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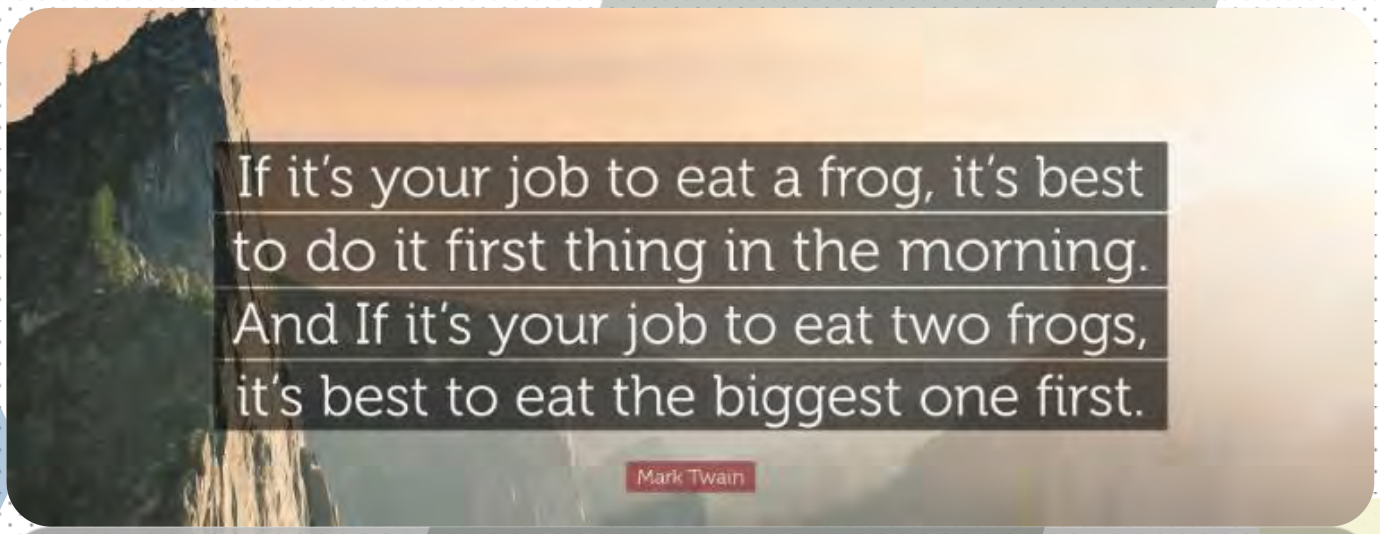


8.4 Increases/*Toeneem* ✓
(Total) resistance increases./(*Totale) weerstand neem toe.* ✓
Current decreases./*Stroom neem af.* ✓
$V_{internal}$ /Internal volts decreases./V_{intern}/*Interne volts neem af.* ✓ (4)

Note/*Aantekening:*
Award marks if learner proved the statement using calulated numerical values./ *Ken punte toe indien leerder die stelling bewys deur berekende waardes te gebruik.*

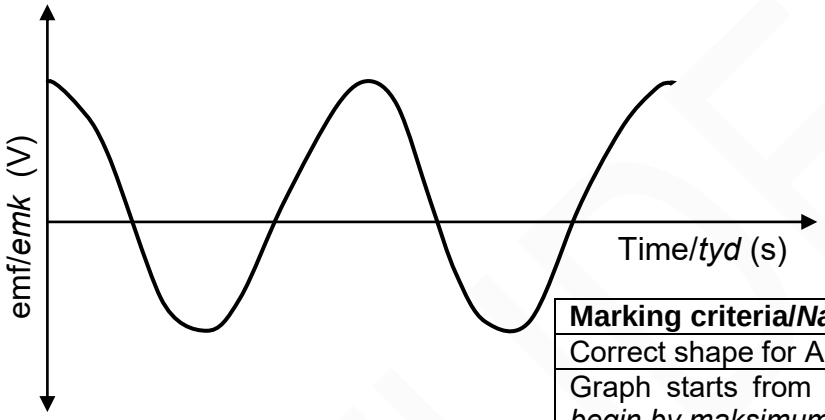
[21]

QUESTION 9/*VRAAG 9*

9.1.1 North pole/*Noord-pool* ✓ (1)

9.1.2 Y to X/*Y na X* ✓ (1)

9.1.3



Marking criteria/*Nasienkriteria*	
Correct shape for AC./*Korrekte vorm vir WS.*	✓
Graph starts from maximum value./*Grafiek begin by maksimum waarde.*	✓
Two complete waves/ *Twee volledige golwe*	✓
Note/*Aantekening:* Accept graph starting at negative max./*Aanvaar grafiek wat by negatiewe maks begin*.	

(3)

9.2.1

Marking criteria/*Nasienkriteria*:
- Formula to calculate V_{max} or I_{rms}./*Formule om V_{maks} of I_{wgk} te bereken.* ✓
- Correct substitution of V_{rms} or I_{max}./*Korrekte vervanging van V_{wgk} of I_{maks}.* ✓
- Correct substitution to calculate R./*Korrekte vervanging om R te bereken.* ✓
- Correct final answer/*Korrekte finale antwoord*: 47,14 Ω to/*tot* 47,2 Ω ✓

OPTION 1/*OPSIE 1*

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

$200 = \frac{V_{max}}{\sqrt{2}}$ ✓

$V_{max} = 282,84$ V

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

$= \frac{282,84}{6}$ ✓

R = 47,14 Ω ✓

OPTION 2/*OPSIE 2*

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

$I_{rms} = \frac{6}{\sqrt{2}}$ ✓

$I_{rms} = 4,24$ A

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

$= \frac{200}{4,24}$ ✓

R = 47,17 Ω ✓

OPTION 3/*OPSIE 3*	
$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓ $I_{rms} = \frac{6}{\sqrt{2}}$ ✓ $I_{rms} = 4,24$ A $P_{ave} = V_{rms}I_{rms}$ $= (200)(4,24)$ $= 848$ W (848,53)	$P_{ave} = \frac{V^2_{rms}}{R}$ $848 = \frac{(200)^2}{R}$ ✓ $= 47,17\ \Omega$ ✓ **OR/*OF*** $P_{ave} = I^2_{rms}R$ $848 = (4,24)^2R$ ✓ $= 47,17\ \Omega$ ✓

(4)

9.2.2 **POSITIVE MARKING FROM QUESTION 9.2.1.**
POSITIEWE NASIEN VANAF VRAAG 9.2.1.

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$W = I^2R\Delta t$ ✓ $= \underline{(4,24)^2(47,17)}$ ✓(7200) ✓ $= 6,11 \times 10^6$ J ✓ ($6,10 \times 10^6$)	$W = VI\Delta t$ ✓ $= \underline{(200)(4,24)}$ ✓(7200) ✓ $= 6,11 \times 10^6$ J ✓
OPTION 3/*OPSIE 3*	**OPTION 4/*OPSIE 4***
$W = \frac{V^2\Delta t}{R}$ ✓ $= \frac{(200^2)\ ✓ (7200)✓}{47,27}$ $= 6,11 \times 10^6$ J ✓ ($6,10 \times 10^6$)	$P = \frac{W}{\Delta t}$ ✓ ✓ $848 = \frac{W}{7200}$ ✓ $= 6,11 \times 10^6$ J ✓

(4)
[13]

QUESTION 10/*VRAAG 10*

10.1 $6,63 \times 10^{-34}$ ✓ (1)

10.2

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted or extra incorrect words added, deduct 1 mark./*Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat of inkorrekte woorde bygevoeg is, trek 1 punt af.*

The minimum energy needed to eject an electron from a (metal) surface. ✓✓
Die minimum energie benodig om 'n elektron uit 'n (metaal)oppervlak vry te stel. (2)

10.3.1 $W_o = hf_o$ ✓
$= \underline{(6,63 \times 10^{-34})(5 \times 10^{14})}$ ✓
$= 3,32 \times 10^{-19}$ J ✓ (3)

QUESTION 9/*VRAAG 9*

9.1.1 Split ring/commutator/*Splitring*/*kommutator* ✓ (1)

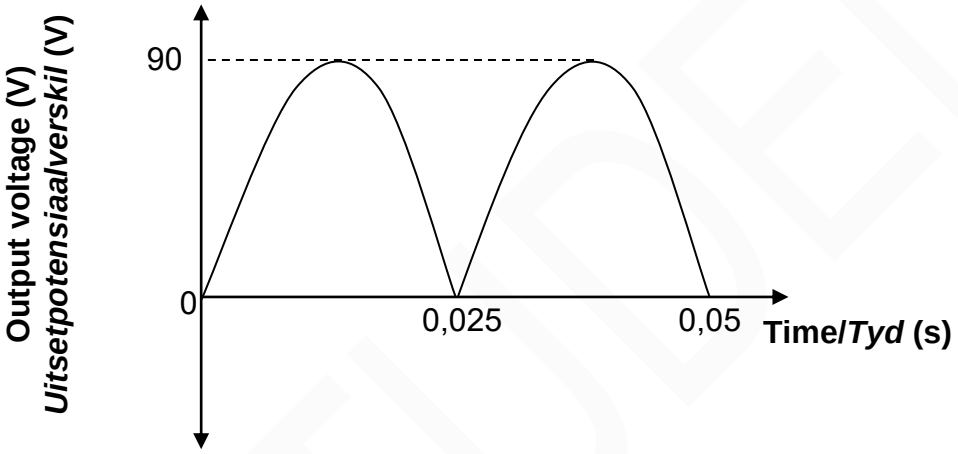
9.1.2 **Y** to/*na* **X** **OR/*OF*** 0 /no current/*geen stroom nie*✓ (1)

9.1.3 $T = \frac{1}{f}$

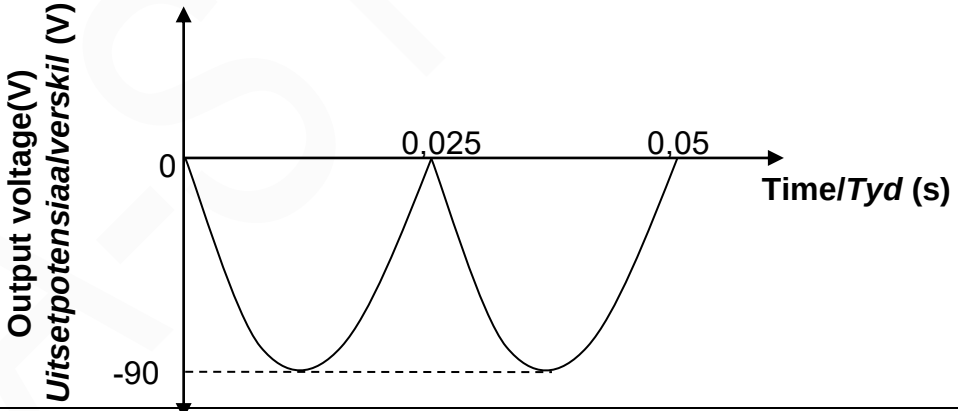
$T = \frac{1}{20}$

$T = 0,05$ s ✓ (1)

9.1.4 **POSITIVE MARKING FROM QUESTION 9.1.3.**
POSITIEWE NASIEN VANAF VRAAG 9.1.3.



OR/*OF*



Criteria for graph/*Kriteria vir grafiek*	
Correct shape with one full cycle./*Korrekte vorm met 1 volledige siklus.*	✓
Curve starts at zero to first peak./*Kurwe begin by nulpunt tot eerste piek.*	✓
Any one of the correct time values at the correct position./*Enige een van die korrekte tyd waardes op die korrekte posisie.*	✓
Maximum voltage of 90 V OR -90 V/ *Maksimum potensiaalverskil van 90 V OF -90 V*	✓
NOTE/*LET WEL*: - 1 mark for half cycle/incomplete cycle or more than one cycle *-1 punt vir halwe siklus/onvoltooide siklus of meer as een siklus*	

(4)

9.2

Marking criteria/*Nasienkriteria*

- Formula to calculate W_{ave} (do not penalise if subscripts are ommited)./ *Formule om W_{gem} te bereken (moenie penaliseer indien onderskrifte uitgelaat is nie).* ✓
- Substitution of 220 and 32 in correct equation. ✓ *Vervanging van 220 en 32 in die korrekte vergelyking.*
- Substitution of 120 for Δt/*Vervanging van 120 in Δt.* ✓
- Correct answer in range: 181 500 J to 181 764 J ✓ *Korrekte antwoord in gebied: 181 500 J tot 181 764 J* ✓

OPTION 1/*OPSIE 1*

$W_{ave} = \frac{^2_{rms}\Delta t}{}$ ✓

$= \frac{220^2(120)}{32}$ ✓ ✓

= 181 500 J ✓

OPTION 2/*OPSIE 2*

$R = \frac{rms}{rms}$ ✓

$32 = \frac{220}{rms}$

I_{rms} = 6,88 A (6,875 A)

$W_{ave} = V_{rms}I_{rms}\Delta t$ ✓
$= (220)(6,88)(\underline{120})$ ✓
= 181 632 J ✓

OR/*OF*

$W_{ave} = I_{rms}^2R\Delta t$ ✓
$= (6,88)^2(32)(\underline{120})$ ✓
= 181 764,10 J ✓

OPTION 3/*OPSIE 3*

$R = \frac{rms}{rms}$ ✓

$32 = \frac{220}{rms}$ ✓

I_{rms} = 6,88 A (6,875 A)

$P_{ave} = V_{rms}I_{rms}$
$= (220)(6,88)$
$= 1\,513,6$ W
$(1,51 \times 10^3$ W)

$P_{ave} = I_{rms}^2R$
$= (6,88)^2(32)$
$= 1\,514,7$ W (1 512,5 W)
$(1,51 \times 10^3$ W)

OPTION 4/OPSIE 4

$P_{ave} = \frac{^2_{rms}}{}$

$P_{ave} = \frac{220^2}{32}$ ✓

$P_{ave} = 1\,512,5$ W
$(1,51 \times 10^3$ W)

$P = \frac{}{\Delta t}$ ✓

$1\,513,6 = \frac{}{120}$ ✓

W = 181 632 J ✓ $(1,82 \times 10^5$ J)

(4)

[11]

QUESTION 9/*VRAAG 9*

9.1.1 Electrical to mechanical/kinetic/rotational ✓
Elektries na meganies/kineties/rotasie (1)

9.1.2 DC/*GS* ✓ (1)

9.1.3 Ensures continuous rotation of the coil. ✓
Verseker aanhoudende rotasie van spoel.

OR/*OF*
Ensures change in direction of the current in the coil. ✓
Verseker verandering van rigting van stroom in spoel. (1)

9.2 **QUESTIONS 9.2.1 AND 9.2.2/*VRAE 9.2.1 EN 9.2.2***
Only penalise once if subscripts are omitted.
Penaliseer slegs een keer indien onderskrifte uitgelaat is.

