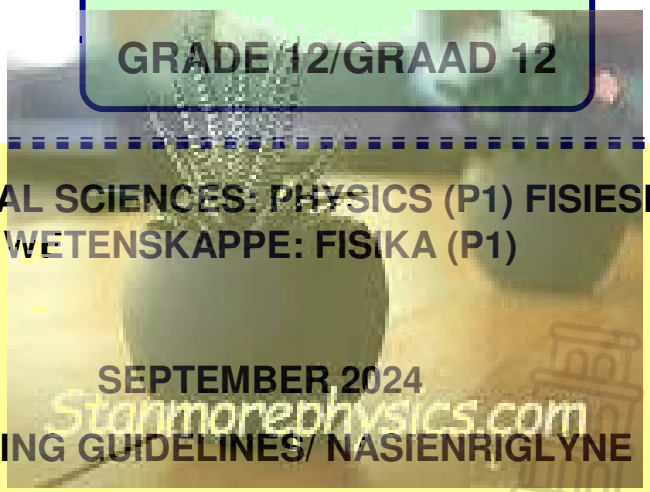
LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE

NASIONALE SENIOR SERTIFIKAAT

GRADE 12/GRAAD 12



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

SEPTEMBER 2024

MARKING GUIDELINES/ NASIENRIGLYNE

MARKS/PUNTE: 150

These marking guidelines consist of 14 pages./

Hierdie nasienriglyne bestaan uit 14 bladsye.

QUESTION 1/ VRAAG 1

1.1 D ✓✓ (2)

1.2 A ✓✓ (2)

1.3 D ✓✓ (2)

1.4 D ✓✓ (2)

1.5 C ✓✓ (2)

1.6 A ✓✓ (2)

1.7 C ✓✓ (2)

1.8 A ✓✓ (2)

1.9 B ✓✓ (2)

1.10 B ✓✓ (2)

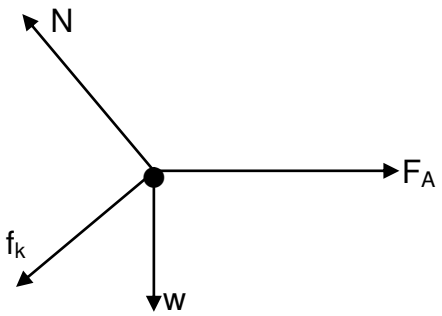
[20]

QUESTION 2/ *VRAAG 2*

2.1.1 It is a ratio of the magnitude of two forces.✓ (1)
Dit is 'n verhouding van die grootte van twee kragte.

2.1.2 A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it.✓✓ (2)
'n Liggaam sal in sy toestand van rus of beweging teen 'n konstante snelheid volhard, tensy 'n nie-nul resulterende/netto krag daarop inwerk

2.1.3



Accepted labels	
N✓	Normal force/ F_N/$F_{surface\ on\ crate}$ *Normaal krag/F_N /$F_{\ oppervlakte\ op\ krat}$*
F_k✓	Frictional force /kinetic frictional force/f *Wrywingskrag /kinetiese wrywingskrag/f*
F_A✓	Applied force/$F_{applied}$/F *Toegepaste krag/$F_{toegepas}$/F*
w✓	F_g/mg/weight/gravitational force/ $F_{Earth\ on\ crate}$/3333,2 N *F_g/mg/gewig/gravitasiekrag/* *$F_{aarde\ op\ krat}$/3333,2 N*

Notes/Aantekeninge:
- Mark is awarded for label and arrow/
  Punt word toegeken vir benoeming en pyl.
- Do not penalize for length of arrows/
  Moenie penaliseer vir lengte van pyle nie
- Deduct 1 mark for any additional force/
  Trek 1 punt af vir enige bykomende krag
- If force(s) do not make contact with dot/body: 3/4/
  Indien krag(te) nie kontak maak met kol/voorwerp nie: 3/4
- If arrows missing: 3/4 /*As pyle ontbreek: 3/4*

