GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

VOORBEREIDENDE EKSAMEN

2016

MEMORANDUM

PHYSICAL SCIENCES: PHYSICS P1 (10841)

FISIESE WETENSKAPPE V1 (10841)

13 pages / 13 *bladsye*

GAUTENG DEPARTMENT OF EDUCATION

GAUTENG DEPARTEMENT VAN ONDERWYS

PREPARATORY EXAMINATION
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PROOFREAD ☐ DATE _____
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PHYSICAL SCIENCES: PHYSICS (First Paper)
FISIESE WETENSKAPPE: FISIKA (Eerste vraestel)

MEMORANDUM

QUESTION / VRAAG 1

1.1 D ✓✓ (2)

1.2 B ✓✓ (2)

1.3 A ✓✓ (2)

1.4 B ✓✓ (2)

1.5 C ✓✓ (2)

1.6 A ✓✓ (2)

1.7 A ✓✓ (2)

1.8 B ✓✓ (2)

1.9 D ✓✓ (2)

1.10 C ✓✓ (2)

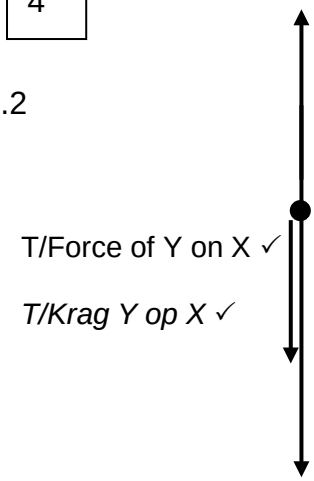
[20]

QUESTION / VRAAG 2

2.1 When a resultant/net force acts on an object, the object accelerates in the direction of the (net) force at an acceleration directly proportional to the force ✓ and inversely proportional to the mass of the object. ✓

Wanneer 'n resultante /netto krag op 'n voorwerp uitgeoefen word, versnel die voorwerp in die rigting van die (netto) krag met 'n versnelling direk eweredig aan die grootte van die krag ✓ en omgekeerd eweredig aan die massa van die voorwerp. ✓ (2)

2.2



Notes/*Aantekeninge:*
- Correct arrow and label for each force for one mark. / *Korrekte pyle en benoeming vir elke krag vir een punt.*
- Comparative lengths of arrows are not required. / *Vergelykende lengte van pyle nie vereiste nie.*

(3)

2.3 2.3.1 For block **X** / *Vir blok **X***:

F_{net} = ma ✓
180 - w – T = ma
180 - (4)(9,8) – T = 4a ✓
140,8 – T = 4a ……(i)

For block **Y**/ *Vir blok **Y***:
F_{net} = ma
T - w = ma
T - (8)(9,8) = 8a ✓
-78,4 +T = 8a……(ii)

281,6 – 2T = 8a
-78,4 + T = 8a
360 – 3T = 0
T = 120 N
T = 120 N upwards / *opwaarts* ✓

Note/*Aantekeninge:*
- If the system approach is used to first calculate acceleration and then acceleration is substituted to obtain T:

  Max. $^{2}/_{4}$
- *Indien die stelsel benader word om eerstens versnelling te bereken en dan die versnelling gebruik om T te bereken:*

  Maks $^{2}/_{4}$

(4)

2.3.2 **POSITIVE MARKING FROM *QUESTION 2.3.1* / *POSITIEWE NASIEN VAN VRAAG 2.3.1***

OPTION / *OPSIE* 1	**OPTION / *OPSIE* 2**
-78,4 +T = 8a -78,4 + 120 = 8a ✓ a = 5,2 m·s^{-2} ✓	140,8 – T = 4a 140,8 – 120 = 4a ✓ a = 5,2 m·s^{-2} ✓
OPTION / *OPSIE* 3	
281,6 -2T = 8a 281,6 + 220 = 8a ✓ a = 5,2 m·s^{-2} ✓	

(2)
[11]

***QUESTION / VRAAG* 3**

3.1 The object had an upward velocity when it was released. ✓ / *Die voorwerp het 'n opwaartse snelheid toe dit losgelaat is.*
OR/ *OF*
The object continues with its state of motion in a straight line. / *Die voorwerp beweeg voort in dieselfde rigting van beweging in 'n reguit lyn.*
OR/ *OF*
The object has inertia. / *die voorwerp het inersie.* (1)