9.2.1

Marking criteria/*Nasienkriteria:*
- Correct formula to calculate resistance. ✓
  Korrekte formule om weerstand te bereken.
- Substitute into formula to calculate resistance. ✓
  Vervang in formule of weerstand te bereken.
- Final answer/*Finale antwoord:* 484 to/*tot* 493,83 Ω ✓

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***	**OPTION 3/*OPSIE 3***
$P_{ave} = \frac{V_{rms}^2}{R}$ ✓ $100 = \frac{220^2}{R}$ ✓ R = 484 Ω ✓	$P_{ave} = V_{rms}I_{rms}$ $100 = 220I_{rms}$ I_{rms} = 0,45 A (0,455) $I_{rms} = \frac{V_{rms}}{R}$ ✓ $0,45 = \frac{220}{R}$ ✓ R = 488,89 Ω ✓	$P_{ave} = V_{rms}I_{rms}$ $100 = 220I_{rms}$ I_{rms} = 0,45 A (0,455) $P_{ave} = I_{rms}^2R$ ✓ $100 = (0,45)^2R$ ✓ R = 493,83 Ω ✓

(3)

9.2.2

POSITIVE MARKING FROM QUESTION 9.2.1/
POSITIEWE NASIEN VANAF VRAAG 9.2.1.

Marking criteria:
- Uses power of Y in circuit (80 W) to calculate I_{rms} of the circuit. ✓
- Determines V_{rms} across R_Z in the circuit. ✓
- Uses I_{rms} and V_{rms} across R_Z in the circuit to calculate resistance R_Z. ✓
- Use of any one relevant power equation. ✓
- Uses R_Z and 220 V to calculate X. ✓
- Final answer for X. ✓

Accept range*:*
846,07 W to 856,03 W

Nasienriglyne:
- *Gebruik drywing van Y in stroombaan (80 W) om I_{wgk} te bereken.* ✓
- *Bepaal V_{wgk} oor R_Z in die stroombaan.* ✓
- *Gebruik I_{wgk} en V_{wgk} oor R_Z in die stroombaan om weerstand R_Z te bereken.* ✓
- *Gebruik van enige drywing-formule.*
- *Gebruik R_Z en 220 V om X te bereken.* ✓
- *Finale antwoord vir X.* ✓

Aanvaar gebied:
846,07 W tot 856,03 W

For resistor Y/*Vir resistor Y*

$P_{ave} = I_{rms}^2 R$

$80 = {}^{2}_{rms}(484)$ ✓

$I_{rms} = 0,407$ A

OR/*OF*

$P_{ave} = \frac{V_{rms}^2}{R}$

$80 = \frac{V_{rms}^2}{484}$

$V_{rms} = 196,77$ V

$I_{rms} = \frac{V_{rms}}{R}$

$= \frac{196,77}{484}$ ✓

$= 0,407$ A

For/*Vir Z*

$V_{rms} = 220 - 196,77$ ✓

$= 23,23$ V

$I_{rms} = \frac{V_{rms}}{R}$

$[0,407 = \frac{23,23}{R}]$ ✓

$R = 57,08\ \Omega$

Range/*Gebied*:
56,66 Ω to/tot 57,13 Ω

X for Z/*X vir Z:*

$X = P_{ave} = \frac{V_{rms}^2}{R}$ ✓

$= \frac{220^2}{57,08}$ ✓

$= 847,93$ W ✓

OR/*OF*

$I_{rms} = \frac{V_{rms}}{R}$

$= \frac{220}{57,08}$

$= 3,85$ A

$X = P_{ave} = I_{rms}^2 R$ ✓

$= \underline{(3,85)^2(57,08)}$ ✓

$= 846,07$ W ✓

OR/*OF*

$I_{rms} = \frac{V_{rms}}{R}$

$= \frac{220}{57,08}$

$= 3,85$ A

$X = P_{ave} = V_{rms} I_{rms}$ ✓

$= (220)(3,85)$ ✓

$= 847$ W ✓

(6)

[12]

8.6 Decreases/*Neem af* ✓
Total resistance decreases. / *Totale weerstand neem af*. ✓
Current increases. /*Stroom neem toe*. ✓
$V_{internal}$ /Internal voltage ("lost volts") increases. /*Interne potensiaalverskil neem toe.* ✓
$V_{external}$ /*external voltage decreases.* /*Eksterne potensiaalverskil neem af.*

NOTE/*LET WEL*
Do not penalise if "total" is omitted. / *Moenie penaliseer indien "totaal" uitgelaat is nie.* (4)
[19]

QUESTION 9/*VRAAG 9*

9. 1 Slip rings/*Sleepringe* ✓

ACCEPT/*AANVAAR*
Split ring/slip ring commutator /*splitring*/*sleepring kommutator* (1)

9. 2 Y to/*na* X ✓✓ (2)

9.3

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 sleutel woorde/frases in die korrekte konteks uitgelaat is, trek 1 punt af.*

The AC potential difference which dissipates the same amount of energy as an equivalent DC potential difference.
Die WS-potensiaalverskil wat dieselfde hoeveelheid energie verbruik as die ekwivalente/soortgelyke GS-potensiaalverskil.

ACCEPT/*AANVAAR*
The DC potential difference which dissipates the same amount of energy as an equivalent AC potential difference.
Die GS-potensiaalverskil wat dieselfde hoeveelheid energie verbruik as die ekwivalente/soortgelyke WS-potensiaalverskil. (2)

9.4

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***	**OPTION 3/*OPSIE 3***
$V_{rms/wgk} = \frac{V_{max/maks}}{\sqrt{2}}$ $= \frac{100}{\sqrt{2}}$ ✓ $= 70{,}71$ V $I_{rms/wgk} = \frac{V_{rms/wgk}}{R}$ ✓ $= \frac{70{,}71}{25}$ ✓ $= 2{,}83$ A ✓ **ACCEPT/*AANVAAR*** If subscipts omitted in V = IR *Indien onderskrifte uitgelaat is in V = IR*	$I_{max/maks} = \frac{V_{max/maks}}{R}$ $= \frac{100}{25}$ ✓ $= 4$ A $I_{rms/wgk} = \frac{I_{max/maks}}{\sqrt{2}}$ ✓ $= \frac{4}{\sqrt{2}}$ ✓ $= 2{,}83$ A ✓	$P_{ave} = \frac{V_{rms}^2}{R}$ $= \frac{\frac{100^2}{\sqrt{2}}}{25}$ ✓ $= 200$ W $P_{ave} = V_{rms}I_{rms}$ ✓ $200 = \left(\frac{100}{\sqrt{2}}\right)I_{rms}$ ✓ $I_{rms} = 2{,}83$ A ✓

(4)

9.5 **POSITIVE MARKING FROM QUESTION 9.4 /**
POSITIEWE NASIEN VANAF VRAAG 9.4

OPTION 1/*OPSIE 1*

$P_{ave/gem} = \frac{V^2_{rms/wgk}}{R}$ ✓

$= \frac{70,71^2}{25}$ ✓

= 200,00 W ✓ (200 W)

OPTION 2/*OPSIE 2*

$P_{ave} = V_{rms}I_{rms}$ ✓

= (70,71)(2,83) ✓

= 200,11 W ✓

OPTION 3/*OPSIE 3*

$P_{ave/gem} = I^2_{rms/wgk}R$ ✓

$= (2,83)^2(25)$ ✓

= 200,22 W ✓

OPTION 4/*OPSIE 4*

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

$2,83 = \frac{I_{max}}{\sqrt{2}}$

$I_{max/maks}$ = 4 A

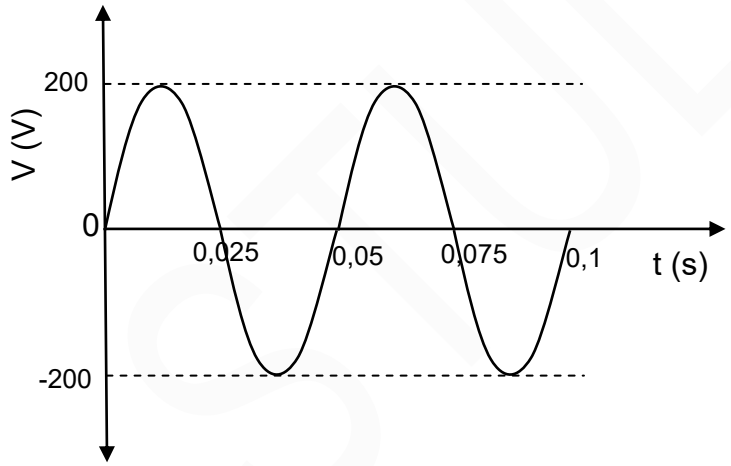
$P_{ave/gem} = \frac{V_{max/maks}I_{max/maks}}{2}$ ✓

$= \frac{(100)(4)}{2}$ ✓

= 200 W ✓

(3)

9.6



Marking criteria/*Nasienkriteria*

- 2 waves ✓
  2 golwe
- Period of wave is 0,05 s ✓
  Periode van golf is 0,05 s
- Amplitude = 200 V ✓

(3)

[15]

8.3.2 **POSITIVE MARKING FROM QUESTION 8.3.1/**
POSITIEWE NASIEN VANAF VRAAG 8.3.1
Option depends on the equation in which r is substituted/
Opsie hang af van die vergelyking waarin r vervang is

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$\varepsilon = V_{ext} + Ir$ $\varepsilon = 2,8 + (0,4)r$ $= 2,8 + (0,4)(0,49)$ ✓ $= 3$ V ✓	$\varepsilon = V_{ext} + Ir$ $\varepsilon = 2,63 + (0,75)r$ $= 2,63 + (0,75)(0,49)$ ✓ $= 3$ V ✓
OPTION 3/*OPSIE 3*	**OPTION 4/*OPSIE 4***
$\varepsilon = I(R + r)$ $= 0,4(7 + 0,49)$ ✓ $= 3$ V ✓	$\varepsilon = I(R + r)$ $= 0,75(3,5 + 0,49)$ ✓ $= 2,99$ V ✓

(2)
[16]

QUESTION 9/*VRAAG 9*

9.1 Slip rings/*sleepringe* ✓ (1)

9.2 Allows the slips rings to rotate while maintaining contact with the external circuit.
Laat die sleepringe toe om te roteer terwyl dit kontak met die eksterne stroombaan behou.
OR/*OF*
Transfer/conduct current to the external circuit. ✓
Dra stroom oor/Gelei stroom na eksterne stroombaan.
OR/*OF*
Connection between external circuit and coil/slip rings/internal circuit.
Verbinding tussen eksterne stroombaan en spoel/sleepringe/interne stroombaan. (1)

9.3 According to the principle of electromagnetic induction, an emf/current is induced as a result of the change in the magnetic flux linkage ✓✓ with the coil. **(2 or 0)**
Volgens die beginsel van elektromagnetiese induksie word 'n emk/stroom geïnduseer as gevolg van die verandering in magnetiese-vloedkoppeling met die spoel. ***(2 of 0)***

Accept/*Aanvaar*
When the coil rotates there is a change of magnetic flux linked/associated with the coil and according to the principle of electromagnetic induction, an emf/current is induced in the coil. **(2 or 0)**
Wanneer die spoel roteer is daar 'n verandering in magnetiese-vloedkoppeling met die spoel en volgens die beginsel van elektromagnetiese induksie word 'n stroom/emk in die spoel geïnduseer. ***(2 of 0)***
Accept/*Aanvaar*
There is relative motion between the conductor and the magnetic field.**(2 or 0)**
Daar is relatiewe beweging tussen die geleier en die magneetveld . ***(2 of 0)*** (2)

9.4 **P** to/*na* **Q** ✓✓ (2)

9.5

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$T = \frac{1}{f} = \frac{1}{50}$ ✓ = 0,02 s $t = (1,5)(0,02)$ ✓ = 0,03 s ✓ **OR/*OF*** t = (0,02) + ½ (0,02) ✓ = 0,03 s ✓	50 waves/*golwe* = 1 s ✓ 1,5 waves/*golwe* ✓ = 0,03 s ✓
OPTION 3/*OPSIE 3*	
$t = \frac{1,5}{50}$ ✓✓ = 0,03 s ✓	
OPTION 4/*OPSIE 4*	
$t = \frac{3}{4}(0,04)$ ✓✓ = 0,03 s ✓	

(3)

