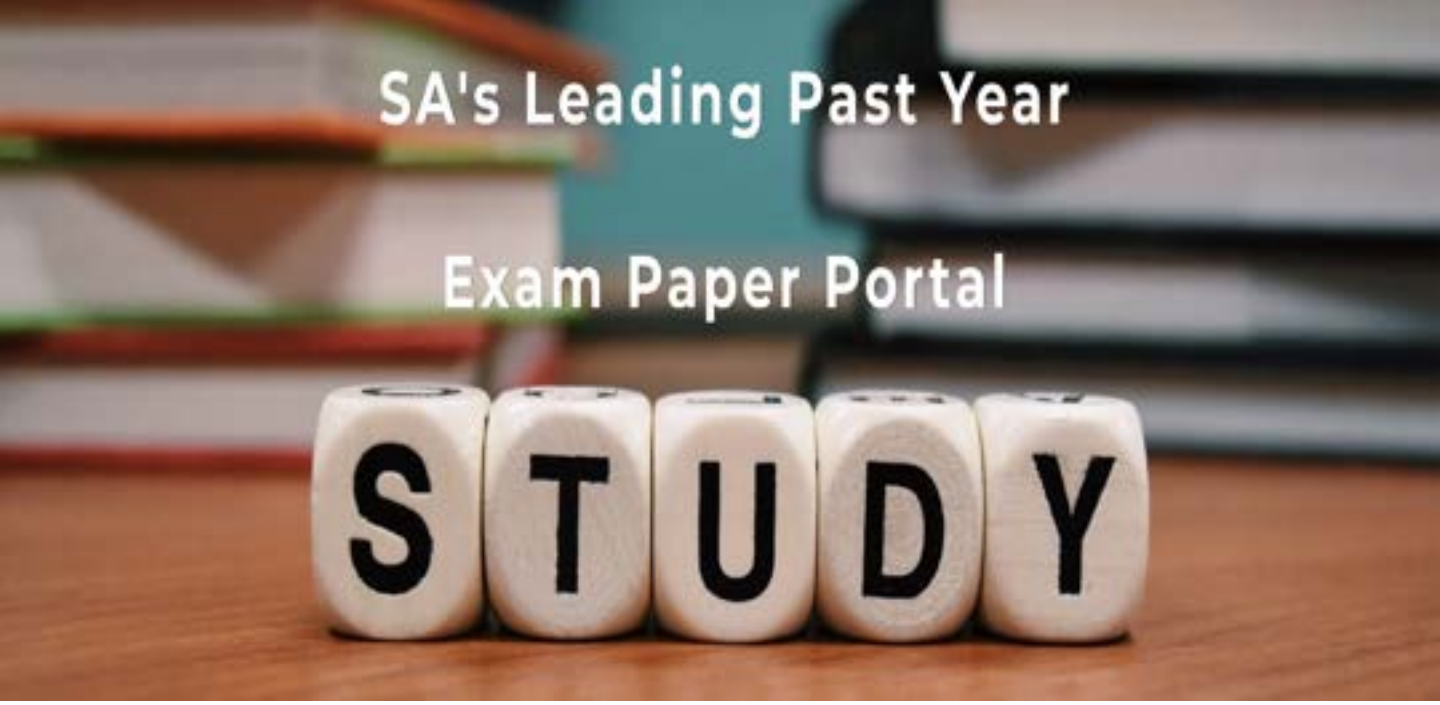


education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT

GRADE/*GRAAD* 12

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

SEPTEMBER 2020

MARKING GUIDELINES / *NASIENRIGLYNE*

MARKS/*PUNTE*: 150

These marking guidelines consists of 15 pages

Hierdie nasienriglyne bestaan uit 15 bladsye

QUESTION 1 / VRAAG 1

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

QUESTION 2 / VRAAG 2

2.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force ✓ at an acceleration directly proportional to the force and inversely proportional to the mass of the object. ✓
Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag teen 'n versnelling direk eweredig aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

