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Basic Education
REPUBLIC OF SOUTH AFRICA

**SENIOR CERTIFICATE EXAMINATIONS/
NATIONAL SENIOR CERTIFICATE EXAMINATIONS
SENIORSERTIFIKAAT-EKSAMEN/
NASIONALE SENIORSERTIFIKAAT-EKSAMEN**

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

2019

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

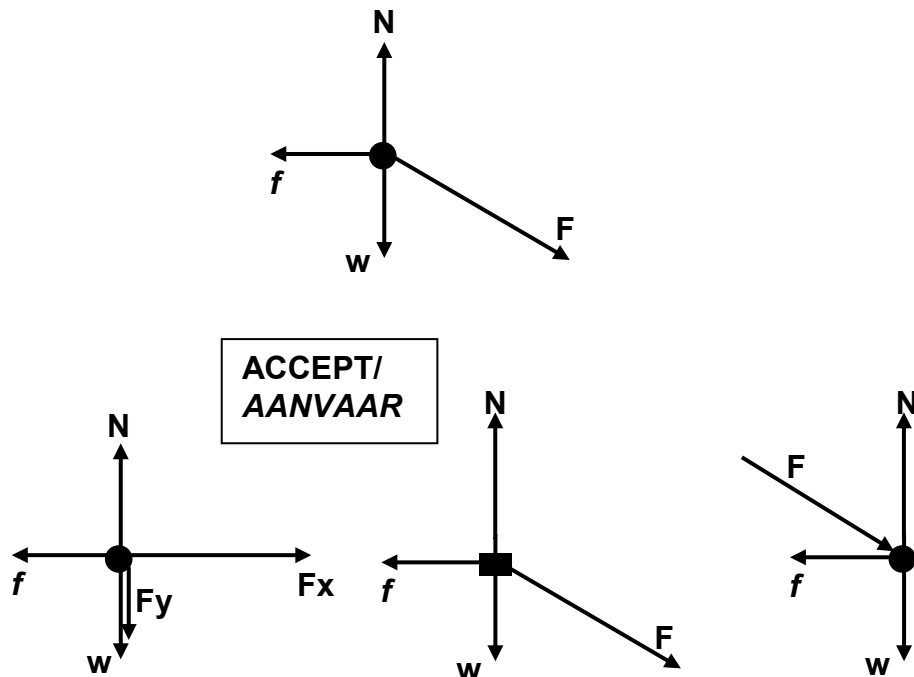
**These marking guidelines consist of 28 pages./
Hierdie nasienriglyne bestaan uit 28 bladsye.**

QUESTION 1/VRAAG 1

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

QUESTION 2/VRAAG 2

2.1.1



Accepted labels/Aanvaarde benoemings	
F	$F_A/90\text{ N}/F_{90}$
w	$F_g / F_w/\text{weight} / mg / \text{gravitational force}$ $F_g / F_w/\text{gewig} / mg / \text{gravitasiekrag}$
f	(Kinetic) Friction / $F_f / f_k / \text{wrywing} / F_w$
N	$F_{\text{Normal}} / \text{Normal}/\text{Normaal} / F_N$

Notes/Aantekeninge

- Mark 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 addisionele krag(te) Max/Maks $\frac{3}{4}$
- If force(s) do not make contact with body / Indien krag(te) nie met die voorwerp kontak maak nie: Max/Maks: $\frac{3}{4}$
- Deduct 1 mark for an arrow/arrows omitted / trek 1 punt af indien pyl/pyle weggelaat

(4)

2.1.2 It is moving at constant speed in a straight line/, the acceleration is zero/ the net force (resultant) acting on it is zero/it is moving at constant velocity ✓

Dit beweeg teen konstante spoed in 'n reguit lyn / versnelling is nul / netto krag (resultant) wat daarop inwerk is nul/ dit beweeg teen konstante snelheid

(1)

2.1.3

$$\begin{array}{l}
 F_{\text{net}} = ma \\
 F_{\text{net}} = 0 \\
 F_x = f \\
 F_x - f = 0 \\
 F \cos 40^\circ - f = 0
 \end{array}
 \left. \vphantom{\begin{array}{l} F_{\text{net}} = ma \\ F_{\text{net}} = 0 \\ F_x = f \\ F_x - f = 0 \\ F \cos 40^\circ - f = 0 \end{array}} \right\} \begin{array}{l} \checkmark \text{ any one} \\ \text{enige een} \end{array}$$

$$\begin{array}{l}
 \underline{90 \cos 40^\circ - f = 0} \checkmark \\
 f = 68,94 \text{ N} \checkmark
 \end{array}$$

OR/OF

$$\begin{array}{l}
 F_{\text{net}} = ma \\
 F_{\text{net}} = 0 \\
 F_x = f \\
 F_x - f = 0 \\
 F \cos 320^\circ - f = 0
 \end{array}
 \left. \vphantom{\begin{array}{l} F_{\text{net}} = ma \\ F_{\text{net}} = 0 \\ F_x = f \\ F_x - f = 0 \\ F \cos 320^\circ - f = 0 \end{array}} \right\} \begin{array}{l} \checkmark \text{ any one} \\ \text{enige een} \end{array}$$

$$\begin{array}{l}
 \underline{90 \cos 320^\circ - f = 0} \checkmark \\
 f = 68,94 \text{ N} \checkmark
 \end{array}$$

$$\begin{array}{l}
 F_{\text{net}} = ma \\
 F_{\text{net}} = 0 \\
 F_x = f \\
 F_x - f = 0 \\
 F \sin 50^\circ - f = 0
 \end{array}
 \left. \vphantom{\begin{array}{l} F_{\text{net}} = ma \\ F_{\text{net}} = 0 \\ F_x = f \\ F_x - f = 0 \\ F \sin 50^\circ - f = 0 \end{array}} \right\} \begin{array}{l} \checkmark \text{ any one} \\ \text{enige een} \end{array}$$

$$\begin{array}{l}
 \underline{90 \sin 50^\circ - f = 0} \checkmark \\
 f = 68,94 \text{ N} \checkmark
 \end{array}$$

(3)

NOTE:

1 mark for formula/equation, 1 mark substitution with zero, 1 mark answer.

LW: 1 punt vir formule/vergelyking, 1 punt substitusie, 1 punt antwoord.