3.2 3.2.1 Upwards / *opwaarts*✓ (1)

3.2.2 Downwards / af*waarts* ✓ (1)

3.3 3.3.1

Upward positive / *opwaarts positief*	**Downward positive/ *afwaarts positief***
$v_f = v_i + a\Delta t$ ✓ $0 = 110 - 9{,}8\Delta t$ ✓ $\Delta t = 11{,}22$ s ✓	$v_f = v_i + a\Delta t$ ✓ $0 = -110 + 9{,}8\Delta t$ ✓ $\Delta t = 11{,}22$ s ✓

(3)

3.3.2 **OPTION 1**

Upward positive / *opwaarts positief*	**Upward negative / *opwaarts negatief***
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ -550 ✓ $= 110\Delta t + \frac{1}{2}(-9{,}8)\Delta t^2$ ✓ $4{,}9\Delta t^2 - 110\,\Delta t - 550 = 0$ $\Delta t = \frac{-(-110) \pm \sqrt{(-110)^2 - 4(4{,}9)(-550)}}{2(4{,}9)}$ $\Delta t = 26{,}66$ s or $-4{,}21$ s $\Delta t = 26{,}66$ s ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ 550 ✓ $= -110\Delta t + \frac{1}{2}(9{,}8)\Delta t^2$ ✓ $4{,}9\Delta t^2 - 110\,\Delta t - 550 = 0$ $\Delta t = 26{,}66$ s or $-4{,}21$ s $\Delta t = 26{,}66$ s ✓

OPTION 2
POSITIVE MARKING FROM QUESTION 3.3.1 / POSITIEWE NASIEN VAN VRAAG 3.3.1.

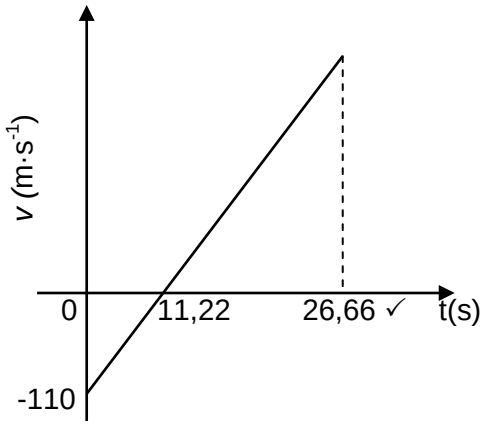
Time(point **Q** to **R)**: 11,22 s Time(point **R** to **Q)**: 11,22 s Time(point Q to ground): **Upward positive / *opwaarts positief*** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ -550 ✓ $= (-110)\Delta t + \frac{1}{2}(-9{,}8)\Delta t^2$ ✓ $4{,}9\,\Delta t^2 + 110\,\Delta t - 550 = 0$ $\Delta t = \frac{-110 \pm \sqrt{(110)^2 - 4(4{,}9)(-550)}}{2(4{,}9)}$ $\Delta t = 4{,}21$ s Total time = 11,22 + 11,22 + 4,21 = 26,65 s ✓	Time(point **Q** to **R)**: 11,22 s Time(point **R** to **Q)**: 11,22 s Time(point Q to ground): **Upward negative / *opwaarts negatief*** $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ 550 ✓ $= (110)\Delta t + \frac{1}{2}(9{,}8)\Delta t^2$ ✓ $4{,}9\,\Delta t^2 + 110\,\Delta t - 550 = 0$ $\Delta t = \frac{-110 \pm \sqrt{(110)^2 - 4(4{,}9)(-550)}}{2(4{,}9)}$ $\Delta t = 4{,}21$ s Total time = 11,22 + 11,22 + 4,21 = 26,65 s ✓

(4)

OPTION 3 **POSITIVE MAKING FROM *QUESTION 3.3.1 / POSITIEWE NASIEN VAN VRAAG* 3.3.1.**	
Upward positive / *opwaarts positief*	**Upward negative / Opwaarts negatief**
Height reached above point Q: $v_f^2 = v_i^2 + 2a\Delta y_2$ $(0)^2 = (110)^2 + 2(-9,8)\,\Delta y_2$ $\therefore \Delta y_2 = 617,35$ m Displacement from point **R** to ground: $\Delta y = 550 + 617,35 = 1\,167,35$ m $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ -1 167,35 ✓ = (0)Δt + ½(-9,8)Δt² ✓ Δt = 15,435 s Total time = 11,22 + 15,435 = 26,66 s ✓	Height reached above point Q: $v_f^2 = v_i^2 + 2a\Delta y_2$ $(0)^2 = (-110)^2 + 2(9,8)\,\Delta y_2$ $\therefore \Delta y_2 = 617,35$ m Displacement from point **R** to ground: $\Delta y = 550 + 617,35 = 1\,167,35$ m $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ 1 167,35 ✓= (0)Δt + ½(9,8)Δt²✓ Δt = 15,435 s Total time = 11,22 + 15,435 = 26,66 s ✓

