LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

NATIONAL SENIOR CERTIFICATE/ *NASIONALE SENIOR SERTIFIKAAT*

GRADE/*GRAAD* 12

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

SEPTEMBER 2017

MARKS/*PUNTE*: 150

This memorandum consists of 19 pages.
Hierdie memorandum bestaan uit 19 bladsye.

QUESTION 1 // *VRAAG 1*

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

[20]

QUESTION 2 // *VRAAG 2*

2.1 The force that opposes the motion of a moving object relative to a surface. ✓✓ // (2)
Die krag wat die beweging van 'n bewegende voorwerp relatief tot 'n oppervlak teenstaan

2.2 It is a ratio of two forces. ✓/It is a quotient of two force magnitudes. ✓ // (1)
Dit is die verhouding van 2 kragte

2.3 $\mathbf{F}_{net}$ = 0 N. ✓ (1)

2.4 A body will remain in the state of rest or motion at constant velocity✓ unless a (non-zero) resultant/net force✓acts on its. //
'n *Voorwerp bly in 'n toestand van rus of beweging teen konstante snelheid behalwe as 'n (nie-nul) resultante/netto krag daarop inwerk*

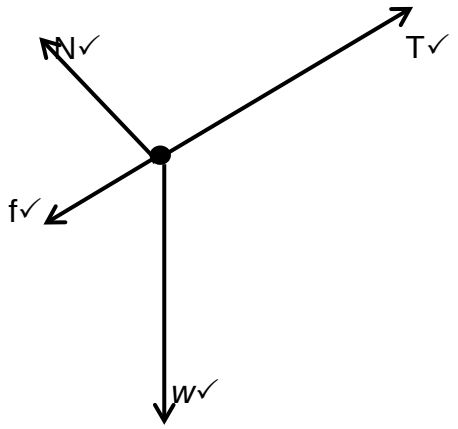
OR //***OF***

Everybody continues in its state of rest or of uniform motion in a straight line✓ unless a (non-zero) resultant/net force✓ acts on its.

OR//*OF*

An object at rest remains at rest or a moving object continues to move with constant velocity✓ if there is zero net force ✓ acting on it. (2)

2.5

Accept labels *// aanvaar byskrifte*	
w	F_g/ weight/ mg/ Gravitational force //*gewig / gravitasiekrag*
T	F_T/ tension //*spanning*
f	F_f/ friction/ frictional force // *wrywing /wrywingskrag*
N	F_N/ F_{normal}/ normal force/ $F_{surface\ on\ block}$/ *normaalkrag / F oppervlak*
	

(4)

Notes: *// NOTAS*

· mark awarded for label and arrow // *punt vir byskrif en pyl*

- Do not penalise for length of arrow //
  moenie penaliseer vir lengte van pyl
- Any other additional force(s): minus one (-1) //
  addisionele kragte -1
- if force(s) do not make contact with body: minus one (-1) //
  Indien nie kontak met kolletjie -1
- if no arrows indicated // *geen pyl* 0/4
- if no labels indicated // *geen byskrifte* 0/4

2.6

$\Sigma F_y = ma$ (perpendicular to the incline)

$N+(-mg\cos\theta) = 0$✓

$\therefore$ $N-(50)(9.8)(8/10)$ ✓$= 0$

$\therefore$ $N = 392N$

$\Sigma F_x = ma$✓ (along the incline)

$\therefore T+ (-w_{II}) + (-f_k) = 0$

$\therefore T- mg\sin\theta- \mu_k \cdot N = 0$

$\therefore T-$ $(50)(9,8)(6/10)$✓$-$ $(07)(392)$✓ $= 0$

$\therefore T - 294 - 374,4 = 0$

$\therefore T – 568,4 = 0$

$\therefore T = 568,4$ N

(6)
[16]

QUESTION 3 *// VRAAG 3*

3.1 $9.8\ m.s^{-2}$✓ (1)

3.2.1

OPTION 1 // *OPSIE 1*:

Upwards positive // *opwaarts as positief*

Consider YZ:

$\triangle y = v_i \triangle t + \frac{1}{2} a(\triangle t)^2$✓

$(-2,0) = v_i (0,125) + \frac{1}{2}(-9,8)(0,125)^2$✓

$-2,0 = v_i (0,125) - 0,077$

$-1,923 = v_i(0,125)$

$\therefore v_i = -15,384\ m{\cdot}s^{-1}$

Consider XY:

$v_f^2 = v_i^2 + 2a \triangle y$

$(-15,3875)^2 = (0)^2 + 2(-9,8) \triangle y$✓

$(-15,3875)^{2-} = (-19, 6) \triangle y$

$\therefore \triangle y = -12,08m$

$\therefore h = 12,08 + 2,0$

$= 14,08\ m$✓

OPTION 2 // *OPSIE 2*:

Downwards positive // *afwaarts as positief*

ConsiderYZ:

$\triangle y = v_i \triangle t + \frac{1}{2} a (\triangle t)^2$✓

$2,0 = v_i (0,125) + \frac{1}{2}(9,8)(0,125)^2$✓

$2,0 = v_i (0,125) + 0,077$

$1,923 = v_i (0,125)$

$\therefore v_i = 15,384\ m{\cdot}5^{-1}$

Consider XY:

$V_f^2 = v_i^2 + 2a \triangle y$

$\underline{(15,384)^2 = (0)^2 + 2(9,8)} \triangle y$✓

$(15,384)^2 = (19,6) \cdot \triangle y$

$\therefore \triangle y = 12,075$ m

$\therefore = 12,075 + 2.0 = 14,075$ m✓

(4)

3.2.2 **<u>OPTION 1 // *OPSIE 1*</u>:**
Upwards positive // *// opwaarts as positief*

$v_f = v_i + a \triangle t$✓

$\underline{-15,384 = 0 + (-9,8)} \triangle t$✓

$-15,384 = (-9,8) \triangle t$

$\therefore \triangle t = 1,57$ s

$\therefore \triangle t_{required} = 157 + 0,125 = 1,695$ s✓

<u>OPTION 2 // *OPSIE 2*</u>:
Downwards positive // *// afwaarts as positief*

$V_f = v_i + a \triangle t$✓

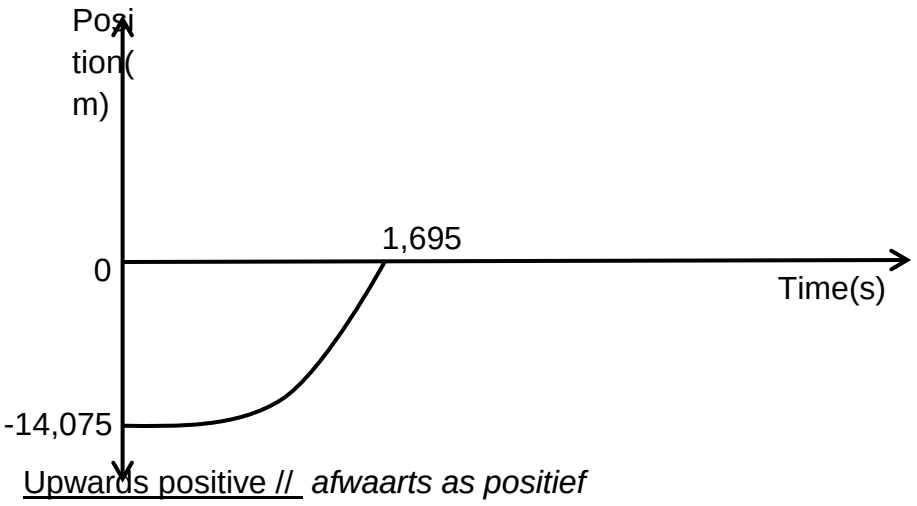
$\underline{15,384 = 0 + (9,8)} \triangle t$✓