2.1.4

**POSITIVE MARKING FROM 2.1.3 / POSITIEWE NASIEN VANAF 2.1.3
OPTION 1/OPSIE 1**

$$\begin{array}{l}
 v_f = v_i + a\Delta t \\
 \underline{2 = 0} \checkmark + \underline{a(3)} \checkmark \\
 a = 0,67 \text{ m}\cdot\text{s}^{-2}
 \end{array}$$

$$\begin{array}{l}
 F_{\text{net}} = ma \checkmark \\
 \underline{F \cos 40^\circ} \checkmark - \underline{68,94} \checkmark = 15(0,67)
 \end{array}$$

$$F = 103,11 \text{ N} \checkmark (103,05 \text{ N} - 103,11 \text{ N})$$

$$\begin{array}{l}
 F_{\text{net}} = ma \checkmark \\
 F \cos 320^\circ - f = 15(0,67) \\
 \underline{F \cos 320^\circ} \checkmark - \underline{68,94} \checkmark = 15(0,67) \\
 F = 103,11 \text{ N} \checkmark
 \end{array}$$

**POSITIVE MARKING FROM 2.1.3 / POSITIEWE NASIEN VANAF 2.1.3
OPTION 2/OPSIE 2**

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

$$\underline{F \cos 40^\circ} \checkmark - \underline{(68,94)} \checkmark = \underline{15(2 - 0)} \checkmark$$

$$F = 103,11 \text{ N} \checkmark$$

**POSITIVE MARKING FROM 2.1.3 / POSITIEWE NASIEN VANAF 2.1.3
OPTION 3/OPSIE 3**

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

$$F_x - f_k = ma$$

✓ any one
enige een

$$F_x - 68,94 \checkmark = 15 \frac{(2-0)}{3} \checkmark$$

$$F_x = 78,94 \text{ N}$$

$$\tan \theta = \frac{F_y}{F_x}$$

$$\tan 40^\circ = \frac{F_y}{78,94}$$

$$F_y = 66,24 \text{ N}$$

$$F^2 = F_x^2 + F_y^2$$

$$F^2 = (78,94)^2 + (66,24)^2 \checkmark$$

$$F = 103,05 \text{ N} \checkmark$$

**POSITIVE MARKING FROM 2.1.3 / POSITIEWE NASIEN VANAF 2.1.3
OPTION 4/OPSIE 4**

$$\Delta x = \frac{v_i + v_f}{2} \Delta t$$

$$= \frac{(2+0)}{2} (3) \checkmark$$

$$\Delta x = 3 \text{ m}$$

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

$$W_F + W_f = \Delta K \checkmark$$

$$F \Delta x \cos \theta + f \Delta x \cos \theta = \Delta K$$

$$\underline{F(3)\cos 40^\circ} \checkmark + \underline{68,94(3)\cos 180^\circ} \checkmark = \frac{1}{2} (15)(2^2) - \frac{1}{2} (15)(0)^2$$

$$F = 103,06 \text{ N} \checkmark$$

(6)

2.2

OPTION 1/OPSIE 1

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

$$20 \checkmark = (6,67 \times 10^{-11}) \frac{m_{\text{planet}} (10)}{(6 \times 10^5)^2} \checkmark$$

$$m_{\text{planet}} = 1,08 \times 10^{22} \text{ kg} \checkmark$$

OPTION 2/OPSIE 2

$$w = mg$$

$$20 = (10)(g) \checkmark$$

$$g = 2 \text{ m} \cdot \text{s}^{-2}$$

$$g = \frac{GM}{R^2}$$

$$2 = \frac{(6,67 \times 10^{-11})M}{(6 \times 10^5)^2} \checkmark$$

$$M = 1,08 \times 10^{22} \text{ kg} \checkmark$$

✓ Any one
Enige een

(4)
[18]

QUESTION 3/VRAAG 3

- 3.1 Motion of an object under the influence of gravity/gravitational force (weight) only✓✓.

Beweging van 'n voorwerp slegs onder die invloed van gravitasie/gravitasie krag (gewig).

OR/OF

Motion in which the only force acting on the object is gravity/weight. ✓✓

Beweging waar die enigste krag wat op die voorwerp inwerk, gravitasie/gewig is.

ACCEPT/AANVAAR

Vertical motion in which friction/air resistance is absent. ✓✓

Vertikale beweging waar wrywing/lugweerstand afwesig is.

Motion in air with an acceleration of $9,8 \text{ m}\cdot\text{s}^{-2}$. ✓✓

Beweging in lug met 'n versnelling van $9,8 \text{ m}\cdot\text{s}^{-2}$.

NOTE: 2 OR ZERO/ 2 of nul

(2)

3.2.1

OPTION 1/OPSIE 1

Upwards positive/Opwaarts positief:

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

$$0 = v_i + (-9,8)(1,53) \checkmark$$

$$\therefore v_i = 14,99 \text{ m}\cdot\text{s}^{-1} (15 \text{ m}\cdot\text{s}^{-1}) \checkmark$$

Downwards positive/Afwaarts positief

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

$$0 = v_i + (9,8)(1,53) \checkmark$$

$$\therefore v_i = -14,99 \text{ m}\cdot\text{s}^{-1}$$

$$v_i = 14,99 \text{ m}\cdot\text{s}^{-1} (15 \text{ m}\cdot\text{s}^{-1}) \checkmark$$

OPTION 2/OPSIE 2

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

$$= 9,8 \text{ (m)}$$

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

$$(9,8)(\text{m})(1,53) = (\text{m})(v_f - 0) \checkmark$$

$$v_f = 14,99 \text{ m}\cdot\text{s}^{-1} (15 \text{ m}\cdot\text{s}^{-1}) \checkmark$$

OPTION 3/OPSIE 3

Upwards positive/Opwaarts positief:

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

$$0 = v_i(3,06) + \frac{1}{2}(-9,8)(3,06)^2 \checkmark$$

$$v_i = 14,99 \text{ m}\cdot\text{s}^{-1} \checkmark (15 \text{ m}\cdot\text{s}^{-1})$$

Downwards positive/Afwaarts positief

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

$$0 = v_i(3,06) + \frac{1}{2}(9,8)(3,06)^2 \checkmark$$

$$v_i = 14,99 \text{ m}\cdot\text{s}^{-1} \checkmark (15 \text{ m}\cdot\text{s}^{-1})$$

NOTE: initial and final velocities can be swapped if starting from top, as long as sign of g is changed accordingly.

LW: v_f en v_i kan omgeruil word indien van bopunt begin, solank teken van g dienooreenkomstig verander word.

