education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

MEMORANDUM

EXEMPLAR 2008

MARKS: 150

TIME: 3 hours

This Memorandum consists of 16 pages.

National Department of Education

MEMORANDUM
PHYSICAL SCIENCES GRADE 12 P1
EXEMPLAR

Learning Outcomes and Assessment Standards *Leeruitkomste en Assesseringstandaarde*		
LO 1 / *LU 1*	**LO 2 / *LU 2***	**LO 3 / *LU 3***
AS 12.1.1: Design, plan and conduct a scientific inquiry to collect data systematically with regard to accuracy, reliability and the need to control variables. *Ontwerp, beplan en voer 'n wetenskaplike ondersoek uit om data te versamel ten opsigte van akkuraatheid, betroubaarheid en die kontroleer van veranderlikes.* **AS 12.1.2:** Seek patterns and trends, represent them in different forms, explain the trends, use scientific reasoning to draw and evaluate conclusions, and formulate generalisations. *Soek patrone en tendense, stel dit in verskillende vorms voor, verduidelik tendense, gebruik wetenskaplike beredenering om gevolgtrekkings te maak en te evalueer, en formuleer veralgemenings.* **AS 12.1.3:** Select and use appropriate problem-solving strategies to solve (unseen) problems. *Kies en gebruik geskikte probleemoplossingsstrategieë om (ongesiene) probleme op te los.*	**AS 12.2.1:** Define, discuss and explain prescribed scientific knowledge. *Definieer, bespreek en verduidelik voorgeskrewe wetenskaplike kennis.* **AS 12.2.2** Express and explain prescribed scientific principles, theories, models and laws by indicating the relationship between different facts and concepts in own words. *Verduidelik en druk voorgeskrewe wetenskaplike beginsels, teorieë, modelle en wette uit deur die verwantskap tussen verskillende feite konsepte in eie woorde aan te dui.* **AS 12.2.3:** Apply scientific knowledge in everyday life contexts. *Pas wetenskaplike kennis in kontekste van die alledaagse lewe toe.*	**AS 12.3.2:** Research case studies and present ethical and moral arguments from different perspectives to indicate the impact (pros and cons) of different scientific and technological applications. *Vors gevallestudies na en lewer etiese en morele argumente uit verskillende perspektiewe om die impak (voordele en nadele) van verskillende wetenskaplike en tegnologiese toepassings aan te dui.* .

SECTION A / *AFDELING A*

QUESTION 1 / *VRAAG 1*

1.1	Impulse / *Impuls* ✓	[12.2.1]	(1)
1.2	Kinetic / *Kinetiese* ✓	[12.2.1]	(1)
1.3	Diffraction / *Diffraksie* ✓	[12.2.1]	(1)
1.4	Electric-potential / *Elektriesepotensiaal* ✓	[12.2.1]	(1)
1.5	Work-function/*Werkfunksie* ✓	[12.2.1]	(1)
			[5]

QUESTION 2 / *VRAAG 2*

2.1	F ✓	[12.2.1]	(1)
2.2	I ✓	[12.2.1]	(1)
2.3	J ✓	[12.2.1]	(1)
2.4	A ✓	[12.2.1]	(1)
2.5	C ✓	[12.2.1]	(1)
			[5]

QUESTION 3 / *VRAAG 3*

3.1	True / *Waar* ✓✓	[12.2.3]	(2)
3.2	False / *Onwaar* ✓ … to reduce the force ✓ / …verminder die krag	[12.2.3]	(2)
3.3	False / *Onwaar* ✓ Frequency remains constant. ✓ / *Frekwensie bly dieselfde.*	[12.2.3]	(2)
3.4	False / *Onwaar* ✓ Non-ohmic conductor/ *nie-ohmiese geleier*✓	[12.2.1]	(2)
3.5	False / *Onwaar* ✓ Proof of particle nature OR Diffraction/interference is proof of wave nature ✓ *Bewys van deeltjie-aard OF diffraksie/interferensie is bewys van golfaard*	[12.2.1]	(2)
			[10]