$\therefore \triangle t = 1,57$ s

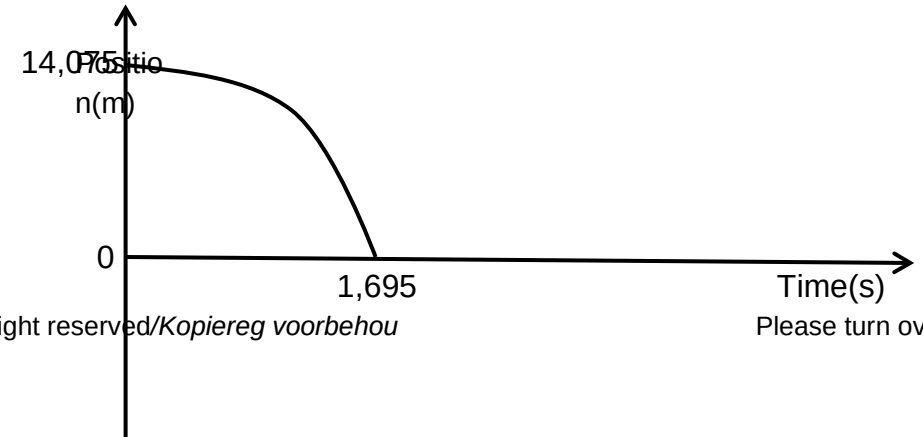
$\therefore \triangle t_{required} = 1,57 + 0,125 = 1,695$ s✓

(3)

3.3 Downwards positive // *opwaarts as positief*



Upwards positive // *afwaarts as positief*



POSITIVE MARKING FROM Q3.2 *// positiewe nasien vanaf V 3.2*:

Notes:

- shape✓ // *vorm*
- value of // *waarde van* 1,695✓
- value of // *waarde van* 14,75✓
- deduct 1 mark if axes are not labeled // *trek 1 punt af indien asse nie benoem nie*

(3)

3.4

θ

Equal to✓ // *gelyk aan*

The ratios of their weights to their masses are equal✓ // *die verhouding van hulle gewigte en massas is gelyk*

OR // OF:

Gravitational acceleration is independent of the mass of the bogy // *Gravitasieversnelling is onafhanklik van die massa van 'n liggaam*

$g = \frac{GMe}{r^2}$

(2)

[13]

QUESTION 4 // *VRAAG 4*

4.1 The product of an object's mass and its velocity.✓✓ // *Produk van die massa en snelheid van 'n voorwerp* (2)

4.2 **OPTION 1 // *OPSIE 1*:**

Take to the right as positive // *neem na regs as positief*

$\Sigma p_i = \Sigma p_f$

$M_T v_{Ti} + m_b v_{bi} = (m_T m_b)\ v_f$✓

$\therefore$ m·(+0,4) + (0,5)(0)✓(0) = (m+0,5)(+0,15)✓

$\therefore (0,4)\cdot m = (0,15)\cdot m + 0,075$

$\therefore m = 0,3$ kg

OPTION 2 // *OPSIE 2*:
Take to the left as positive // *neem na links as positief*

