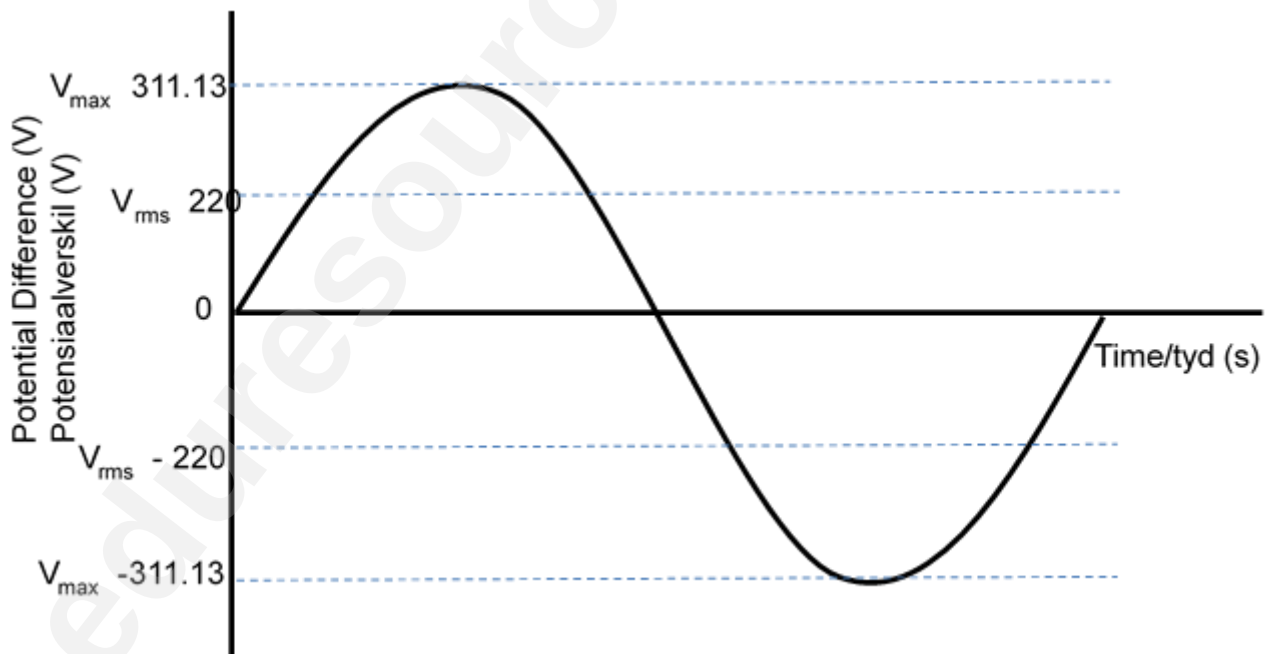
(5)

[12]



QUESTIONS 3/VRAAG3

- 3.1 Direct Current Generator ✓ / Gelykstroom-generator ✓
OR/OF
DC generator/ GS generator (1)
- 3.2 Alternating Current Generator ✓ / Wisselstroom-generator ✓
OR/OF
AC generator/WS generator (1)
- 3.3 DC (Direct Current) generator – has a splitting commutator ✓
GS (Gelykstroom) generator – bevat 'n splitting – kommutator ✓ AC
(Alternating Current) generator – has slip rings ✓
WS (Wisselstroom) generator – bevat sleepringe ✓ (2)
- 3.4 $V_{rms/wgk} = \frac{V_{max/maks}}{\sqrt{2}}$ ✓
 $220 = \frac{V_{max/maks}}{\sqrt{2}}$ ✓
 $V_{max/maks} = 311.13 V$ ✓ (3)
- 3.5



Criteria/Kriteria	Marks/punte
Shape / Vorm	✓
One cycle / Een siklus	✓
Both rms – values / Beide wgk-waardes	✓
Both peak – values / Beide piek-waardes	✓

(4)



3.6 ANY TWO CORRECT APPLICATIONS ✓✓

- Car alternator
- Bicycle dynamo
- Hybrid electric vehicle (HEV) drive systems,
- Aircraft auxiliary power generation,
- Wind generators,
- High speed gas turbine generators

ENIGE TWEE KORREKTE TOEPASSINGS

- Motor alternator /
- Fiets dinamo
- Hibriede elektriese voertuig (HEV) dryfstelsels,
- Vliegtuig hulp kragopwekkers,
- Windgenerators,
- Hoë spoed gas turbine kragopwekkers.

(2)

[13]

QUESTION 4/ VRAAG 4

- 4.1 Generators operate on the principle of electromagnetic induction✓ and mechanical energy is used to move a conductor through a magnetic field to produce motional emf.✓

Generators werk op die beginsel van elektromagnetiese induksie en meganiese energie word gebruik om 'n geleier deur 'n magnetiese veld te beweeg om motionele emk te produseer. (2)

- 4.2 Slip rings are used to transfer power to and from the rotor (coil/armature) allowing the current to alternate in direction.✓

Slip ringe word gebruik om krag na en van die rotor (spoel / armatuur) oor te dra sodat die stroom in die alternatiewe rigting kan wees. (1)

4.3 4.3.1 Option 1/Opsie 1

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

$$V_{rms/wgk} = \frac{24}{\sqrt{2}} \checkmark$$

$$V_{rms/wgk} = 16,97 \text{ V}$$



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

$$I_{rms/wgk} = \frac{16,97}{265} \checkmark$$

$$I_{rms/wgk} = 0,064 \text{ A} \checkmark$$

Option 2/Opsie 2

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

$$I_{rms/wgk} = \frac{24}{\sqrt{2}(265)} \checkmark$$

$$I_{rms/wgk} = 0,064 \text{ A} \checkmark$$

(5)

4.3.2 POSITIVE MARKING FROM QUESTIONS 4.3.1

POSITIEWE NASIE VANAF VRAE 4.3.1

Option 1/Opsie 1

$$P_{ave} = V_{rms/wgk} I_{rms/wgk} \checkmark$$

$$P_{ave} = 16,97 \times 0,064 \checkmark$$

$$P_{ave} = 1,09 \text{ W} \checkmark$$

Option 2/Opsie 2

$$P_{ave/gemiddeld} = I_{rms/wgk}^2 R \checkmark$$

$$P_{ave/gemiddeld} = (0,064)^2 265 \checkmark$$

$$P_{ave/gemiddeld} = 1,09 \text{ W} \checkmark$$

Option 3/Opsie 3

$$P_{ave/gemiddeld} = \frac{V_{rms/wgk}^2}{R} \checkmark$$

$$P_{ave/gemiddeld} = \frac{(16,97)^2}{265} \checkmark$$

$$P_{ave/gemiddeld} = 1,09 \text{ W} \checkmark$$

(3)

4.5 POSITIVE MARKING FROM QUESTIONS 4.3.2

POSITIEWE NASIE VANAF VRAE 4.3.2

The resistance should be decreased. ✓

Die weerstand moet verminder word.