QUESTION 4 / *VRAAG 4*

4.1	A ✓✓✓	[12.2.3]	(3)
4.2	D ✓✓✓	[12.2.3]	(3)
4.3	C ✓✓✓	[12.2.3]	(3)
4.4	D ✓✓✓	[12.2.3]	(3)
4.5	B ✓✓✓	[12.2.3]	(3)

[15]

TOTAL SECTION A = 35
TOTAAL AFDELING A = 35

SECTION B / *AFDELING B*

QUESTION 5 / *VRAAG 5*

5.1 For complete motion of stone/*Vir volledige beweging van klip:*
Upward motion negative / Opwaartse *beweging negatief*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓∴ 88 ✓= $v_i(6)$ ✓+ $\frac{1}{2}(9,8)(6)^2$ ✓

v_i = - 14,7 m·s^{-1} ∴ 14,7 m·s^{-1} upwards/*opwaarts* ✓

$v_{balloon} = v_{stone}$✓ = 14,7 m·s^{-1}

OR/*OF*

For complete motion of stone/*Vir volledige beweging van klip:*
Downward motion negative / A*fwaartse beweging negatief*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓∴ - 88 ✓= $v_i(6)$ ✓+ $\frac{1}{2}(-9,8)(6)^2$ ✓

v_i = 14,7 m·s^{-1} ∴ 14,7 m·s^{-1} upwards/*opwaarts* ✓

$v_{balloon} = v_{stone}$✓ = 14,7 m·s^{-1}

OR/*OF*

Consider upward motion only/*Beskou slegs opwaartse beweging*:
Upward motion negative / Opwaartse *beweging negatief*

$v_f = v_i + g\Delta t$ ✓∴ 0 ✓= v_i + (9,8)(1,5) ✓

∴ v_i = - 14,7 m·s^{-1} ∴ 14,7 m·s^{-1} ✓upwards/*opwaarts* ✓

$v_{balloon} = v_{stone}$✓ = 14,7 m·s^{-1}

OR/*OF*

Consider upward motion only/*Beskou slegs opwaartse beweging*:
Downward motion negative / A*fwaartse beweging negatief*

$v_f = v_i + g\Delta t$ ✓∴ 0 ✓= v_i + (- 9,8)(1,5) ✓

∴ v_i = 14,7 m·s^{-1} ∴ 14,7 m·s^{-1} ✓upwards/*opwaarts* ✓

$v_{balloon} = v_{stone}$✓ = 14,7 m·s^{-1}

OR/*OF*
Consider upward motion only/*Beskou slegs opwaartse beweging*:
Upward motion negative / Opwaartse *beweging negatief*

$v_f^2 = v_i^2 + 2g\Delta y$ ✓ ∴ 0^2 ✓= v_i^2 + 2(9,8)(99 - 88) ✓

∴ v_i = - 14,7 m·s^{-1} ∴ 14,7 m·s^{-1} ✓upwards/*opwaarts* ✓

$v_{balloon} = v_{stone}$✓ = 14,7 m·s^{-1}

OR/*OF*
Consider upward motion only/*Beskou slegs opwaartse beweging*:
Downward motion negative / A*fwaartse beweging negatief*

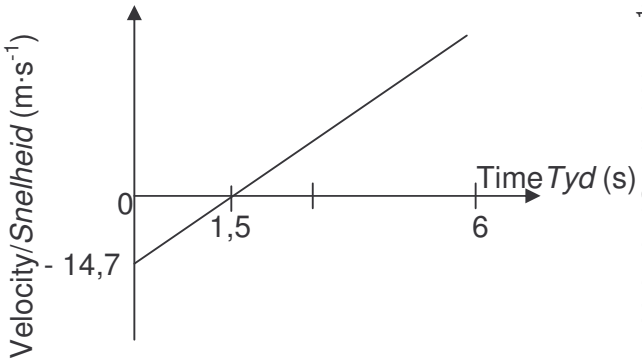
$v_f^2 = v_i^2 + 2g\Delta y$ ✓ ∴ 0^2 ✓= v_i^2 + 2(- 9,8)(99 - 88) ✓