$\Sigma p_i = \Sigma p_f$

$m_T v_{Ti} + m_b v_{bi} = (m_T m_b)\, v_f$

$\therefore m\cdot(+0,4) + (0,5)(0)\checkmark(0) = (m+0,5)(+0,15)\checkmark$

$\therefore (0,4)\cdot m = (0,15)\cdot m + 0,075$

$\therefore (0,25)\cdot m = 0,075$

$\therefore m = 0,3$ kg

$\Sigma k_i = \frac{1}{2} m_T v_T^2 + \frac{1}{2} m_b v_b^2$

$= \frac{1}{2}(0,3)(0,4)^2 + \frac{1}{2}(0,5)(0)^2$

$= 0,024$ J✓

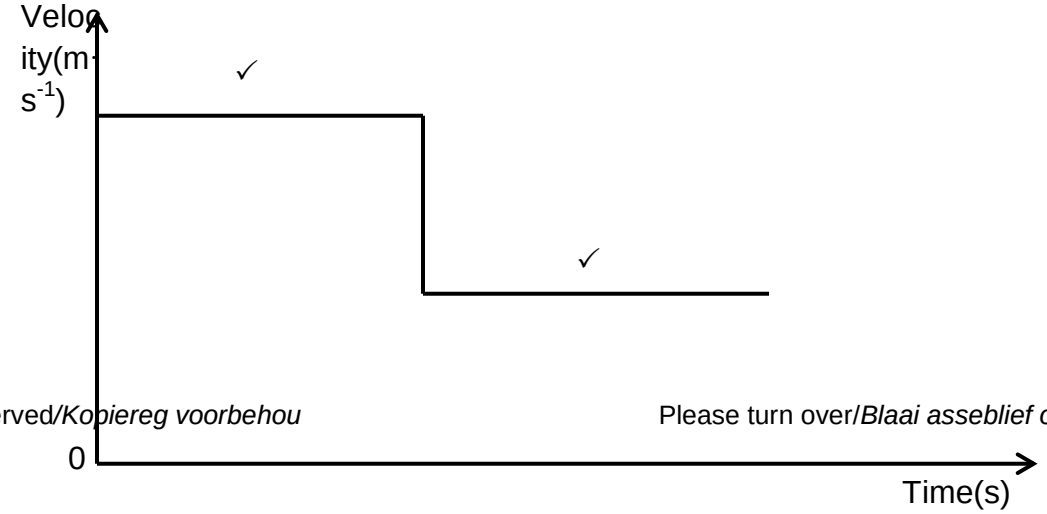
$\Sigma k_f = \frac{1}{2}(m_T + m_b) v_f^2$

$= \frac{1}{2}(0,3 + 0,5)(0,15)^2$

$= 0,009$ J✓

∴ collision is <u>inelastic</u>✓ since kinetic energy is not conserved //
botsing is onelastie omdat kinetiese energie nie behoue bly nie (6)

4.3



Notes // *Notas*:

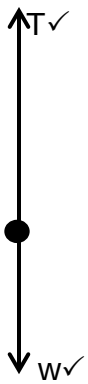
- graph higher before collision than after collision // *grafiek voor botsing hoër as na botsing*
- straight lines // *reguit lyne*

(2)

[10]

QUESTION 5 // *VRAAG 5*

5.1



NB: See Question 2.5 for NOTES and Accepted labels!

LW! *Sien VRAAG 2.5 vir NOTAS en aanvaarbare byskrifte*

(2)

5.2 Gravitational force✓ // *Gravitasiekrag* (1)

5.3 The net/total work done on an object is equal✓ to the change in the object's kinetic energy.✓ // *die netto/totale arbeid op 'n voorwerp verrig is gelyk aan die verandering in die voorwerp se kinetiese energie.*

OR // *OF*:

The work done on an object by a net/resultant force is equal to the change in the object's kinetic energy.// *die arbeid op 'n voorwerp verrig deur 'n netto/resultante krag is gelyk aan die verandering in die voorwerp se kinetiese energie.* (2)

5.4 Take clockwise as positive // *Vat klokgewys as positief*

For block **B** // *vir blok **B**:*

$F_{net} = ma$

$w + (-T)m = ma$

$mg - T = ma$ ✓

$(10)(9,8) - T = 10 \cdot a$ ✓

$98 - T = 10 \cdot a \ldots (1)$

For block **A** //*vir blok **A*** :

$F_{net} = ma$

$\therefore T = (-w) = ma$

$\therefore T - mg = ma$

$\therefore T - (4,0)(9,8) = (4,0) \cdot a$ ✓

$\therefore T - 39,2 = (4,0) \cdot a \ldots (2)$

$\therefore 98 - T = (10)\ a \ldots (1)$

$\therefore -39,2 + T = (4,0)\ a$

$(1) + (2) : 58,8 = (14)\ a$

$\therefore a = 4,2\ m \cdot 5^{-2}$

From (2): $T - 39,2 = (4,0)(4,2$

$\therefore T - 39,2 = 16,8$

$\therefore T = 56\ N$ ✓

$$W_{net} = \triangle k \checkmark$$

$$W_w + W_T = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$$

$$mg \cdot \triangle x \cdot \cos\theta + T \cdot \triangle x \cdot \cos\beta = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$$

$$\underline{(10)(9,8)(4,0)(\cos 0°) + (56)(4,0)(180°)} \checkmark = \underline{\frac{1}{2}(10)v_f^2 - 0} \checkmark$$

$$392 + (-224) = 5v_f^2$$

$$1.68 = 5v_f^2$$

$$\therefore \quad v_f^2 = 33,6$$

$$\therefore \quad v_f = \sqrt{33,6} = 5,797 \text{ m·s}^{-1}$$ (7)