9.6

$V_{rms} = \frac{V_{max}}{\sqrt{2}}$
$= \frac{311}{\sqrt{2}}$ ✓
= 219,91 V

$I_{rms} = \frac{V_{rms}}{R}$
$= \frac{219,91}{100}$ ✓
= 2,2 A (2,199)

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***	**OPTION 3/*OPSIE 3***
$W = \frac{V^2 \Delta t}{R}$ ✓ ✓✓ $= \frac{(219,11)^2}{100}(60)$ = 29 016,24 J ✓	$W = VI\Delta t$ ✓ = (219,91)✓(2,2)✓(60) ✓ = 29 028,12 J ✓ (29 013,61– 29 028,12)	$W = I^2R\Delta t$ ✓ $= (2,2^2)$✓✓(100)(60) = 29 040 J ✓ (29 013,61 – 29 040)

OPTION 4/*OPSIE 4*	**OPTION 5/*OPSIE 5***	**OPTION 6/*OPSIE 6***
$P_{ave} = V_{rms}I_{rms}$ = (219,11)(2,2) ✓ = 483,605 W $P = \frac{W}{\Delta t}$ ✓ $483,605 = \frac{W}{60}$ ✓ W = 29 016,30 J ✓	$P_{ave} = \frac{V_{rms}^2}{R}$ $= \frac{(219,11)^2}{100}$ ✓ = 483,605 W $P = \frac{W}{\Delta t}$ ✓ $483,605 = \frac{W}{60}$ ✓ W = 29 016,30 J ✓	$P_{ave} = I_{rms}^2 R$ $= (2,2)^2$ ✓(100) = 483,605 W $P = \frac{W}{\Delta t}$ ✓ $483,605 = \frac{W}{60}$ ✓ W = 29 016,30 J ✓

(5)
[14]

QUESTION 9/*VRAAG 9*

9.1.1 (DC) motor/*(GS-)motor* ✓ (1)

9.1.2 **POSITIVE MARKING FROM QUESTION 9.1.1**
POSITIEWE NASIEN VANAF VRAAG 9.1.1
Electrical to mechanical /kinetic (energy) ✓✓ **(2 or 0)**
Elektriese na meganiese/kinetiese (energie) ***(2 of 0)*** (2)

9.1.3 Split ring/commutator/*Splitring/kommutator* ✓ (1)

9.1.4 Anticlockwise/*antikloksgewys* ✓✓ (2)

9.2.1 (The rms voltage/value of AC is) the AC voltage/potential difference which dissipates the same amount of energy/heat/power as an equivalent DC voltage/potential difference. ✓✓ **(2 or 0)**
(Die wgk-waarde van WS is) die WS-potensiaalverskil/spanning wat dieselfde hoeveelheid energie/hitte/drywing verbruik as 'n ekwivalente GS-spanning/ potensiaalverskil. ***(2 of 0)***

ACCEPT/*AANVAAR*
The rms voltage/value of AC is the DC potential difference which dissipates the same amount of energy/heat/power as AC.
Die wgk-waarde van WS is die GS-potensiaalverskil wat dieselfde hoeveelheid energie/hitte/drywing verbruik as die WS. (2)

9.2.2

Marking criteria/*Nasienriglyne*
- Appropriate formula for P_{ave}/*Geskikte formule* vir P_{ave} ✓
- Substitution to calculate/*Vervanging vir berekening van* R ✓
- Final answer/*Finale antwoord*: 242 Ω ✓

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***	**OPTION 3/*OPSIE 3***
$P_{ave} = \frac{V_{rms}^2}{R}$ ✓ $200 = \frac{220^2}{R}$ ✓ R = 242 Ω ✓	$P_{ave} = V_{rms}I_{rms}$ ✓ $200 = I_{rms}(220)$ I_{rms} = 0,909 A (0,91) $R = \frac{V_{rms}}{I_{rms}}$ or/*of* $R = \frac{V}{I}$ $R = \frac{220}{0,909}$ ✓ R = 242 Ω ✓ (241,76 Ω)	$P_{ave} = V_{rms}I_{rms}$ ✓ $200 = I_{rms}(220)$ I_{rms} = 0,909 A(0,91) $P_{ave} = I_{rms}^2R$ $200 = (0,909)^2R$ ✓ R = 242 Ω ✓ (241,52 Ω)

(3)

9.2.3

Marking criteria for options 1,2 and 3 /*Nasienriglyne vir opsies 1,2 en 3*

- Appropriate formula to calculate P or I_{rms} /*Geskikte formule om* P *of* I_{rms} te bereken ✓
- Substitution/*Vervanging* ✓
- Formula for P or W containing Δt/*Formule vir P of W wat Δt bevat* ✓
- Substitution/*Vervanging* ✓
- Final answer/Finale antwoord: 55 785,12 J ✓

POSITIVE MARKING FROM QUESTION 9.2.2.
POSITIEWE NASIEN VANAF VRAAG 9.2.2.

OPTION 1/*OPSIE 1*
Marking criteria / *Nasienriglyne*

- Appropriate formula for W containing V/*Geskikte formule vir W wat V bevat* ✓✓
- Substitution/*Vervanging* ✓✓
- Final answer/*Finale antwoord*: 55 785,12 J ✓

$W = \frac{V^2\Delta t}{R}$ ✓✓
$= \frac{(150^2)(10 \times 60)}{242}$ ✓
= 55 785,12 J ✓

OPTION 2/*OPSIE 2*

$P_{ave} = \frac{V_{rms}^2}{R}$ ✓
$= \frac{150^2}{242}$ ✓
P_{av} = 92,975 W
$P = \frac{W}{\Delta t}$ ✓
$92{,}975 = \frac{W}{(10)(60)}$ ✓
W = 55 785,12 J ✓
(55785,12 – 55896 J)

OPTION 3/*OPSIE 3*

$R = \frac{V_{rms}}{I_{rms}}$ ✓/ $R = \frac{V}{I}$
$242 = \frac{150}{I_{rms}}$ ✓
I_{rms} = 0,620 A
$P_{ave} = I_{rms}V_{rms}$
= (0,62)(150)
= 92,97 W (93 W)
$P = \frac{W}{\Delta t}$ ✓
$92{,}975 = \frac{W}{(10)(60)}$ ✓
W = 55 785,12 J ✓
(55785,12 – 55896 J)

OPTION 4/*OPSIE 4*

$R = \frac{V_{rms}}{I_{rms}}$ ✓/ $R = \frac{V}{I}$
$242 = \frac{150}{I_{rms}}$ ✓
I_{rms} = 0,620 A
$W = I^2R\Delta t$ ✓
$= (0{,}62)^2(242)(10)(60)$ ✓
= 55 814,88 J ✓
(55785,12 – 55896 J)

OR/*OF*
W = VIΔt
= (150)(0,62)(600)
= 55 800 J

OPTION 5/*OPSIE 5*

$P_{ave} = \frac{V_{rms}^2}{R}$ ✓ $= \frac{150^2}{242}$ ✓= 92,975 W
$P_{ave} = I_{rms}^2R$
$92{,}975 = I_{rms}^2(242)$
I_{rms} = 0,6198 A
$W = I^2R\Delta t$ ✓
$= (0{,}6198)^2(242)(10)(60)$ ✓
= 55 778,88 J ✓

(5)
[16]

OPTION 7/*OPSIE 7*

$\mathcal{E} = I(R + r)$ ✓

$V_{ext} = \underline{13 - (4)(1,31)}$ ✓

$= 7,76$ V

$V_{ext} = IR_{ext}$

$7,76 = (4)\left(\frac{1}{2X} + \frac{1}{5,6}\right)^{-1}$ ✓

$X = 1,48\ \Omega$ ✓ (5)

[19]

QUESTION 9/*VRAAG 9*

9.1

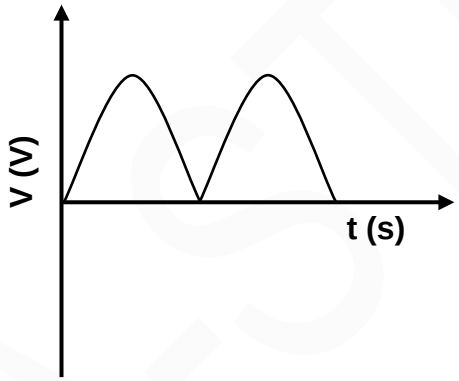
9.1.1 DC/*GS* ✓ (1)

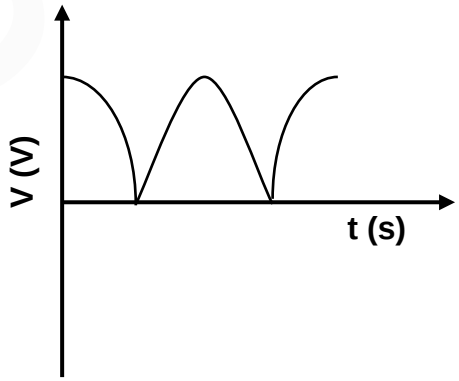
9.1.2 **NOTE:** -1 mark for each key word/phrase omitted in correct context.
LET WEL: *-1 punt vir elke sleutel woord/frase weggelaat in die korrekte konteks.*

Emf is induced as a result of change of magnetic flux (linked) with the coil. ✓✓

Emk word geïnduseer as gevolg van verandering van die magnetiese vloedkoppeling. (2)

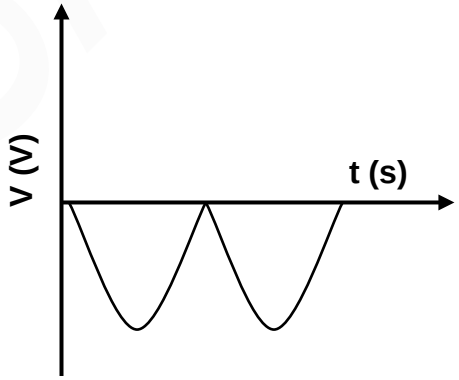
9.1.3 **POSITIVE MARKING FROM QUESTION 9.1.1**
POSITIEWE NASIEN VANAF VRAAG 9.1.1

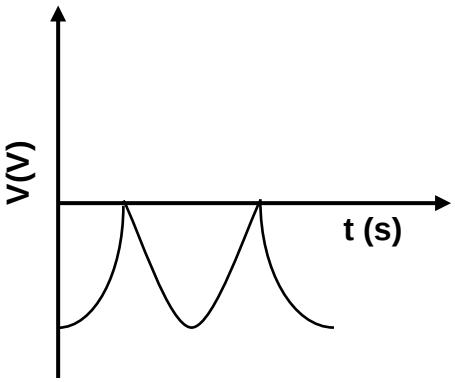




OR/*OF*

Marking criteria for graph:	
Correct shape *Korrekte vorm*	✓
One complete cycle/*Een volledige siklus*	✓





(2)

9.2.1 The AC potential difference/voltage which dissipates the same amount of energy ✓ as DC potential difference. ✓
Die WS potensiaalverskil/spanning wat dieselfde hoeveelheid energie verbruik as GS potensiaalverskil/spanning

OR/*OF*

(The rms value of AC is) the DC potential difference/voltage which dissipates the same amount of energy ✓ as AC potential difference/voltage. ✓
Dit is die GS potensiaalverskil/spanning wat dieselfde hoeveelheid energie verbruik as WS potensiaalverskil/spanning. (2)

9.2.2

OPTION 1/ *OPSIE 1*	**OPTION 2 / *OPSIE 2***	**OPTION 3 / *OPSIE 3***	**OPTION 4 / *OPSIE 4***
$W = \frac{V^2}{R}\Delta t$ ✓ $500 = \frac{V^2}{200}(10)$ ✓ $V = V_{rms} = 100\ V$ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓ $100 = \frac{V_{max}}{\sqrt{2}}$ ✓ $V_{max} = 141,42\ V$ ✓	$W = I^2R\Delta t$ $500 = I^2(200)(10)$ $I = I_{rms} = 0,5\ A$ $P_{ave} = V_{rms}I_{rms}$ ✓ $\frac{500}{10} = V_{rms}(0,5)$ ✓ $V_{rms} = 100\ V$ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓ $100 = \frac{V_{max}}{\sqrt{2}}$ ✓ $V_{max} = 141,42\ V$ ✓	$P_{ave} = I^2_{rms}R$ $\frac{500}{10} = I^2_{rms}(200)$ $I_{rms} = 0,5\ A$ $P_{ave} = V_{rms}I_{rms}$ ✓ $\frac{500}{10} = V_{rms}(0,5)$ ✓ $V_{rms} = 100\ V$ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓ $100 = \frac{V_{max}}{\sqrt{2}}$ ✓ $V_{max} = 141,42\ V$ ✓	$R = \frac{V_{rms}}{I_{rms}}$ ✓ $200 = \frac{V_{rms}}{0,5}$ ✓ $V_{rms} = 100\ V$ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓ $100 = \frac{V_{max}}{\sqrt{2}}$ ✓ $V_{max} = 141,42\ V$ ✓