(3)

3.2.2

OPTION 1/OPSIE 1**POSITIVE MARKING FROM 3.2.1/ Positiewe nasien vanaf 3.2.1****Upwards positive/Opwaarts positief:**

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

$$= 14,99 (1,53) + \frac{1}{2} (-9,8)(1,53)^2 \checkmark$$

$$= 11,47 \text{ m} \checkmark (11,46-11,48)$$

Maximum height is/Maksimum hoogte is 11,47 m

Downwards positive/Afwaarts positief

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

$$= -14,99 (1,53) + \frac{1}{2} (9,8)(1,53)^2 \checkmark$$

$$= -11,47 \text{ m} (11,46-11,48)$$

Maximum height is /Maksimum hoogte is 11,47 m✓

OPTION 2/OPSIE 2**POSITIVE MARKING FROM 3.2.1/ Positiewe nasien vanaf 3.2.1****Upwards positive/Opwaarts positief:**

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

$$0 = (14,99)^2 + 2(-9,8)(\Delta y) \checkmark$$

$$\Delta y = 11,47 \text{ m} \checkmark (11,46-11,48)$$

Maximum height reached is/Maksimum hoogte bereik is 11,47 m

Downwards positive/Afwaarts positief:

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

$$0 = (-14,99)^2 + 2(9,8)(\Delta y) \checkmark$$

$$\Delta y = -11,47 \text{ m} \cdot (11,46-11,48)$$

Maximum height reached is/Maksimum hoogte bereik is 11,47 m✓

OPTION 3/OPSIE 3**POSITIVE MARKING FROM 3.2.1/ Positiewe nasien vanaf 3.2.1****Upwards positive/Opwaarts positief:**

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

$$= \left(\frac{(14,99 + 0)}{2} \right) (1,53) \checkmark$$

$$\Delta y = 11,47 \text{ m} \checkmark$$

Maximum height reached is /Maksimum hoogte bereik is 11,47 m

Downwards positive/Afwaarts positief:

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

$$= \left(\frac{(-14,99 + 0)}{2} \right) (1,53) \checkmark$$

$$\Delta y = -11,47 \text{ m} (11,46-11,48)$$

Maximum height reached is /Maksimum hoogte bereik is 11,47 m✓

OPTION 4/OPSIE 4**POSITIVE MARKING FROM 3.2.1**

$$\Delta E = \Delta K + \Delta U$$

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

1 mark for any✓
1 punt vir enige

$$\frac{1}{2} (14,994)^2 + (9,8)(0) = 0 + 9,8 h_f \checkmark$$

$$h_f = 11,47 \text{ m} \checkmark (11,46-11,48)$$

Maximum height reached is /Maksimum hoogte bereik is 11,47 m

OR/OF

$$\Delta K = - \Delta U \checkmark$$

$$\frac{1}{2} m (v_f^2 - v_i^2) = - m g (h_f - h_i)$$

$$\frac{1}{2} (0 - 14,99^2) = - 9,8 (h_f - 0) \checkmark$$

$$h_f = 11,47 \text{ m} (11,46-11,48)$$

Maximum height reached is /Maksimum hoogte bereik is 11,47 m✓

(3)

3.3

OPTION 1/OPSIE 1**POSITIVE MARKING FROM 3.2.1**

Upwards positive/Opwaarts positief:

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

$$= (14,99) (4) + \frac{1}{2} (- 9,8)(4)^2 \checkmark$$

$$= -18,4 \text{ m}$$

Position is 18,4 m downwards (below the edge of the roof) ✓ / Posisie is 18,4 m afwaarts (onder die kant van die dak).

Downwards positive/Afwaarts positief

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

$$= (-14,99) (4) + \frac{1}{2} (9,8)(4)^2 \checkmark$$

$$= 18,4 \text{ m}$$

Position is 18,4 m downwards (below the edge of the roof) ✓ / Posisie is 18,4 m afwaarts (onder die kant van die dak)

OPTION 2/OPSIE 2**POSITIVE MARKING FROM 3.2.1****Upwards positive/Opwaarts positief:**

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

$$= (14,99) + (-9,8) (4)$$

$$= -24,2 \text{ m}\cdot\text{s}^{-1}$$

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

$$(-24,2)^2 = (14,99)^2 + 2(-9,8)(\Delta y) \checkmark$$

$$\Delta y = -18,4 \text{ m}$$

Ball is 18,4 m downwards (below the edge of the roof) / *Bal is 18,4 m afwaarts (onder die kant van die dak)* ✓

Downwards positive/Afwaarts positief:

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

$$= (-14,99) + (9,8) (4)$$

$$= 24,2 \text{ m}\cdot\text{s}^{-1}$$

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

$$(24,2)^2 = (-14,99)^2 + 2(9,8)(\Delta y) \checkmark$$

$$\Delta y = 18,4 \text{ m}$$

Ball is 18,4 m downwards (below the edge of the roof) ✓ / *Bal is 18,4 m afwaarts (onder die kant van die dak)*

OPTION 3/OPSIE 3**POSITIVE MARKING FROM 3.2.1****Upwards positive/Opwaarts positief:**

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

$$= \left(\frac{(14,99 - 24,2)}{2} \right) (4) \checkmark$$

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

$$= (14,99) + (-9,8) (4)$$

$$= -24,2 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = -18,4 \text{ m}$$

Ball is 18,4 m downwards (below the edge of the roof) ✓ / *Bal is 18,4 m afwaarts (onder die kant van die dak)*.

Downwards positive/Afwaarts positief:

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

$$= \left(\frac{(-14,99 + 24,2)}{2} \right) (4) \checkmark$$

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

$$= (-14,99) + (9,8) (4)$$

$$= 24,2 \text{ m}\cdot\text{s}^{-1}$$

$$\Delta y = 18,4 \text{ m}$$

Ball is 18,4 m downwards (below the edge of the roof) ✓ / *Bal is 18,4 m afwaarts (onder die kant van die dak)*.

OPTION 4/OPSIE 4Total time to return to starting point/*totale tyd terug na beginpunt*

$$= 2(1,53) = 3,06 \text{ s}$$

∴ time from reference point to ground/ *tyd vanaf verwysingspunt tot by grond*

$$= (4 - 3,06) = 0,94 \text{ s}$$

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

$$= (14,99)(0,94) + \frac{1}{2}(9,8)(0,94)^2 \checkmark$$

$$= 18,43 \text{ m} \checkmark \text{ downwards (below the edge of the roof) /afwaarts (onder die kant van die dak.}$$

(3)

3.4

No/Nee✓

The motion of the ball is only dependent on its initial velocity✓✓/the initial velocity depends on the time taken to reach maximum height.

Die beweging van die bal is slegs afhanklik van sy beginsnelheid./die aanvanklike snelheid hang af van die tyd wat dit neem om maksimum hoogte te bereik.

ACCEPT for 1 mark/ AANVAAR vir 1 punt:

The ball will still be in the air.✓

Die bal sal nog steeds in die lug wees.

OR/OF

The ball is still falling.✓

Die bal is steeds besig om te val.

OR/OF

The ball would not have reached the ground.✓

Die bal sal nog nie die grond bereik het nie.

OR/OF

The motion of the ball is independent of the height of the building. ✓

Die beweging van die bal is onafhanklik van die hoogte van die gebou.