5.5 P**OSITIVE MARKING FROM QUESTION 5.4 /*I positiewe nasien vanaf VRAAG 5.4*:**

$$\triangle t(\mathbf{A}) = \triangle t(\mathbf{B})$$

$$\therefore v_f = v_i + \cdot \triangle t \checkmark$$

$$\underline{5,797 = 0 + (4,2) \cdot} \triangle t \checkmark$$

$$\therefore \triangle t = 1,38 \text{ s} \checkmark$$ (3)

[15]

QUESTION 6/*I VRAAG 6*

6.1 There must be relative motion between observer and source of sound. ✓// (1)
Daar moet relatiewe beweging wees tussen die waarnemer en die klankbron.

6.2

θ

(Towards) **X** ✓

As the car approaches **X**, the wave lengths are shortened/waves are compressed. ✓ for the same speed of sound,✓the frequency increases ✓// *Soos die motor na X beweeg word die golwe saamgepers . Spoed van klank dieselfde so frekwensie neem toe*

OR/*OF*:

Towards **X** ✓// *Na **X***

The source of sound is following after the approaching waves and the crests therefore came closer together.✓for the same

(4)

6.3.1

$$f_{LX}=\left(\frac{v \pm v_L}{V \pm v_s}\right) \quad f_s \checkmark$$

$$538 \checkmark = \left(\frac{340}{340-15}\right) f_s \checkmark$$

$$\therefore f_s = 514{,}265 \text{ Hz} \checkmark$$

(4)

6.3.2

$$f_{LX} = \left(\frac{v \pm v_L}{v \pm v_s}\right) f_s \checkmark$$

$$= \left(\frac{340}{340+15}\right) \checkmark (514{,}265) \checkmark$$

$$= 492{,}535 \text{ Hz} \checkmark$$

(4)

6.4 **ANY ONE /// *ENIGE EEN:***

- To measure rate of blood flow. ✓// *meet spoed van bloedvloei.*
- To measure the heartbeat of foetus. ✓// *meet hartklop van fetus.*

(1)

[14]

QUESTION 7/// *VRAAG 7*

7.1.1 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 een puntlading op 'n ander een 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)

7.1.2 Let the distance from Q_1 be "d" m.

$$F = \frac{k Q_1 Q_2}{r^2} \quad \checkmark$$

$$|F_{Q1 \text{ on } e}| = |F_{Q2 \text{ on } e}|$$

$$\frac{K Q_1 q}{r^2} = \frac{K Q_2 q}{r_1^2} \quad \checkmark$$

$$\frac{Q_1}{r^2} = \frac{Q_2}{r_1^2}$$

$$\frac{1,0 \times 10^{-6}}{d^2} \checkmark = \frac{2,0 \times 10^{-6}}{(0,1 - d)^2} \quad \checkmark$$

$$\frac{(0,1 - d)^2}{d^2} = \frac{2,0 \times 10^{-6}}{1,0 \times 10^{-6}}$$

$$\left(\frac{0,1 - d}{d}\right)^2 = 2$$

$$(1,4142)\, d = 0,1 - d$$

$$(2,4142)\, d = 0,1$$

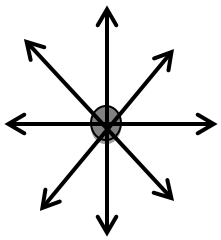
$$d = 0,04142 \text{ m}$$

$$d = 4,142 \text{ cm} \checkmark$$

- Formula // formule
- Equation // *vergelyking*
- Substitution on the LHS // *vervanging aan linkerkant*
- Substitution on the RHS // *vervanging aan regterkant*
- Final answer // *Finale antwoord*

(5)

7.2.1



Marking criteria:

- Direction ✓
- Field lines radially inwards ✓

NB: -1 mark if lines cross or do not touch the dot.