(1)

[12]



QUESTION 5/VRAAG 5

5.1 DC generator (dynamo)✓ (1)
GS-generator (dinamo)

5.2 Mechanical energy to electrical energy.✓ (1)
Meganiese energie na elektriese energie.

5.3 **X** Armature/Anker ✓ (1)
OR/OF

Coil/spoel

5.4.1 **(Y)** Carbon brushes ensure that the coil is connected to the external circuit.✓ (1)
Koolstofborsels verseker dat die spoel aan die eksterne stroombaan verbind is.

5.4.2 **(Z)** Split ring or commutator ensures that the direction of the current in the external circuit remains the same.✓ (1)
Splitring of kommutator verseker dat die rigting van die stroom in die eksterne stroombaan dieselfde bly.

5.5.1 $V_{\text{rms/wgk}} = \frac{V_{\text{max}}}{\sqrt{2}}$ ✓
 $V_{\text{rms/wgk}} = \frac{12,73}{\sqrt{2}}$ ✓
 $V_{\text{rms/wgk}} = 9,00 \text{ V}$ ✓ (3)

5.5.2 **POSITIVE MARKING FROM QUESTION 5.5.1/POSITIEWE NASIEN VAN VRAE 5.5.1.**

OPTION 1/OPSIE 1

$$P_{\text{ave/gem}} = \frac{V_{\text{rms/wgk}}^2}{R} \checkmark$$

$$= \frac{(9)^2}{25} \checkmark$$

$$P_{\text{ave/gem}} = 3,24 \text{ W} \checkmark$$

OPTION 2/OPSIE 2

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



$$= \frac{9,00}{25}$$

$$I_{\text{rms/wgk}} = 0,36 \text{ A}$$

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

$$= 9,00 \times 0,36 \checkmark$$

$$P_{\text{ave/gem}} = 3,24 \text{ W} \checkmark$$

OPTION 3/OPSIE 3

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

$$= \frac{9,00}{25}$$

$$I_{\text{rms/wgk}} = 0,36 \text{ A}$$

$$P_{\text{ave/gem}} = I_{\text{rms/wgk}}^2 R \checkmark$$

$$= (0,36)^2 (25) \checkmark$$

$$P_{\text{ave/gem}} = 3,24 \text{ W} \checkmark$$

OPTION 4/OPSIE 4

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

$$= \frac{12,73}{25\sqrt{2}}$$

$$I_{\text{rms/wgk}} = 0,36 \text{ A}$$

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

$$= 9,00 \times 0,36 \checkmark$$

$$P_{\text{ave/gem}} = 3,24 \text{ W} \checkmark$$

OPTION 5/OPSIE 5

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

$$= \frac{12,73}{25\sqrt{2}}$$

$$I_{\text{rms/wgk}} = 0,36 \text{ A}$$

$$P_{\text{ave/gemiddeld}} = I_{\text{rms/wgk}}^2 R \checkmark$$

$$= (0,36)^2 (25) \checkmark$$

$$P_{\text{ave/gemiddeld}} = 3,24 \text{ W} \checkmark$$

(3)

[11]



QUESTION 6/VRAAG 6

6.1.1 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)

6.1.2 Electromagnetic induction/*Elektromagnetiese induksie* ✓

(1)

6.1.3 Commutator/*kommutator* / split rings/*spleetringe* ✓

(1)

6.2.1

<u>OPTION 1/OPSIE 1</u> $P_{\text{average}} = \frac{V_{\text{rms}}^2}{R} \checkmark$ $= \frac{220^2}{40,33} \checkmark$ $= 1\,200,10 \text{ W (J}\cdot\text{s}^{-1}) \checkmark$	$W = \frac{V_{\text{rms}}^2}{R} \Delta t \checkmark$ $= \frac{220^2}{40,33} (1) \checkmark$ $= 1\,200,10 \text{ J} \checkmark$
<u>OPTION 2/OPSIE 2</u> $I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \checkmark$ $= \frac{220}{40,33} \checkmark$ $= 5,45 \text{ A}$ $P_{\text{average}} = I_{\text{rms}}^2 R \checkmark$ $= (5,45^2)(40,33)$ $= 1\,197,9 \text{ W OR/OF } 1\,200,10 \text{ W} \checkmark$	$I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \checkmark$ $= \frac{220}{40,33} \checkmark$ $= 5,45 \text{ A}$ $W = I_{\text{rms}}^2 R \Delta t$ $= (5,45^2)(40,33)(1) \checkmark$ $= 1\,197,9 \text{ J OR/OF } 1\,200,10 \text{ J} \checkmark$

(4)

(4)



<u>OPTION 3/OPSIE 3</u> $I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \checkmark$ $= \frac{220}{40,33} \checkmark$ $= 5,45 \text{ A}$ $P_{\text{average}} = V_{\text{rms}} I_{\text{rms}}$ $= (220)(5,45) \checkmark$ $= 1\,199 \text{ W or/of } 1\,200,10 \text{ W} \checkmark$	$I_{\text{rms}} = \frac{V_{\text{rms}}}{R} \checkmark$ $= \frac{220}{40,33} \checkmark$ $= 5,45 \text{ A}$ $W = V_{\text{rms}} I_{\text{rms}} \Delta t$ $= (220)(5,45)(1) \checkmark$ $= 1\,199 \text{ J or/of } 1\,200,10 \text{ J} \checkmark$
--	---

(4)

6.2.2

<u>OPTION 1/OPSIE 1</u> $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$ $220 = \frac{V_{\text{max}}}{\sqrt{2}}$ $V_{\text{max}} = 311,13 \text{ V}$ $I_{\text{max}} = \frac{V_{\text{max}}}{R} = \frac{311,13}{40,33} \checkmark$ $= 7,71 \text{ A} \checkmark$ OR/OF $P_{\text{ave}} = \frac{V_{\text{max}} I_{\text{max}}}{2}$ $1200,1 = \frac{(311,13) I_{\text{max}}}{2}$ $I_{\text{max}} = 7,71 \text{ A}$

(3)



OPTION 2/OPSIE 2

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

$$1200,1 = (220) I_{\text{rms}} \checkmark$$

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

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

$$= 7,71 \text{ A} \checkmark \quad (7,715 \text{ A})$$

(3)

OPTION 3/OPSIE 3

$$P_{\text{average}} = I_{\text{rms}}^2 R \checkmark$$

$$1200,1 = I_{\text{rms}}^2 (40,33) \checkmark$$

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

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

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

$$= 7,71 \text{ A} \checkmark$$

(3)