NOTE: If learners gave separate answers for 3.2 and 3.3, mark them together. Thus, if one answer is correct and the other incorrect 0/3

LW: Indien leerders twee afsonderlike antwoorde gee vir 3.2 en 3.3, sien as geheel na. Dus, indien een verkeerd is, 0/3

(3)

[14]

QUESTION 4/VRAAG 4

- 4.1 The total (linear) momentum in a isolated/closed system remains constant./ is conserved. ✓✓

Die totale lineêre momentum in 'n geslote sisteem bly konstant/behoue.

OR/OF

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

In 'n geslote/geïsoleerde sisteem is die totale momentum voor die botsing gelyk aan die totale momentum na die botsing.

NOTE/LET WEL:

-1 for each key word/phrase omitted.

-1 vir elke sleutel woorde/frase weggelaat.

Take the whole statement in context /Vat die hele stelling in konteks.

(2)

- 4.2

OPTION 1/OPSIE 1

$$\sum p_i = \sum p_f$$

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

$$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$$

1 mark for any
1 punt vir enige

$$\{0,45(9) + 0,20(0)\} \checkmark = (0,45 + 0,20)v \checkmark$$

$$v = 6,23 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OR

$$\Delta p_{\text{ball/bal}} = - \Delta p_{\text{cont/houer}} \checkmark$$

$$0,45(v - 9) \checkmark = - 0,2(v - 0) \checkmark$$

$$v = 6,23 \text{ m} \cdot \text{s}^{-1} \checkmark$$

If – sign omitted from formula 0/4
Indien – teken weggelaat uit
formula 0/4

OPTION 2/OPSIE 2

$$\sum p_i = \sum p_f$$

$$p_{f \text{ Total}} = p_{i \text{ Total}}$$

1 mark for any✓
1 punt vir enige

(Thus change in total momentum = 0 /Dus verandering in momentum is=0))

$$0 \checkmark = (0,65v_f) - (9)(0,45) \checkmark$$

$$v_f = 6,23 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(4)

4.3

POSITIVE MARKING FROM 4.2/POSITIEWE NASIEN VANAF 4.2

$$K = \frac{1}{2} mv^2 \checkmark \text{ (or } E_K = \frac{1}{2} mv^2 \text{)}$$

Total kinetic energy before collision: / *Totale kinetiese energie voor botsing:*

$$\frac{1}{2} (0,45)(9)^2 + 0 \checkmark = 18,225\text{J}$$

Total kinetic energy after collision: / *Totale kinetiese energie na botsing:*

$$\frac{1}{2} (0,45 + 0,20)(6,23)^2 \checkmark = 12,614\text{J}$$

$$\sum K_{\text{before/voor}} \neq \sum K_{\text{after/na}}$$

Collision is inelastic. / *Botsing is onelasties* ✓✓If start with/ *indien begin met* $\sum E_{Ki} = \sum E_{Kf}$ 4/5 max/maksNo calculation/ *geen berekening*: 0Do not accept a conclusion of inelastic collision based on any other calculation (such as that of momentum or mechanical energy). / *Moet geen afleiding van 'n onelastiese botsing aanvaar wat op enige ander berekening gebaseer is nie (soos byvoorbeeld momentum of meganiese energie).*(5)
[11]

QUESTION 5/VRAAG 5

5.1 Tension/Spansing✓

(1)

5.2 There is friction/ tension in the system ✓

Daar is wrywing/spanning in die sisteem

OR/OF

Friction/tension is a non-conservative force ✓

Wrywing/spanning 'n 'n nie-konserwatiewekrag

OR/OF

The system is not isolated because there is friction/tension ✓

Die sisteem is nie geïsoleerd nie omdat daar wrywing/spanning is

OR/OF

The internal energy increases because of friction ✓

Die interne energie neem toe as gevolg van wrywing.

OR

The applied force is non-conservative✓

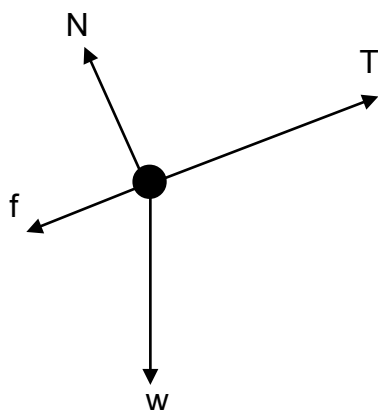
Die toegepaste krag is nie-konservatief

OR

It is not an isolated system✓

(1)

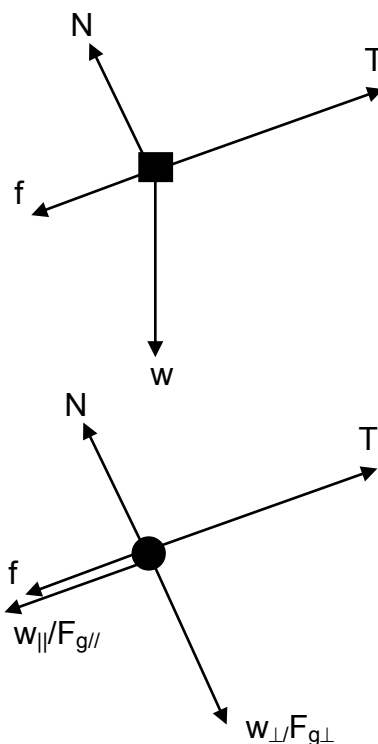
5.3



NOTE: maximum $\frac{3}{4}$ if friction and tension are not on a straight line

LW: maksimum $\frac{3}{4}$ indien wrywing en spanning nie in 'n reguitlyn nie.

ACCEPT/AANVAAR



NOTE: maximum $\frac{3}{4}$ if N and w_{\perp} are not on a straight line
LW: maksimum $\frac{3}{4}$ indien N en w_{\perp} nie in 'n reguitlyn nie.