(2)

7.2.2 The electrostatic force.✓ experienced per unit positive charge. ✓ placed at that point. (2)

7.2.3 Assume distance mp=rm

$$E_p = \frac{kQ}{r^2} \quad \checkmark$$

$$\frac{E_p}{E_T} = \frac{kQ}{r_1}$$

$$\frac{4 \times 10^6}{2,5 \times 10^5} \checkmark = \frac{(r+ 0,003)^2}{r^2} \quad \checkmark$$

$$16 = \left(\frac{r + 0,003}{r}\right)^2$$

$$r + 0,003 = 4r$$

$$0,003 = 3r$$

$$\therefore \quad r = 0,001 \text{ m} \checkmark$$

$$r_{MT} = 0,003 + 0,001$$

$$= 0,004 \text{ m}$$

$$E_p = \frac{kQ_M}{r^2}$$

$$4 \times 10^6 = \frac{(9 \times 10^9)\, Q_M}{(0,001)^2} \quad \checkmark$$

$$Q_M = 4,444 \times 10^{-10} \text{ C} \quad \checkmark$$

OR

$$E_T = \frac{KQ_M}{r^2}$$

$$2,5 \times 10^5 = \frac{9 \times 10^9\, Q_M}{(0,004)^2}$$

$$Q_M = 4,444 \times 10^{-10} \text{ C}$$

(6)

[17]

QUESTION 8 // *VRAAG 8*

8.1

Daily cost = number of kW·h x tariff //

Daaglikse koste = getal kWh x tarief

= (0,12)(4)✓(261/180)✓

= R 0,696

Monthly cost = daily cost x number of days //
Maandelikse koste = daaglikse koste x aantal dae

= 0,696 x 30.✓

= R 20, 88 ✓

OR //OF:

Monthly cost = daily cost x number of days //

(4)

8.2.1 The maximum electrical energy ✓ that a battery can supply per unit charge.✓ // *Maksimum elektriese energie wat 'n battery per eenheidlading kan verskaf*

OR //OF:

The energy transferred ✓ to every coulomb of charge ✓ passing through the battery. // *die energie oorgedra aan elke coulmb lading wat deur die battery beweeg* (2)

8.2.2 $P = 2(12) = 24\ V$ ✓ (1)

8.2.3

$R = \frac{V}{I}$ ✓

$9,6 = \frac{21,6\ ✓}{I}$

$I = 2,25\ A$ ✓

Marking criteria //*nasienriglyne*

- Formula ✓ // *formule*
- Substitutions ✓ // *vervangings*
- Answer ✓ // *antwoord*

(3)

8.2.4 **POSITIVE MARKING FROM QUESTION 8.2.2 + 8.2.3 //**
POSITIEWE NASIEN VANAF VRAAG 8.2.2 + 8.2.3

$V_{lost} = Ir$

$\therefore$ 24 – 21,6 ✓ = (2,25) · r ✓

$\therefore 2,4 = (2,25)\ .\ r$

$\therefore r = 1,067\ \Omega$ ✓

Marking criteria://*nasienkriteria*

- finding volt ✓ // *kry volts*
- Substitution for I ✓// *vervang vir I*
- Final answer ✓// *finale antwoord*

(3)

8.2.5 $E = IR + Ir$ ✓

$$\underline{24 = 8R + 8\,(1,067)}\ \checkmark$$

$$15,464 = 8 \cdot R$$

$$\therefore R = 1,933\ \Omega$$

$$1,933 = \frac{(9,6)(2R_L)}{9,6 + 2R_L}\ \checkmark$$

$$1,933(9,6 + 2R_L) = (19,2)\,R_L$$

$$18,5568 + 3,866\,R_L = (19,2)\,R_L$$

$$\therefore 18,5568 = (15,334)\,R_L$$

$$\therefore R_L = 1,21\ \Omega\ \checkmark$$

OR: $\frac{1}{1,933} = \frac{1}{9,6} + \frac{1}{2R_L}$

(4)

8.2.6

θ

Increases ✓ // *neem toe*

The total resistance of the circuit increases. ✓//

totale weerstand neem toe

Thus, the current in the circuit decreases, resulting in the decrease in the lost volts (due to internal voltage).✓// *Stroom neem af, dus neem verlore volts af*

(3)
[20]

QUESTION 9 // *VRAAG 9*

9.1.1 Slip rings ✓ // *sleepringe* (1)

9.1.2 Connects the external circuit to commutator/slip rings✓// (1)
verbind eksterne stroombaan met die kommutator/sleepringe.