OPTION 4/OPSIE 4

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

$$220 = I_{\text{rms}} (40,33) \checkmark$$

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

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

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

$$= 7,71 \text{ A} \checkmark$$

(3)

[11]

QUESTION 7/VRAAG 7

7.1

7.1.1 North pole/*Noordpool*✓

(1)

7.1.2 Q to P✓

(1)

7.2

7.2.1 **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

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

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

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

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

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

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



7.2.2

POSITIVE MARKING FROM QUESTION 7.4.1/POSITIEWE NASIEN VANAF VRAAG 7.4.1**OPTION 1/OPSIE 1**

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

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

$$= 1\,245,2 \text{ W}$$

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

$$1245,2 = \frac{W}{7200} \checkmark$$

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

$$P_{\text{average}} = I_{\text{rms}}^2 R$$

$$= (5,66)^2 (38,89)$$

$$= 1245,86$$

$$E = Pt$$

(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

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

$$P_{\text{average}} = \frac{220^2}{38,87} \checkmark$$

$$= 1245,18 \text{ W}$$



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

$$1245,18 = \frac{W}{7200} \quad \checkmark$$

$$W = 8\,965\,296 \text{ J} \quad \checkmark$$

OPTION 3/OPSIE 3

$$W = I_{\text{rms}}^2 R \Delta t$$

$$= \left(\frac{I_{\text{max}}}{\sqrt{2}} \right)^2 R \Delta t$$

$$= \left(\frac{8}{\sqrt{2}} \right)^2 (38,87)(7200)$$

$$W = 8\,965\,296 \text{ J} \quad \checkmark$$

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

$$P_{\text{average}} = \frac{220^2}{38,89}$$

$$= 1244,54 \text{ W}$$

$$E = Pt$$

$$= (1244,54)(7200)$$

$$= 8960688 \text{ J}$$

(5)

[12]



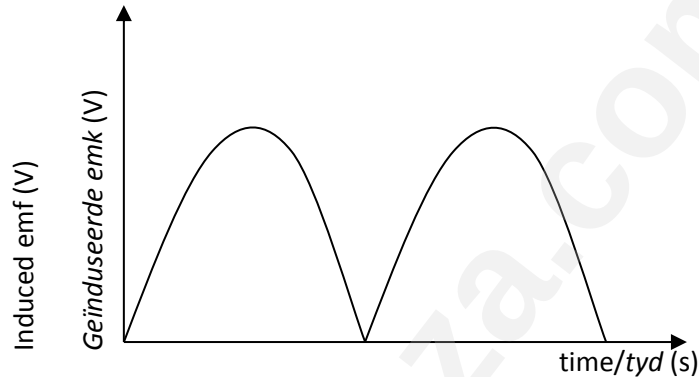
QUESTION 8/VRAAG 8

8.1.1 DC/GS-generator✓

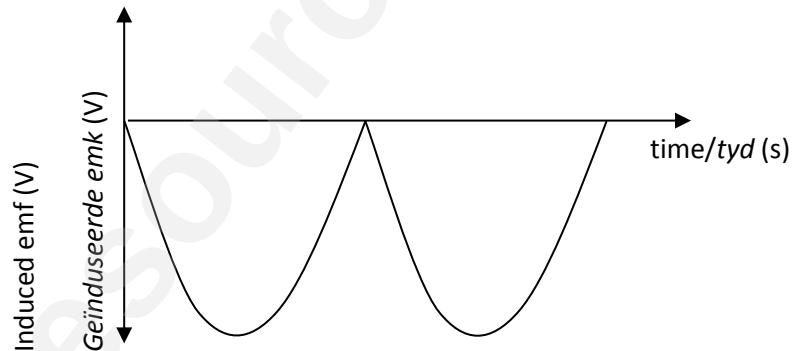
Uses split ring/commutator/*Gebruik spleetring/kommutator*✓

(2)

8.1.2



OR/OF



(2)

8.2.1

OPTION 1/OPSIE 1	OR/OF
$V_{\text{rms/wgk}} = \frac{V_{\text{max/maks}}}{\sqrt{2}}$ $P_{\text{ave/gem}} = V_{\text{rms/wgk}} I_{\text{rms/wgk}} \checkmark$ $800 = \frac{340}{\sqrt{2}} (I_{\text{rms/wgk}}) \checkmark$ $I_{\text{rms/wgk}} = 3,33 \text{ A} \checkmark$	$V_{\text{rms/wgk}} = \frac{V_{\text{max/maks}}}{\sqrt{2}} = \frac{340}{\sqrt{2}} = 240,416$ $P_{\text{ave/gem}} = V_{\text{rms/wgk}} I_{\text{rms/wgk}} \checkmark$ $800 = I_{\text{rms/wgk}} (240,416) \checkmark$ $I_{\text{rms/wgk}} = 3,33 \text{ A} \checkmark$



OPTION 2/OPSIE 2

$$P_{ave/gem} = \left(\frac{V_{rms/wgk}^2}{R} \right) = \frac{(V_{max/maks}^2)}{(2)(R)}$$

$$800 = \frac{(340)^2}{(\sqrt{2})^2(R)}$$

$$R = 72,25 \, \Omega$$

$$P_{ave/gem} = I_{rms/wgk}^2 R$$

$$800 = I_{rms/wgk}^2 (72,25) \checkmark$$

$$V_{rms/wgk} = I_{rms/wgk} R$$

$$I_{rms/wgk} = \frac{240,416}{72,25} \checkmark$$

$$= 3,33 \, A \checkmark$$

(3)

8.2.2

POSITIVE MARKING FROM QUESTION 8.2.1**POSITIEWE NASIEN VANAF VRAAG 8.2.1****OPTION 1/OPSIE 1**

$$P_{ave/gemid} = V_{rms/wgk} I_{rms/wgk} \checkmark$$

for the kettle/vir die ketel:

$$2000 = \frac{340}{\sqrt{2}} (I_{rms/wgk}) \checkmark$$

$$I_{rms/wgk} = 8,32 \, A$$

$$I_{tot} = (8,32 + 3,33) \checkmark$$

$$= 11,65 \, A \checkmark$$



OPTION 2/OPSIE 2

$$P_{\text{ave/gemid}} = \left(\frac{V_{\text{rms/wgk}}^2}{R} \right) \checkmark = \frac{(V_{\text{max/maks}}^2)}{(2)(R)}$$

$$800 = \frac{(340)^2}{(\sqrt{2})^2(R)} \checkmark$$

$$R = 72,25 \, \Omega$$

$$2\,000 = \frac{(340)^2}{(\sqrt{2})^2(R_{2000})}$$

$$R = 28,9 \, \Omega$$

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

$$R = \frac{(28,9)(72,25)}{(28,9 + 72,25)} = 20,64 \, \Omega$$

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

$$\underline{240,42 = I_{\text{rms/wgk}} (20,64)} \checkmark$$

$$\underline{I_{\text{rms/wgk}} = 11,65 \, \text{A}} \checkmark$$

OPTION 3/OPSIE 3

$$P_{\text{ave/gemid}} = V_{\text{rms/wgk}} I_{\text{rms/wgk}} \checkmark = \frac{V_{\text{max/maks}} I_{\text{max/maks}}}{2}$$