Accepted labels/Aanvaarde benoemings		
w	F_g/F_w /weight/mg/gravitational force F_g/F_w /gewig/mg/gravitasiekrag	✓
f	Friction/ F_f/f_k /178,22 N/wrywing/ F_w	✓
N	Normal (force)/ F_{normal} / F_N / $F_{normaal}$ / $F_{reaction}$ /reaksie	✓
T	F_T/F_A / $F_{applied}$ /toegepas/700 N/Tension	✓

Notes/Aantekeninge

- Mark 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 addisionele krag(te) Max/Maks $\frac{3}{4}$
- If force(s) do not make contact with body / Indien krag(te) nie met die voorwerp kontak maak nie: Max/Maks: $\frac{3}{4}$

Deduct 1 mark for an arrow/arrows omitted / trek 1 punt af indien pyl/pyle weggelaat

(4)

5.4

$$W = F\Delta x \cos\theta \checkmark$$

$$W_f = [178,22(4)\cos 180^\circ] \checkmark$$

$$= -712,88 \text{ J} \checkmark$$

(3)

5.5

OPTION 1/OPSIE 1**POSITIVE MARKING FROM QUESTIONS 5.4 POSITIEWE NASIEN VANAF VRAE 5.4**

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

$$W_f + W_g + W_T = \Delta K$$

$$W_f + mgsin\theta\Delta x \cos\theta + W_T = \Delta K$$

1 mark for any one ✓ /
1 punt vir enige een

$$-712,88 + (70)(9,8)(\sin 30^\circ)(4) \cos 180^\circ \checkmark + (700 \times 4 \times \cos 0^\circ) \checkmark = \frac{1}{2} 70(v_f^2 - 0) \checkmark$$

$$v_f = 4,52 \text{ m}\cdot\text{s}^{-1} \checkmark$$

NOTE: W_g can be obtained using any of the following formulae:

LW: w_g kan verkry word deur enige een van die volgende formules:

$$W_{\text{gravity/gravitasie}} = mg\Delta x \cos\theta$$

$$= (70)(9,8)(4) \cdot (\cos 120^\circ)$$

$$\therefore -712,88 + (70)(9,8)(4) \cos 120^\circ \checkmark + (700 \times 4 \times \cos 0^\circ) \checkmark = \frac{1}{2} 70(v_f^2 - 0) \checkmark$$

$$v_f = 4,52 \text{ m}\cdot\text{s}^{-1} \checkmark$$

$$W_{\text{gravity/gravitasie}} = -\Delta mgh = -mg(h_f - h_0)$$

$$= mg\Delta y \cos\theta$$

$$= ((70)(9,8) 4(\sin 30^\circ) \cdot \cos 180^\circ$$

$$W_{\text{gravity/gravitasie}} = mgsin\theta\Delta x \cos\theta$$

$$= (70)(9,8)(\sin 30^\circ)(4) \cdot \cos 180^\circ$$

OPTION 2/OPSIE 2**POSITIVE MARKING FROM 5.4 / POSITIEWE NASIEN VANAF 5.4**

$$W_{nc} = \Delta E_K + \Delta E_p \checkmark$$

$$W_T + W_f = \Delta E_K + \Delta E_p$$

$$(700)(4) \cos 0^\circ \checkmark + (-712,88) = [(70)(9,8) 4(\sin 30^\circ) - 0] \checkmark + \frac{1}{2} 70(v_f^2 - 0) \checkmark$$

$$v_f = 4,52 \text{ m} \cdot \text{s}^{-1} \checkmark$$

OPTION 3

$$F_{net} = F_T - [mg \sin \theta + f_k]$$

$$= 700 - [(70 \times 9,8 \sin 30^\circ) + 178,22] \checkmark$$

$$= 178,78 \text{ N}$$

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

$$F_{net} \cdot \Delta x \cos \theta = \Delta E_K$$

$$(178,78)(4) \cos 0^\circ \checkmark = \frac{1}{2} 70(v_f^2 - 0) \checkmark$$

$$v_f = 4,52 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(5)

5.5

WHERE EQUATIONS OF MOTION ARE USED:/ WAAR**BEWEGINGSVERGELYKING GEBRUIK: MAX/MAKS $\frac{1}{5}$**

$$F_{net} = ma$$

$$F_T - [mg \sin \theta + f_k] = ma$$

$$700 - [(70 \times 9,8 \sin 30^\circ) + 178,22] \checkmark = 70a$$

$$a = 2,554 \text{ ms}^{-2}$$

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

$$= 0 + 2(2,554)(4)$$

$$v_f = 4,52 \text{ m} \cdot \text{s}^{-1}$$

5.6

POSITIVE MARKING FROM 5.4/POSITIEWE NASIEN VANAF 5.4

$$2(-712,88) = -1425,76 \text{ J} \checkmark$$

OR/OF

Double the answer (in question 5.4). \checkmark *Dubbel die antwoord (in vraag 5.4)*

(1)

[15]

QUESTION 6/VRAAG 6

6.1.1

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

$$300 = v_i (10) \checkmark$$

$$v_i = 30 \text{ m} \cdot \text{s}^{-1} \checkmark$$

$$v = \frac{d}{t} = \frac{300}{10} \checkmark = 30 \text{ m} \cdot \text{s}^{-1} \checkmark$$

NOTE/LET WEL:Accept/Aanvaar $\Delta x = v_i \Delta t$

(2)

6.1.2

The change in frequency (or pitch) (of the sound) detected by a listener because the source and the listener have different velocities relative to the medium of sound propagation. $\checkmark \checkmark$

Die verandering in die frekwensie (of toonhoogte) (van die klank) waargeneem deur 'n luisteraar omdat die bron en die luisteraar verskillende snelhede relatief tot die voortplantingsmedium 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). $\checkmark \checkmark$

'n Skynbare verandering in waargenome frekwensie (toonhoogte), (golflengte) as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer/luisteraar.

NOTE/LET WEL:

-1 for each key word/phrase omitted.

-1 vir elke sleutel woorde/frase weggelaat

(2)

6.1.3

Car/source (just) passes observer $\checkmark \checkmark$

Motor beweeg net verby die waarnemer

Accept:Car moves away from observer $\checkmark \checkmark$ No relative motion between car and observer $\checkmark \checkmark$ Car and observer at the same place/position $\checkmark \checkmark$ **Aanvaar:**

Motor beweeg verby waarnemer

Geen relatiewe beweging tussen motor en waarnemer

Motor en waarnemer by dieselfde plek/posisie.

(2)

6.1.4

POSITIVE MARKING FROM 6.1.1/POSITIEWE NAISEN VANF 6.1.1

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

$$932 = \frac{340}{340 - 30} f_s \quad \checkmark$$

$$f_s = 849,76 \text{ Hz} \quad \checkmark$$

(4)

Notes/Aantekeninge:

- Any other Doppler formula, e.g. /Enige ander Doppler formula b.v.

$$f_L = \frac{v - v_L}{v - v_s} f_s \quad \text{Max/Maks. } \frac{3}{4}$$

Marking rule 1.5: No penalisation if zero substitutions are omitted.