∴ v_i = 14,7 m·s^{-1} ∴ 14,7 m·s^{-1} ✓upwards/*opwaarts* ✓

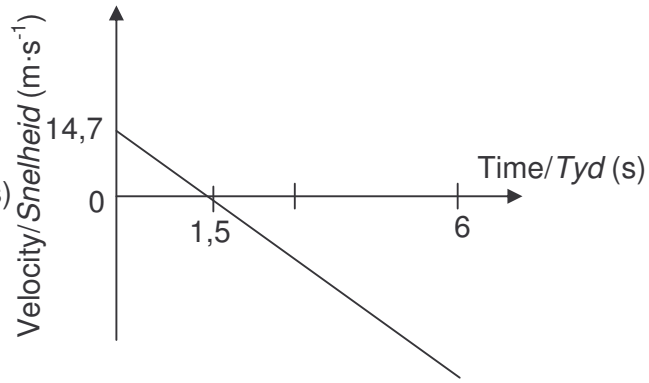
$v_{balloon} = v_{stone}$✓ = 14,7 m·s^{-1} [12.1.2] (6)

5.2

Upward motion as negative:
Opwaartse beweging negatief:



Downward motion as negative:
Afwaartse beweging negatief:



Checklist/*Kontrolelys* Criteria for graph/ *Kriteria vir grafiek*	Marks/ *Punte*
Graph is a straight line that intercepts x-axis at 1,5 s *Grafiek is 'n reguit lyn wat die x-as by 1,5 s sny*	✓
Maximum velocity after 6 s/ Maksimum snelheid na 6 s.	✓
Initial velocity indicated as 14,7 m·s^{-1}/ Beginsnelheid aangedui as 14,7 m·s^{-1}	✓

(3)

[12.1.2] **[9]**

QUESTION 6 / *VRAAG 6*

6.1 Consider motion to the right as positive:/*Beskou beweging na regs as positief:*

$p_{before} = p_{after}$ ✓

$m_1v_{i1} + m_2v_{i2} = (m_1 + m_2)v_f$

(1 600)(30) ✓+ (3 000)(-20) ✓ = (1 600 + 3 000) v_f✓

48 000 – 60 000 = (4 600)v_f

v_f = - 2,6 m·s^{-1} ∴ v_f = 2,6 m·s^{-1} ✓ to the right/*na regs*✓ [12.2.3] (6)

6.2 Before collision/*voor botsing*:

$E_k = \frac{1}{2}m_1v_{i1}^2 + \frac{1}{2}m_2v_{i2}^2$ ✓$= \frac{1}{2}$ (1 600)(30)^2 + $\frac{1}{2}$(3 000)(16)^2 ✓

= 720 000 + 384 000 = 1,104 x 10^6 J✓

After collision/*na botsing*:

$E_k = \frac{1}{2}m_1v_{f1}^2 + \frac{1}{2}m_2v_{f2}^2 = \frac{1}{2}$ (1 600 + 3 000)(2,6)^2 ✓= 384 000

= 5 980 J ✓

E_k before collision not equal to E_k after collision – thus the collision is inelastic ✓

/*E_k voor botsing nie gelyk aan E_k na botsing – dus is die botsing nie-elasties* [12.1.3] (6)

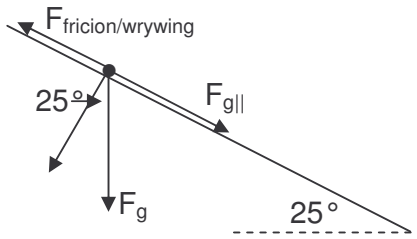
6.3 During a collision, the crumple zone/ airbag **increases the time** during which momentum changes ✓ and according to the equation