$$2\,800 \checkmark = \frac{(340) I_{\text{max/maks}}}{2} \checkmark$$

$$I_{\text{max/maks}} = 16,47 \, \text{A}$$

$$I_{\text{rms}} = \frac{I_{\text{max/maks}}}{\sqrt{2}} = \frac{16,47}{\sqrt{2}}$$

$$I_{\text{rms/wgk}} = 11,65 \, \text{A} \checkmark$$



OPTION 4/OPSIE 4

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

$$2\,800 \square = \frac{340}{\sqrt{2}} I_{\text{rms/wgk}} \square$$

$$I_{\text{rms/wgk}} = 11,65 \text{ A} \square$$

OPTION 5/OPSIE 5

$$P_T : P_K$$

$$800 : 2\,000 \square$$

$$1 : 2,5$$

$$I_T : I_K$$

$$3,33 : 8,325 \square$$

$$I_{\text{rms}} = 3,33 + 8,325 \square$$

$$= 11,66 \text{ A} \square$$

(4)

[11]



QUESTION 9/VRAAG 9

9.1.1 Anticlockwise✓/anti-kloksgewys

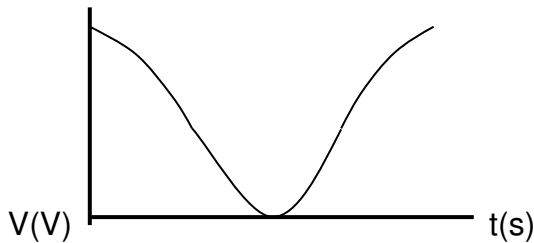
(1)

9.1.2 The rate of change in the magnetic flux✓ is a maximum ✓at this position.

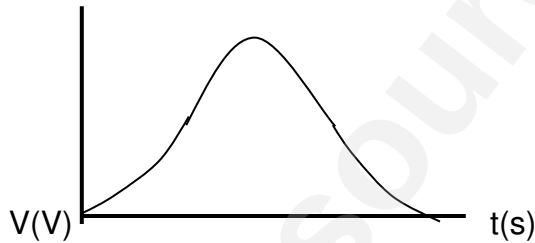
Die tempo van verandering in die magnetiese vloed is 'n maksimum by hierdie posisie .

(2)

9.1.3 **OPTION 1/OPSIE 1**



OPTION 2/OPSIE 2



Criteria for graph/Kriteria vir grafiek:	Marks/ Punte
Shape for one complete rotation of coil. <i>Vorm vir een volledige rotasie van spoel.</i>	✓
Starting at maximum/minimum emf value. <i>Begin by maksimum/minimum waarde van emk.</i>	✓

(2)

9.1.4 Increase the rotation speed of the coil. ✓

Verhoog die rotasiespoed van die spoel.

(1)



- 9.1.5 Electrical energy can be transmitted over long distances (with the use of transformers). ✓ OR

The voltage can easily be adapted for different needs (by means of transformers.)

Elektriese energie kan oor lang afstande oorgedra word (m.b.v. transformers) OF

Die spanning kan maklik aangepas word vir verskillende behoeftes (m.b.v. transformers.)

(1)

9.2

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

$$= \frac{7}{\sqrt{2}} \checkmark$$

$$I_{\text{rms}} = 4,95 \text{ A}$$

$$P_{\text{ave}} = I_{\text{rms}}^2 R \checkmark$$

$$\underline{80 = 4,95^2(R)} \checkmark$$

$$R = 3,26 \text{ A} \checkmark$$

(5)

[12]



QUESTION 10/VRAAG 10

10.1. Electromagnetic induction./*Elektromagnetiese induksie.*✓ (1)

10.2 Rotate the coil faster✓
 Increase the number of coils✓
 Increase the strength of the magnetic field. ✓
Roteer die spoel vinniger
Verhoog die aantal spoele
Verhoog die sterkte van die magneetveld. (3)

10.3.1 Slip rings/*Sleepringe*✓ (1)

10.4.1 It is the value of the voltage in a DC circuit that will have the same heating effect as an AC circuit. ✓✓ (2)
Dit is die waarde van die potensiaalverskil in 'n GS-stroombaan wat dieselfde verhittingseffek het as 'n WS-stroombaan

10.4.2 $V_{\text{rms/wgk}} = \frac{V_{\text{max/maks}}}{\sqrt{2}}$ ✓

$V_{\text{rms/wgk}} = \frac{339,45}{\sqrt{2}}$ ✓

$V_{\text{rms/wgk}} = 240,03 \text{ V}$ ✓

(3)

[10]



TOPIC 4/ONDERWERP 4– MATER & MATERIALS/MATERIE & MATERIALE

4.1. OPTICAL PHENOMENA AND PROPERTIES OF MATERIALS (PHOTOELECTRIC EFFECT EMISSION AND ABSORPTION SPECTRA)/OPTIESE VERSKYNSELS EN EIENSKAPPE VAN MATERIALE (FOTO-ELEKTRIESE EFFEK, EMISSIE- EN ABSORPSIESPEKTR)

QUESTION 1/VRAAG 1

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

[20]



QUESTION 2

- 2.1 What is the relationship between frequency of the incident radiation✓ and the maximum kinetic energy of the ejected electrons? ✓

Wat is die verwantskap tussen frekwensie van die invallende bestraling✓ en die maksimum kinetiese energie van die vrygestelde elektrone? ✓

(2)

2.2

- 2.2.1 frequency/ *frekwensie*. ✓

(1)

- 2.2.2 ANY ONE/✓

Threshold frequency

Work function of the metal

Potential difference

Intensity of the incident radiation

(1)

ENIGE EEN ✓

drumpel frekwensie

werkfunksie van die metaal

potensiaalverskil

intensiteit van die invallende bestraling

- 2.3 As the frequency of the incident radiation increases, the kinetic energy also increases✓✓

(2)

Soos die frekwensie van die invallende bestraling toeneem, neem die kinetiese energie ook toe. ✓✓

2.4 OPTION 1/OPSIE 2

$$E = W_o + E_{K(max/maks)}$$

$$E = W_o + \frac{1}{2}mv_{max/maks}^2$$

$$E = \frac{hc}{\lambda} \checkmark$$

$$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{200 \times 10^{-9}} \checkmark = 8 \times 10^{-19} + E_{K(max/maks)} \checkmark$$

$$E_{K(max/maks)} = 1,95 \times 10^{-19} \text{ J} \checkmark$$

Any one/Enige een✓

OPTION 2/OPSIE 2

$$E = \frac{hc}{\lambda} \checkmark$$

$$E = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{200 \times 10^{-9}} \checkmark$$

$$E = 9,95 \times 10^{-19} \text{ J}$$

$$E = W_o + E_{K(max/maks)} \checkmark$$

$$9,95 \times 10^{-19} = 8 \times 10^{-19} + E_{K(max/maks)} \checkmark$$

$$E_{K(max/maks)} = 1,95 \times 10^{-19} \text{ J} \checkmark$$

(5)



2.5 Remains the same/ No Change ✓

Bly dieselfde/ Geen verandering.