Nasienreël 1.5. Geen penalisering indien nul vervangings uitgelaat word

6.2

Doppler / Blood flow meter

Dopplervloeimeter/ bloedvloeimeter

Measuring the heartbeat of a foetus

Meting van hartklop van 'n fetus

Radar

Sonar

Used to determine whether stars are receding or approaching earth/

Gebruik om te bepaal of sterre na of weg van die aarde beweeg

Any 2 ✓✓
Enige 2

(2)

[12]

QUESTION 7/VRAAG 7

- 7.1 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 wat per eenheid positiewe lading wat by daardie punt geplaas word, ervaar word. ✓✓

NOTE/LET WEL:

-1 for each key word/phrase omitted. If definition of electric field: 0/2

-1 vir elke sleutel woorde/frase weggelaat. Indien definisie van elektriese veld 0/2

(2)

- 7.2 q_2 is positive_✓

↖ The electric field due to q_1 points to the right because q_1 is negative. ✓ Since the net field is zero, field due to q_2 must point to the left away from q_2 , ✓ hence q_2 is positive.

q_2 is positief

Die elektriese veld as gevolg van q_1 is na regs gerig omdat q_1 negatief is. Aangesien die net veld nul is, moet die veld as gevolg van q_2 na links weg van q_2 wees.

OR/OF

q_2 is positive_✓

↖ Since E_{net} is zero, E_1 and E_2 are in opposite directions ✓ therefore q_1 and q_2 are oppositely charged. ✓

q_2 is positief ✓

Omdat E_{net} nul is, is E_1 en E_2 in teenoorgestelde rigtings ✓ daarom is q_1 en q_2 teenoorgesteld gelaai. ✓

(3)

7.3

$E = k \frac{Q}{r^2} \checkmark$ $E_{\text{net}} = 0$ $\therefore k \frac{q_1}{r_1^2} = k \frac{q_2}{r_2^2} \text{ OR}$ $\frac{q_1}{r_1^2} = \frac{q_2}{r_2^2}$ $\frac{(9 \times 10^9)(3 \times 10^{-9})}{(0,1)^2} \checkmark = \frac{(9 \times 10^9)q_2}{(0,4)^2} \checkmark$ $q_2 = + 4,8 \times 10^{-8} \text{ C} \checkmark$	1 mark for formula 1 mark for equating the two fields 1 mark for both substitutions 1 mark for answer 1 punt vir vergelyking 1 punt vir twee velde gelyk gestel 1 punt vir altwee substitusies 1 punt vir antwoord
--	---

(4)

7.4

The electrostatic force (of attraction/repulsion) 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 elektrostatiese krag(aantekking/afstotend) tussen twee puntladings is direk eweredig aan die produk van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.

(2)

NOTE/LET WEL:

-1 for each key word/phrase omitted. If masses used instead of charges 0

-1 vir elke sleutel woorde/frase weggelaat Indien massas gebruik 0

7.5

POSITIVE MARKING FROM 7.3/POSITIEWE NASIEN VANAF 7.3

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$F = \frac{(9 \times 10^9)(3 \times 10^{-9})(4,8 \times 10^{-8})}{(0,3)^2} \checkmark$$

$$= 1,44 \times 10^{-5} \text{ N} \checkmark$$

(3)

7.6

POSITIVE MARKING FROM 7.2 AND 7.3/POSITIEWE NASIEN van 7.2 en 7.3

YES/JA ✓

Both charges are equal and positive ✓

Beide ladings is gelyk en positief

Accept calculation which shows charges the same and positive/ *Aanvaar berekening wat toon dat ladings dieselfde en positief is.*

If the answer is YES, mark according to the memo, if NO check 7.2 first for sign of charge. If stated NEGATIVE at 7.2, then answer is:

No✓, the direction is incorrect. ✓

Positiewe nasien vanaf 7.2: Indien antwoord vir 7.2 NEGATIEF, dan is hierdie antwoord: Nee ✓, die rigting is verkeerd. ✓

(2)

[16]

QUESTION 8/VRAAG 8

- 8.1.1 The rate at which (electrical) energy is converted (to other forms) (in a circuit)
 The rate at which energy is used/Energy used per second
 The rate at which work is done ✓✓

(2 or zero)

Die tempo waarteen elektriese energie omgesit word (in ander vorms) in 'n stroombaan.

Die tempo waarteen energie verbruik word.

Die tempo waarteen arbeid verrig word.

(2 of nul)

(2)

- 8.1.2

$P = \frac{V^2}{R} \checkmark$ $6 = \frac{(12)^2}{R} \checkmark$ $R = 24 \Omega \checkmark$	$W = \frac{V^2 \Delta t}{R} \checkmark$ $6 = \frac{(12)^2 (1)}{R} \checkmark$ $R = 24 \Omega \checkmark$	$P = VI$ $6 = (12)(I)$ $\therefore I = 0,5 \text{ A}$ $P = I^2 R \checkmark$ $6 = (0,5)^2 R \checkmark$ $R = 24 \Omega \checkmark$	$P = VI \checkmark$ $6 = (12)(I)$ $\therefore I = 0,5 \text{ A}$ $V = IR$ $12 = (0,5)R \checkmark$ $R = 24 \Omega \checkmark$
---	--	---	--

(3)

- 8.1.3

POSITIVE MARKING FROM 8.1.2/POSITIEWE NASIEN VANAF 8.1.2
OPTION 1/OPSIE 1

$$\frac{1}{R_{//}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$= \frac{1}{24} + \frac{1}{24} \checkmark$$

$$R_{//} = 12 \Omega$$

$$R_{\text{ext}} = (R_s + R_{//})$$

$$R_{\text{ext}} = (24 + 12) \checkmark$$

$$= 36 \Omega$$

$$V = IR$$

OR

$$\varepsilon = I(R + r)$$

$$12 = I(36 + 2) \checkmark$$

$$I = 0,32 \text{ A} \checkmark (0,316 \text{ A})$$

✓ any one
 Enige 1

$$R_{\text{tot}} = \left(R_s + \frac{R_1 R_2}{R_1 + R_2} \right)$$

$$R_{\text{tot}} = \left\{ 24 + \frac{(24)(24)}{48} \right\} \checkmark$$

$$= 36 \Omega$$

**POSITIVE MARKING FROM 8.1.2/POSITIEWE NASIEN VANAF 8.1.2
OPTION 2/OPSIE 2**

$$R_{\text{ext}} = (R_s + R_{//})$$

$$\frac{1}{R_{//}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$= \frac{1}{24} + \frac{1}{24} \checkmark$$

$$R_{//} = 12 \Omega$$

$$R_{\text{ext}} = (24 + 12) \checkmark$$

$$= 36 \Omega$$

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

$$I^2 (36 + 2) = \frac{(12)^2}{38} \checkmark$$

$$I = 0,32 \text{ A} \checkmark (0,316) \checkmark$$

$$R_{\text{ext}} = R_s + \frac{R_1 R_2}{R_1 + R_2}$$

$$R_{\text{ext}} = \left\{ 24 + \frac{(24)(24)}{48} \right\} \checkmark$$

$$= 36 \Omega$$

$$I^2 R \quad I^2 R = \frac{V^2}{R}$$

$$I^2 R^2 = V^2$$

$$V = IR$$

$$12 = I(38) \checkmark$$

$$I = 0,316 \text{ A} \checkmark$$

(5)

