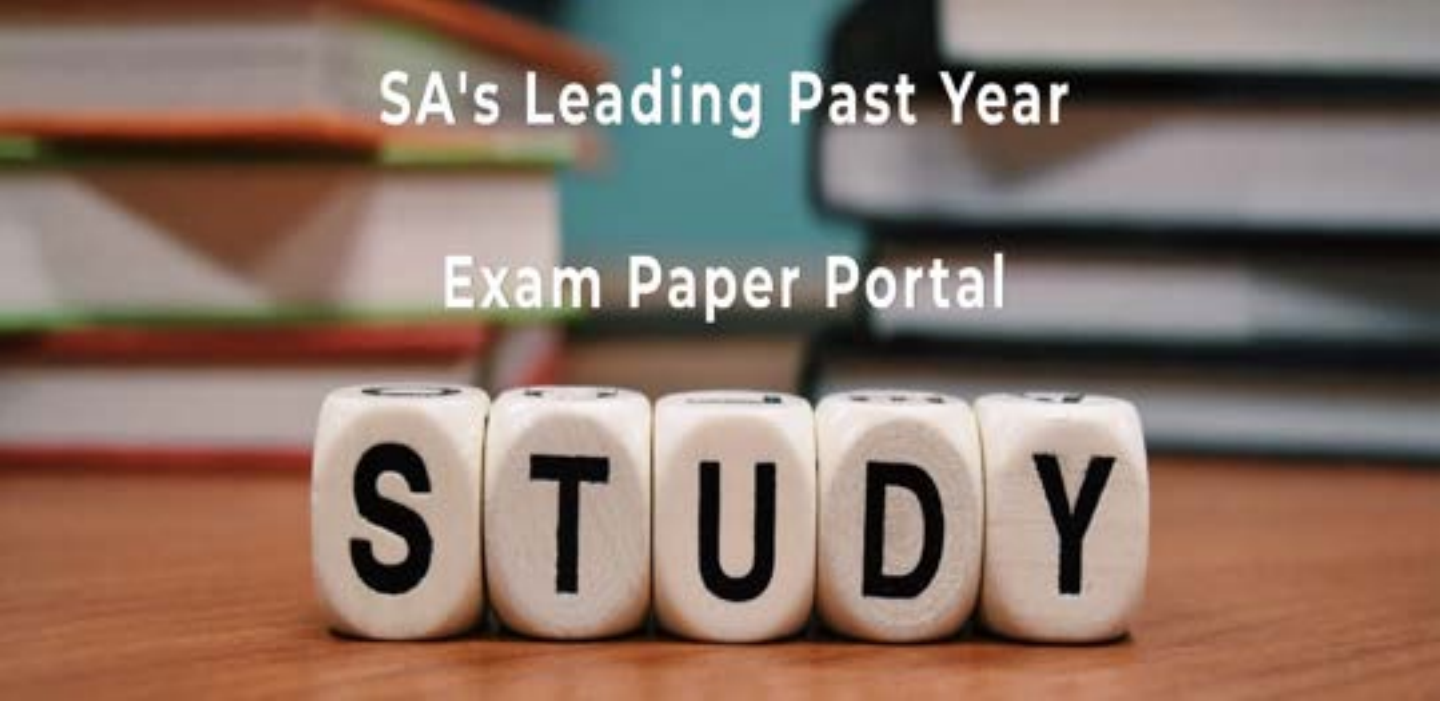

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GRADE/*GRAAD* 12

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

FEBRUARY/MARCH/*FEBRUARIE/MAART* 2018

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consist of 13 pages.
Hierdie nasienriglyne bestaan uit 13 bladsye.