(4)

2.1.4

$f_k = \mu_k N$

$f_k = \mu_k (mg\cos\theta + F_A\sin\theta)$

Any one/ *Enige een* ✓

$= 0,25$✓$[(34)(9,8)(\cos 25)+F\sin 25^\circ]$✓
$= 75,495 + 106 \cdot F$

(3)

2.1.5

$F_{net} = 0$ ACCEPT: $F_{net} = ma$ Any one/ *Enige een* ✓

$F\cos25^\circ - f_k - mg\sin25^\circ = 0$

$F\cos25^\circ - 75{,}495 - 0{,}106 \cdot F - (34)(9{,}8)(\sin25^\circ)$ ✓$= 0$

$F(0{,}800307787) = 216{,}3114048$

$F = 270{,}2853$ N✓ (3)

2.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 1***
$F_{net} = F_g$ $ma = \frac{GmM}{r^2}$ $a = \frac{GM}{r^2}$ $a = \frac{(6{,}67 \times 10^{-11})(5{,}98 \times 10^{24})}{(6{,}38 \times 10^{6} + 1000 \times 10^{3})^2}$ ✓ $a = 7{,}32$ m·s^{-1} towards the Earth/ *na die Aarde toe*. $\frac{a_{E/A}}{a_s} = \frac{9{,}8}{7{,}32}$✓ $= 1{,}338797814$ $w_{E/A} = (3\,600)(1{,}338797814)$✓ $= 4819{,}67$ N ✓downwards *afwaarts* Stanmorephysics.com	$F_{net} = F_g$ $ma = \frac{GmM}{r^2}$ $a = \frac{GM}{r^2}$ $a = \frac{(6{,}67 \times 10^{-11})(5{,}98 \times 10^{24})}{(6{,}38 \times 10^{6} + 1000 \times 10^{3})^2}$ ✓ $a = 7{,}32$ m·s^{-1} towards the Earth. *na die Aarde toe* $\mathbf{w}_{1000\ km} = mg$ $3\,600 = m(7{,}32)$ $m = 491{,}80$ kg $w_{E/A} = mg$✓ $=(491{,}80)(9{,}8)$✓ $= 4819{,}67$ N ✓downwards *afwaarts*

(4)

[17]

QUESTION 3/ VRAAG 3

3.1 Motion during which the only force acting on an object is the gravitational force.✓✓ (2)
Beweging waartydens die enigste krag wat op 'n voorwerp inwerk, die gravitasiekrag is.

3.2 9,8 $m \cdot s^{-2}$✓ downwards/*afwaarts*✓ (2)