$F_{net} = \frac{\Delta p}{\Delta t}$ ✓ the **force during impact will decrease**. ✓ [12.3.2]

*Tydens 'n botsing sal die frommelsone/lugsak die **tyd** waartydens die momentum verander **verhoog** en volgens die vergelyking $F_{net} = \frac{\Delta p}{\Delta t}$ sal die **krag tydens impak verlaag.*** (3)

QUESTION 7 / *VRAAG 7*

7.1 Net force causing motion along the ramp:/ *Netto krag wat beweging langs die skuinsvlak veroorsaak.*



$F_{net} = F_{g||} - F_{friction/wrywing}$ ✓
$= mg \sin 25^o$ ✓✓ $- F_{friction/wrywing}$
$= (50)(9,8)(\sin 25°) - 60$ ✓ $= 147,08$ N✓

[12.1.3] (5)

7.2 Work done by net force: / *Arbeid verrig deur netto krag*:
$W = F\Delta x$ ✓ $= 147,08 \times 20$ ✓ $= 2941,66$ J

$W = E_{kf} - E_{ki}$✓
$E_{kf} = W + E_{ki\ i} = 2941,66 + ½\ 50(2,5)^2$ ✓ $= 3097,91$ J

$E_{kf} = ½\ mv^2 \ \therefore 3097,91 = ½\ (50)v^2$ ✓ $\therefore v = \sqrt{\frac{3097,91}{25}} = 11,13\ m{\cdot}s^{-1}$✓

[12.1.3] (6)
[11]

QUESTION 8 / *VRAAG 8*

8.1 Doppler Effect / *Doppler effek*✓✓ [12.2.3] (2)

8.2 $31\ km{\cdot}h^{-1} = \frac{31\,000}{3\,600}$ ✓ $= 8,61\ m{\cdot}s^{-1}$ ✓

[12.2.3] (2)

8.3 $f_L = \frac{v}{v - v_S} f_S$ ✓

437 ✓ $= \frac{v}{v - 8,61}(426)$ ✓✓

$v = 342,05\ m{\cdot}s^{-1}$ ✓

[12.2.3] (5)

8.4 Higher frequency: source is moving towards observer. ✓
Lower frequency: source is moving away from observer. ✓

Hoër frekwensie bron beweeg na die waarnemer.
Laer frekwensie bron beweeg weg vanaf die waarnemer.

(2)
[12.2.2] **[10]**

QUESTION 9 / *VRAAG 9*

9.1 Every point on a wavefront acts as a source of secondary waves. ✓✓

Elke punt op 'n golffront reageer soos 'n bron van sekondêre golwe. [12.2.1] (2)

9.2 CONSTRUCTIVE ✓ - waves are interfering constructively to increase the amplitude of the wave. ✓✓

KONSTRUKTIEF - gGolwe interfereer konstruktief om die amplitude van die golf te verhoog. [12.2.3] (3)

9.3 Brightness of red light remains the same. ✓ The distance from each source to line MO is the same. (The difference in path length is zero) ✓✓

Die helderheid van rooi lig bly dieselfde. Die afstand vanaf elke bron na lyn MO is dieselfde. (Die padlengte verskil is nul) [12.2.3] (3)