(2)

Maximum kinetic energy is independent of intensity of the incident radiation. ✓

Maksimum kinetiese energie is onafhanklik van die intensiteit van die invallende bestraling.

2.6 DECREASES/ AFNEEM ✓

(1)

[14]

QUESTIONS 3/VRAAG 3

3.1 Photoelectric effect/ foto-elektriese effek. ✓

(1)

3.2 *It establishes the quantum theory ✓ and it illustrates the particle nature of light. ✓*

Dit bevestig die kwantumteorie en dit illustreer die deeltjie-aard van lig.

(2)

3.3 The work function of a metal is the minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓

Die werkfunksie van 'n metaal is die minimum energie benodig om 'n elektron uit die oppervlak van 'n metaal vry te stel.

(2)

3.4 $E_{k\max} = E - W_0$

$$E_{k\max} = \frac{hc}{\lambda} - W_0$$

✓ Any one/ Enige een

$$E_{k\max} = \frac{6,63 \times 10^{-34} \times 3 \times 10^8}{2 \times 10^{-7}} \checkmark - 6,7 \times 10^{-19} \checkmark$$

$$E_{k\max} = \frac{19,89 \times 10^{-26}}{2 \times 10^{-7}} - 6,7 \times 10^{-19}$$

$$E_{k\max} = 9,95 \times 10^{-19} \text{ J} - 6,7 \times 10^{-19} \text{ J}$$

(4)

$$E_{k\max} = 3,25 \times 10^{-19} \text{ J} \checkmark$$

3.5 Increases/ Vermeerder ✓

With light of higher intensity more photons strikes the metal surface per second ✓ / Met lig van hoër intensiteit tref meer fotone die metaaloppervlak per sekonde

Thus more (photo) electrons are emitted per second, ✓ resulting in a bigger current. / Dus word meer (foto-)elektrone per sekonde vrygestel wat 'n hoër stroom tot gevolg het.

(3)

3.6 REMAINS THE SAME/ BLY DIESELFDE ✓.

(1)

[13]



QUESTION 4 / VRAAG 4

4.1 Photoelectric effect ✓
Fotoëlektriese effek ✓ (1)

4.2 What effect will light of different frequencies ✓ have on the emission of electrons from a metal. ✓
Wat is die effek van verskillende frekwensie ✓ van lig op die vrystelling van elektrone uit 'n metaal. ✓ (2)

4.3.1 light of different frequencies ✓
Lig van verskillende frekwensies ✓ (1)

4.3.2 emission of electrons ✓
Vrystelling van elektrone ✓ (1)

4.3.3 Type of metal/work function /threshold frequency (cut off frequency) ✓ (1)
Tipe metaal / werkfunksie / drumpel frekwensie (afgesnyfrekwensie)

4.4.1
work function is the minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓

Werkfunksie is die minimum energie benodig om 'n elektron uit die oppervlak van 'n metaal vry te stel. ✓✓

OR/OF

Minimum energy needed to eject electrons from the surface of a certain metal. ✓✓
Minimum energie benodig om elektrone uit 'n metaaloppervlak vry te stel. ✓✓ (2)

4.4.2
$$E = W_o + \frac{1}{2} mv_{max}^2 \checkmark$$

$$\frac{hc}{\lambda} = W_o + E_{k(max)}$$

$$\frac{(6,63 \times 10^{-34})(3 \times 10^8)}{7,8 \times 10^{-7}} \checkmark = 1,8 \times 10^{-19} + E_{k(max)} \checkmark$$

$$E_k = 7,5 \times 10^{-20} J \checkmark$$

(5)
[13]



QUESTION 5/VRAAG 5

- 5.1 *Work function* is the minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓

Werkfunksie is die minimum energie benodig om 'n elektron uit die oppervlak van 'n metaal vry te stel.

(2)

5.2 $W_o = hf_o$ ✓ OR/OF $f_o = \frac{W_o}{h} =$
 $3,65 \times 10^{-19} \text{ J} = (6,63 \times 10^{-34}) f_o$ ✓
 $f_o = 5,51 \times 10^{14} \text{ Hz}$

Frequencies in this beam that eject electrons/ frekwensies in die ligstraal wat elektrone uitstraal.

(4)

$5,51 \times 10^{14} \text{ Hz}$ to $8 \times 10^{14} \text{ Hz}$ ✓

5.3 **POSITIVE MARKING FROM QUESTION 5.2**

POSITIEWE NASIE VANAF VRAAG 5.2

$E = W_o + E_{k(max/maks)}$



✓ Any one/ Enige een

(4)

$hf = W_o + E_{k(max/maks)}$

$6,63 \times 10^{-34} \times 8 \times 10^{14} \text{ J} = 3,65 \times 10^{-19} \text{ J} + E_{k(max/maks)}$ ✓

$E_{k(max/maks)} = 1,65 \times 10^{-19} \text{ J}$ ✓

5.4 **INCREASES/VERHOOG** ✓

Increase in intensity means that more photons per unit time are incident on the metal plate ✓, therefore the number of photons ejected per second increases. ✓

Toename in intensiteit beteken dat meer fotone per eenheid tyd is op die metaalplate val, dus vermeerderdie aantal fotone wat per sekonde vrygestel word..

3)

[13]

QUESTION 6/VRAAG 6

6.1 Photoelectric effect/*Fotoëlektriese-effek* ✓ (1)

6.2 Particle nature/ *Deeltjie-aard* ✓ (1)

6.3 Work function of a metal is the minimum energy needed to eject an electron from the metal surface ✓✓. (2)

Werksfunksie van 'n metaal is die minimum hoeveelheid energie benodig om 'n elektron uit 'n metaaloppervlak vry te stel.