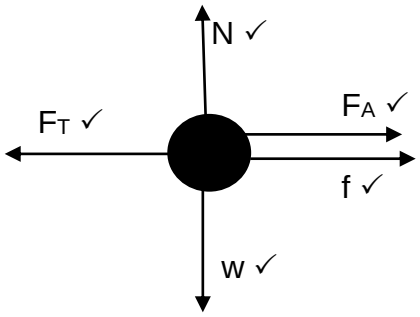
Note: If any one of the underlined key words in the **correct context** is omitted, deduct 1 mark

(2)

2.2 F to the right ✓ OR –F (1)

2.3 B experiences no net force ($F_{net} = 0$) ✓
Therefore B will not accelerate ✓ (2)

2.4



(5)

Accepted labels / Aanvaarde benoemings	
w	F_g / F_w / force of earth on block / weight / mg / gravitational force
F_A	$F_{applied}$ /
F_T	Tension in rope / T
N	Normal force
f	friction / f_k / kinetic friction / F_f

Notes/Aantekeninge:

- Any additional forces: deduct 1 mark: max $^4/_5$
- No labels: deduct 1 mark: max $^4/_5$
- No arrows: $^0/_5$
- Force(s) not touching object: deduct 1 mark: max $^4/_5$

2.5

OPTION 1	
For Block A:	For Block B:
$F_{net} = ma$ } Any one ✓	$F_{net} = ma$
$F_B - f = ma$	$F_T - 4,7 - 11,35 = 4(4,5)$ ✓
$F_B - 2,35$ ✓ $= 2(4,5)$ ✓	$F_T = 34,05$ N ✓
$F_B = 11,35$ N	

(5)

OPTION 2: SYSTEMS APPROACH max $^2/_5$
$F_{net} = ma$ ✓
$F_T - f = ma$
$F_T - (2,35+4,7) = 6(4,5)$
$F_T = 34,05$ N ✓

(5)

[15]

QUESTION 3 / VRAAG 3

3.1 Yes ✓
Only gravitational force/weight is acting on the ball. ✓

Ja ✓
Slegs gravitasiekrag/gewig werk op die bal in. ✓ (2)

3.2

OPTION 1	
Upwards positive:	**Downwards positive:**
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= (8)^2 + 2(-9,8)(-21)$ ✓	$= (-8)^2 + 2(9,8)(21)$ ✓
$v_f = 21,81$ m·s^{-1} ✓	$v_f = 21,81$ m·s^{-1} ✓

(3)

OPTION 2	
Upwards positive:	**Downwards positive:**
$v_f^2 = v_i^2 + 2a\Delta y$	$v_f^2 = v_i^2 + 2a\Delta y$
$0 = (8)^2 + 2(-9,8)\Delta y$	$0 = (-8)^2 + 2(9,8)\Delta y$
$\Delta y = 3,27$ m (3,27+21)	$\Delta y = -3,27$ m (3,27+21)
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= (0)^2 + 2(-9,8)(-24,27)$ ✓	$= (0)^2 + 2(9,8)(24,27)$ ✓
$v_f = 21,81$ m·s^{-1} ✓	$v_f = 21,81$ m·s^{-1} ✓

(3)

OPTION 3
$(mgh + ½mv^2)_{Roof} = (mgh + ½mv^2)_{Ground}$ ✓
$m(9,8)(21) + ½(m)(8)^2 = 0 + ½(m)v^2$ ✓
$v = 21,81$ m·s^{-1} ✓

(3)

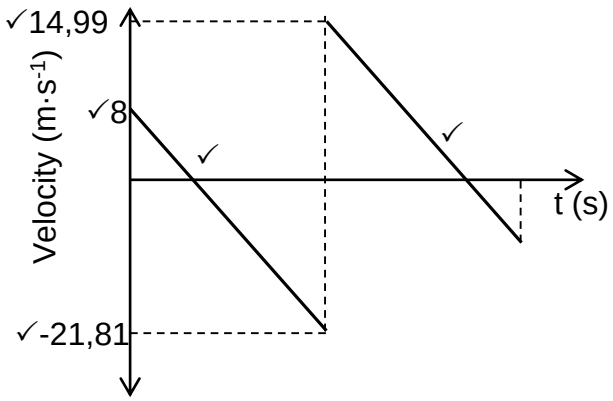
3.3

OPTION 1	
Upwards Positive	**Downwards Positive**
$\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + ½a\Delta t^2$ ✓
9✓ = $\underline{v_i\ (2,24) + ½\ (-9,8)(2,24)^2}$ ✓	(-9)✓ = $\underline{v_i\ (2,24) + ½\ (9,8)(2,24)^2}$ ✓
v_i = 14,99 m·s^{-1} ✓	v_i = -14,99
	v_i = 14,99 m·s^{-1} ✓