8.1.4

**POSITIVE MARKING FROM 8.1.3
POSITIEWE NASIEN VANAF 8.1.3
OPTION 1/OPSIE 1**

$$V = IR$$

$$V = I(R_A + r)$$

$$= 0,316(26) \checkmark$$

$$= 8,216 \text{ V} (8,32 \text{ V})$$

$$V_{//} = (12 - 8,216) \checkmark$$

$$= 3,784 \text{ V} (3,68 \text{ V})$$

$$\therefore V_C = 3,78 \text{ V} (3,68 \text{ V}) \checkmark$$

**POSITIVE MARKING FROM 8.1.3
POSITIEWE NASIEN VANAF 8.1.3
OPTION 2/OPSIE 2**

$$V = IR$$

For the parallel portion (or from 8.1.3):
Vir die parallel gedeelte (of vanaf 8.1.3)

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \text{ OR } R = \frac{R_1 R_2}{(R_1 + R_2)}$$

$$R = \frac{(24)(24)}{48}$$

$$= 12 \Omega$$

$$V_{//} = V_C \checkmark$$

$$V = IR_{//}$$

$$= (0,316)(12) \checkmark$$

$$= 3,79 \text{ V} (3,84 \text{ V}) \checkmark$$

(3)

**POSITIVE MARKING FROM 8.1.3
POSITIEWE NASIEN VANAF 8.1.3
OPTION 3/OPSIE 3**

$$I_A = I_B + I_C$$

$$= 2 I_B$$

$$0,316 = 2 I_B \checkmark$$

$$I_B = 0,158 \text{ A}$$

$$V = 0,158 (24) \checkmark$$

$$= 3,79 \text{ V} \checkmark$$

(3)

8.1.5 OPTION 1/OPSIE 1

The power rating (output voltage) of the bulb is 6 W, 12 V. /Die gloeilamp is gemerk 6W ; 12 V

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

[For a given resistance, power is directly proportional to V^2] ✓

[of Vir 'n gegewe resistor is drywing direk eweredig aan V^2] ✓

Since the potential difference across light bulb C is less than the operating voltage, ✓ the output/power will be less, ✓ / Omdat die potensiaalverskil oor gloeilamp C minder is as die benodigde spanning sal die uitset/drywing minder wees.

OPTION 2/OPSIE 2

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

The potential difference across light bulb C is less than the operating voltage.

✓ Thus for the same resistance, ✓ brightness decreases.

Die potensiaalverskil oor gloeilamp C is minder as die benodigde potensiaalverskil. Dus vir dieselfde weerstand, sal die helderheid afneem.

OPTION 3/OPSIE 3

$$P = I^2 R$$

For a given resistance ✓, power is directly proportional to I^2 Since current decreases ✓, brightness decreases.]

[vir 'n gegewe resistor is drywing direk eweredig aan I^2 Omdat stroom afneem sal die helderheid afneem]

OPTION 4/OPSIE 4

$$P = I^2 R$$

In the circuit, the total current in light bulb C is less than the optimum current required (0,5 A). ✓ Thus for the same resistance, ✓ the power will be less ✓ hence brightness will decrease.

In die stroombaan is die totale stroom in gloeilamp C minder as die optimum stroom benodig (0,5 A). Dus vir dieselfde weerstand, is die drywing minder en die helderheid sal afneem.

OPTION 5/OPSIE 5

$$P = IV$$

[Power is directly proportional/equal to product of V and I. ✓

Since current decreases ✓, brightness decreases/

drywing is direk eweredig/gelyk aan produk van V en I. Omdat stroom afneem sal die helderheid afneem]

OR/OF

The voltage across light bulb C, as well as the current in the bulb are all less ✓ than the optimum values ✓ hence power is less ✓ and brightness is less.

Die potensiaalverskil oor gloeilamp C sowel as die stroom in die gloeilamp is almal minder as die optimum waardes, dus is die drywing minder en die helderheid minder.

NOTE: No mark if only equation is given.

(3)

- 8.2.1 The total current passes through resistor A. ✓ For the parallel portion, the current branches, therefore only a portion of the total current passes through resistor C. ✓

Die totale stroom vloei deur resistor A. Vir die parallelle gedeelte verdeel die stroom, dus vloei slegs 'n gedeelte van die stroom deur resistor C.

(2)

ACCEPT for 1 mark: Resistor C is connected parallel to resistors B and D together. Current is dividing ✓ at the junction.

AANVAAR vir 1 punt: Resistor C is in parallel geskakel met B en D saam. Die stroom breek op ✓ by die koppeling.

- 8.2.2 The current in B is equal ✓ to the current in A. The circuit becomes a series circuit. ✓

Die stroom in B is gelyk aan die stroom in A. Die stroombaan word 'n serie stroombaan.

(2)

[21]

QUESTION 9/VRAAG 99.1 Slip rings/*Sleep ringe* ✓

(1)

9.2 B ✓

(1)

9.3

$$\begin{aligned}
 V_{\text{rms/wgk}} &= \frac{V_{\text{max/maks}}}{\sqrt{2}} \checkmark \\
 &= \frac{312}{\sqrt{2}} \checkmark \\
 &= 220,62 \text{ V} \checkmark
 \end{aligned}$$

(3)

9.4.1

POSITIVE MARKING FROM 9.3/POSITIEWE NASIEN VANAF 9.3
OPTION 1/OPSIE 1

$$\begin{aligned}
 P_{\text{aver / gemid}} &= \frac{V_{\text{rms / wgk}}^2}{R} \checkmark \\
 &= \frac{(220,62)^2}{40} \checkmark \\
 &= 1216,83 \text{ W} \checkmark
 \end{aligned}$$

POSITIVE MARKING FROM 9.3/POSITIEWE NASIEN VANAF 9.3
OPTION 2/OPSIE 2

$$\begin{aligned}
 I_{\text{rms}} &= \frac{V_{\text{rms / wgk}}}{R} \\
 &= \frac{(220,62)}{40} \\
 &= 5,515 \\
 P_{\text{ave}} &= I_{\text{rms}}^2 R \\
 &= (5,515)^2 (40) \checkmark \\
 &= 1216,61 \text{ W} \checkmark
 \end{aligned}$$

OR

$$\begin{aligned}
 P_{\text{ave}} &= V_{\text{rms}} I_{\text{rms}} \\
 &= (220,62)(5,515) \checkmark \\
 &= 1216,72 \text{ W} \checkmark
 \end{aligned}$$