OPTION 5 / *OPSIE 5*	**OPTION 6 / *OPSIE 6***	**OPTION 7 / *OPSIE 7***	**OPTION 8 / *OPSIE 8***
$P_{ave} = \frac{V^2_{rms}}{R}$ ✓ $\frac{500}{10} = \frac{V^2_{rms}}{200}$ ✓ $V_{rms} = 100\ V$ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓ $100 = \frac{V_{max}}{\sqrt{2}}$ ✓ $V_{max} = 141,42\ V$ ✓	$P_{ave} = \frac{P_{max}}{2}$ ✓ $\frac{500}{10} = \frac{P_{max}}{2}$ ✓ $P_{max} = 100\ W$ $P_{max} = \frac{V^2_{max}}{R}$ ✓ $100 = \frac{V^2_{max}}{200}$ ✓ $V_{max} = 141,42\ V$ ✓	$P = \frac{W}{\Delta t} = \frac{500}{10}$ $= 50\ W$ $P_{ave} = \frac{V^2_{rms}}{R}$ ✓ $50 = \frac{V^2_{rms}}{200}$ ✓ $V_{rms} = 100\ V$ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓ $100 = \frac{V_{max}}{\sqrt{2}}$ ✓ $V_{max} = 141,42\ V$ ✓	$P_{ave} = I^2_{rms}R$ ✓ $\frac{500}{10} = I^2_{rms}(200)$ ✓ $I_{rms} = 0,5\ A$ $I_{rms} = \frac{I_{max}}{\sqrt{2}}$ $0,5 = \frac{I_{max}}{\sqrt{2}}$ $I_{max} = 0,71\ A$ $V_{max} = I_{max}R$ ✓ $= (0,71)(200)$ ✓ $= 142\ V$ ✓

(5)
[12]

QUESTION 9/*VRAAG 9*

9.1 Slip rings/*Sleep ringe* ✓ (1)

9.2 B ✓ (1)

9.3

$$V_{rms/wgk} = \frac{V_{max/maks}}{\sqrt{2}} \checkmark$$
$$= \frac{312}{\sqrt{2}} \checkmark$$
$$= 220{,}62 \text{ V} \checkmark$$

(3)

9.4.1

POSITIVE MARKING FROM 9.3/*POSITIEWE NASIEN VANAF 9.3*
OPTION 1/*OPSIE 1*

$$P_{aver/gemid} = \frac{V^2_{rms/wgk}}{R} \checkmark$$
$$= \frac{(220{,}62)^2}{40} \checkmark$$
$$= 1216{,}83 \text{ W} \checkmark$$

POSITIVE MARKING FROM 9.3/*POSITIEWE NASIEN VANAF 9.3*
OPTION 2/*OPSIE 2*

$$I_{rms} = \frac{V_{rms/wgk}}{R}$$
$$= \frac{(220{,}62)}{40}$$
$$= 5{,}515$$

✓ for any/ *vir enige*

$$P_{ave} = I^2_{rms}R$$
$$= (5{,}515)^2(40) \checkmark$$
$$= 1216{,}61 \text{ W} \checkmark$$

OR

$$P_{ave} = V_{rms}I_{rms}$$
$$= (220{,}62)(5{,}515) \checkmark$$
$$= 1216{,}72 \text{ W} \checkmark$$

OPTION 3/*OPSIE 3*

$I_{max} = \frac{V_{max}}{R}$

$= \frac{312}{40}$

$= 7,80$ A

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

$= \frac{(7,8)(312)}{2}$ ✓

$= 1216,80$ W ✓

✓ for any/ *vir enige*

(3)

9.4.2

OPTION 1/*OPSIE 1*

$I_{max/maks} = \frac{V_{max/maks}}{R}$ ✓

$= \frac{312}{40}$ ✓ ✓

$= 7,8$ A✓

Accept/ *Aanvaar*: $I = \frac{V}{R}$

POSITIVE MARKING FROM 9.3 AND 9.4.1/*POSITIEWE NASIEN VANAF 9.3 EN 9.4.1*

OPTION 2/*OPSIE 2*

$P_{ave/gemid} = V_{rms/wgk} I_{rms/wgk}$

$1\,216,83 = 220,62\ I_{rms/wgk}$ ✓

$I_{rms/wgk} = 5,515$ A

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

$5,515 = \frac{I_{max/maks}}{\sqrt{2}}$ ✓

$I_{max/maks} = 7,8$ A✓

✓ for any/ *vir enige*

OPTION 3/*OPSIE 3*

$P_{ave/gemid} = I^2_{rms/wgk} R$

$1\,216,83 = I^2_{rms/wgk}(40)$✓

$I_{rms/wgk} = 5,515$ A

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

$5,515 = \frac{I_{max/maks}}{\sqrt{2}}$ ✓

$I_{max/maks} = 7,8$ A ✓

✓ for any/ *vir enige*

(4)

[12]

8.3 Decreases /*Neem af* ✓
Total resistance decreases /*Totale weerstand neem af*✓
Current increases/*Stroom neem toe* ✓
"Lost volts" increases, ✓(emf the same)/*"Verlore volts" neem toe, (emk dieselfde)*
External potential difference decreases/*eksterne potensiaal verskil neem af*

OR/*OF*
Decreases /*Neem af* ✓
Total resistance decreases /*Totale weerstand neem af* ✓
Current increases/*Stroom neem toe* ✓
$\varepsilon = V_{ext/eks} + Ir$
Ir increases/*Ir neem toe* ✓
ε is constant/*is konstant*
$\therefore V_{ext/eks}$ decreases/*neem af* (4)
[11]

QUESTION 9/*VRAAG 9*

9.1 Temperature/*Temperatuur* ✓ (1)

9.2.1 *r* = 3 Ω or/*of* 1,5 Ω ✓✓

Accept *for one mark only*: /*Aanvaar vir slegs een punt*
r = -3 Ω ✓ or/of -1,5 Ω (2)

9.2.2
ε = slope (gradient) of the graph/*helling(gradiënt)van die grafiek* ✓
$\varepsilon = \frac{7,5-(-3)}{1,5-0}$ ✓
= 7 V✓

Accept any correct values from the graph
Aanvaar enige korrekte waardes vanaf die grafiek

OR/*OF*
POSITIVE MARKING FROM 9.2.1 / *POSITIEWE NASIEN VANAF 9.2.1*
$R = \frac{\varepsilon}{I} - r$ ✓
$7,5 = 1,5\varepsilon - 3$ ✓
ε = 7 V ✓

Accept any correct values on the line from the graph
Aanvaar enige korrekte waardes op die lyn vanaf die grafiek

OR/OF
ε = I(R + r) ✓
= 0,5(11 + 3) ✓
ε = 7 V ✓ (3)
[6]

QUESTION 10/*VRAAG 10*

10.1.1 Y to/*na* X ✓ (1)

10.1.2 Faraday's Law Electromagnetic Induction ✓
Faraday se wet van Elektromagnetiese Induksie

OR/OF
Electromagnetic induction/Faraday's Law✓
Elektromagnetiese induksie/Faraday se wet (1)

10.1.3 Mechanical (kinetic) energy ✓to electrical energy ✓
Meganiese (kinetiese) energie na elektriese energie (2)

10.2.1 340 V ✓ (1)

Accept / Aanvaar
-340 V

10.2.2

POSITIVE MARKING FROM 10.2.1/*POSITIEWE NASIEN VANAF 10.2.1*

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

$$= \frac{340}{\sqrt{2}} \checkmark$$

$$V_{rms/wgk} = 240{,}42 \text{ V} \checkmark$$ (3)

10.2.3

POSITIVE MARKING FROM 10.2.2 / *POSITIEWE NASIEN VANAF 10.2.3*

OPTION 1/*OPSIE 1*

$$P_{ave/gemid} = \frac{V^2_{rms/wgk}}{R} \checkmark$$

$$1\,600 = \frac{(240{,}42)^2}{R} \checkmark$$

$$R = 36{,}13\ \Omega\ (36{,}126\ \Omega) \checkmark$$

OR/*OF*
R = 36,12 Ω (36,124 Ω)

OPTION 2/ *OPSIE 2*

$$P_{ave/gemid} = \frac{V^2_{rms/wgk}}{R} \checkmark = \frac{\frac{V^2_{max/maks}}{2}}{R} = \frac{V^2_{max/maks}}{2R}$$

$$1\,600 = \frac{(340)^2}{2R} \checkmark$$

$$R = 36{,}13\ \Omega\ (36{,}125\ \Omega) \checkmark$$

OPTION 3/*OPSIE 3*

$P_{ave/gemid} = V_{rms/wgk} I_{rms/wgk}$

$1600 = (240,416)\ I_{rms/wgk}$

$I_{rms/wgk} = 6,66$ A

$R = \frac{V_{rms}}{I_{rms}}$ ✓

$= \frac{240,416}{6,66}$ ✓

$= 36,1\ \Omega\ (36,09\ \Omega)$ ✓

(Do not penalise if rms is omitted in $R = \frac{V_{rms}}{I_{rms}}$ / *Moenie penaliseer indien wgk uitgelaat is nie.)*

OPTION 4/*OPSIE 4*

$P_{ave/gemid} = \frac{V_{max/maks} I_{max/maks}}{2}$

$1600 = \frac{340 I_{max/maks}}{2}$

$I_{max/maks} = 9,412$ A

$R = \frac{V_{max}}{I_{max}}$ ✓

$= \frac{340}{9,412}$ ✓

$= 36,12\ \Omega$ ✓

(Do not penalise if max is omitted in $R = \frac{V_{max}}{I_{max}}$ / *Moenie penaliseer indien maks uitgelaat*

(3)
[11]

QUESTION 11/*VRAAG 11*

11.1 Work function of a metal is the minimum energy needed to eject an electron from the metal surface ✓✓
Arbeidsfunksie van 'n metaal is die minimum energie benodig om 'n elektron uit die oppervlakte van 'n metaal vry te stel. (2)

NOTE/*LET WEL*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark.
*Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

11.2 Potassium / *Kalium* / K ✓ (-)

f_o for potassium is greater than f_o for caesium ✓
f_o vir kalium is groter as f_o vir sesium

OR/*OF*
Work function is directly proportional to threshold frequency ✓
Arbeidsfunksie is direk eweredig aan die drumpel frekwensie

ACCEPT/*AANVAAR*
$W_o = hf_o$
$W_o \ \alpha\ f_o$ (2)

11.3 **OPTION 1/*OPSIE 1***
$c = f\lambda$ ✓
$3 \times 10^8 = f(5,5 \times 10^{-7})$ ✓
$f = 5,45 \times 10^{14}$ Hz
$f_{uv} < f_{o\ of\ K(potassium)}$
∴Ammeter in circuit **B** will not show a reading ✓
∴*Ammeter in stroombaan B sal nie 'n lesing toon nie.*

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*)
$= 18\ \Omega$

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

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

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

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

✓

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

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

$= 0{,}33\ A\checkmark$ (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]

9.2.1
$$R = \frac{V}{I}$$
$$= \frac{2,8}{0,7} \checkmark$$
$$= 4\ \Omega \checkmark$$ (2)

9.2.2 Increases ✓/*Neem toe*
Total resistance decreases, ✓ current/power increases✓, motor turns faster/
Totale weerstand neem af, stroom/drywing neem toe, motor draai vinniger (3)
[20]

QUESTION 10/*VRAAG 10*

10.1
10.1.1 Split ring / commutator ✓/*Spleetring/ kommutator* (1)

10.1.2 Anticlockwise ✓✓/*Antikloksgewys* (2)

10.1.3 Electrical energy ✓to mechanical(kinetic) energy ✓
Elektriese energie na meganiese (kinetiese) energie (2)

10.2
10.2.1 DC generator: split ring/commutator and AC generator has slip rings✓
GS-generator spleetringe/kommutator en WS-generator sleepringe

OR/*OF*
AC generator: slip ring and DC generator has split rings✓
WS-generator sleepringe en GS-generator spleetringe (1)

10.2.2
$$V_{rms} = \frac{V_{max}}{\sqrt{2}} \checkmark$$
$$= \frac{320}{\sqrt{2}} \checkmark$$
$$= 226,27\ V \checkmark$$ (3)

10.2.3
<u>OPTION 2/*OPSIE 12*</u>
$$I_{max} = \frac{V_{max}}{R}$$
$$= \frac{320}{35} \checkmark$$
$$= 9,14\ A$$
$$I_{rms} = \frac{I_{max}}{\sqrt{2}} \checkmark$$
$$= \frac{9,14}{\sqrt{2}} \checkmark$$
$$= 6,46\ A \checkmark$$

POSITIVE MARKING FROM 10.2.2/ *POSITIEWE NASIEN VANAF 10.2.2.2.*

OPTION 2/*OPSIE 2*

$$P_{average} = \frac{V_{rms}^2}{R}$$
$$= \frac{226,27^2}{35} \checkmark$$
$$= 1462,80 \text{ W}$$

$P_{average} = V_{rms}I_{rms}$ ✓ $1\,462,80 = (226,27)\, I_{rms}$ ✓ $I_{rms} = 6,46$ A ✓	$P_{average} = I^2_{rms}R$ ✓ $1\,462,80 = I^2_{rms}(35)$ ✓ $I_{rms} = 6,46$ A ✓

(4)

POSITIVE MARKING FROM 10.2.2/ *POSITIEWE NASIEN VANAF 10.2.2.2*

OPTION 1/*OPSIE 1*

$$I_{rms} = \frac{V_{rms}}{R} \checkmark = \frac{226,27}{35} \checkmark = 6,46 \text{ A} \checkmark$$

(4)
[13]

QUESTION 11/*VRAAG 11*

11.1 Work function (of a metal) is the minimum energy needed to eject an electron from the metal/surface
Werksfunksie (van 'n metaal) is die minimum energie benodig om 'n elektron vanaf die metaal/oppervlak vry te stel. (2)

NOTE:/LET WEL
If any one of the underlined key words in the **correct context** is omitted deduct 1 mark.
*Indien enige van die onderstreepte woorde in die **korrekte konteks** uitgelaat is trek 1 punt af.*

11.2 (Maximum) kinetic energy of the ejected electrons✓
(*Maksimum) kinetiese energie van die vrygestelde elektrone.* (1)