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QUESTION 1/*VRAAG 1*

1.1 A✓✓ (2)

1.2 B✓✓ (2)

1.3 C✓✓ (2)

1.4 B✓✓ (2)

1.5 A✓✓ (2)

1.6 B✓✓ (2)

1.7 C✓✓ (2)

1.8 C✓✓ (2)

1.9 D✓✓ (2)

1.10 B✓✓ (2)

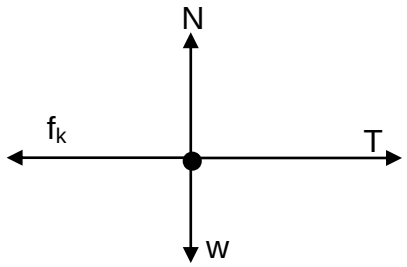
[20]

QUESTION 2/*VRAAG 2*

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

2.2

Accepted labels/*Aanvaarde benoemings*	
w	F_g / F_w/weight / mg / gravitation force *F_g / F_w / gewig / mg / gravitasiekrag*
T	F_T/tension F_s/*spanning*
f_k	(Kinetic) Friction / F_f / 4 N / f / *wrywing* / F_w
N	F_{Normal} / Normal / F_N



(4)

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

2. 3 Object Q/*Voorwerp Q*

$F_{net} = ma$
$F_{net} = 0$ } ✓
$T + (f_k) = ma$
$T - 3$ ✓ $= 0$ ✓
$T = 3$ N

Object P/*Voorwerp Q*
$F_{net} = ma$
$F_{hor} - (f_k + T) = ma$✓
$(F\cos 30^o) - 5 - 3 = 0$ ✓
$F = 9{,}24$ N✓ (9,238 N) (6)

2.4 3 s✓ (1)

2.5 **Y**✓
Graph **Y** represents the motion of Q after the string breaks.
The graph Y shows a decreasing velocity ✓with a negative acceleration. ✓
This is because the net force (friction) acting on Q is in the opposite direction to its motion, ✓ (accept: only frictional force acts on Q).

Grafiek Y verteenwoordig die beweging van Q na die toutjie breek
Die versnelling is negatief vir grafiek Y en toon 'n afnemende snelheid
Dit is omdat wrywing op Q inwerk (4)
[17]

QUESTION 3/*VRAAG 3*

3.1 10 m·s^{-1}✓ (1)

3.2 The gradient represents the acceleration due to gravity (*g) which is constant* for free fall. ✓
Die helling verteenwoordig die versnelling as gevolg van gravitasie (g) wat konstant vir vry-val is.

[The graphs represent free fall/*Die grafieke verteenwoordig vryval*] (1)

3.3.1

POSITIVE MARKING FROM QUESTION 3.1
POSITIEWE NASIEN VANAF VRAAG 3.1

OPTION 1/*OPSIE 1*

$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓ $= (10)(2) + \frac{1}{2}(9,8)(2^2)$ ✓ $= 39,6$ m Height/*Hoogte*= 39,6 m ✓	$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓ $= (-10)(2) + \frac{1}{2}(-9,8)(2^2)$ ✓ $= -39,6$ m Height/*Hoogte* = 39,6 m ✓

OPTION 2/*OPSIE 2*

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

$\Delta x = \left(\frac{10 + 29,6}{2}\right)(2)$ ✓

$\Delta x = 39,6\ m$ ✓

OPTION 3/*OPSIE 3*

$v_f^2 = v_i^2 + 2a\Delta x$ ✓

$(29,6)^2 = (10)^2 + 2(9,8)a\Delta x$ ✓

$\Delta x = 39,6\ m$ ✓

OPTION 4/*OPSIE 4*

Height = Area under the graph
Hoogte = Area onder die grafiek
} Any one/*Enige een*✓

=Area of/*van* ☐+Area of/*van* △
= (10)(2)+(½)(2)(19,6) ✓
= 39,6 m ✓

OPTION 5/*OPSIE 5*

Height = Area of trapezium = *Hoogte = Area van trapesium* ✓
= ½ (10 +29,6) x 2 ✓= 39,6 m ✓

(3)