6.4 $E = W_0 + E_{k(max/maks)}$ ✓

$$h \frac{c}{\lambda} \checkmark = W_0 + \frac{1}{2} m v_{max/mks}^2$$

$$\frac{6,63 \times 10^{-34} \times 3 \times 10^8}{\lambda} \checkmark = 3,65 \times 10^{-19} + \frac{1}{2} \times 9,1 \times 10^{-31} (5,14 \times 10^5)^2 \checkmark$$

$$\lambda = 4,10 \times 10^{-7} \text{ m} \checkmark$$

(5)

6.5

6.5.1 INCREASES/*TOENEEM* ✓ (1)

6.5.2 When the intensity increases, the number of photons also increases. ✓ This leads to more number of photo electrons *ejected*. ✓ (2)

*Wanneer die intensiteit toeneem, sal die aantal fotone toeneem. ✓
Meer elektrone word vrygestel. ✓*

6.6 Ultraviolet is essential for the production of vitamin D ✓ but too much exposure to sunlight can cause skin cancer. ✓

Ultraviolet is noodsaaklik vir die produksie van vitamien D ✓, maar te veel blootstelling aan sonlig kan velkanker veroorsaak. ✓

(2)

[14]



QUESTION 7/VRAAG 7

7.1 **Photoelectric effect** is the process whereby electrons are ejected from a metal surface when light of suitable frequency is incident on that surface. ✓✓

Foto-elektriese effek is die proses waardeur elektrone uit 'n metaaloppervlak vrygestel word wanneer lig van geskikte frekwensie invallend op die oppervlak is. ✓✓

OR/ OF

The emission of electrons from the surface of a metal by light of an appropriate frequency.

Die vrystelling van elektrone vanaf die oppervlak van 'n metal deur lig van 'n toepaslike frekwensie

(2)

7.1.2 Total energy transferred per second/ *Totale energie oorgedra per sekonde*
 $= 8,0 \times 10^{-19} \text{ J}$

Energy of one photon/ *Energie van een foton*

$$E_{\text{photon/foton}} = hf \text{ ✓ OR } E_{\text{photon/foton}} = h \frac{c}{\lambda}$$

OR/OF

Energy of the radiation/ *Energie van die straling*

$$E_{\text{radiation/straling}} = Nhf \text{ OR } E_{\text{radiation/straling}} = Nh \frac{c}{\lambda}$$

$$8,0 \times 10^{-9} \text{ ✓} = N(6,63 \times 10^{-34} \frac{(3 \times 10^8) \text{ ✓}}{2,60 \times 10^{-7} \text{ ✓}})$$

$$8,0 \times 10^{-9} = N(7,65 \times 10^{-19})$$

$$N = 1,05 \times 10^{10} \text{ photons}$$

As each photon ejects one electron the number of electrons ejected per second is $1,05 \times 10^{10} \text{ ✓}$

Soos een foton een elektron vrystel, die elektrone wat vanaf die oppervlak van daardie area van die vrysteller in een sekonde vrygestel is $1,05 \times 10^{10} \text{ ✓}$

(5)

7.1.3 $I = \frac{q}{\Delta t} \text{ ✓}$
 $q = N_e(e)$
 $q = 1,05 \times 10^{10}(1,6 \times 10^{-19}) \text{ ✓}$

$$q = 1,68 \times 10^{-9} \text{ C}$$

$$I = \frac{1,68 \times 10^{-9}}{1} \text{ ✓}$$

$$I = 1,68 \times 10^{-9} \text{ A ✓}$$

(4)



7.2 An atomic absorption spectrum is formed when certain frequencies of electromagnetic radiation that passes through a medium (a cold gas) is absorbed. ✓

An atomic emission spectrum is formed when certain frequencies of electromagnetic radiation are emitted due to an atom's electrons making a transition from a high-energy state to a lower energy state. ✓

(2)
[13]

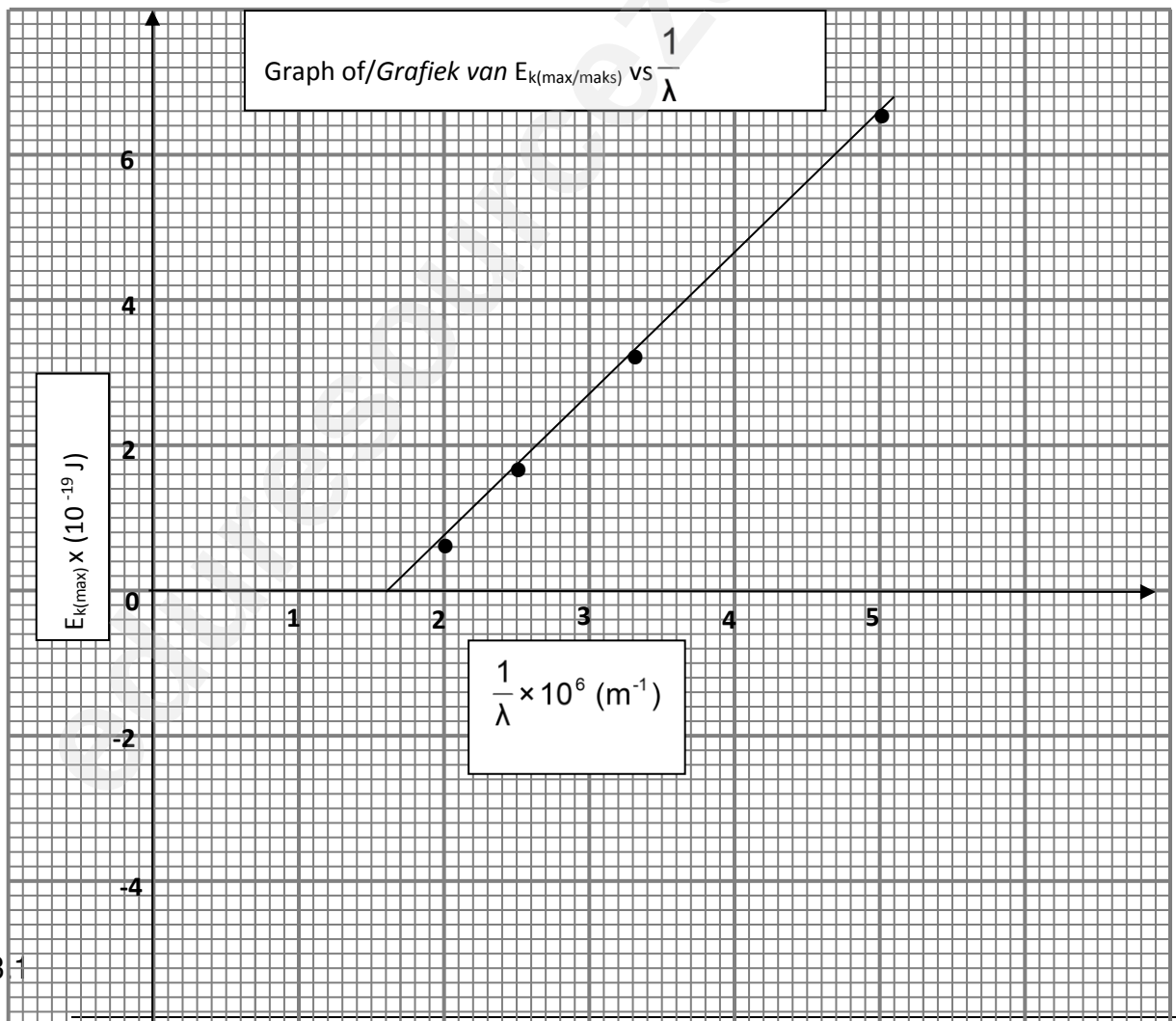
QUESTION 8/VRAAG 8

8.1 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)