3.3

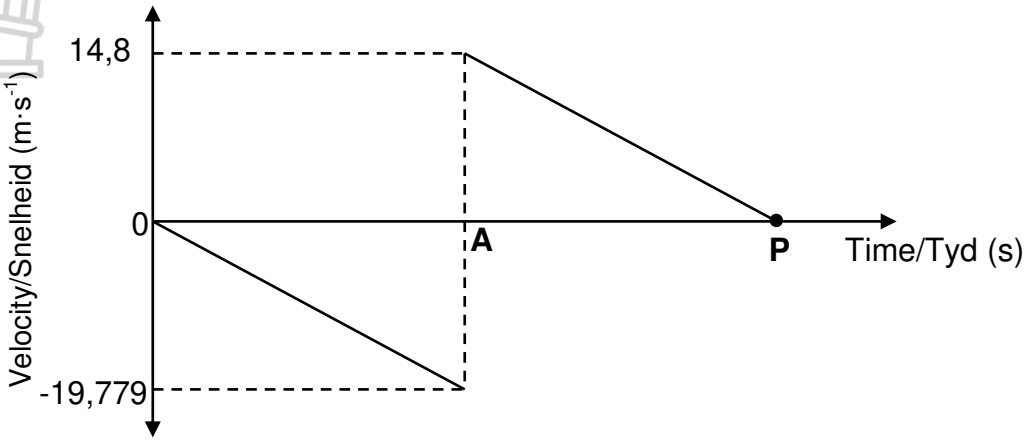
UPWARDS AS POSITIVE DIRECTION ***OPWAARTS AS POSITIEF***	**DOWNWARDS AS POSITIVE** ***AFWAARTS AS POSITIEF***
$v_f^2 = v_i^2 + 2a\Delta y$ $= (0)^2 + 2(-9,8)(-20)$ ✓ $= 392$ $v_f = -19,799\ m \cdot s^{-1}$ $(-14\sqrt{2}\ m \cdot s^{-1})$ $v_i = \frac{3}{4}(+14\sqrt{2})$✓ $= +14,8492\ m \cdot s^{-1}$ $v_f = v_i + a\Delta t$ ✓ $0 = 14,8492 + (-9,8)\Delta t$✓ $\Delta t = 1,51522449$ s $\Delta t_{AB} = 2(1,51522449)$ ✓ $= 3,03045$ s✓	$v_f^2 = v_i^2 + 2a\Delta y$ $= (0)^2 + 2(+9,8)(+20)$ ✓ $= 392$ $v_f = 19,799\ m \cdot s^{-1}$ $(14\sqrt{2}\ m \cdot s^{-1})$ $v_i = \frac{3}{4}(-14\sqrt{2})$ ✓ $= -14,8492\ m \cdot s^{-1}$ $v_f = v_i + a\Delta t$ ✓ $0 = -14,8492 + (9,8)\Delta t$✓ $\Delta t = 1,51522449$ s $\Delta t_{AB} = 2(1,51522449)$ ✓ $= 3,03045$ s✓

(6)

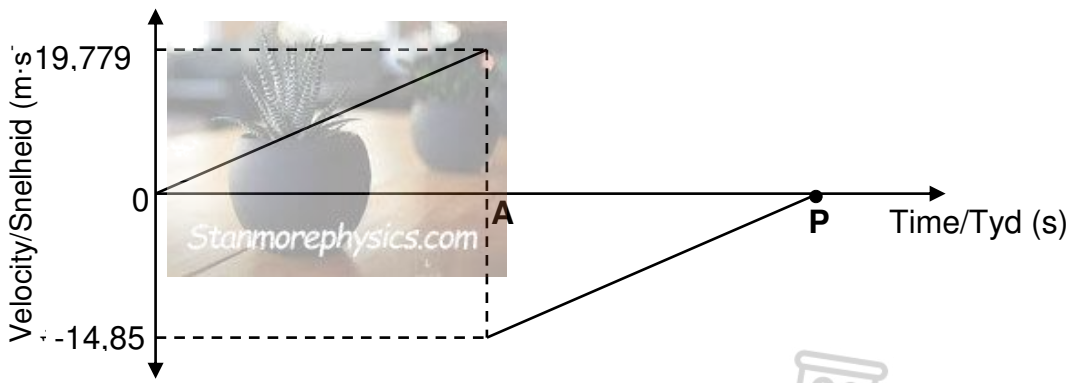
3.4

POSITIVE MARKING FROM QUESTION 3.3
POSITIEWE NASIEN VANAF VRAAG 3.3

Upwards as the positive direction/*Opwaarts as positief:*



Downwards as the positive direction/*Afwaarts as positief*:



Marking Criteria/ *Nasienkriteria*	**Marks/ *Punte***
Straight line graph from 0 to 12,799 or -19,799 m·s^{-1} *Reguitlyngrafiek van 0 tot 12 799 of -19 799 m·s^{-1}*	✓
Times A and P correctly shown *Tyd A en P korrek aangedui*	✓
Straight line graph starting from A (14,85 or -14,85 m·s^{-1}) to P *Reguitlyngrafiek begin by A (14,85 of -14,85 m·s^{-1}) tot P*	✓

(3)

[13]