9.2 An alternating current is generated.✓// (1)
'n Wisselstroom word opgewek.

9.3 Electrical energy to mechanical/kinetic energy ✓ // (1)
Elektriese energie na mechaniese energie

9.4 What is the relationship between the speed of rotation of the armature and the current induced in an alternator? ✓✓ //
Wat is die verhouding tussen die spoed van rotasie en die stroom wat geïnduseer word? (2)

OR // OF:
Any question with correct <u>dependent</u> and <u>independent</u> variables!
Enige vraag wat die korrekte afhanklike en onafhanklike veranderlikes het

9.5 The faster the armature is rotated in the magnetic field, the higher the induced current.✓ // (1)
Hoe vinniger die lus/klos/windings in die magneetveld gedraai word, hoe groter is die geïnduseerde stroom

9.6 Electromagnetic induction ✓ // *elektromagnetiese induksie* (1)

9.7

$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$
$$= 0{,}35/\sqrt{2} \checkmark$$
$$= o{,}25 \text{ A}$$

$P_{ave} = V_{rms}I_{rms}$ ✓

$1{,}5 = V_{rms}(0.25)$ ✓

$V_{rms} = 6$ V ✓ (4)
[12]

QUESTION 10 // *VRAAG 10*

10.1 Frequency ✓ // *frekwensie* (1)

10.2 Threshold frequency ✓ // *drumpelfrekwensie*

Accept: Cut-off frequency //*aanvaar: afsnyfrekwensie* (1)

10.3 The <u>minimum energy</u>✓ that an electron in the metal needs to be <u>emitted/ejected from the metal surface</u>.✓ //
die minimum energie wat 'n electron in 'n metal benodig om vrygestel te word vanaf die metaaloppervlak
<u>OR//OF</u>:
The minimum energy required by light photons that will cause metal surface electrons to be set free once the light shines upon the metal. //

Die minimum energie wat ligfotone moet hê om elektrone vanaf die metaaloppervlak vry te stel as lig daarop val. (2)

OR // OF:

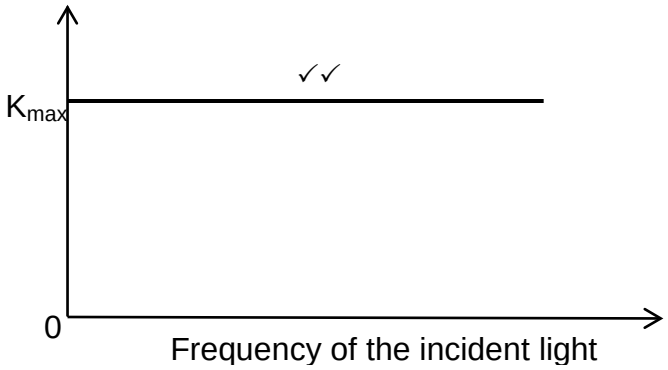
The minimum amount of energy required for the ejection of an electron from the surface of a metal. //
Die minimum energie benodig vir die vrystel van 'n elektron vanaf die oppervlak van 'n metal.

10.4 $E = W_o + K_{max}$ / $hf_1 = W_o + K_{max}$ ✓ Any one // *enige een*

$(6{,}63 \times 10^{-34})f_1 = 6{,}08634 \times 10^{-19} + 3{,}66 \times 10^{-19}$ ✓

$\therefore f_1 = 1{,}47 \times 10^{15}$ Hz ✓ (3)

10.5



(2)

10.6 No ✓ // *Nee*
The photoelectron will have less energy than the blue light ✓. A certain amount of the energy of the blue light is required/needed to liberate the electron ✓ ($W_o = hf_o$). Only part of the energy is left ✓to be transferred to the photoelectron as kinetic energy ($\frac{1}{2}mv^2$). $\therefore E = W_o + K_{max}$ //
Die fotoelektron sal minder energie hê as die blou lig. 'n Sekere gedeelte van die blou lig word benodig om die elektron vry te stel. Slegs 'n gedeelte van die energie sal oorwees om aan die fotoelektron (4)

oor te dra as kinetiese energie

[13]

GRAND TOTAL: 150