8.2



8.3

(4)



OPTION 1/OPSIE 1

$$\frac{1}{\lambda} = 1,6 \times 10^6 \text{ m}^{-1} \checkmark$$

$$f_0 = c \frac{1}{\lambda} \checkmark$$

$$= (3 \times 10^8)(1,6 \times 10^6) \checkmark$$

$$= 4,8 \times 10^{14} \text{ Hz} \checkmark \quad (\text{Accept/Aanvaar } 4,8 \times 10^{14} \text{ Hz to/tot } 5,1 \times 10^{14} \text{ Hz})$$

OPTION 2/OPSIE 2

By extrapolation: y-intercept = $-W_0$ / *Deur ekstrapolasie : y-afsnit = $-W_0$*

$$W_0 = hf_0 \checkmark$$

$$3,2 \times 10^{-19} \checkmark = (6,63 \times 10^{-34})f_0 \checkmark$$

$$f_0 = 4,8 \times 10^{14} \text{ Hz} \checkmark \quad (\text{Accept/Aanvaar } 4,8 \times 10^{14} \text{ Hz to/tot } 4,83 \times 10^{14} \text{ Hz})$$

(4)

OPTION 3/OPSIE 3 (Points from the graph/ *Punte vanaf grafiek*)

$$E = W_0 + E_{k(\text{max})}$$

$$\frac{hc}{\lambda_0} = hf_0 + E_{k(\text{max})} \checkmark$$

$$(6,63 \times 10^{-34})(3 \times 10^8)(1,6 \times 10^6) = (6,63 \times 10^{-34})f_0 + 0 \checkmark$$

$$f_0 = 4,8 \times 10^{14} \text{ Hz} \checkmark$$

OR/OF

$$(6,63 \times 10^{-34})(3 \times 10^8)(5 \times 10^6) = (6,63 \times 10^{-34})f_0 + 6,6 \times 10^{-19}$$

$$f_0 = 4,92 \times 10^{14} \text{ Hz}$$

OR/OF

$$(6,63 \times 10^{-34})(3 \times 10^8)(3,3 \times 10^6) = (6,63 \times 10^{-34})f_0 + 3,3 \times 10^{-19}$$

$$f_0 = 4,8 \times 10^{14} \text{ Hz}$$

(4)



OR/OF

$$(6,63 \times 10^{-34})(3 \times 10^8)(2,5 \times 10^6) = (6,63 \times 10^{-34})f_0 + 1,7 \times 10^{-19}$$

$$f_0 = 4,94 \times 10^{14} \text{ Hz}$$

OR/OF

$$(6,63 \times 10^{-34})(3 \times 10^8)(2,2 \times 10^6) = (6,63 \times 10^{-34})f_0 + 0,7 \times 10^{-19}$$

$$f_0 = 5,54 \times 10^{14} \text{ Hz}$$

8.3.2

OPTION 1/OPSIE 1

$$hc = \text{Gradient/ Helling} \quad \checkmark$$

$$= \frac{\Delta y}{\Delta x}$$

$$= \frac{6,6 \times 10^{-19}}{(5 - 1,6) \times 10^6} \quad \checkmark$$

$$= 1,941 \times 10^{-25} \text{ (J}\cdot\text{m)}$$

$$h = \frac{\text{gradient/helling}}{c}$$

$$h = \frac{1,941 \times 10^{-25}}{3 \times 10^8} \quad \checkmark$$

$$= 6,47 \times 10^{-34} \text{ J}\cdot\text{s} \quad \checkmark$$

OPTION 2/OPSIE 2

$$W_0 = \text{y intercept/afsnit} \quad \checkmark$$

$$= 3,2 \times 10^{-19} \text{ J}$$

Accept /Aanvaar

$$3,2 \times 10^{-19} \text{ J to/tot } 3,4 \times 10^{-19} \text{ J}$$

$$W_0 = hf_0$$

$$3,2 \times 10^{-19} \checkmark = h(4,8 \times 10^{14}) \quad \checkmark$$

$$h = 6,66 \times 10^{-34} \text{ J}\cdot\text{s} \quad \checkmark$$

Accept /Aanvaar

$$6,66 \times 10^{-34} \text{ J}\cdot\text{s to/tot } 7,08 \times 10^{-34} \text{ J}\cdot\text{s}$$

(4)



<u>OPTION 3/OPSIE 3</u> (Points from the graph (Punte vanaf grafiek) $\frac{hc}{\lambda} = W_0 + K_{\max} = 3,2 \times 10^{-19} \checkmark + 6,6 \times 10^{-19} \checkmark$ $h = \frac{9,8 \times 10^{-19}}{(3 \times 10^8)(5 \times 10^6)} \checkmark = 6,53 \times 10^{-34} \text{ J} \cdot \text{s}$ OR/OF $\frac{hc}{\lambda} = W_0 + K_{\max} = 3,2 \times 10^{-19} \checkmark + 3,3 \times 10^{-19} \checkmark$ $h = \frac{6,5 \times 10^{-19}}{(3 \times 10^8)(3,3 \times 10^6)} \checkmark = 6,57 \times 10^{-34} \text{ J} \cdot \text{s}$ OR/OF $\frac{hc}{\lambda} = W_0 + K_{\max} = 3,2 \times 10^{-19} \checkmark + 1,7 \times 10^{-19} \checkmark$ $h = \frac{4,7 \times 10^{-19}}{(3 \times 10^8)(2,5 \times 10^6)} \checkmark = 6,27 \times 10^{-34} \text{ J} \cdot \text{s}$ OR/OF $\frac{hc}{\lambda} = W_0 + K_{\max} = 3,2 \times 10^{-19} \checkmark + 0,7 \times 10^{-19} \checkmark$ $h = \frac{3,9 \times 10^{-19}}{(3 \times 10^8)(2 \times 10^6)} \checkmark = 6,5 \times 10^{-34} \text{ J} \cdot \text{s}$	<u>OPTION 4/OPSIE 4</u> $W_0 = \frac{hc}{\lambda_0} \text{ or / of } W_0 = hc \frac{1}{\lambda_0}$ $3,2 \times 10^{-19} \checkmark = h(3 \times 10^8)(1,6 \times 10^6) \checkmark$ $h = 6,66 \times 10^{-34} \text{ J} \cdot \text{s} \checkmark$
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(4)