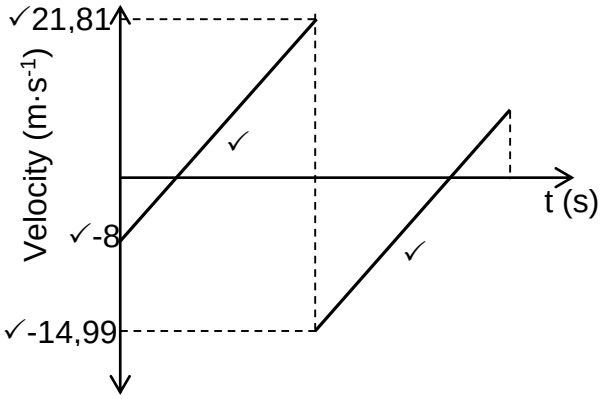
(4)

3. 4 **POSITIVE MARKING FROM QUESTION 3.2 & 3.3**

Upwards positive:



Downwards positive:



CRITERIA	
Graph starts at ±8 m·s^{-1}	✓
First line is a straight line through the t-axis.	✓
Line ends at v = ±21,81 m·s^{-1}	✓
Second line correctly drawn starting from v = ±14,99 m·s^{-1}	✓
Two sloping parallel straight lines	✓

(5)

[14]

QUESTION 4 / VRAAG 4

4.1 The total (linear) momentum in a closed system remains constant. ✓✓
Die totale (liniêre) momentum in 'n geslote sisteem bly behoue.

Note: If any one of the underlined key words in the **correct context** is omitted, deduct 1 mark

(2)

4.2.1 **OPTION 1**

$\Sigma p_i = \Sigma p_f$
$(mv_i)_1 + (mv_i)_2 = (mv_f)_1 + (mv_f)_2$ ✓ Any one

$(0,65)(8) + (0,16)(-20)$ ✓ $= (0,65)v_f + (0,16)(30)$ ✓

$v_f = -4,31$

$v_f = 4,31\ m\cdot s^{-1}$ West ✓ (Accept: left)

OR

$(0,65)(-8) + (0,16)(20)$ ✓ $= (0,65)v_f + (0,16)(-30)$ ✓

$v_f = 4,31\ m\cdot s^{-1}$ West/to the left / *Wes/na links* ✓

(4)

4.2.2 **OPTION 1**
TO THE RIGHT AS POSITIVE

$F_{net}\cdot\Delta t = mv_f - mv_i$ ✓
$F_{net}(0,015) = (0,16)(30) - (0,16)(-20)$ ✓
$F_{net} = -533,33$
$F_{net} = 533,33$ N East/to the right / *Oos/na regs* ✓

TO THE LEFT AS POSITIVE

$F_{net}\cdot\Delta t = mv_f - mv_i$ ✓
$F_{net}(0,015) = (0,16)(-30) - (0,16)(20)$ ✓
$F_{net} = 533,33$ N East/to the right / *Oos/na regs* ✓

(3)

POSITIVE MARKING FROM QUESTION 4.2.1

OPTION 2
For the stick:

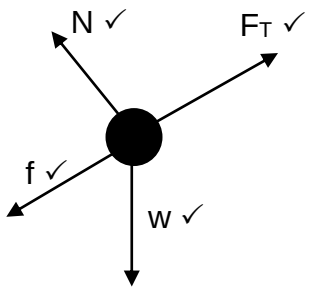
$F_{net}\cdot\Delta t = mv_f - mv_i$ ✓
$F_{net}(0,015) = (0,65)(-4,31) - (0,65)(8)$ ✓
$F_{net} = -533,43$
$\therefore (F_{net})_{Ball} = 533,43$ N East/to the right / *Oos/na regs* ✓