11.3 Wavelength/Frequency (of light) ✓
Golflengte/frekwensie (van lig) (1)

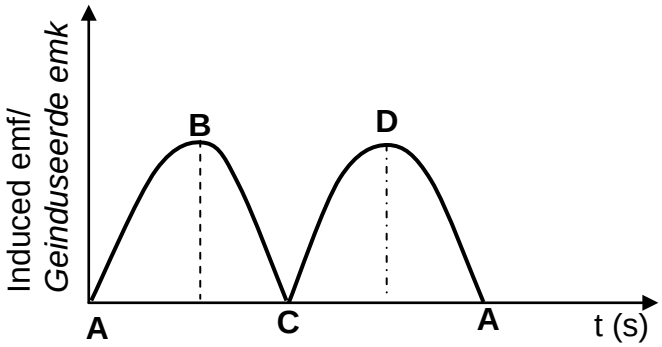
11.4 Silver✓/*Silwer*

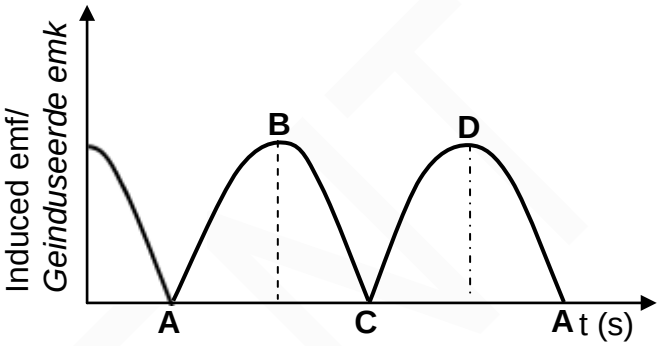
- According to Photoelectric equation, $hf = W_o + ½ mv^2$
(For a given constant frequency), as the work function increases the kinetic energy decreases. ✓ Silver has the smallest kinetic energy✓ and hence the highest work function./
Volgens die fotoelektriese vergelyking $hf = W_o + ½ mv^2$:
(Vir 'n gegewe konstante frekwensie) as die werksfunksie verhoog, verlaag die kinetiese energie. Silwer het die kleinste kinetiese energie en dus die hoogste werksfunksie. (3)

QUESTION 10 / *VRAAG10*

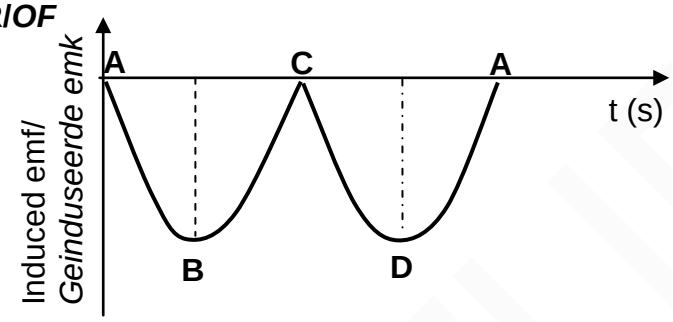
10.1
10.1.1 Mechanical to electrical / Meganies na elektries ✓ (1)

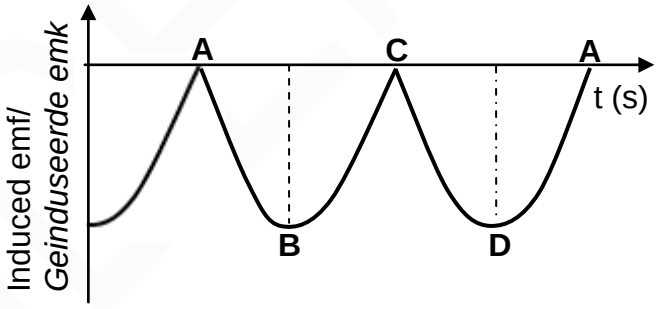
10.1.2





OR/*OF*





Criteria for graph/*Kriteria vir grafiek*	**Marks/*Punte***
Correct DC shape, starting from zero/*Korrekte GS vorm wat by nul begin*	✓
Positions ABCDA correctly indicated on the graph/*Posisies ABCDA of grafiek aangedui*	✓

(2)

10.2.1 20,5 Ω✓ (1)

10.2.2

OPTION 1/*OPSIE 1*

$I_{rms} = \frac{V_{rms}}{R}$✓ $= \frac{25}{20,5}$✓
$= 1,22\ (1,2195)\ A$

$P_{ave} = I_{rms}^2 R$ $=(1,22)^2(0,5)$ $= 0,74\ W$ $P_{ave} = \frac{V_{rms}^2}{R}$ ✓ $P_{ave} = \frac{(25)^2}{20,5}$✓ $P_{ave} = 30,49\ W$ Actual energy delivered per second(power) / *Energie aan toestel gelewer per sekonde (drywing)* $= (30,49 – 0,74)$ $= 29,75\ W$✓	$P_{ave} = I_{rms}^2 R$✓ $= (1,22)^2(20)$ ✓ $= 29,77\ W$✓ **OR/OF** $V_{rms/wgk\ device/toestel} = \frac{20}{20,5}$ ✓ $\times 25 = 24,39\ V$ $P_{ave} = V_{rms} I_{rms}$ ✓ $= (24,39)(1,22)$ $= 29,76\ W$ ✓	$W = I^2_{rms} R\Delta t$ $= (1,22)^2\ (0,5)(1)$ $= 0,74\ J$ $P_{ave} = \frac{V_{rms}^2}{R}$ ✓ $P_{ave} = \frac{(25)^2}{20,5}$ ✓ $P_{ave} = 30,49\ W$ Actual energy delivered per second(power) / *Energie aan toestel gelewer per sekonde (drywing)* $= (30,49 – 0,74)$ $= 29,75\ W$✓

OPTION 2/*OPSIE 2*

$V_{rms/wgk\ device/toestel} = \frac{20}{20,5}$ ✓ $\times 25 = 24,39\ V$

$P_{ave} = \frac{V_{rms}^2}{R}$✓ $= \frac{(24,39)^2}{20}$✓ $= 29,74\ W$✓

(5)
[9]

QUESTION 11 / *VRAAG 11*

11.1.1 (Line) emission (spectrum) / *(Lyn) emissiespektrum* ✓ (1)

11.1.2 (Line) absorption (spectrum) / *(Lyn) absorpsiespektrum* ✓ (1)

11.2.1 Emission ✓/ *Emissie* (1)

11.2.2

Energy released in the transition from E_4 to $E_2 = E_4 – E_2$
Energie vrygestel in die oorgang vanaf E_4 na $E_2 = E_4 – E_2$
$E_4 – E_2 = (2,044 \times 10^{-18} – 1,635 \times 10^{-18})$✓ $= 4,09 \times 10^{-19} J$

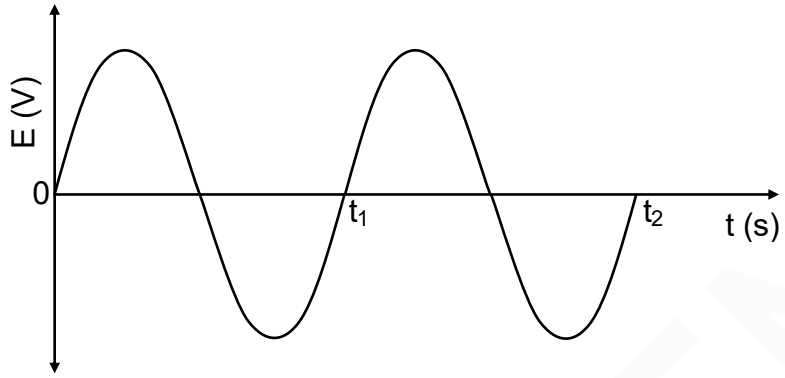
$E = hf$✓
$4,09 \times 10^{-19} = (6,63 \times 10^{-34})f$✓
$f = 6,17 \times 10^{14}\ Hz$✓

(4)

QUESTION 9/*VRAAG 9*

9.1 Slip rings/*Sleepringe* ✓ (1)

9.2



Marking criteria/*Nasienriglyne*	
Sine graph starts from 0. *Sinusgrafiek begin by 0*	✓
Two complete waves (between t_0 and t_2) *Twee volledige golwe tussen (t_0 en t_2)*	✓

(2)

9.3 Any TWO/*Enige TWEE*
Increase the speed of rotation/*Verhoog die rotasie spoed*✓
Increase the number of coils (turns)/*Verhoog die getal spoele*✓
Use stronger magnets/*Gebruik sterker magnete*
ACCEPT/*AANVAAR*: Increase surface area/*Verhoog die oppervlakarea* (2)

9.4 The rms value of an AC voltage it that value of the AC voltage which will dissipate the same amount of energy as DC.
Die wgk waarde van WS potensiaalverskil/stroom hoeveelheid energie as GS verkwis

OR/*OF*
The rms value of an AC voltage it that value of the AC voltage which will produce the same joule heating effect as DC.
Die wgk waarde van WS potensiaalverskil is die waarde van die WS potensiaalverskil wat dieselfde joule verhittingseffek as GS lewer. (2)

9.5

OPTION 1/OPSIE 1	**OPTION 2/OPSIE 2**
$P_{ave/gem} = I_{rms/wgk}V_{rms/wgk}$ ✓ $1500 = I_{rms/wgk}(240)$ ✓ $I_{rms/wgk} = \frac{1500}{240}$ $= 6,25$ A ✓	$P_{ave} = \frac{V^2}{R}$ ✓ $1500 = \frac{240^2}{R}$ $R = 38,4\ \Omega$ $I_{rms} = \frac{V}{R}$ $= \frac{240}{38,4}$ ✓ $= 6,25$ A✓

(3)
[10]

QUESTION/*VRAAG10*

10.1.1 **R:** armature/Coil(s)/*Spoel*✓
T: (Carbon/*Koolstof*) brushes/*borsels*✓
X: Slip rings/*sleepringe*✓
NOTE/*LETWEL*:
Answers must be in that order if R, T and X are omitted.
Antwoorde moet in hierdie orde wees as R, T en X weggelaat (3)

10.1.2 Faraday's Law/*Faraday se wet* ✓ (1)

10.2.1 15 V✓ (1)

10.2.2

OPTION 1/*OPSIE 1*

$V_{rms} = I_{rms}R$

$I_{rms} = \frac{15}{45}$ ✓

$= 0,333$ A

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

$I_{max} = (0,333)\sqrt{2}$ ✓

$= 0,47$ A✓

✓any one/*enige een*

OPTION 2/*OPSIE 2*

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

$V_{max} = (15)\sqrt{2}$ ✓

$= 21,213$V

$V_{max} = I_{max}R$

$I_{max} = \frac{21,213}{45}$ ✓

$= 0,47$ A✓

✓any one/*enige een*

OPTION 3/*OPSIE 3*

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

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

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

$= \sqrt{2}\frac{15}{45}$ ✓✓

$= 0,47$ A ✓

✓any one/*enige een*

OPTION 4/*OPSIE 4*

$P_{ave} = \frac{V_{rms}^2}{R} = \frac{15^2}{45} = 5\,W$

$P_{ave} = V_{rms}I_{rms}$
$5 = (15)I_{rms}$ ✓
$I_{rms} = 0,33$ A

✓any one/*enige een*

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

$0,33 = \frac{I_{max}}{\sqrt{2}}$ ✓

$I_{max} = 0,47$ A ✓ (4)

[9]

QUESTION/*VRAAG 11*

11.1 It is the process whereby electrons are ejected from a (metal) surface when light of suitable frequency is incident on that surface. ✓✓
Dit is die proses waarby elektrone vanaf die oppervlak van 'n metaal vrygestel word wanneer lig van geskikte frekwensie daarop skyn. (2)

11.2 INCREASE /*TOENEEM* ✓

Increase in intensity means that (for the same frequency) the number of photons incident per unit time increase. ✓ Therefore the number of electrons ejected per unit time increases. ✓
Thus current increases.
Toename in intensiteit beteken dat (vir dieselfde frekwensie) die aantal fotone per eenheid tyd neem toe. Dus sal die aantal elektrone per eenheid tyd vrygestel, toeneem. (3)

11.3 **OPTION 1/*OPSIE 1***

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

✓Any one/*Enige een*

$(6,63 \times 10^{-34} \times 5,9 \times 10^{14})$ ✓ $= \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{\lambda_0}$ ✓ $+ 2,9 \times 10^{-19}$

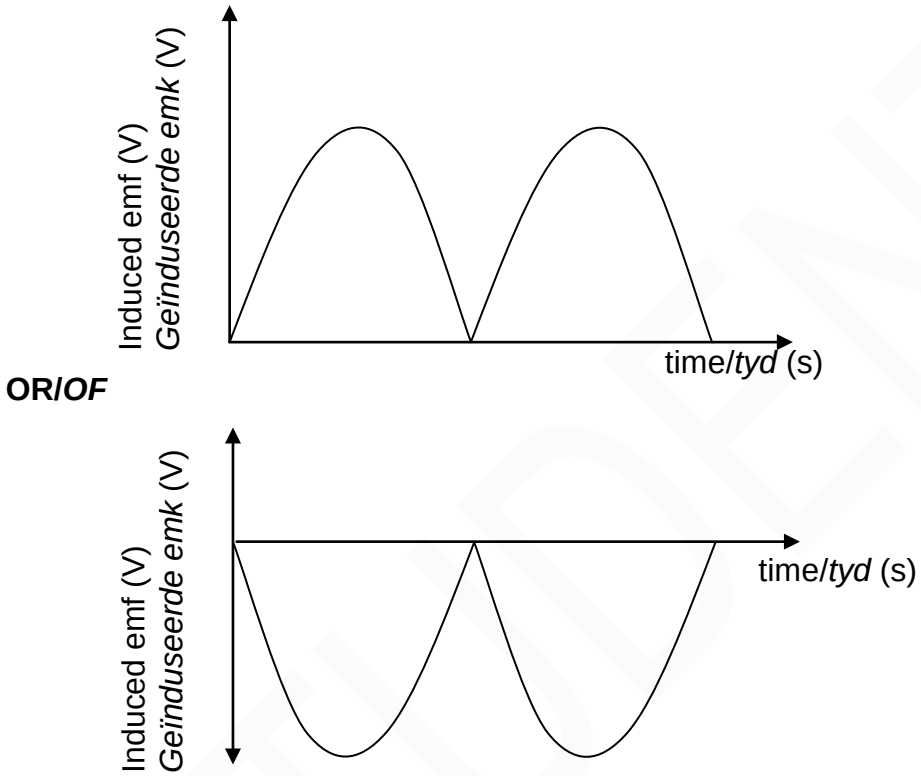
$39,117 \times 10^{-20} - 2,9 \times 10^{-19} = \frac{19,89 \times 10^{-26}}{\lambda_o}$