QUESTION 4/ *VRAAG 4*

4.1 The product of an object's mass and its velocity. ✓✓ (2)
Die produk van 'n voorwerp se massa en sy snelheid.

4.2

Upwards as positive/ ***Opwaarts as positief***	**Downwards as positive/** ***Afwaarts as positief***
$v_f^2 = v_i^2 + 2a\Delta y$✓	$v_f^2 = v_i^2 + 2a\Delta y$✓
$(0)^2 = v_i^2 + 2(-9,8)(+13,7)$ ✓	$(0)^2 = v_i^2 + 2(9,8)(-13,7)$ ✓
$v_i^2 = 268,52$	$v_i^2 = 268,52$
$v_i = \pm 16,39\ m\cdot s^{-1}$	$v_i = \pm 16,39\ m\cdot s^{-1}$
$v_i = 16,39\ m\cdot s^{-1}$ ✓ (upwards) *(opwaarts)*	$v_i = 16,39\ m\cdot s^{-1}$ ✓ (upwards) *(opwaarts)*

(3)

4.3 The total linear momentum of an isolated system remains constant (is conserved). ✓✓ (2)
Die totale lineêre momentum van 'n geïsoleerde sisteem bly konstant (behoue).

4.4

Upwards as positive/ ***Opwaarts as positief***	**Downwards as positive/** ***Afwaarts as positief***
$\sum p_i = \sum p_f$	$\sum p_i = \sum p_f$
$(m + m)v_i = m_1V_{1_f} + m_2V_{2_f}$ Any one/ *Enige een* ✓	$(m + m)v_i = m_1V_{1_f} + m_2V_{2_f}$ Any one/ *Enige een* ✓
$(2m)v_i = m_1V_{1_f} + m_2V_{2_f}$	$(2m)v_i = m_1V_{1_f} + m_2V_{2_f}$
$\underline{2m)(-9,2)}$ ✓$= \underline{(m)(16,39) + mV_{2_f}}$✓	$\underline{(2m)(9,2)}$ ✓$= \underline{(m)(-16,39) + mV_{2_f}}$✓
$(2)(-9,2) = 16,39 + V_{2_f}$	$(2)(9,2) = 16,39 + V_{2_f}$
$V_{2_f} = -18,4 - 16,39$	$V_{2_f} = 34,79\ m\cdot s^{-1}$✓
$V_{2_f} = -34,79\ m\cdot s^{-1}$	The velocity is $34,79\ m\cdot s^{-1}$
The velocity is $34,79\ m\cdot s^{-1}$✓	The magnitude of the velocity is $34,79\ m\cdot s^{-1}$/
The magnitude of the velocity is $34,79\ m\cdot s^{-1}$/	*Die snelheid is 34,79m·s^{-1}*✓
Die snelheid is 34,79m·s^{-1}✓	*Die grootte van die snelheid is 34,79 m·s^{-1}*
Die grootte van die snelheid is 34,79 m·s^{-1}	

(4)
[11]

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QUESTION 5/ VRAAG 5

5.1 Non – conservative✓ *Nie-konserwatief* (1)

5.2 The rate at which work is done.✓✓
Die tempo waarteen arbeid verrig word.

OR/OF: The rate at which energy is expended/transferred./✓✓
Die tempo waarteen energie verbruik/oorgedra word. (2)

5.3

OPTION 1/*OPSIE 1*:

$W_{nc} = \Delta E_k + \Delta E_p$
$W_{engine/enjin} + W_f = \Delta E_k + \Delta E_p$
} Any one/ *Enige een* ✓

$W_{engine/enjin} + f\cdot\Delta x\cdot\cos\theta = \frac{1}{2}m\left(v_f^2 - v_i^2\right) + mg(h_f - h_i)$

$W_{engine/enjin} + (3{,}84\text{x}10^4)(480)(\cos 180^\circ) = \frac{1}{2}(6000)(11^2 - 0^2) + (6000)(9{,}8)(0 - 55)$✓