3.3.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$v_f = v_i + a\Delta t$ ✓ 0 = -25 + (9,8)(Δt) ✓ Δt = 2,55 s Total time T/*Totale tyd* = 8 +2,55 ✓ = 10,55 s ✓	$v_f = v_i + a\Delta t$ ✓ 0 = 25 + (-9,8)(Δt) ✓ Δt = 2,55 s Total time T/*Totale tyd* = 8 +2,55 ✓ = 10,55 s ✓
OPTION 3/*OPSIE 3*	**OPTION 4/*OPSIE 4***
$v_f^2 = v_i^2 + 2a\Delta x$ ✓ $\Delta x = 31{,}89\ m$ $\Delta x = \frac{(v_i + v_f)}{2}\Delta t$ $31{,}89 = \left(\frac{25+0}{2}\right)\Delta t$ ✓ $\Delta t = 2{,}55\ s$ Total time T/*Totale tyd* = 8 +2,55 ✓ = 10,55 s ✓	$\boldsymbol{E_{Mi} = E_{Mf}}$ $\boldsymbol{W_{nc} = 0}$ $\boldsymbol{W_{net} = \Delta E_K}$ ✓ $\boldsymbol{W_{con} = \Delta E_K}$ $\boldsymbol{\Delta E_K + \Delta E_P = 0}$ $\boldsymbol{E_{Ki} + E_{Pi} = E_{Kf} + E_{Pf}}$ $\boldsymbol{\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f}$ $\boldsymbol{\frac{1}{2}(25)^2 + 0 = 0 + 9{,}8h_f}$ $\Delta x = 31{,}89\ m$ $\Delta x = \frac{(v_i + v_f)}{2}\Delta t$ $31{,}89 = \left(\frac{25+0}{2}\right)\Delta t$ ✓ $\Delta t = 2{,}55\ s$ Total time T/*Totale tyd* = 8 +2,55 ✓ = 10,55 s ✓
OPTION 5/*OPSIE 5*	If values of v_i and v_f are swopped around,and a negative time is obtained, give 1 mark for formula and 1 mark for adding calculated time to 8 s, (max 2/4).
Slope of graph = 9,8 ✓ $= \frac{0-(-25)}{T-8}$ ✓ ✓ Total time T/*Totale tyd* = 10,55 s ✓	

(4)

3.4.1 0,2 s✓ (1)

3.4.2 4,955 s✓✓ (2)

3.4.3 - 27 ($m \cdot s^{-1}$) ✓[Must include the negative/*Moet negatief insluit*] (1)

3.5 Inelastic./*Onelasties*✓
The speeds at which it strikes and leaves the ground are not the same/The kinetic energies will not be the same ✓
Die spoed waarmee dit die grond tref en die grond verlaat is nie dieselfde nie./Die kinetiese energieë sal nie dieselfde wees nie (2)
[16]

QUESTION 4/*VRAAG 4*

4.1 The total linear momentum of a closed (isolated) system remains constant (is conserved). ✓✓
Die totale lineêre momentum in 'n geslote sisteem bly konstant (bly behoue)

OR/*OF*
In an isolated system, the total linear momentum before collision is equal to the total linear momentum after collision ✓✓
In 'n geïsoleerde sisteem is die totale lineêre momentum voor botsing gelyk aan die totale lineêre momentum na botsing.
(If key words isolated and total missing -1 mark for each.) (2)

4.2 $\Sigma p_i = \Sigma p_f$
$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$ } Any one/ *Enige een* ✓

For the system cat-skate board **A/***Vir die sisteem kat-skaatsplank*
$\underline{(3,5)(0) + (2,6)(0)}$ ✓ = $\underline{(3,5)v_{skateboard/skaatsplank} + (2,6)(3)}$ ✓

$v_{skateboard/skaatsplank}$ = 2,23 m·s^{-1}✓ to the left/*na links*✓

ACCEPT/AANVAAR v = -2,23 m·s^{-1}✓✓ (5)

4.3 $F_{net}\,\Delta t = \Delta p = mv_f - mv_i$✓
= (3,5)(1,28 - 0) ✓
= 4,48 N·s (4,48 kg·ms^{-1}) ✓

OR/*OF*
$F_{net}\,\Delta t = \Delta p = mv_f - mv_i$✓
= (2,6)(1,28 - 3) ✓
= -4,48 N·s (4,48 kg·ms^{-1})
∴ Δp = 4,48 N·s✓ (3)
[10]

QUESTION 5/*VRAAG 5*

5.1 The total mechanical energy/sum of kinetic and gravitational potential energy in a closed/isolated system is constant (conserved).✓✓
Die totale meganiese energie/some van kinetiese en gravitasionele potensiële energie in 'n geslote sisteem bly behoue.
(If key words isolated and total missing -1 mark for each.) (2)