$\lambda_o = 1,97 \times 10^{-6}$ m✓

QUESTION 9/*VRAAG 9*

9.1.1 DC/*GS*-generator✓
Uses split ring/commutator/*Gebruik spleetring/kommutator*✓ (2)

9.1.2



OR/*OF*

(2)

9.2.1

OPTION 1/*OPSIE 1*	**OR/*OF***
$V_{rms/wgk} = \frac{V_{max/maks}}{\sqrt{2}}$ $P_{ave/gem} = V_{rms/wgk} I_{rms/wgk}$ ✓ $800 = \frac{340}{\sqrt{2}} \left(I_{rms/wgk}\right)$ ✓ $I_{rms/wgk}$ = 3,33 A ✓	$V_{rms/wgk} = \frac{V_{max/maks}}{\sqrt{2}} = \frac{340}{\sqrt{2}} = 240{,}416$ $P_{ave/gem} = V_{rms/wgk} I_{rms/wgk}$ ✓ $800 = I_{rms/wgk}(240{,}416)$ ✓ $I_{rms/wgk}$ = 3,33 A ✓

OPTION 2/*OPSIE 2*

$$P_{ave/gem} = \left(\frac{V^2_{rms/wgk}}{R}\right) = \frac{\left(V^2_{max/maks}\right)}{(2)(R)}$$

✓

$$800 = \frac{(340)^2}{\left(\sqrt{2}\right)^2(R)}$$

$R = 72{,}25\ \Omega$

$P_{ave/gem} = I_{rms/wgk}^2\ R$
$\underline{800 = I_{rms/wgk}^2\ (72{,}25)}$ ✓
$I_{rms/wgk} = 3{,}33$ A ✓

$V_{rms/wgk} = I_{rms/wgk}R$

$$I_{rms/wgk} = \frac{240{,}416}{72{,}25}$$ ✓

$= 3{,}33$ A✓ (3)

9.2.2 **POSITIVE MARKING FROM QUESTION 9.2.1**
POSITIEWE NASIEN VANAF VRAAG 9.2.1
OPTION 1/*OPSIE 1*

$P_{ave/gemid} = V_{rms/wgk}\,I_{rms/wgk}$ ✓

for the kettle/*vir die ketel*:

$$2000 = \frac{340}{\sqrt{2}}\left(I_{rms/wgk}\right)$$ ✓

$I_{rms/wgk} = 8{,}32$ A
$I_{tot} = (8{,}32 + 3{,}33)$ ✓
$= 11{,}65$ A ✓

OPTION 2/*OPSIE 2*

$$P_{ave/gemid} = \left(\frac{V^2_{rms/wgk}}{R}\right)$$ ✓ $= \frac{\left(V^2_{max/maks}\right)}{(2)(R)}$

$$800 = \frac{(340)^2}{\left(\sqrt{2}\right)^2(R)}$$ ✓

$R = 72{,}25\ \Omega$

$$2\,000 = \frac{(340)^2}{\left(\sqrt{2}\right)^2\left(R_{2000}\right)}$$

$R = 28{,}9\ \Omega$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$R = \frac{(28{,}9)(72{,}25)}{(28{,}9 + 72{,}25)} = 20{,}64\ \Omega$$

$V_{rms/wgk} = I_{rms/wgk}\ R$
$\underline{240{,}42 = I_{rms/wgk}\ (20{,}64)}$ ✓
$\underline{I_{rms/wgk} = 11{,}65\ A}$✓

OPTION 3/*OPSIE 3*

$P_{ave/gemid} = V_{rms/wgk}\ I_{rms/wgk}$ ✓ $= \frac{V_{max/maks} I_{max/maks}}{2}$

2 800✓ $= \frac{(340)\ I_{max/maks}}{2}$ ✓

$I_{max/maks}$ = 16,47 A

$I_{rms} = \frac{I_{max/maks}}{\sqrt{2}} = \frac{16,47}{\sqrt{2}}$

$I_{rms/wgk}$ = 11,65 A✓

OPTION 4/*OPSIE 4*

$P_{ave/gemid} = V_{rms/wgk}\ I_{rms/wgk}$✓

2 800 ✓= $\frac{340}{\sqrt{2}}\ I_{rms/wgk}$✓

$I_{rms/wgk}$ = 11,65 A ✓

OPTION 5/*OPSIE 5*

P_T : P_K

800 : 2 000 ✓

1 : 2,5

I_T : I_K

3,33 : 8,325 ✓

I_{rms} = 3,33 + 8,325 ✓

= 11,66 A ✓

(4)

[11]

QUESTION 10/*VRAAG 10*

10.1.1 The minimum frequency (of a photon/light) needed✓ to emit electrons from (the surface of) a metal. (substance) ✓

Die minimum frekwensie (van 'n foton/lig) benodig om elektrone vanaf die (oppervlakte van)'n metaal (stof) vry te stel

OR/OF

The frequency (of a photon/light) needed✓ to emit electrons from (the surface of) a metal. (substance) with zero kinetic energy✓

Die frekwensie (van 'n foton/lig) benodig om elektrone vanaf die (oppervlakte van)'n metaal (stof) met nul/geen kinetiese energie vry te stel (2)

QUESTION 10/*VRAAG 10*

10.1

10.1.1 North pole/*Noordpool*✓ (1)

10.1.2 Q to P✓ (1)

10.2

10.2.1

OPTION 1/*OPSIE 1*

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

$I_{rms} = \frac{8}{\sqrt{2}}$ ✓

= 5,66 A

$V_{rms} = I_{rms}\ R$✓

220 = (5,66)R✓

R = 38,87 Ω✓

(5)

OPTION 2/*OPSIE 2*

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

$220 = \frac{V_{max}}{\sqrt{2}}$ ✓

V_{max} = 311,12 V

$V_{max} = I_{max}\ R$✓

311,12 = (8)R✓

R = 38,89 Ω✓

10.2.2 **POSITIVE MARKING FROM QUESTION 10.4.1/*POSITIEWE NASIEN VANAF VRAAG 10.4.1***

OPTION 1/*OPSIE 1*

$P_{average} = V_{rms}I_{rms}$✓

= (220)(5,66)✓

= 1 245,2 W

$P = \frac{W}{\Delta t}$ ✓

$1245,2 = \frac{W}{7200}$ ✓

W = 8 965 440 J ✓

$P_{average} = I_{rms}^2 R$

$= (5,66)^2(38,89)$

= 1245,86

E = Pt

= (1245,86)(7200)

= 8970192J

(5)

OPTION 2/*OPSIE 2*

$P_{average} = I_{rms}^2 R$ ✓

$= (5,66)^2(38,87)$ ✓

$= 1\ 245,22$ W ✓

$1245,22 = \frac{W}{7200}$ ✓

W = 8 965 584 J ✓

OPTION 3/*OPSIE 3*

$P_{average} = \frac{V_{rms}^2}{R}$ ✓

$P_{average} = \frac{220^2}{38,87}$ ✓

= 1245,18 W

$P = \frac{W}{\Delta t}$ ✓ ✓

$1245,18 = \frac{W}{7200}$ ✓

W = 8 965 296 J ✓

$P_{average} = \frac{V_{rms}^2}{R}$

$P_{average} = \frac{220^2}{38,89}$

= 1244,54 W

E = Pt
= (1244,54)(7200)
= 8960688 J

OPTION 3/*OPSIE 3*

$W = I_{rms}^2 R\Delta t$

$= \left(\frac{I_{max}}{\sqrt{2}}\right)^2 R\Delta t$

$= \left(\frac{8}{\sqrt{2}}\right)^2 (38,87)(7200)$

W = 8 965 296 J ✓ (5)

[12]

OPTION 2/*OPSIE 2*
POSITIVE MARKING FROM 9.2.1/*POSITIEWE NASIEN VANAF 9.2.1*

$V_{"lost"} = Ir$
$1,5\checkmark = I(1,2)$
$I = 1,25$ A

$V_{||} = I_pR_p$
$4,5 = (1,25)R_p\checkmark$
$R_p = 3,6\ \Omega$

$\frac{1}{R_{//}} = \frac{1}{R_X} + \frac{1}{R_6}$ ✓
$\frac{1}{R_{//}} = \frac{1}{R_X} + \frac{1}{6}\checkmark$
$\therefore R_{//} = \frac{6R_X}{R_X + 6} = 3,6$
$R_X = 9\ \Omega\checkmark$

$R_{//} = \frac{R_X R_6}{R_X + R_6}$ ✓
$3,6 = \frac{(R_X)(6)}{(R_X + 6)}$ ✓
$R_X = 9\ \Omega\checkmark$

(5)
[17]

QUESTION/*VRAAG 10*

10.1.1 a to b/*a na b* ✓ (1)

10.1.2 Fleming's left hand rule /Left hand motor rule✓
Fleming se linkerhandreël / *Linkerhand motorreël*

ACCEPT/*AANVAAR*
Right hand rule
Regterhandreël (1)

10.1.3 Split rings /commutator ✓ (1)
Splitringe / *kommutator*

10.2.1 Mechanical/Kinetic energy to electrical energy. ✓✓ (2 or/*of* 0)
Meganiese /kinetiese energie na elektriese energie (2)

10.2.2

OPTION 1/*OPSIE 1*

$V_{rms} = \frac{V_{max}}{\sqrt{2}}\checkmark$
$= \frac{430}{\sqrt{2}}\checkmark$
$= 304,06$ V
$I = \frac{V}{R}\checkmark$
$= \frac{304,06}{400}$ ✓
$= 0,76$ A✓

OPTION 2/*OPSIE 2*

$V_{max} = I_{max}R$ ✓
$430 = I_{max}(400)$ ✓
$I_{max} = 1,075$
$I_{rms} = \frac{I_{max}}{\sqrt{2}}\checkmark = \frac{1,075}{\sqrt{2}}$ ✓
$= 0,76$ A✓

(5)

OPTION 3/*OPSIE 3*	**OPTION 4/*OPSIE 4***
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓ $= \frac{430}{\sqrt{2}}$ ✓ = 304,06 V $P_{average} = \frac{V^2_{rms}}{R} = \frac{(304,06)^2}{400}$ = 231,13 W $P_{ave} = I_{rms}V_{rms}$✓ 231,13 = I_{rms} (304,06) ✓ I_{rms} = 0,76 A✓	$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓ $= \frac{430}{\sqrt{2}}$ ✓ = 304,06 V $P_{average} = \frac{V^2_{rms}}{R} = \frac{(304,06)^2}{400}$ = 231,13 W $P_{ave} = I^2_{rms}R$✓ 231,13 = I^2_{rms} (400) ✓ I_{rms} = 0,76 A✓

[10]

QUESTION/*VRAAG 11*

11.1.1 It tells us that light has a particle nature.✓
Dit sê vir ons dat lig 'n deeltjie-aard het (1)

11.1.2 Remain the same. ✓
Bly dieselfde

For the same colour/ frequency/wavelength the energy of the photons will be the same✓. (The brightness causes more electrons to be released, but they will have the same maximum kinetic energy.)
Vir dieselfde kleur / frekwensie/ golflengte is die energie van die fotone dieselfde. (Die helderheid veroorsaak dat meer elektrone vrygestel word, maar hulle sal dieselfde maksimum kinetiese energie hê.)