$W_{engine/enjin} - 18432000 = 363000 - 3234000$

$W_{engine/enjin} = 15561000$ J

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

$= \frac{15561000}{86}$✓

$= 176829, 5455$ W✓

OPTION 2:

$W_{nc} = \Delta E_k + \Delta E_p$
$W_N + W_w + W_{f_k} + W_{engine/enjin} = \frac{1}{2}m\left(v_f^2 - v_i^2\right)$
} Any one/ *Enige een* ✓

$0 + (mg\sin\theta)\Delta x\cdot\cos\beta + f_k\Delta x\cos\theta + W_{engine/enjin} = \frac{1}{2}m\left(v_f^2 - v_i^2\right)$

$(6000)(9{,}8)\left(\frac{55}{480}\right)(480)(\cos 0^\circ) + (3{,}84\text{x}10^4)(480)(\cos 180^\circ) + W_{engine} = \frac{1}{2}(6000)(11^2 - 0^2)$✓

$3234000 - 18432000 + W_{engine/enjin} = 363000$

$W_{engine/enjin} = 15561000$ J

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

$= \frac{15561000}{86}$✓

$= 176829, 5455$ W✓

(6)

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5.4

$f_k = 0{,}35 \cdot w$
$= (0{,}35)(6000)(9{,}8)$
$= 20580$ N

$W_{net} = \Delta E_k$
$= W_{f_k} = \frac{1}{2}m\left(v_f^2 - v_i^2\right)$ } Any one/ *Enige een* ✓

$(20\,580)\Delta x\cos 180° ✓ = \frac{1}{2}(6000)(11^2 - 0^2)$ ✓

$(20\,580)\Delta x = -363000$

$\Delta x = 17{,}6385$ m

Therefore the bed will stop the truck since 17,6385 m < 20 m/✓
Daarom sal die bedding die vragmotor stop omdat 17,6385 m < 20 m

(4)

[13]

QUESTION 6/ *VRAAG 6*

6.1.1

Marking criteria/Nasienkriteria
If any of the underlined key words/phrases in the correct context is omitted deduct 1 mark.
Indien enige van die onderstreepte sleutelwoorde/frases in die korrekte konteks weggelaat word, trek 1 punt af.

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. ✓✓

(2)

Die (skynbare) 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:

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/bespeurde frekwensie/toonhoogte/golflengte, as gevolg van die relatiewe beweging tussen 'n bron en 'n waarnemer (luisteraar)

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6.1.2

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

f_L (approaching/*naderend*) $= \left(\frac{340}{340 - 40{,}0}\right)(320)$ ✓

……= 362,6667 Hz

(4)

6.1.3

$v = f\lambda$✓

$340 = (362{,}6667)\,\lambda$✓

$\lambda = 0{,}937$ m✓

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(3)

6.2

$$f_L = \left(\frac{v \pm v_L}{v \pm v_s}\right) f_s$$

$0{,}9\, f_s$ ✓$= \left(\frac{340 - v_L}{343}\right) f_s$ ✓

$308{,}7 = 343 - v_L$

$v_L = 34{,}3\ m \cdot s^{-1}$

$v_f^2 = v_i^2 + 2a\Delta x$✓

$(34{,}3)^2$ ✓$= (0)^2 + 2(2{,}81)\,\Delta x$✓

$x = 209{,}34$ m

(5)

[14]

QUESTION 7/ *VRAAG 7*

7.1.1 The electrostatic force experienced per unit positive charge placed at that point. ✓✓ (2)
Die elektrostatiese krag wat per eenheidpositiewe-lading by daardie punt geplaas, ondervind word.