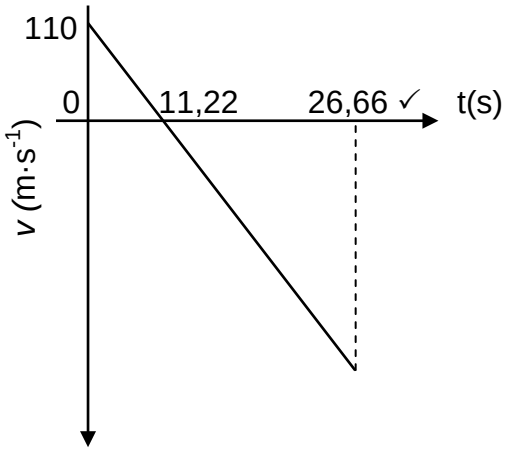
3.4 **POSITIVE MARKING FROM *QUESTION 3.3 / POSITIEWE NASIEN VAN VRAAG* 3.3.**

Downward as positive / *afwaarts as positief*:



Marking criteria/*nasienriglyne*	
Positive slope / *positiewe helling*	✓
Graph starts at v = -110 m·s^{-1} *Grafiek begin by v = -110* m·s^{-1}	✓
Graph intercepts x axis at 11,22 s *Grafiek sny x axis by 11,22 s*	✓
Graph ends at 26,66 s *Grafiek eindig by 26,66 s*	✓

Upward as positive / *opwaarts as positief*:



Marking criteria	
Negative slope / *negatiewe helling*	✓
Graph starts at v = 110 m·s^{-1} *Grafiek begin by v = 110* m·s^{-1}	✓
Graph intercepts x axis at 11,22 s *Grafiek sny x axis by 11,22 s*	✓
Graph ends at 26,66 s *Grafiek eindig by 26,66 s*	✓

(4)
[14]

***QUESTION / VRAAG* 4**

4.1 The total (linear) momentum of a closed system remains constant/is conserved. ✓✓
(2 marks or zero)

Die totale (liniêre) momentum van 'n geslote sisteem bly konstant/bly behoue. ✓✓
(2 punte or niks) (2)

4.2 $\Sigma p_i = \Sigma p_f$ ✓
$m_1v_2 + m_2v_2 = (m_1 + m_2)v_c$
$(\underline{68 \times 20})$ ✓+ $(12 \times 0) = \underline{(68 + 12)v_c}$ ✓
$\therefore v_c = 17\ m \cdot s^{-1}$ ✓ (4)

4.3 **POSITIVE MARKING FROM *QUESTION 4.2* / POSITIEWE NASIEN VAN VRAAG 4.2.**

OPTION / *OPSIE* 1
$(E_p + E_k)_i = (E_p + E_k)_f$ ✓
$(mgh + ½mv_c^2)_i = (mgh + ½ mv_c^2)_f$
$0 + \underline{½(80)(17)^2}$ ✓ $= \underline{(80)(9,8)h} + 0$ ✓
$\therefore h = 14,75$ m

Distance up the incline, d/ *Afstand opwaarts teen skuinsvlak*
$\sin\theta = \frac{h}{\Delta x}$
$\sin 25° = \frac{14,75}{\Delta x}$ ✓
$\therefore \Delta x = 34,89$ m ✓

OPTION / *OPSIE* 2
$W_{net} = \Delta E_k$ ✓
$W_w = E_{kf} - E_{ki}$
$mg\sin 25°\cos 180° = \frac{1}{2}m(v_f^2 - v_i^2)$
$(80)(9,8)\sin 25°$ ✓ $\Delta x \cos 180°$ ✓ $= \frac{1}{2}(80)(0^2 - 17^2)$ ✓
$\Delta x = 34,89$ m ✓

(5)