OR/*OF*
Intensity only affects the number of ejected photo-electrons and not the maximum kinetic energy or maximum speed of the ejected photo-electrons
Intensiteit beinvloed slegs die aantal vrygestelde foto-elektrone en nie die maksimum kinetiese energie of maksimum spoed van die foto-elektrone.
OR/OF
Maximum kinetic energy of ejected photo-electrons is independent of intensity of radiation
Maksimum kinetiese energie van vrygestelde foto-elektrone is onafhanklik van die intensiteit van straling. (2)

11.1.3
$E = W_0 + E_k$
$hf = hf_0 + E_k$
$hf = hf_0 + ½ mv^2$
$E = W_0 + ½ mv^2$
✓ Any one/*Enige een*

$\frac{(6,63\times10^{-34})(3\times10^8)}{420\times10^{-9}}$✓ $= \frac{(6,63\times10^{-34})(3\times10^8)}{\lambda_0}$✓ $+ \frac{1}{2}(9,11\times10^{-31})(4,76\times10^5)^2$ ✓

$\lambda_o = 5,37 \times 10^{-7}$ m
∴ the metal is sodium / *die metaal is natrium* ✓ (5)

QUESTION 10/*VRAAG10*

10.1.1 Move the bar magnet very quickly✓
up and down inside the coil ✓
Beweeg die staafmagneet baie vinnig op en af binne in die spoel. (2)

10.1.2 Electromagnetic induction/*Elektromagnetiese induksie* ✓ (1)

10.1.3 Commutator/*kommutator* / split rings/*spleetringe* ✓ (1)

10.2.1

OPTION 1/*OPSIE 1*	
$P_{average} = \frac{V_{rms}^2}{R}$ ✓	$W = \frac{V_{rms}^2}{R}\Delta t$ ✓
$= \frac{220^2}{40{,}33}$ ✓	$= \frac{220^2}{40{,}33}$ ✓ (1)
= 1 200,10 W (J·s^{-1})✓	= 1200,10 J ✓
OPTION 2/*OPSIE 2*	
$I_{rms} = \frac{V_{rms}}{R}$ ✓	$I_{rms} = \frac{V_{rms}}{R}$ ✓
$= \frac{220}{40{,}33}$ ✓	$= \frac{220}{40{,}33}$ ✓
= 5,45 A	= 5,45 A
$P_{average} = I_{rms}^2 R$	$W = I_{rms}^2 R\Delta t$
= (5,45^2)(40,33) ✓	= (5,45^2)(40,33)(1)✓
= 1 197,9 W **OR/*OF*** 1 200,10 W✓	= 1 197,9 J **OR/*OF*** 1 200,10 J✓
OPTION 3/*OPSIE 3*	
$I_{rms} = \frac{V_{rms}}{R}$ ✓	$I_{rms} = \frac{V_{rms}}{R}$ ✓
$= \frac{220}{40{,}33}$ ✓	$= \frac{220}{40{,}33}$ ✓
= 5,45 A	= 5,45 A
$P_{average} = V_{rms} I_{rms}$	$W = V_{rms} I_{rms}\Delta t$
= (220)(5,45) ✓	= (220)(5,45)(1) ✓
= 1 199 W **or/*of*** 1 200,10 W✓	= 1 199 J **or/*of*** 1 200,10 J✓

(4)

(4)

(4)

10.2.2

OPTION 1/*OPSIE 1*

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

$220 = \frac{V_{max}}{\sqrt{2}}$

$V_{max} = 311,13$ V

$I_{max} = \frac{V_{max}}{R} = \frac{331,13}{40,33}$ ✓

$= 7,71$ A✓

OR/OF

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

$1200,1 = \frac{(311,13) I_{max}}{2}$

$I_{max} = 7,71$ A

(3)

OPTION 2/*OPSIE 2*

$P_{average} = V_{rms} I_{rms}$ ✓

$1200,1 = (220) I_{rms}$ ✓

$I_{rms} = 5,455$ A

$I_{max} = \sqrt{2}\,(5,455)$

$= 7,71$ A✓ (7,715 A)

(3)

OPTION 3/*OPSIE 3*

$P_{average} = I^2_{rms} R$ ✓

$1200,1 = I^2_{rms} (40,33)$ ✓

$I_{rms} = 5,455$ A

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

$= \sqrt{2}\,(5,455)$

$= 7,71$ A✓

(3)

OPTION 4/*OPSIE 4*

$V_{rms} = I_{rms} R$ ✓

$220 = I_{rms} (40,33)$ ✓

$I_{rms} = 5,455$ A

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

$= \sqrt{2}\,(5,455)$

$= 7,71$ A✓

(3)

[11]

QUESTION 9/*VRAAG 9*

9.1.1

OPTION 1/*OPSIE 1*	**Notes / *Aantekeninge***
$P_{av} = \frac{V^2_{rms}}{R}$ ✓ $100✓ = \frac{\left(\frac{340}{\sqrt{2}}\right)^2}{R}$ ✓ ✓ R = 578 Ω✓	Assume correct formula for V_{rms} and give a mark if the substitution is correct1 mark *Aanvaar die korrekte formule vir* V_{wgk} *en ken 'n punt toe indien die vervanging korrek is.*
OPTION 2/*OPSIE 2*	
$V_{rms} = \frac{V_{max}}{\sqrt{2}} = \frac{340}{\sqrt{2}}$ ✓= 240,04 $P_{ave} = \frac{V^2_{rms}}{R}$ ✓ $100✓ = \frac{240{,}04^2}{R}$ ✓ R = 578 Ω ✓	

(5)

9.1.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$P_{av} = I_{rms}V_{rms}$✓ $100 = I_{rms}\frac{340}{\sqrt{2}}$ ✓ $I_{rms} = \frac{100}{\frac{340}{\sqrt{2}}}$ = 0,417 A ✓	$V_{rms} = I_{rms}$ R✓ $\frac{340}{\sqrt{2}} = I_{rms}(578)$ ✓ I_{rms} = 0,417 A✓

(3)

9.2 Can be stepped up or down/ can be transmitted with less power loss.
Kan verhoog of verlaag word/ kan versend word met minder energie verlies. (1)

[9]

OPTION 4/*OPSIE 4*

$P = VI$ ✓
$250 = (20)I$ ✓
$I = 12,5$ A

$V = Ir$ ✓
$4 = (12,5)r$ ✓
$r = 0,32\ \Omega$ ✓ (5)

8.2.4 Device Z is a voltmeter ✓.
Toestel Z is 'n voltmeter (1)

8.2.5 Device **Z** should be a voltmeter (or a device with very high resistance) because it has a very high resistance ✓ and will draw very little current. ✓
The current through **X** and **Y** will remain the same hence the device can operate as rated.
*Toestel **Z** moet 'n voltmeter wees (of 'n toestel met 'n baie hoë weerstand) omdat dit 'n baie hoë weerstand het en baie min sal stroom trek*
*Die stroom deur **X** en **Y** sal dieselfde bly, gevolglik kan die toestel werk soos ontwerp.* (2)
[22]

QUESTION 9/*VRAAG 9*

9.1 Electromagnetic induction / *Elektromagnetiese induksie* ✓ (1)

9.2 Rotate the coil faster/Increase the number of coils/ Increase the strength of the magnetic field.
Roteer die spoel vinniger/Verhoog die aantal spoele / Verhoog die sterkte van die magneetveld. (1)

9.3 Slip rings/*Sleepringe* ✓ (1)

9.4.1 It is the value of the voltage in a DC circuit ✓ that will have the same heating effect as an AC circuit. ✓
Dit is die waarde van die potensiaalverskil in 'n GS-stroombaan ✓ wat dieselfde verhittingseffek het as 'n WS-stroombaan ✓ (2)

9.4.2 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓
$= \frac{339,45}{\sqrt{2}}$ ✓
$V_{rms} = 240,03$ V ✓ (3)
[8]

QUESTION 10/*VRAAG 10*

10.1

10.1.1 A: coil / rotor / armature / *spoel* ✓
B: brushes / *borsels*✓
C: commutator / *kommutator* OR/*OF*
split-ring (commutator) / *(split-ring)kommutator* ✓ (3)

10.1.2 **ANY ONE/*ENIGE EEN*:**
Takes current into the coil./ *Neem stroom in spoel* in. ✓
Maintains contact with the commutator / *Bly in kontak met kommutator.* (1)

10.1.3 DC motor /*GS Motor* ✓ (1)

10.1.4 Due to the motor effect / *As gevolg van die motoreffek* ✓✓

OR / OF
There is an interaction between the external magnetic field ✓and the magnetic field produced by the current in the conductor. ✓
Daar is 'n wisselwerking tussen die eksterne magneetveld en die magneetveld veroorsaak deur die stroom in die geleier. (2)

10.2

10.2.1 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓

$= \frac{1}{\sqrt{2}}$ ✓

= 0,707 V ✓ (3)

10.2.2 0,04 s ✓✓

(v doubles ∴ emf doubles ∴ f doubles ∴ period halves)
(v verdubel ∴ emk verdubbel ∴ f verdubbel ∴ periode halveer)

Notes/*Aantekeninge:*
IF/*INDIEN:* 0,04 - Max/*Maks*. $\frac{1}{2}$

(2)

10.2.3 **POSITIVE MARKING FROM QUESTION 10.2.1.**
POSITIEWE NASIEN VANAF VRAAG 10.2.1.

OPTION 1 / OPSIE 1

$P_{ave} = V_{rms}I_{rms}$ ✓

$= \left(\frac{V_{max}}{\sqrt{2}}\right)\left(\frac{I_{max}}{\sqrt{2}}\right)$ ✓ (1 mark for formula/*1 punt vir formule*)

$= \left(\frac{1}{\sqrt{2}}\right)$ ✓ $\left(\frac{2}{\sqrt{2}}\right)$

$= 1$ W ✓

OPTION 2 / *OPSIE 2*

$P_{ave} = V_{rms}I_{rms}$ ✓

$= \left(\frac{1}{\sqrt{2}}\right)\left(\frac{I_{max}}{\sqrt{2}}\right)$ ✓

$= \left(\frac{1}{\sqrt{2}}\right)\left(\frac{2}{\sqrt{2}}\right)$ ✓

$= 1$ W ✓ (4)

[16]

QUESTION 10/*VRAAG10*

10.1 Increase the speed of rotation. / *Verhoog spoed van rotasie.* ✓

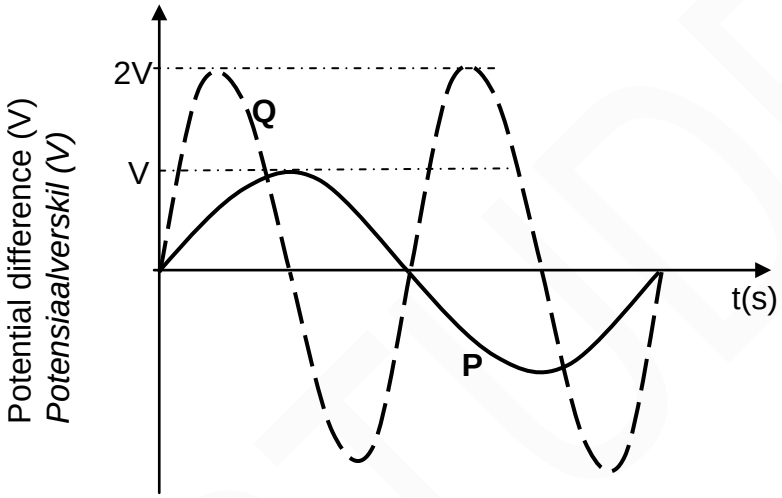
OR/*OF*
Increase the number of coils. / *Verhoog getal windings/spoele.*

OR/*OF*
Increase the strength of the magnetic field. / *Verhoog magetiese veldsterkte.* (1)

10.2 Commutators replaced by slip rings./ *Kommutators vervang met sleepringe.* ✓

OR/*OF*
Slip rings were used. /*Sleepringe is gebruik.* ✓ (1)

10.3



Criteria for graph/*Kriteria vir grafiek:*	**Marks *Punte***
Correct shape with higher amplitude as shown (accept more than one cycle) *Korrekte vorm met hoër amplitude soos aangetoon (aanvaar meer as een siklus)*	✓
Correct shape with higher frequency as shown (accept more than one cycle) *Korrekte vorm met hoër frekwensie soos aangetoon (aanvaar meer as een siklus)*	✓

(2)

10.4

$$P_{ave} = \frac{V_{rms}^2}{R} \checkmark = \frac{\left(\frac{V_{max}}{\sqrt{2}}\right)^2}{R} \checkmark$$

$$120 = \frac{\left(\frac{340}{\sqrt{2}}\right)^2}{R} \checkmark$$

$$R = 481{,}67\ \Omega \checkmark$$

(4)
[8]

9.4 No / *Nee* ✓

Total resistance (R) increases. / *Totale weerstand (R) neem toe*.✓
Current (I) decreases / *Stroom (I) neem af.* ✓
(For a constant R) power ($P = I^2R$) decreases.✓
(Vir konstante R) drywing ($P = I^2R$) verminder. (4)
[16]

QUESTION 10/*VRAAG 10*

10.1
10.1.1 slip rings / *sleepringe* ✓ (1)

10.1.2 brush(es) / *borsel(s)* ✓ (1)

10.2 Maintains electrical contact with the slip rings.
Handhaaf elektriese kontak met die sleepringe.

OR/*OF*
To take current out/in of the coil.
Om die stroom uit/in die spoel te neem. (1)

10.3 Mechanical /kinetic energy to electrical energy. ✓
Meganiese / kinetiese energie na elektriese energie. (1)

10.4 1½ ✓ (1)

10.5

OPTION 1/ *OPSIE 1*

$f = \frac{1}{T}$ ✓

$= \frac{1}{0,02}$ ✓

= 50 Hz ✓

(3)

OPTION 2/ *OPSIE 2*

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

$= \frac{1,5}{0,03}$ or/of $\frac{1}{0,02}$ or/of $\frac{0,5}{0,01}$ ✓

= 50 Hz ✓

(3)

(3)

10.6 Parallel to / *Parallel aan* ✓ (1)

10.7

OPTION 1/ *OPSIE 1*

$P_{ave} = V_{rms}I_{rms}$ ✓

$= \left(\frac{V_{max}}{\sqrt{2}}\right)\left(\frac{I_{max}}{\sqrt{2}}\right)$ ✓ (1 mark for both formulae / *1 punt vir beide formules*)

$= \left(\frac{311}{\sqrt{2}}\right)$✓$\left(\frac{21{,}21}{\sqrt{2}}\right)$ ✓

= 3 298,16 W ✓ (Accept range / *Aanvaar gebied*: 3298,13 – 3299,18 W)