(3)

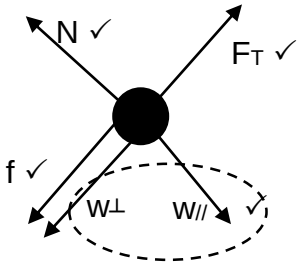
[9]

QUESTION 5 / VRAAG 5

5.1



ACCEPT



Accepted labels / Aanvaarde benoemings	
w	F_g / F_w / force of earth on block / weight / 29,4 N / mg / gravitational force / *gewig / gravitasiekrag / krag van aarde op blok*
N	Normal force / F_N / Force of incline on block / *Normaalkrag / Normaal / krag van skuinsvlak op blok*
F_T	Tension / T / force of rope / F / *spanning / spankrag / krag van tou op blok*
f	Friction / Kinetic friction / f_k / F_f / *wrywing / kinetiese wrywingskrag*

Notes/*Aantekeninge:*
- Mark is awarded for label and arrow./*Punt word toegeken vir byskrif en pyltjie.*
- Do not penalise for length of arrows./*Moenie vir die lengte van pyle penaliseer nie.*
- Deduct 1 mark when more than 4 forces drawn. / *Trek 1 punt af vir meer as 4 kragte geteken.*
- Deduct 1 mark if force(s) do not make contact with dot. / *Trek 1 punt af indien krag(te) nie met die kolletjie kontak maak nie.*
- If arrows missing/*Indien pylpunte uitgelaat word:* Max/*Maks* $^3/_4$

(4)

5.2.1 Weight / Gravitational force / F_g / *gewig / Gravitasiekrag* (1)

5.2.2 Weight of block R / *Gewig van blok R* (1)

5.2.3 Tension / Force in rope / Toukrag / Spankrag (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 verrig op 'n voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp.

ACCEPT:
The work done on an object by a resultant/net force is equal to the change in the object's kinetic energy.
Die arbeid verrig op die voorwerp deur 'n resulterende/netto krag is gelyk aan die verandering in kinetiese energie van die voorwerp.

Note: If any one of the underlined key words in the **correct context** is omitted, deduct 1 mark

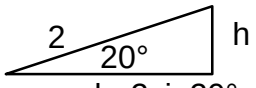
(2)

5.4 **OPTION 1**

$W_{net} = \Delta E_k$
$(W_{Fg//})_P + (W_f)_P + (W_{Fg})_R = ½mv_f^2 – ½mv_i^2$ } Any one ✓

$(3)(9,8)\sin20°(2)\cos180°$✓ + $(15)(2)\cos180°$✓+ $(8\times9,8)(2)\cos0°$ ✓= $½(11)v^2 – 0$✓
$v = 4,40\ m\cdot s^{-1}$ ✓ (6)

OPTION 2



$W_{net} = \Delta E_k$
$(W_{Fg})_P + (W_f)_P\ (W_{Fg})_R = ½mv_f^2 – ½mv_i^2$ } Any one ✓

$(3)(9,8)(2\sin20°)\cos180°$✓ + $(15)(2)\cos180°$✓+ $(8\times9,8)(2)\cos0°$ ✓= $½(11)v^2 – 0$✓
$v = 4,40\ m\cdot s^{-1}$ ✓ (6)

OPTION 3

$W_{nc} = \Delta E_k + \Delta E_p$
$(W_f)_P = [½mv_f^2 – ½mv_i^2] + [mgh_f - mgh_i]_P + [mgh_f - mgh_i]_R$ } Any one ✓

$(15)(2)\cos180°$✓ = $[½(11)v^2 – 0]$ ✓ + $[(3)(9,8)(2\sin20°) - 0$✓$]$ + $[0-8(9,8)(2)]$ ✓
$v = 4,40\ m\cdot s^{-1}$ ✓ (6)

[15]

QUESTION 6 / VRAAG 6

6.1

$v = f\lambda$ ✓
$1\,500 = 380\,\lambda$ ✓
$\lambda = 3{,}95$ m ✓ (3)