4.4 Decreases / *verminder* ✓

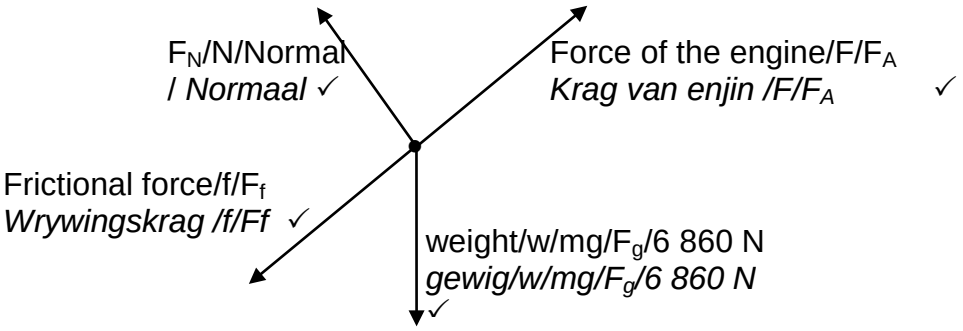
Friction is a non-conservative force/ opposes motion/removes kinetic energy from the system. ✓

Wrywing is 'n nie-konserwatiewe krag /opponeer beweging / verwyder kinetiese energie van die sisteem. ✓ (2)
[13]

***QUESTION / VRAAG* 5**

5.1 Zero/0 (J) ✓ (1)

5.2



(4)

5.3 5.3.1 The net/total work done on an object is equal to the change in the object's kinetic energy. ✓✓ **(2 marks or zero.)**

Die netto/totale werk verrig op 'n voorwerp is gelyk aan die verandering in die voorwerp se kinetiese energie. ✓✓ **(2 punte or niks.)** (2)

5.3.2

Marking guidelines / *nasienriglyne*

- Formula/ *Formule*: $W_{net} = \Delta E_k$ or $W_{nc} = \Delta E_p + \Delta E_k$ ✓
- Formula / *Formule*: $W = F\Delta x\cos\theta$ ✓
- Substitution to calculate / *Vervanging in formule*$f = \mu_k mg\cos 30°$ ✓
- Substitute to calculate / *Vervanging om te bereken:* W_f ✓
- Substitute to calculate / *Vervanging om te bereken:* W_w OR ΔE_p ✓
- Substitute to calculate / *Vervanging om te bereken:* W_F ✓
- Substitute to calculate / *Vervanging om te bereken:* ΔE_k ✓
- Final answer / *Finale antwoord*: 11,59 $m\cdot s^{-1}$ ✓

OPTION / *OPSIE* 1:

$W_{net} = \Delta E_k$ ✓

$$W_N + W_f + W_w + W_F = \Delta E_k$$

$$0 + f\Delta x\cos 180° + w\Delta x\cos 180° + F\Delta x\cos 0° \checkmark = E_{kf} - E_{ki}$$

$$\mu_k mg\cos 30°\Delta x\cos 180° + mg\Delta x\sin 30°180° + F\Delta x\cos 0° = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$0{,}32(700)(9{,}8)\cos 30°\checkmark(70)\cos 180°\checkmark + (700)(9{,}8)\sin 30°(70)\cos 180°\checkmark + (6000)(70)\cos 0° \checkmark =$$

$$\frac{1}{2}(700)(v_f^2 - 0) \checkmark$$

$$-1{,}33 \times 10^5 - 2{,}4 \times 10^5 + 4{,}2 \times 10^5 = 350v_f^2$$

$$v_f = 11{,}59\ m\cdot s^{-1} \checkmark$$

OPTION / *OPSIE* 2:

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

$$W_f + W_F = mg\Delta h + \tfrac{1}{2}m(v_f^2 - v_i^2)$$

$$f\Delta x\cos 180° + F\Delta x\cos 0° \checkmark = mg\Delta h + \tfrac{1}{2}m(v_f^2 - v_i^2)$$

$$0{,}32(700)(9{,}8)\cos 30°\checkmark(70)\cos 180° \checkmark + (6000)(70)\cos 0° \checkmark =$$

$$(700)(9{,}8)(70\sin 30^\circ - 0) \checkmark + \tfrac{1}{2}(700(v_f^2 - 0) \checkmark$$

$$v_f = 11{,}59 m\cdot s^{-1} \checkmark$$

(8)