✓ for any/ *vir enige*

OPTION 3/OPSIE 3

$$\begin{aligned}
 I_{\max} &= \frac{V_{\max}}{R} \\
 &= \frac{312}{40} \\
 &= 7,80 \text{ A} \\
 P_{\text{ave}} &= \frac{I_{\max} V_{\max}}{2} \\
 &= \frac{(7,8)(312)}{2} \quad \checkmark \\
 &= 1216,80 \text{ W} \quad \checkmark
 \end{aligned}$$

✓ for any/ vir enige

(3)

9.4.2

OPTION 1/OPSIE 1

$$\begin{aligned}
 I_{\max/\text{maks}} &= \frac{V_{\max/\text{maks}}}{R} \quad \checkmark \\
 &= \frac{312}{40} \quad \checkmark \\
 &= 7,8 \text{ A} \quad \checkmark
 \end{aligned}$$

Accept/ Aanvaar: $I = \frac{V}{R}$ **POSITIVE MARKING FROM 9.3 AND 9.4.1/POSITIEWE NASIEN VANAF 9.3 EN 9.4.1****OPTION 2/OPSIE 2**

$$\begin{aligned}
 P_{\text{ave/gemid}} &= V_{\text{rms/wgk}} I_{\text{rms/wgk}} \\
 1\,216,83 &= 220,62 I_{\text{rms/wgk}} \quad \checkmark
 \end{aligned}$$

✓ for any/ vir enige

$$I_{\text{rms/wgk}} = 5,515 \text{ A}$$

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

$$5,515 = \frac{I_{\max/\text{maks}}}{\sqrt{2}} \quad \checkmark$$

$$I_{\max/\text{maks}} = 7,8 \text{ A} \quad \checkmark$$

OPTION 3/OPSIE 3

$$\begin{aligned}
 P_{\text{ave/gemid}} &= I_{\text{rms/wgk}}^2 R \\
 1\,216,83 &= I_{\text{rms/wgk}}^2 (40) \quad \checkmark
 \end{aligned}$$

$$I_{\text{rms/wgk}} = 5,515 \text{ A}$$

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

$$5,515 = \frac{I_{\max/\text{maks}}}{\sqrt{2}} \quad \checkmark$$

$$I_{\max/\text{maks}} = 7,8 \text{ A} \quad \checkmark$$

✓ for any/ vir enige

(4)
[12]

QUESTION 10/VRAAG 10

- 10.1 The minimum frequency of light needed to eject electrons from a metal (surface) ✓✓.

Minimum frekwensie van lig benodig om elektrone vanaf 'n metaal (oppervlak) vry te stel.

NOTE/LET WEL:

-1 for each key word/phrase omitted.

-1 vir elke sleutel woorde/frase weggelaat.

(2)

10.2

OPTION 1/OPSIE 1

$$E = h \frac{c}{\lambda} \checkmark$$

$$= \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{5 \times 10^{-7}} \checkmark$$

$$= 3,98 \times 10^{-19} \text{ J} \checkmark$$

OPTION 2/OPSIE 2

$$c = f\lambda$$

$$3 \times 10^8 = f(5 \times 10^{-7})$$

$$f = 6 \times 10^{14} \text{ Hz}$$

$$E = hf$$

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

$$= 3,98 \times 10^{-19} \text{ J} \checkmark$$

✓ Both equations
Beide vergelykings

(3)

NOTE: do not penalise if v is used in place of c .

10.3

OPTION 1/OPSIE 2**POSITIVE MARKING FROM QUESTION 10.2/POSITIEWE NASIEN VANAF VRAAG 10.2**

$$E = W_0 + E_{\text{kmax}}$$

$$hf = W_0 + \frac{1}{2}mv_{\text{max}}^2$$

$$h \frac{c}{\lambda} = W_0 + E_{\text{K(max/maks)}}$$

$$h \frac{c}{\lambda} = hf_0 + E_{\text{K(max/maks)}}$$

$$3,98 \times 10^{-19} = (6,63 \times 10^{-34})(5,55 \times 10^{14}) + E_{\text{K(max/maks)}} \checkmark$$

$$E_{\text{K(max/maks)}} = 3,0 \times 10^{-20} \text{ J} \checkmark$$

$$E_{\text{K(max/maks)}} > 0 \checkmark$$

1 mark any one/1 punt vir enige

(The electrons emitted from the metal plate have kinetic energy to move between the plates, hence the ammeter registers a reading.

Die elektrone vrygestel vanaf die metaalplaat het kinetiese energie om tussen die plate te beweeg en gevolglik registreer die ammeter 'n lesing)

OPTION 2/OPSIE 2**POSITIVE MARKING FROM QUESTION 10.2/POSITIEWE NASIEN VANAF VRAAG 10.2**

$$W_0 = hf_0 \checkmark$$

$$= (6,63 \times 10^{-34})(5,55 \times 10^{14}) \checkmark$$

$$= 3,68 \times 10^{-19} \text{ J}$$

$$E_{\text{photon}} > W_0 \checkmark$$

(The energy of the incident photon is greater than the work function of potassium. From the equation $hf = W_0 + E_{K\text{max}}$, the ejected photoelectrons will move between the plates, \checkmark hence the ammeter registers a reading.

Die energie van die invallende foton is hoër as die arbeidsfunksie van kalium. Vanaf die vergelyking $hf = hf_0 + E_{K(\text{maks})}$, sal die vrygestelde foto-elektrone tussen die plate te beweeg en gevolglik registreer die ammeter 'n lesing.)

OPTION 3/OPSIE 3

$$c = f\lambda \checkmark$$

$$3 \times 10^8 = f(5 \times 10^{-7}) \checkmark$$

$$f = 6 \times 10^{14} \text{ Hz}$$

$$f > f_0 \checkmark$$

The frequency of the incident photon is higher than the threshold frequency. From the equation $hf = hf_0 + E_{K(\text{max})}$, the ejected photoelectrons will be able to move between the plates \checkmark (for the given frequency), hence the ammeter registers a reading.

Die frekwensie van die invallende foton is hoër as die drumpelfrekwensie.

Vanaf die vergelyking $hf = hf_0 + E_{K(\text{maks})}$, sal die vrygestelde foto-elektrone tussen die plate kan beweeg en gevolglik registreer die ammeter 'n lesing.)

10.4

The increase in intensity increases the number of photons per second. \checkmark
Soos die intensiteit toeneem, neem die aantal fotone per sekonde toe.

Since each photon releases one electron \checkmark the number of ejected electrons per second increases. \checkmark

Aangesien elke foton een elektron vrystel, neem die aantal vrygestelde elektrone per sekonde toe.

ACCEPT: Flow of electrons per unit time increases \checkmark (1 mark)

AANVAAR: vloeï van elektrone per eenheidstyd neem toe (1 punt)

This causes the current /ammeter reading to increase.

Dit veroorsaak dat die stroom/ammeterlesing toeneem.

(4)

(3)
[12]**TOTAL/TOTAAL:****150**