7.1.2

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

$$9 \times 10^{-3} \checkmark = \frac{(9 \times 10^9)Q_1Q_2}{(0,02)^2} \checkmark$$

$$9 \times 10^{-3} = \frac{(9 \times 10^9)(2Q_1)(Q_2)}{(0,02)^2}$$

$Q_2 = 1,414 \times 10^{-8}$ C
$Q_1 = 2(1,414 \times 10^{-8}$ C)
$= 2,828 \times 10^{-8}$ C

$$E = \frac{KQ}{r^2} \checkmark$$

$$E_{net} = E_{Q_1} + E_{Q_2}$$

$$= \frac{(9 \times 10^9)(2,828 \times 10^{-8})}{(0,04)^2} \checkmark + \frac{(9 \times 10^9)(1,414 \times 10^{-8})}{(0,02)^2} \checkmark$$

$= 159075 + 31815$
$= 477225$ N·C^{-1} ✓ (EAST/OOS) (7)

7.2.1 The magnitude of the electrostatic force exerted by one stationary point charge (Q_1) on another stationary 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. ✓✓ (2)
Die grootte van die elektrostatiese krag wat een puntlading (Q_1) op 'n ander puntlading (Q_2) uitgeoefen , is direk eweredig aan die produk van die groottes van die ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle.

7.2.2

$$n = \frac{Q}{q_e}$$

$$= \frac{-1,0 \times 10^{-6}}{-1,6 \times 10^{-19}} \checkmark$$

$= 6,25 \times 10^{-12}$ electrons/*elektrone* ✓ (2)

7.2.3

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

$$45{,}0\checkmark = \frac{(9 \times 10^9)Q_1Q_2}{(2{,}0 \times 10^{-2})^2}\checkmark$$

$$(45{,}0)(2{,}0 \times 10^{-2})^2 = (9 \times 10^9)Q_2$$

$$Q = 1{,}41421 \times 10^{-6}\ C$$

$\Delta Q = Q_f - Q_i$

$= 1{,}41421 \times 10^{-6} - 1{,}0 \times 10^{-6}\checkmark$

$\Delta Q = 4{,}1421 \times 10^{-6}\ C$

$$n = \frac{Q}{q_e}$$

$$n = \frac{Q}{e}\checkmark$$

$$= \frac{4{,}142 \times 10^{-6}}{1{,}6 \times 10^{-19}}\checkmark$$

$= 2{,}59 \times 10^{12}$ electrons/*elektrone*.

(6)
[19

QUESTION 8/ *VRAAG 8*

8.1 The maximum energy provided by a battery per unit charge passing through it. ✓✓ (2)
Die maksimum energie wat 'n battery lewer per eenheidslading wat daardeur vloei.

8.2.1

$V_2 = 3V_1 = 3V$

$V_{10\Omega} = 3V - V$

$= 2V$

$I_{R_1} = I_{10\Omega}\checkmark$

$$\frac{V}{R_1} = \frac{2V}{10}\checkmark$$

$R_1 = 5\Omega\checkmark$

(3)

8.2.2

$A_1 = 2A_2$
$I_{R_1} = A_2$✓ $\Rightarrow R_P$ is the same/*is dieselfde*
$R_2 = R_1 + 10$
$= 5 + 10$✓
$= 15\Omega$✓

(3)

8.3.1

$V_2 = 9V$
$V_1 = \frac{9V}{3}$
$= 3V$✓
$\therefore V_{10\Omega} = 9 - 3$✓
$= 6V$✓

(3)

8.3.2

$I_{R_2} = \frac{V}{R}$
$= \frac{9}{15}$✓
$= 0,60$ A

$I_{total\ /\ totaal} = 2(0,60)$ ✓
$= 1,2$ A✓
$= I_{A_1}$

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(3)

8.3.3

$V_{ext} = 9 + (1,2)(9)$ ✓
$= 19,8$ V

$V_{lost} = 20,4 - 19,8$✓
$= 0,6$ V
$R = \frac{0,6}{1,2}$
$= 0,50\ \Omega$✓

(3)
[17]

QUESTION 9/ *VRAAG 9*

9.1 AC (generator) the ends of the coil are attached to *slip rings*✓✓ (2)
WS (generator) die punte van die spoel is aan sleepringe geheg