5.2 $E_{MECH\ P} = E_{MECH\ Q}$
$(E_P + E_K)_P = (E_P + E_K)_Q$
$W_{net} = \Delta E_K$
$W_{con} = \Delta E_K$
$\Delta E_K + \Delta E_p = 0$

✓1 mark for any of the three/
1 punt vir enige van die drie

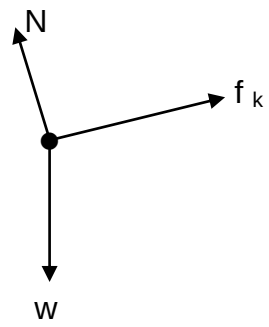
$(mgh + \frac{1}{2}mv^2)_P = (mgh + \frac{1}{2}mv^2)_Q$
$50\ (9,8)(3) + 0$ ✓$= 0 + ½\ (50)v^2$✓

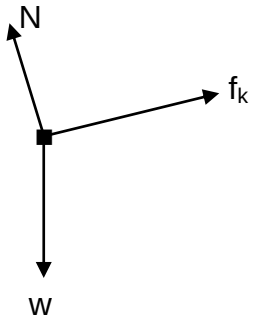
$v = 7,67\ m\cdot s^{-1}$ ✓ $(7,668\ m\cdot s^{-1})$ (4)

5.3

Accepted labels/*Aanvaarde benoemings*		
w	F_g / F_w / weight / mg / gravitational force *F_g/ F_w/ gewig / mg / gravitasiekrag*	✓
N	F_N	✓
f_k	F_f/friction/f	✓

(3)





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- Any other additional force(s)/*Enige ander addisionele krag(te) Max/Maks* $\frac{2}{3}$
- If force(s) do not make contact with body/*Indien krag(te) nie met die voorwerp kontak maak nie:* Max/*Maks:* $\frac{2}{3}$

5.4 $f_k = \mu_k N$
$= \mu_k\ (mg\cos\theta)$ ✓ Any one/*Enige een*

$= 0,08\ (50 \times 9,8)\ \cos 30^o$✓
$= 33,95\ (33, 948)\ N$ ✓ (3)

NOTE/*LET WEL*:
IN ALL THE OPTIONS FOR QUESTION 5.5 BELOW, ACCEPT THE SUBSTITUTION:/*IN AL DIE OPSIES VIR VRAAG 5.5 HIERONDER, AANVAAR DIE VERVANGING*
5 cos 60^o IN PLACE OF/*IN PLAAS VAN* 5 sin 30^o

5.5

OPTION 1/*OPSIE 1*
POSITIVE MARKING FROM QUESTION 5.4/*POSITIEWE NASIEN VANAF VRAAG 5.4*

$W = F_{net}\Delta x \cos\theta$

$W_{net} = W_f + W_w + W_N$
$W_{net} = W_f + (-\Delta E_P) + W_N$
$W_{net} = f_k \Delta x \cos 180^o + mg\sin\theta \Delta x \cos 0 + 0$

$W_{net} = \Delta E_K / \Delta K$

✓1 mark for any one/
1 punt vir enige van die drie

W_{net} = [33,948)(5)(-1)] ✓+ [(50)(9,8) (5)sin 30 ^{o} + 0]✓
= 1055, 26 (1055,259)
$\underline{1055,259 = ½ (50) (v_f^{\ 2} – 7,668^2)}$ ✓
v_f = 10,05 m·s^{-1}✓

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM QUESTION 5.2/*POSITIEWE NASIEN VANAF VRAAG 5.3*

$W_{nc} = \Delta E_p + \Delta E_k$
$f\Delta x\cos\theta = (mgh_f – mgh_i) + (½ mv_f^2 – ½ mv_i^2)$

1 mark for any of the two/
1 punt vir enige van die twee

$\mu mg\Delta x \cos 180^o = [0 - (mg\Delta x \sin 30^o] + ½ m(v_f^2 – v_i^2)$
[33,948)(5)(-1)] ✓= $\underline{[0 - 50(9,8) (5) \sin 30^o]}$✓ + ½ (50) ($v_f^{\ 2}$ – 7,668^2)✓
v_f = 10,05 m·s^{-1}✓