[13]



QUESTION 9/VRAAG 9

- 9.1 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)
- 9.2 Frequency/Intensity ✓/Frekwensie/Intensiteit (1)
- 9.3 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)

9.4 POSITIVE MARKING FROM QUESTION 9.4/

POSITIEWE NASIEN VANAF VRAAG 9.4

$$\left. \begin{aligned} E &= W_0 + E_{k(\text{max/maks})} \\ hf &= hf_0 + E_{k(\text{max/maks})} \end{aligned} \right\} \checkmark \text{ Any one/Enige een}$$

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

$$\therefore v_{(\text{max/maks})} = 4,67 \times 10^5 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OR/OF

$$\begin{aligned} E_{K(\text{max/maks})} &= E_{\text{light}} - W_0 \checkmark \text{ Any one/Enige een} \\ &= hf_{\text{light}} - hf_0 \\ &= (6,63 \times 10^{-34})(6,50 \times 10^{14} - 5,001 \times 10^{14}) \checkmark \\ &= 9,94 \times 10^{-20} \text{ J} \end{aligned}$$

$$E_{K(\text{max/maks})} = \frac{1}{2} m v_{\text{max/maks}}^2 \checkmark$$

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

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

- 9.5 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]



QUESTION 10/VRAAG 10

- 10.1.1 The minimum frequency (of a photon/light) needed✓ to emit electrons from (the surface of) a metal. (substance) ✓

Die minimum frekwensie (van 'n foton/lig) benodig om elektrone vanaf die (oppervlakte van)'n metaal (stof) vry te stel

OR/OF

The frequency (of a photon/light) needed✓ to emit electrons from (the surface of) a metal. (substance) with zero kinetic energy✓

Die frekwensie (van 'n foton/lig) benodig om elektrone vanaf die (oppervlakte van)'n metaal (stof) met nul/geen kinetiese energie vry te stel

(2)

- 10.1.2 Silver/Silwer✓

Threshold/cutoff frequency (of Ag) is higher/Drumpel/afsnayfrekwensie (van Ag) is hoër✓

$$W_o \propto f_o / W_o = hf_o \checkmark$$

OR/OF

To eject electrons with the same kinetic energy from each metal, light of a higher frequency/energy is required for silver. ✓ Since $E = W_o + E_{k(max)}$ (and E_k is constant), the higher the frequency/energy of the photon/light required, the greater is the work function/ W_o .✓

Om elektrone met dieselfde kinetiese energie van elke metal vry te stel, is lig van hoër frekwensie benodig vir silwer. Aangesien $E = W_o + E_{k(maks)}$ (en $E_{k(maks)}$ is konstant) word fotone/lig van hoër frekwensie/energie benodig, dus is arbeidsfunksie hoër

(3)

- 10.1.3 Planck's constant /Planck se konstante ✓

(1)

- 10.1.4 Sodium/Natrium✓

(1)

- 10.2.1 Energy radiated per second by the blue light /Energie per sekonde uitgestraal deur die bloulig = $(\frac{5}{100})(60 \times 10^{-3}) \checkmark = 3 \times 10^{-3} \text{ J} \cdot \text{s}^{-1}$

$$E_{\text{photon/foton}} = \frac{hc}{\lambda} \checkmark$$



$$= \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{470 \times 10^{-9}} \checkmark$$

$$= 4,232 \times 10^{-19} \text{J}$$

Total number of photons incident per second/ *Totale aantal fotone wat per*

$$\text{sekonde inval} = \frac{3 \times 10^{-3}}{4,232 \times 10^{-19}} \checkmark \quad (5)$$

$$= 7,09 \times 10^{15} \checkmark$$

10.2.2 POSITIVE MARKING FROM QUESTION 10.2.1

POSITIEWE NASIEN VANAF VRAAG 10.2.1

$7,09 \times 10^{15}$ (electrons per second/ *elektron per sekonde*) $\checkmark$

OR/OF

Same number as that calculated in Question 10.2.1 above/ *Dieselfde as die in Vraag 10.2.1 hierbo bereken*

(1)

[13]

QUESTION 11/VRAAG 11

11.1 The work function of a metal is the minimum energy needed to eject an electron from the metal surface $\checkmark \checkmark$.

Die werkfunksie van 'n metaal is die minimum energie benodig om 'n elektron uit die oppervlak van 'n metaal vry te stel. $\checkmark \checkmark$

(2)

11.2 What is the relationship between work function of metals on the kinetic energy of the ejected electrons when it is irradiated with a light of the same (constant) frequency? $\checkmark \checkmark$

Wat is die verwantskap tussen werksfunksie / arbeidsfunksie van metale en die kinetiese energie van die vrygestelde elektrone wanneer dit met lig met 'n konstante frekwensie bestraal word? $\checkmark \checkmark$

(2)

11.3

11.3.1 Kinetic energy (of the ejected electrons)/Kinetiese energie (van vrygestelde elektrone $\checkmark$

(1)

11.5.2 Work function/metal/ *Werksfunksie/Arbeidsfunksie / Metaal* $\checkmark$

(1)



11.5.1 **ANY ONE/ENIGE EEN**

Frequency (of incident light)/ wavelength (of incident light.) ✓
 Frekwensie (van invallende lig) / Golflengte (van invallende lig)

(1)

11.4 Silver/*Silwer* ✓✓

(2)

11.5 According to Einstein's photoelectric equation $hf = W_0 + \frac{1}{2}mv^2$ ✓ if the frequency is the same/does not change (constant), as the work function increases the kinetic energy decreases. ✓ Here silver is having the least kinetic energy ✓ and hence the highest work function.

Volgens Einstein se fotoëlektriese vergelyking $hf = W_0 + \frac{1}{2}mv^2$ ✓ sal die kinetiese energie afneem indien die werkfunksie (van die metaal) toeneem ✓ indien die frekwensie (van die invallende lig) konstant / onveranderd / dieselfde bly. Silwer het die minste kinetiese energie ✓ en gevolglik die hoogste werkfunksie.

(3)

11.6 $hf = W_0 + E_{K(max/maks)}$ ✓ OR/OF $hf = W_0 + \frac{1}{2}mv_{max}^2$

$$E = h \frac{c}{\lambda} \quad \checkmark$$

$$\frac{6,63 \times 10^{-34} \times 3 \times 10^8}{2 \times 10^{-8}} \checkmark = W_0 + 9,28 \times 10^{-18} \checkmark$$

$$9,945 \times 10^{-18} = W_0 + 9,28 \times 10^{-18}$$

$$W_0 = 6,65 \times 10^{-19} \text{ J} \checkmark$$

(5)

[17]