6.2

Smaller than / *Kleiner as* ✓
$\lambda \propto v$ ✓ if f stays constant / *mits f konstant bly* ✓

OR
Smaller than / *Kleiner as* ✓
$v = f\lambda$
$340 = 380\,\lambda$ ✓
$\lambda = 0{,}89$ m ✓ (3)

6.3

<u>The change in frequency (or pitch) of the sound detected by a listener</u> ✓ because the <u>sound source and the listener have different velocities relative to the medium of sound propagation</u>. ✓
<u>Die verandering in frekwensie (of toonhoogte) van klank wat deur 'n luisteraar waargeneem</u> word omdat die <u>klankbron en die luisteraar verskillende snelhede relatief tot die medium waarin die klank voortgeplant word, het</u>.

OR
<u>The change in frequency (or pitch) of the sound detected by a listener</u> ✓as a result of the <u>relative motion between the source and the observer</u>.✓
<u>Die verandering in frekwensie (of toonhoogte) van die klank waargeneem deur 'n luisteraar</u> as gevolg van die <u>relatiewe beweging tussen die bron en die waarnemer.</u>

Note: If any one of the underlined key words in the **correct context** is omitted, deduct 1 mark

(2)

6.4

Marking criteria/*Nasienriglyne:*

- Appropriate formula/*Toepaslike formule* ✓
- Substitution for detector A/*Vervanging vir detektor A* ✓
- Substitution for detector B/*Vervanging vir detektor B* ✓
- Equating difference in frequency/*Vergelyking vir verskil in frekwensie* ✓
- Final answer/*Finale antwoord*: 7,99 m·s^{-1} ✓

Detector A/*Detektor A*	**Detector B/*Detektor B***
$f_L = \frac{v \pm v_L}{v \pm v_S} f_S$ ✓	$f_L = \frac{v \pm v_L}{v \pm v_S} f_S$
$= \frac{340 + v_L}{340}(380)$ ✓	$= \frac{1\,500 + v_L}{1\,500}(380)$ ✓

$(f_L)_A - (f_L)_B$ ✓ = 6,91

$$\frac{340 + v_L}{340}(380) - \frac{1\,500 + v_L}{1\,500}(380) = 6{,}91$$

v_L = 7,99 m·s^{-1} ✓

(5)

[13]

QUESTION 7 / VRAAG 7

7.1

The magnitude of the electrostatic force exerted by one point charge (Q_1) on another 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 ✓

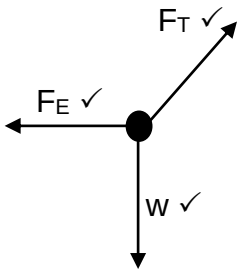
Die grootte van die elektrostatiese krag wat een puntlading (Q_1) op 'n ander puntlading (Q_2) uitoefen, is direk eweredig aan die produk van die groottes van die ladings ✓ *en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle*. ✓

Note: If any one of the underlined key words in the **correct context** is omitted, deduct 1 mark

- If masses used ($^0/_2$)

(2)

7.2



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w	F_g / F_w / force of earth on block / weight / 29,4 N / mg / gravitational force / *gewig / gravitasiekrag / krag van aarde op blok*
F_T	Tension / T / force of rope / F / *spanning / spankrag / krag van tou op blok*
F_E	Electrostatic force/Coulomb force/$F_{E\ Field}$

Notes/*Aantekeninge:*
- Mark is awarded for label and arrow./*Punt word toegeken vir byskrif en pyltjie.*
- Do not penalise for length of arrows./*Moenie vir die lengte van pyle penaliseer nie.*
- Deduct 1 mark when more than 3 forces drawn. / *Trek 1 punt af vir meer as 3 kragte geteken.*
- Deduct 1 mark if force(s) do not make contact with dot. / *Trek 1 punt af indien krag(te) nie met die kolletjie kontak maak nie.*
- If arrows missing/*Indien pylpunte uitgelaat word:* Max/*Maks* $^2/_3$

(3)