OPTION 3/*OPSIE*
POSITIVE MARKING FROM QUESTION 5.2 AND 5.4/*POSITIEWE NASIEN VANAF VRAAG 5.2 EN 5.4*

$W_{nc} = \Delta E_p + \Delta E_k$
$f \Delta x\cos\theta = (mgh_f – mgh_i) + (½ mv_f^2 – ½ mv_i^2)$

1 mark for any of the two/
1 punt vir enige van die twee

(33,95)(5) cos 180 ✓= [(50)(9,8) {0 - 5 sin30^o}]✓ + $\underline{½ (50)(v_f^2 - 7,668^2)}$ ✓
v_f = 10,05 m·s^{-1}✓

(5)
[17]

QUESTION 6/*VRAAG 6*

6.1 An (apparent) change in the observed frequency (pitch), (wavelength) ✓as a result of the relative motion between a source and an observer ✓(listener).
'n (Waarskynlike) verandering in die waargenome frekwensie (toonhoogte) (golflengte) aas gevolg van die relatiewe beweging tussen bron en waarnemer (luisteraar) (2)

6.2 Towards A./*Na A*✓
Recorded frequency higher./*Aangetekende frekwensie is hoër*✓ (2)

6.3 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

FOR A/*VIR A*

$$690 \checkmark = \left(\frac{340}{340 - v_s}\right) f_s \checkmark$$ (1)

FOR B/*VIR B*:

$$610 \checkmark = \left(\frac{340}{340 + v_s}\right) f_s \checkmark$$ (2)

$$\frac{690}{610} = \frac{340 + v_s}{340 - v_s}$$

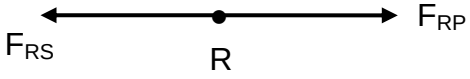
$1{,}131\,(340 - v_s) = 340 + v_s$
$v_s = 20{,}90\ m.s^{-1}$✓ (20.90 to 20.92 $m.s^{-1}$) (6)

6.4 **ANY ONE/*ENIGE EEN***
Doppler flow meter/*Doppler-vloeimeter* ✓
Measuring foetal heartbeat/*Meet van fetale hartslag*
Measure speed of blood flow
Ultra sound/*Ultraklank*
Sonar
Radar (for speeding/*vir jaag*) (1)
[11]

QUESTION 7/*VRAAG 7*

7.1 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 uitgeoefen deur een puntlading op 'n ander puntlading is direk eweredig aan die produk (van die groottes) van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle (2)

7.2



NOTE/*LET WEL*: (2)
One mark for each force, correctly shown./*Een punt vir elke krag korrek getoon.*

7.3 Taking right as positive/*Neem regs as positief*

$F = k\frac{Q_1Q_2}{r^2}$ ✓

$F_{netR} = F_{PR} + F_{SR}$

$$F_{net} = \frac{kQ_1Q_2}{r^2} + \frac{kQ_1Q_2}{r^2}$$

$$-1,27 \times 10^{-6} = \left\{\frac{(9\times10^9)(1,5\times10^{-9})(Q)}{(0,3)^2} - \frac{(9\times10^9)(2\times10^{-9})(Q)}{(0,2)^2}\right\}$$

✓ ✓ ✓ ✓

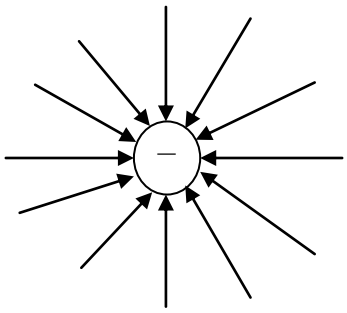
$-1,27\times10^{-6} = 150Q - 450Q$ ✓ (for subtraction/*vir aftrekking*)

$Q = 4,23\text{x}10^{-9}$ C✓ (7)

Accept answers where left is taken as positive. **[11]**

QUESTION 8/*VRAAG 8*

8.1



Shape (radial)/*Vorm (radiaal)*✓
Polarity (sign) of A/*Polariteit (Teken) van A*✓
Do not penalize for incorrect direction/*Moet nie penaliseer vir verkeerde rigting nie*

(2)