[15]

***QUESTION / VRAAG* 6**

6.1 6.1.1 It is the apparent change in frequency of a source when there is relative motion between the source and the observer. ✓✓

Dit is die skynbare verandering in frekwensie van 'n bron wanneer daar 'n relatiewe verandering in beweging tussen die bron en die waarnemer is. ✓✓ (2)

6.1.2 Away / *Weg*✓ (1)

6.1.3
$$f_L = \frac{v \pm v_L}{v \pm v_S} f_s \checkmark$$
$$73 \overset{\checkmark}{=} \frac{340}{340 + v_s} 75 \checkmark$$
$$v_s = 9{,}32\ m \cdot s^{-1} \checkmark$$
(4)

6.2
- The <u>absorption spectrum observed for elements on a distant star compared to spectrum</u> of elements on the earth or sun. ✓
- <u>Absorption lines in spectrum from star shifted to red end</u> of the spectrum/ red shifted. ✓
- <u>Wavelengths in the absorption spectrum lines have increased</u>. ✓
- According to the <u>Doppler effect the star is thus moving away</u> from the earth. ✓

- *The <u>absorbsiespektrum waargeneem vir elemente van 'n verafgeleë ster in vergelyking met die spektrum</u> van elemente nader aan die aarde of die son.* ✓
- *<u>Absorbsielyne in die spektrum van ster verskuif na die rooi kant</u> van die spektrum/ rooiverskuiwing.* ✓
- *<u>Golflengte in the absorbsiespektrumlyne vermeerder</u>.* ✓
- *Volgens die <u>Doppler effek beweeg die ster</u> dus verder van die aarde.* ✓ (4)

6.3 Ultrasound scans / *ultraklankskandering*✓
Measuring rate of flow of blood (Blood-flow meter) / *Meting van die tempo waarteen bloed vloei (bloedvloeimeter)*✓ (2)

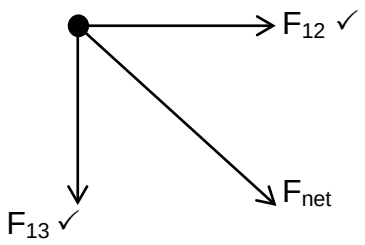
[13]

QUESTION / VRAAG 7

7.1 The force of attraction that two charges at rest exert on each other is directly proportional to the product of the two charges ✓and inversely proportional to the square of the distance between their centres. ✓

Die aantrekkingskrag wat twee ladings in rus op mekaar uitoefen is direk eweredig aan die produk van die twee ladings ✓ en omgekeerd eweredig aan die vierkant van die afstand tussen die middelpunte. ✓ (2)

7.2



(2)

7.3 $F_{12} = \frac{kQ_1Q_2}{r_{12}^2}$ ✓

$= \frac{(9\times10^9)(2\times10^{-5})(2\times10^{-4})}{(0,5)^2}$ ✓✓

$= 144$ N, to the right / na regs

$F_{13} = \frac{kQ_1Q_3}{r_{13}^2}$

$= \frac{(9\times10^9)(2\times10^{-5})(2\times10^{-4})}{(0,4)^2}$ ✓✓

$= 225$ N, downwards / afwaarts

$F_{net} = \sqrt{(225)^2 + (144)^2}$

$= 267,13$ N

$\tan\theta = \frac{225}{144} \quad \therefore \theta = 57,38^\circ$

$F_{net} = 267,13$ N, ✓ $147,38^\circ$ / E57,38°S / 57,38° south of east / *suid van oos* ✓ (7)

[11]

***QUESTION / VRAAG* 8**

8.1 12 V ✓ (1)

8.2 8.2.1

OPTION / *OPSIE* 1	**OPTION 2 / *OPSIE 2***
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ $= \frac{1}{6} + \frac{1}{10}$ ✓ $R_p = 3{,}75\ \Omega$ ↓ $R_{external} = 3{,}75 + 2$ ✓ $= 5,\ 75\ \Omega$ ✓	$R_p = \frac{R_1 R_2}{R_1 + R_2}$ ✓ $= \frac{(6)(10)}{6+10}$ ✓ $R_p = 3{,}75\ \Omega$ ↓ $R_{external} = 3{,}75 + 2$ ✓$= 5{,}75\ \Omega$ ✓

(4)