9.2 From mechanical energy to electrical energy✓ (1)
Van meganiese energie tot elektriese energie

9.3.1 Brushes/*Borsels*✓ (1)

9.3.2 They conduct current from the slip rings to the external circuit.✓ (1)
Hulle gelei stroom vanaf die sleepringe na die eksterne stroombaan

9.4 From X to Y/ *Van X na Y*✓ (1)

9.5.1 O V✓ (1)

9.5.2 The rms current is the alternating current which dissipates/produces the same amount of energy as an equivalent direct current (DC).✓✓ (2)
Die wgk stroom is die wisselstroom wat dieselfde hoeveelheid energie verbruik /oordra as 'n ekwivalente gelykstroom (GS).

9.3

$$V_{rms/wgk/} = \frac{V_{max/maks}}{\sqrt{2}}\checkmark$$

$$= \frac{120}{\sqrt{2}}$$

$$= 60\sqrt{2}$$

$$P_{ave/gem} = I_{rms/wgk}V_{rms/wgk}\checkmark$$

$$= (1,2)(60\sqrt{2})\checkmark$$

$$= 101,8234\ W\checkmark$$

(4)
[13]

QUESTION 10/ *VRAAG 10*

10.1 The process whereby electrons are ejected from a metal surface when light of suitable frequency is incident on that surface. ✓✓ (2)
Die proses waardeur elektrone uit 'n metaaloppervlak vrygestel word wanneer lig van geskikte frekwensie invallend op die oppervlak is.

10.2.1 Intensity (of light) /*Intensiteit (van lig)* ✓ (1)

10.2.2 Type of light/wavelength/frequency /*Tipe lig/golflengte/frekwensie*✓ (1)

10.2.3 What is the relationship between the intensity of light and the current strength (of the cell)? ✓✓
Wat is die verband tussen die intensiteit van lig en die stroomsterkte (van die sel)?

OR/OF: How will the intensity of light influence the current strength of the cell? ✓✓ (2)
Hoe sal die intensiteit van lig die stroomsterkte van die sel beïnvloed?

OR/OF: What influence does the intensity of blue light have on the current strength (of a cell)? ✓✓
Watter invloed het die intensiteit van blou lig op die stroomsterkte (van 'n sel)?

10.3 Greater intensity means/ *Groter intensiteit beteken:*

- More photons irradiate (strikes) the metal surface per unit time. ✓
  Meer fotone bestraal (slaan) die metaaloppervlak per tydseenheid.
- More photoelectrons are emitted/ejected/dislodge per unit time. ✓
  Meer foto-elektrone word per tydseenheid vrygestel. (2)
- Higher rate of flow of electric charge.
  Hoër tempo van vloei van elektriese lading.

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10.4

$E = W_o + E_{k(max/maks)}$

$hf = W_o + E_{k(max/maks)}$ Any one/ *Enige een* ✓

$\frac{hc}{\lambda} = W_o + E_{k(max/maks)}$

$= \frac{(6{,}63 \times 10^{-34})(3 \times 10^{8})}{(470 \times 10^{-9})}$ ✓

$= 2{,}35 \times 10^{-19}\ J + E_{k(max/maks)}$

$\therefore E_{k(max/maks)} = 1{,}882 \times 10^{-19}\ J$ ✓

(3)

10.5 When the frequency of the radiation is less than the threshold frequency of the metal no electrons are emitted. The energy is absorbed and causes the electrons within the metal to jump to higher energy levels. When they drop down again they emit energy in the form of light. ✓✓
Wanneer die frekwensie van die straling minder is as die drempelfrekwensie van die metaal, word geen elektrone vrygestel nie. Die energie word geabsorbeer en veroorsaak dat die elektrone binne die metaal, na hoër energievlakke spring. Wanneer hulle weer afsak, straal hulle energie, in die vorm van lig uit.

(2)
[13]

GRAND TOTAL/*GROOT* TOTAAL: [150]

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