8.2 $E = \frac{kQ}{r^2}$ ✓

$3 \times 10^7 = \frac{(9 \times 10^9)(Q)}{(0,5)^2}$

$Q = 8,33 \times 10^{-4}$ C✓ (3)

8.3 $Q = ne$✓

$= (10^5)(1,6 \times 10^{-19})$ ✓

$= 1,6 \times 10^{-14}$ C

$E = \frac{F}{Q}$ ✓

$3 \times 10^7 = \frac{F}{1,6 \times 10^{-14}}$ ✓

$F = 4,8 \times 10^{-7}$ N✓ Right/*Regs*✓

(**Positive marking from 8.2 for this option)**

$F = k\frac{Q_1 Q_2}{r^2}$ ✓

$F = (9 \times 10^9)\frac{(8,33 \times 10^{-4})(1,6 \times 10^{-14})}{(0,5)^2}$ ✓

$= 4,8 \times 10^{-7}$ N✓ Right/*Regs*✓

(6)
[11]

QUESTION 9/*VRAAG 9*

9.1.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature.✓✓.
Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur.

OR/*OF*
The current in a conductor is directly proportional to the potential difference across the conductor at constant temperature. ✓✓
Die stroom in 'n geleier is direk eweredig aan die potensiaalverskil oor die geleier by konstante temperatuur (2)

9.1.2 Graph X./*Grafiek X*✓
Graph X is a straight line (passing through the origin) therefore potential difference is directly proportional to current. ✓
/*Grafiek X is lineêr*
(2)

9.2.1

$$\frac{1}{R_{//}} = \frac{1}{R_{10}} + \frac{1}{R_{15}}$$

$$\frac{1}{R_{//}} = \frac{1}{10} + \frac{1}{15}\checkmark$$

$R_{//} = 6\ \Omega$

$$R_{//} = \frac{R_{10} \times R_{15}}{R_{10} + R_{15}}$$

$$R_{//} = \frac{10 \times 15}{25}\checkmark$$

$= 6\ \Omega$

$\therefore R = (10 + 6 + 2)\checkmark$(for the addition/*vir optelling*)
$= 18\ \Omega$

$R_{ext} = (10 + 6) = 16\ \Omega$

✓

$\mathcal{E} = I(R + r)$

$6 = I(16 + 2)\checkmark$

$$R = \frac{V}{I}$$

$I = 0{,}33\ A\checkmark$

$$I = \frac{6}{18}\checkmark$$

$= 0{,}33\ A\checkmark$ (5)

9.2.2 Decrease. ✓
The total resistance of the circuit increases✓.
Afneem
Die totale weerstand van die stroombaan neem toe. (2)

9.2.3 Increase/*Neem toe* ✓ (1)

9.2.4 The total resistance in the external circuit increases./*Die totale weerstand in die eksterne stroombaan neem toe*✓
Current decreases/*Stroom neem af*✓
"Lost" volts decreases/*"Verlore" volts neem af*✓

OR/*OF*

The total resistance in the external circuit increases./*Die totale weerstand in die eksterne stroombaan neem toe* ✓
V α R✓ for constant/*vir konstante* I✓
Therefore V increases./*Dus neem V toe* (3)
[15]

QUESTION 10/*VRAAG10*

10.1 **ANY THREE/*ENIGE DRIE***
I. Permanent magnets/*Permanente magnete*
II. coils (armature)/*spoel*
III. commutator/*kommutator*
IV. brushes/*borsels*
V. power supply/battery/*kragbron* (3)

10.2.1 The rms voltage of AC is the potential difference which dissipates the same amount of energy as the equivalent DC potential difference. ✓✓
Die wgk spanning/potensiaalverskil van WS is die potensiaalverskil wat dieselfde aantal energie verkwis as GS.
Accept formula for V_{rms} as 1 mark. (2)

10.2.2 **OPTION 1/*OPSIE 1***

$V_{rms} = I_{rms}R$ ✓
$I_{rms} = \frac{V_{rms}}{R}$
$I_{rms} = \frac{240}{11}$ ✓
$= 21,82$ A
$I_{rms} = \frac{I_{max}}{\sqrt{2}}$
$I_{max} = (21,82)\sqrt{2}$ ✓
$I_{max} = 30,86$ A✓