8.2.2 **POSITIVE MARKING FROM QUESTION 8.2.1 / *POSITIEWE NASIEN VAN VRAAG* 8.2.1.**

OPTION / *OPSIE* 1	**OPTION / *OPSIE* 2**
$V_1 = IR_{ext}$ ✓ $\therefore I = \frac{10}{5{,}75}$ ✓ $= 1{,}74$ A ↓ $\varepsilon = IR_{ext} + Ir$ ✓ $12 = (1{,}74)(5{,}75) + 1{,}74r$ ✓ $\therefore r = 1{,}15\ \Omega$ ✓	$V_1 = IR_{ext}$ ✓ $\therefore I = \frac{10}{5{,}75}$ ✓ $= 1{,}74$A ↓ $V_{lost} = Ir$ ✓ $12 - 10 = 1{,}74r$ ✓ $r = 1{,}15\ \Omega$ ✓

(5)

8.3 Increases / *Verhoog* ✓
Closing S_2 effectively cuts off the 2 Ω resistor / is a short circuit. / *Sluit van* S_2 *sny die 2* Ω *weerstand effektief af* ✓
Total resistance decreases / *Totale weerstand verminder*. ✓ (3)

[13]

***QUESTION / VRAAG* 9**

9.1 9.1.1 AC / Alternating current / *Wisselstroom* ✓ (1)

9.1.2 DC ✓
Due to <u>the presence of the split ring commutator</u>, current always exits through the one brush and then through the other brush. ✓

Agv die teenwoordigheid van die splitringkommutator, is daar altyd stroom wat deur een borsel beweeg en dan deur die ander borsel. ✓

(2)

9.2 9.2.1 <u>AC generator has slip rings</u> ✓ whilst a <u>DC generator has a split ring commutator.</u> ✓

<u>AC generator het slipringe</u>, ✓ *terwyl die <u>DC generator</u> splitringkommutator het.* ✓ (2)

9.2.2 An <u>AC voltage can be stepped up.</u> / *<u>'n AC stroom kan verhoging ondergaan.</u>* ✓
Increase in voltage and <u>decrease in current.</u> / *Verhoging in potensiaalverskil en <u>verlaging in stroom</u>.* ✓
Loss in power/P = I^2R decreases. / *Verlies aan drywing*/P = I^2R verminder ✓ (3)

9.3 9.3.1

<u>OPTION / OPSIE 1</u>	**<u>OPTION / OPSIE 2</u>**
$f = \frac{1}{T}$ $= \frac{1}{0,02}$ ✓ $= 50$ <u>Hz</u> ✓	$f = \frac{\text{cycles}}{\text{time}}$ $= \frac{3,5}{0,07}$ ✓ $= 50$ Hz ✓

(2)

9.3.2

<u>OPTION 1</u>	**<u>OPTION 2</u>**
$I_{max} = \frac{V_{max}}{R}$ ✓ $= \frac{200}{20}$ ✓ $= 10$ A ↘ $P_{ave} = ½(V_{max}I_{max})$ ✓ $= ½(200 \times 10)$ ✓ $= 1000$ W (1 kW) ✓	$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓ $= \frac{200}{\sqrt{2}}$ ✓ $= 141,42$ V ↘ $I_{rms} = \frac{V_{rms}}{R}$ $= \frac{141,42}{20}$ $= 7,07$A ↓ $P_{ave} = I_{rms}^2R$ $= (7,07)^220$ $= 999,70$ W OR $P_{ave} = V_{rms}I_{rms}$ ✓ $= (141,42)(7,07)$ ✓ $= 999,84$ W ✓ Accept range / *Aanvaar:* 999,70 to 1000 W
<u>OPTION / *OPSIE 3*</u>	
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓ $= \frac{200}{\sqrt{2}}$ ✓ $= 141,42$ V ↓ $P_{ave} = \frac{V_{rms}^2}{R}$ ✓ $= \frac{(141,42)^2}{20}$ ✓ $= 999,98$ W ✓	

(5)
[15]

***QUESTION / VRAAG* 10**

10.1 Minimum energy required to release (photo) electrons from a metal surface.✓✓

Minimum energie nodig om (foto)elektrone uit 'n metaaloppervlak vry te stel. ✓✓ (2)