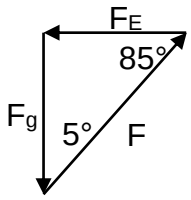
7.3

85° ✓
Both spheres experiences the same force ✓ (in magnitude) and have the same mass ✓. /
Beide sfere ervaar dieselfde grootte krag en het dieselfde massa. (3)

7.4

$F_E = \frac{kQ_1Q_2}{r^2}$ ✓

$= \frac{(9\times10^9)(q)(2q)}{(0,2)^2}$ ✓



$F_g = F_E\tan85°$ ✓

$(0,03)(9,8)$ ✓ $= \frac{(9\times10^9)(q)(2q)}{(0,2)^2}\tan85°$ ✓

$q = 2,39\times10^{-7}$ C ✓

OR

$F_E = F_g\tan5°$ ✓

$\frac{(9\times10^9)(q)(2q)}{(0,2)^2}$ ✓ $= (0,03)(9,8)\tan5°$ ✓

$q = 2,39\times10^{-7}$ C ✓

(6)

[14]

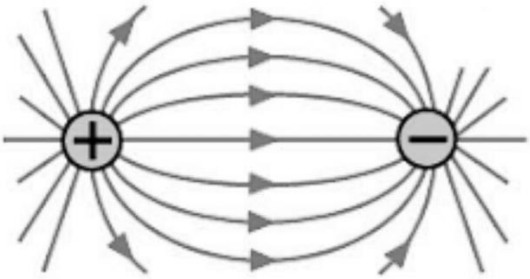
QUESTION 8 / VRAAG 8

8.1

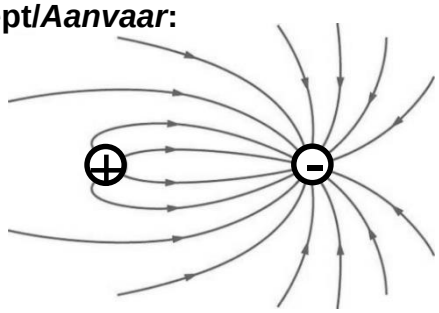
Marking criteria/Nasienriglyne: -1 mark for each of the 5 key words omitted in the correct context. -1 punt vir elk van die 5 sleutelwoorde weggelaat in die korrekte konteks.

The electric field at a point is the (electrostatic) <u>force</u> experienced <u>per</u> <u>unit</u> <u>positive</u> <u>charge</u> placed at that point.
Die elektriese veld by 'n punt is die (elektrostatiese) <u>*krag*</u> *wat* <u>*per*</u> <u>*positiewe*</u> <u>*eenheids*</u>-<u>*lading*</u> *wat by daardie punt geplaas is, ondervind word.* (2)

8.2



Accept/*Aanvaar*:



Shape / *Vorm*	✓
Direction / *Rigting*	✓
Lines don't cross or touch /*Lyne kruis of raak nie.*	✓

(3)

8.3

$E_A = \frac{kQ}{r^2}$ ✓

$= \frac{(9\times10^9)(0{,}6\times10^{-6})}{0{,}09^2}$ ✓

$= 6{,}67 \times 10^5$ N·C^{-1} (to the right)

$E_B = \frac{kQ}{r^2}$

$= \frac{(9\times10^9)(1{,}2\times10^{-6})}{0{,}03^2}$ ✓

$= 1{,}20 \times 10^7$ N·C^{-1} (to the right)

$E_{net} = E_A + E_B$

$= 6{,}67\times 10^5 + 1{,}20 \times 10^7$ [addition of 2✓]

$= 1{,}27 \times 10^7$ N·C^{-1} ✓ (5)

8.4 Smaller than/*Kleiner as* ✓ (1)

[11]

QUESTION 9 / VRAAG 9

9.1 The rate of flow of charge. ✓✓ (2 or 0)
Die tempo van ladingvloei. (2)

9.2.1 $P = I^2R$ ✓
$37,5 = (2,5)^2 R$ ✓
$R = 6\ \Omega$ ✓ (3)

9.2.2 **POSITIVE MARKING FROM QUESTION 9.2.1**

$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2}$

$= \frac{1}{2} + \frac{1}{6}$ ✓

$R_p = 1,5\ \Omega$

$Re = 1,5 + 6$ ✓ $= 7,5\ \Omega$

$\varepsilon = I(R+r)$ ✓

$= 2,5(7,5+0,5)$ ✓

$\varepsilon = 20\ V$ ✓ (5)