OPTION 2/*OPSIE 2*

$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓
$V_{max} = (240)\sqrt{2}$ ✓
$= 339,41$
$V_{max} = I_{max}R$
$I_{max} = \frac{339,41}{11}$ ✓
$I_{max} = 30,86$ A✓

OPTION 3/*OPSIE 3*

$P_{ave} = \frac{V_{rms}^2}{R}$ ✓
$P_{ave} = \frac{(240)^2}{11}$ ✓
$P_{ave} = 5236,36\ W$

$P_{ave} = I_{rms}V_{rms}$
$5236,36 = I_{rms}240$
$I_{rms} = 21,82\ A$
$I_{rms} = \frac{I_{max}}{\sqrt{2}}$
$21,82 = \frac{I_{max}}{\sqrt{2}}$ ✓
$I_{max} = 30,86\ A$ ✓

$P_{ave} = \frac{I_{max}V_{max}}{2}$
$P_{ave} = \frac{I_{max}V_{rms}\sqrt{2}}{2}$
$5236,36 = \frac{I_{max}(240)\sqrt{2}}{2}$ ✓
$I_{max} = 30,86\ A$ ✓

(4)
[9]

QUESTION 11/*VRAAG 11*

11.1.1 Greater than/*Groter as*✓

Electrons are ejected from the metal plate./*Elektrone word vrygestel vanaf die metaalplaat* ✓ Accept: a current is registered on the ammeter. (2)

11.1.2 Increase in intensity means that (for the same frequency) the number of photons per second increases (ammeter reading increases)✓but the energy of the photons stays the same ✓(Therefore the statement is incorrect).
OR
An increase in the energy of the photons only increases the kinetic energy of the photoelectrons and not the number of photoelectrons, thus the ammeter reading will not change.
Toename in intensiteit beteken dat (vir dieselfde frekwensie) die aantal fotone neem toe (ammeterlesing neem toe) maar die energie van die fotone bly dieselfde. (Dus is die stelling verkeerd) (2)

11.1.3 Light has a particle nature/*Lig het 'n deeltjieaard*
Accept light energy is quantized/*Aanvaar ligenergie is gekwantiseer*✓ (1)

11.2.1 The minimum frequency needed for the emission of electrons (from a metal surface).
Die minimum energie benodig vir die vrystelling van elektrone (vanaf die metaaloppervlak) (2)

11.2.2 $W_0 = hf_0$ ✓
$= \frac{(6{,}63 \times 10^{-34})(5{,}73 \times 10^{14})}{}$✓
$= 3{,}8 \times 10^{-19}$J✓ [$3{,}799 \times 10^{-19}$ J] (3)

11.2.3 **POSITIVE MARKING FROM QUESTION 11.2.2**
POSITIEWE NASIE VANAF VRAAG 11.2.2
OPTION 1/*OPSIE 1*

$E = W_0 + E_{k(max/maks)}$
$hf = hf_0 + E_{k(max/maks)}$
$hf = hf_0 + ½ mv^2$
$E = W_0 + ½ mv^2$

✓ Any one/*Enige een*

$(6{,}63 \times 10^{-34})f = 3{,}8 \times 10^{-19} + [½(9{,}11 \times 10^{-31})(4{,}19 \times 10^5)^2]$✓
$f = 6{,}94 \times 10^{14}$ Hz✓ [7×10^{14} Hz]

OPTION 2/*OPSIE 2*

$E = W_0 + E_{k(max/maks)}$
$hf = hf_0 + E_{k(max/maks)}$
$hf = hf_0 + ½ mv^2$
$E = W_0 + ½ mv^2$

✓ Any one/*Enige een*

$E = 3{,}8 \times 10^{-19} + [½(9{,}11 \times 10^{-31})(4{,}19 \times 10^5)^2]$✓
$hf = 4{,}599 \times 10^{-19}$
$(6{,}63 \times 10^{-34})f = 4{,}599 \times 10^{-19}$
$f = 6{,}94 \times 10^{14}$ Hz✓ [7×10^{14} Hz] (3)

[13]

TOTAL/*TOTAAL*: 150

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