OPTION 2/ *OPSIE 2*

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

$= \frac{(311)(21.21)}{2}$ ✓✓

= 3298,16 W✓

OPTION 3 / *OPSIE 3*

$V_{rms} = \frac{V_{max}}{\sqrt{2}} = \frac{311}{\sqrt{2}}$ ✓✓= 219,91 V

$I_{rms} = \frac{I_{max}}{\sqrt{2}} = \frac{21{,}21}{\sqrt{2}}$ ✓= 14,998 A

$P_{ave} = V_{rms}I_{rms}$ ✓

= (219,91)(14,998)

= 3 298,21 W ✓

OPTION 4/ *OPSIE 4*

$R = \frac{V_{max}}{I_{max}}$

$= \frac{311}{21{,}21}$ ✓

= 14,66 Ω

$V_{rms} = \frac{V_{max}}{\sqrt{2}} = \frac{311}{\sqrt{2}}$ ✓= 219,91 V

$P_{ave} = \frac{V_{rms}^2}{R}$ ✓

$= \frac{(219{,}91)^2}{14{,}66}$ ✓

= 3 298,8 W✓

OPTION 6/*OPSIE 6*

$R = \frac{V_{max}}{I_{max}}$

$= \frac{311}{21{,}21}$ ✓

= 14,66 Ω

$I_{rms} = \frac{I_{max}}{\sqrt{2}} = \frac{21{,}21}{\sqrt{2}}$ ✓= 14,998 A

$P_{ave} = I_{rms}^2R$ ✓

$= (14{,}998)^2(14{,}66)$ ✓

= 3 297,62 W✓

(5)
[14]

QUESTION 11/*VRAAG 11*

11.1

11.1.1 Photo-electric effect / *Foto-elektriese effek* ✓ (1)

QUESTION 10/*VRAAG 10*

10.1 Q/split ring commutator/commutator ✓
Q/splitringkommutator/kommutator (1)

10.2 Replace Q/split ring commutator with slip rings. ✓
Vervang Q/splitringkommutator met sleepringe. (1)

10.3 AC can be stepped-up at power stations/*WS kan by die kragstasie verhoog word* ✓
to reduce energy loss during transmission./*om energieverlies tydens transmissie te verminder.* ✓ (2)

10.4
10.4.1

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

$$= \frac{0,35}{\sqrt{2}} \checkmark$$

$$\therefore I_{rms/wgk} = 0,25 \text{ A} \checkmark$$

(3)

Notes/*Aantekeninge*
If subscripts omitted: no mark for formula
Indien onderskifte weggelaat is: geen punt vir formule

10.4.2

OPTION 1/*OPSIE 1*

$$P_{ave\,/\,gemid} = \frac{V^2_{rms/wgk}}{R} \checkmark$$

$$60 = \frac{240^2}{R} \checkmark$$

$$\therefore R = 960\ \Omega \checkmark$$

OPTION 2/*OPSIE 2*

$P_{ave/gemid} = I^2_{rms/wgk}R$ ✓
$60 = (0,25)^2R$ ✓
$\therefore R = 960\ \Omega$ ✓

OPTION 3/*OPSIE 3*

$$R = \frac{V_{rms/wgk}}{I_{rms/wgk}} \checkmark$$

$$= \frac{240}{0,25} \checkmark$$

$= 960\ \Omega$ ✓

(3)

Notes/*Aantekeninge*
Do not penalise if subscripts are omitted.
Moenie penaliseer indien onderskrifte weggelaat is nie

Notes/*Aantekeninge*
Accept/*Aanvaar:*

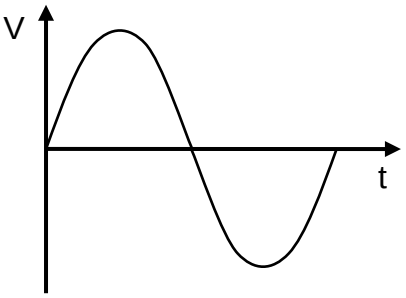
$$R = \frac{V}{I}$$ as formula/*formule*

[10]

QUESTION 10/*VRAAG 10*

10.1 AC /*WS* ✓ (1)

10.2



Criteria for graph/*Kriteria vir grafiek:*	**Marks** ***Punte***
Correct shape as shown; accept more than one cycle. *Korrekte vorm soos aangetoon; aanvaar meer as een siklus.*	✓✓
If no/wrong labels: minus 1 mark *Indien geen/verkeerde byskifte: minus 1 punt*	

(2)

10.3

OPTION 1/*OPSIE 1*	**OPTION 2 / *OPSIE 2***
$V_{rms\,/\,wgk} = \frac{V_{max/\,maks}}{\sqrt{2}}$ ✓ $= \frac{30\times10^3}{\sqrt{2}}$ ✓ $= 2{,}12 \times 10^4$ V $P_{ave} = V_{rms}I_{rms}/P_{gem.} = V_{wgk}I_{wgk}$ ✓ $4{,}45 \times 10^9$ ✓ $= (2{,}12 \times 10^4)I_{rms/wgk}$ $\therefore I_{rms/wgk} = 2{,}10 \times 10^5$ A ✓	$P_{ave} = V_{rms}I_{rms}/P_{gem.} = V_{wgk}I_{wgk}$ $P_{ave/gem.} = \frac{V_{max}I_{rms}}{\sqrt{2}} / \frac{V_{maks}I_{wgk}}{\sqrt{2}}$ ✓✓ $4{,}45 \times 10^9$ ✓ $= \frac{(30\times10^3)I_{rms\,/\,wgk}}{\sqrt{2}}$ ✓ $\therefore I_{rms/wgk} = 2{,}10 \times 10^5$ A ✓

(5)

10.4 Less loss in (electrical) energy (as heat). ✓
Minder verlies aan (elektriese) energie (as hitte). ✓ (1)

[9]

QUESTION 10/*VRAAG 10*

10.1
10.1.1
(a) Reverses the direction of the current in the coil each half cycle. ✓
Keer die stroomrigting in die spoel elke halwe siklus. ✓

OR/*OF*
Maintains constant direction of rotation of the coil.
Onderhou die konstante rigting van rotasie van die spoel. (1)

10.1.1 Makes electrical contact (with the commutator). ✓
(b) *Maak elektriese kontak (met kommutator).* ✓

OR/*OF*
Allows split-ring commutator to rotate freely.
Laat splitringkommutator toe om vry te roteer.

OR/*OF*
Allows charges to flow/current in and out of the coil.
Laat vloei van lading/stroom in en uit spoel toe. (1)

10.1.2 B to/*na* A ✓ (1)

10.1.3 Maximum/*Maksimum* ✓ (1)

10.1.4 Any ONE/*Enige EEN*:

- Increase the current in the coil. ✓
  Verhoog die stroom in die spoel. ✓
- Increase the magnitude of the magnetic field./Use a stronger magnet.
  Vergroot die grootte van die magneetveld./Gebruik 'n sterker magneet.
- Increase the number of turns in the coil.
  Verhoog die aantal windinge in die spoel.
- Use a soft iron core as the core of the *coil.*
  Gebruik 'n sagte ysterkern in die spoel.

(1)

10.2
10.2.1 Any ONE/*Enige EEN:*

- Can be transmitted over long distances without major energy loss. ✓
  Kan oor groot afstande oorgedra word sonder groot energieverlies. ✓
- The potential difference can be increased or decreased.
  Die potensiaalverskil kan verhoog of verlaag word. (1)

10.2.2
(a) $V_{rms/wgk} = \frac{V_{max/maks}}{\sqrt{2}}$ ✓

$230 = \frac{V_{max/maks}}{\sqrt{2}}$ ✓

$V_{max/maks}$ = 325, 27 V ✓

(3)

10.2.2

(b) $P_{ave} = V_{rms/wgk}I_{rms/wgk}$ ✓

$2\ 000 = (230)I_{rms/wgk}$ ✓

$I_{rms/wgk} = 8,70$ A ✓ (8,696 A) (3)

[12]

QUESTION 11/*VRAAG 11*

11.1 Photoelectric effect/*Foto-elektriese effek* ✓ (1)

11.2

11.2.1 $E = hf$ ✓

$= (6,63 \times 10^{-34})(6,16 \times 10^{14})$ ✓

$= 4,08 \times 10^{-19}$ J ✓ (3)

11.2.2 $E = W_0 + K$ ✓

$4,08 \times 10^{-19}$ ✓ $= (6,63 \times 10^{-34})f_0$ ✓ $+ 5,6 \times 10^{-20}$ ✓

$f_0 = 5,31 \times 10^{14}$ Hz ✓ (5)

11.3

11.3.1 Increases ✓

More photoelectrons emitted per second ✓

Vermeerder ✓

Meer foto-elektrone vrygestel per sekonde ✓ (2)

11.3.2 Remains the same ✓

Intensity does not affect energy. ✓

Bly dieselfde ✓

Intensiteit het geen effek op energie nie. ✓

OR/*OF*

Remains the same ✓

The frequency of light remains the same. ✓

Bly dieselfde ✓

Die frekwensie van die lig bly dieselfde. ✓ (2)

[13]

TOTAL SECTION B/*TOTAAL AFDELING B*: 125

GRAND TOTAL/*GROOTTOTAAL*: 150

QUESTION 11 / *VRAAG 11*

11.1.1 Electrical (energy) to mechanical / kinetic (energy) ✓
Elektriese (energie) na meganiese / kinetiese (energie) ✓ (1)

11.1.2 Mechanical / kinetic (energy) to electrical (energy) ✓
Meganiese / kinetiese (energie) na elektriese (energie) ✓ (1)

11.1.3 Motor effect / *Motor-effek* ✓ (1)

11.1.4 Electromagnetic induction ✓
Elektromagnetiese induksie ✓ (1)

11.2 BC / conductor is parallel ✓ to the magnetic field. ✓
BC / geleier is parallel ✓ aan die magneetveld. ✓

OR / *OF*
Open switch ✓, no current. ✓
Oop skakelaar ✓, geen stroom. ✓ (2)

11.3

Option 1 / *Opsie 1*:

$P_{ave} = V_{rms}I_{rms}$ ✓
$= \frac{V_{max}}{\sqrt{2}}$ ✓ . $\frac{I_{max}}{\sqrt{2}}$ ✓
$= \frac{(311)(21)}{2}$ ✓✓
$= 3\,265{,}5$ W ✓

OR / OF
$P_{max} = V_{max}I_{max}$ ✓
$= (311)$ ✓ (21) ✓
$= 6531$ W
$\therefore P_{ave} = \frac{P_{max}}{2}$ ✓✓ $= \frac{6531}{2}$
$= 3\,265{,}5$ W ✓

Option 2 / *Opsie 2*:

$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓
$= \frac{311}{\sqrt{2}}$ ✓
$= 219{,}91$ V
$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓
$= \frac{21}{\sqrt{2}}$ ✓
$= 14{,}85$ A
$P_{ave} = V_{rms}I_{rms}$ ✓
$= (219{,}91)(14{,}85)$
$= 3\,265{,}66$ W ✓

Option 3 / *Opsie 3*

$R = \frac{V}{I}$ ✓ $= \frac{311}{21}$ ✓ $= 14{,}81\ \Omega$
$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓
$= \frac{21}{\sqrt{2}}$ ✓
$= 14{,}85$ A
$P_{ave} = I^2_{rms}R$ ✓
$= (14{,}85)^2(14{,}81)$
$= 3\,265{,}83$ W ✓

Option 4 / *Opsie 4*

$R = \frac{V}{I}$ ✓ $= \frac{311}{21}$ ✓ $= 14{,}81\ \Omega$
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓
$= \frac{311}{\sqrt{2}}$ ✓
$= 219{,}91$ V
$P_{ave} = \frac{V^2_{rms}}{R}$ ✓
$= \frac{219{,}41^2}{14{,}81}$
$= 3\,265{,}83$ W ✓

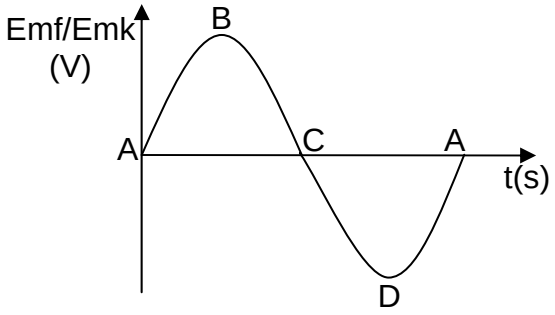
(6)
[12]

QUESTION 13 / *VRAAG 13*

13.1 Electromagnetic induction / Faraday's law ✓
Elektromagnetiese induksie / Faraday se wet [12.2.1] (1)

13.2 Provides a (sliding) contact (between coil and conducting wires) ✓/ Ensures free rotation
Verskaf 'n (glyende) kontak (tussen die spoel en die geleidende drade)/ Verseker dat spoel vrylik roteer [12.2.1] (1)

13.3



Checklist / *Kontrolelys* Criteria for graph / *Kriteria vir grafiek*	Marks/ *Punte*
Correct shape **with full cycle (ignore if more than one cycle shown** / *Korrekte vorm* ***met volle siklus (ignoreer indien meer as een siklus getoon word)***	✓✓
Points A, B, C and D correctly indicated/Punte A, B, C en D korrek aangedui,	✓

[12.1.2] (3)

13.4 Increase the speed at which the coil rotates ✓
Verhoog die spoed waarteen die spoel roteer [12.2.3] (1)

13.5 (Splitring) commutator ✓
(Splitring)kommutator [12.2.3] (1)
[7]

QUESTION 14/*VRAAG 14*

14.1 Photoelectric effect / *Foto-elektriese effek* ✓ [12.2.1] (1)

14.2 The minimum energy of light needed to emit (photo)electrons from a metal ✓✓
Die minimum energie benodig deur lig om (foto-)elektrone uit 'n metaal vry te stel [12.2.1] (2)