9.3 **POSITIVE MARKING FROM QUESTION 9.2.1 and 9.2.2**

OPTION 1

$I = \frac{180}{100}(2,5) = 4,5\ A$ ✓

$\varepsilon = I(R+r)$

$20 = 4,5(R_e + 0,5)$ ✓

$Re = 3,94\ \Omega$

$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2}$

$\frac{1}{3,94} = \frac{1}{7,5} + \frac{1}{R}$ ✓

$R = 8,32\ \Omega$ ✓ [Range: 8,30 Ω - 8,32Ω] (4)

[14]

QUESTION 10 / VRAAG 10

10.1 Mechanical (energy)/kinetic (energy) TO electrical (energy) ✓
Meganiese (energie)/kinetiese (energie) NA elektriese (energie) (1)

10.2 1,5 OR 1½ ✓ (1)

10.3.1

$f = \frac{1}{T}$ ✓

$= \frac{1}{2\times10^{-2}}$ ✓

= 50 Hz ✓

OR

$f = \frac{\text{number of cycles}}{\text{time}}$ ✓

$f = \frac{1,5}{3\times10^{-2}}$ ✓

= 50 Hz ✓

(3)

10.3.2

OPTION 1

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$

$= \frac{23}{\sqrt{2}}$ ✓

= 16,26 A

$V_{rms} = \frac{V_{max}}{\sqrt{2}}$

$= \frac{311}{\sqrt{2}}$ ✓

= 219,91 V

$P_{ave} = V_{rms}I_{rms}$ ✓

= (219,91)(16,26) ✓

= 3575,74 W ✓

OPTION 2

$P_{ave} = \frac{V_{max}I_{max}}{2}$ ✓

$= \frac{(23)✓(311)✓}{2}$ ✓

= 3576,5 W ✓

(5)

[10]

QUESTION 11 / VRAAG 11

11.1 The minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓
Die minimum energie benodig om 'n elektron uit die oppervlak van 'n metaal vry te stel.

Note: If any one of the underlined key words in the **correct context** is omitted, deduct 1 mark

(2)

11.2 The frequency of red light is less than the threshold frequency of the metal. ✓✓
Die frekwensie van rooi lig is kleiner as die drumpelfrekwensie van die metaal.
OR/*OF*
The energy of a photon of red light is less than the workfunction of the metal. ✓✓
Die energie van 'n foton van rooi lig is kleiner as die arbeidsfunksie/ werksfunksie van die metaal. (2)

11.3
$E = W_0 + E_{k(max)}$
$\frac{hc}{\lambda} = hf_0 + \frac{1}{2}mv_{max}^2$ } Any one ✓

$\frac{(6{,}63\times10^{-34})(3\times10^{8})}{430\times10^{-9}}$ ✓ $= (6{,}63\times10^{-34})(6{,}94\times10^{14}) + ½\,(9{,}11\times10^{-31})v_{max}^2$ ✓

$v_{max} = 7{,}31 \times 10^{4}\ m\cdot s^{-1}$ ✓ (4)

11.4.1
$P = \frac{W}{\Delta t}$ ✓

$= \frac{(4{,}63\times10^{-19})(5\times10^{20})}{60}$ ✓

$= 3{,}86\ W$ ✓ (3)

11.4.2
5×10^{20} photons eject 5×10^{20} photo electrons per minute

$\frac{5\times10^{20}}{60} = 8{,}33\times10^{18}$ electrons s^{-1}

$n = \frac{Q}{q}$ ✓

$Q = (8{,}33\times10^{18})\,(1{,}6\times10^{-19})$

$= 1{,}33\ C$ ✓ (3)

NOTE:
Any calculation of $8{,}33\times10^{18}$ ✓
Enige berekening van $8{,}33\times10^{18}$

11.4.3 **POSITIVE MARKING FROM QUESTION 11.4.2**
1,33 A ✓ (1)
[15]

TOTAL/*TOTAAL*: 150