10.2

OPTION / OPSIE 1	**OPTION / OPSIE 2**
$W_o = hf$ ✓ $= \frac{hc}{\lambda}$ ✓ $= \frac{(6{,}63\times10^{-34})(3\times10^{8})}{500\times10^{-9}}$ ✓ ✓ $= 3{,}978 \times 10^{-19}$ J ✓	$f = \frac{c}{\lambda}$ ✓ $= \frac{3\times10^{8}}{500\times10^{-9}}$ ✓ $= 6\times10^{14}$ Hz $W_o = hf$ ✓ $= (6{,}63\times10^{-34})(6\times10^{14})$ ✓ $= 3{,}98\times10^{-19}$ J ✓

(5)

10.3 10.3.1 Remains the same / *Bly dieselfde* ✓ (1)

10.3.2 Remains the same / *Bly dieselfde* ✓ (1)

10.4 **POSITIVE MARKING FROM QUESTION 10.2 / POSITIEWE NASIEN VAN VRAAG 10.2.**

OPTION / OPSIE 1	**OPTION / OPSIE 2**
$E = W_o + E_{k(max)}$ ✓ $\frac{hc}{\lambda} = W_o + E_{k(max)}$ $\frac{(6{,}63\times10^{-34})(3\times10^{8})}{400\times10^{-9}}$ ✓ ✓ $= 3{,}978 \times 10^{-19} + E_{k(max)}$ $E_{k(max)} = 9{,}95 \times 10^{-20}$ J ✓ **Range/** *aanvaar***:** $9{,}93 \times 10^{-20}$ J to $9{,}95 \times 10^{-20}$ J	$f = \frac{c}{\lambda}$ $= \frac{3\times10^{8}}{400\times10^{-9}}$ ✓ $= 7{,}5\times10^{14}$ Hz $E = hf$ $= (6{,}63\times10^{-34})(7{,}5\times10^{14})$ ✓ $= 4{,}97\times10^{-19}$ J $E = W_o + E_{k(max)}$ ✓ $4{,}97 \times 10^{-19} = 3{,}98 \times 10^{-19} + E_{k(max)}$ ✓ $E_{k(max)} = 9{,}93 \times 10^{-20}$ J ✓

(5)

[14]

***QUESTION / VRAAG* 11**

11.1 The energy transferred to / work done on ✓ each coulomb (of charge) / per C charge ✓ passing through the battery.

Die lading oorgedra / arbeid verrig op✓ elke coulomb (lading) / per C lading ✓ wat deur die battery beweeg. (2)

11.2 Gradient/*helling* = $\frac{3,8 - 0,5}{9 - 0}$ ✓ ✓ = 0,37 (V^{-1})

Note/*Aantekening*:
- Accept any correct values from graph to calculate the gradient.
- *Aanvaar enige korrekte waarde vanaf grafiek om helling te bereken.*

(3)

11.3 $\frac{1}{\text{emf}}$ ✓ (1)

11.4 11.4.1 **POSITIVE MARKING FROM QUESTION *11.2* / *POSITIEWE NASIEN VAN VRAAG 11.2.***

OPTION /OPSIE 1	**OPTION / OPSIE 2**
$\frac{1}{\text{emf}}$ = 0,37 ✓ ε (emf) = 2,70 V ✓ **Range/*Aanvaar*:** 2,67 – 2,70 V	emf = 2(0) + 2r emf = 0,26(9) + 0,26r 0 = - 2,34 + 1,74r r = 1,34 Ω ε = 2(0) + 2r = 2(1,34) = 2,67 V ✓

(2)

11.4.2 **POSITIVE MARKING FROM QUESTION 11.2 AND 11.3.1 / *POSITIEWE NASIEN VAN* VRAAG 11.2 EN 11.3.1.**

OPTION / OPSIE 1	**OPTION / OPSIE 2**
Emf = I(R + r) y = mx + c: $\frac{1}{I} = \frac{1}{\text{emf}}R + \frac{r}{\text{emf}}$ y intercept / afsnit = $\frac{r}{\text{emf}}$ 0,5 ✓ = $\frac{r}{2,70}$ ✓ R = 1,35 Ω ✓ Range/ *aanvaar*: 1,34 - 1,35 Ω	Any two equation using values from the graph/ *Enige twee vergelykings waar waardes van grafiek gebruik is*: emf = 2(0) + 2r ✓ emf = 0,26(9) + 0,26r ✓ 0 = - 2,34 + 1,74r r = 1,34 Ω ✓

(3)

[11]

GRAND TOTAL: 150