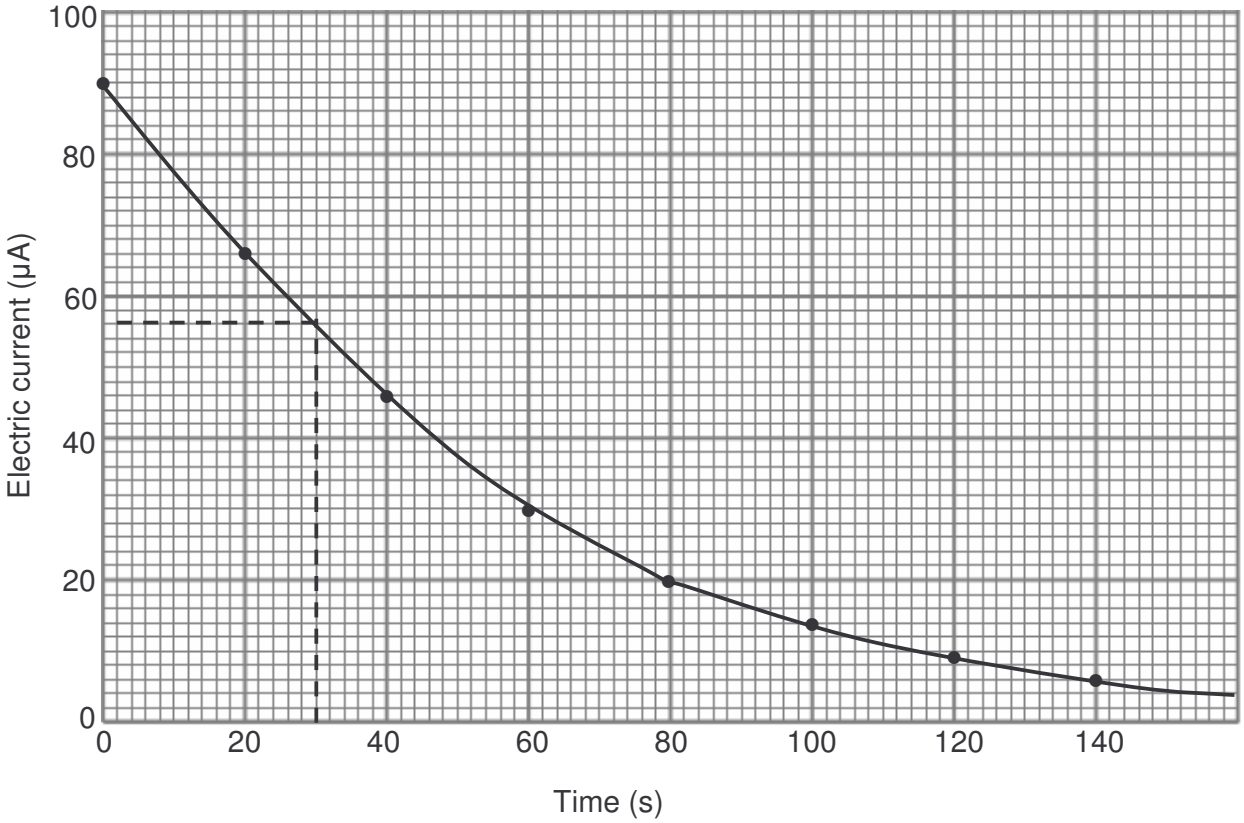
9.4 Green and dark bands are narrower. ✓✓

Groen en donker bande is smaller [12.2.2] (2)
[10]

QUESTION 10 / *VRAAG 10*

10.1

Graph of electric current versus time/*Grafiek van elektriese stroom teenoor tyd*



Checklist/*Kontrolelys* Criteria for graph/ *Kriteria vir grafiek*	Marks/ *Punte*
Suitable heading / Geskikte opskrif	✓
Correct scale on both axes/ Korrekte skaal op beide asse	✓
Correct labels on both axes/ *Korrekte byskrifte op beide asse*	✓
Points plotted correctly/*Punte korrek gestip.*	✓
Curve drawn through points/*Kurwe deur punte getrek.*	✓

[12.1.2] (5)

10.2 56 μA ✓ [12.1.2] (1)

10.3 As the **potential difference across the plates of the capacitor increases** during charging, the **potential difference of the battery is opposed**, ✓causing the current in the circuit to gradually decrease. ✓ [12.1.2] (2)

10.4 $C = \frac{Q}{V}$ ✓ $\therefore 50 \times 10^{-6} = \frac{Q}{9}$ ✓$\therefore Q = 4{,}5 \times 10^{-4}$ C✓

[12.2.3] (3)

10.5 Any one/ *Enige een:*
Supply electrical energy faster ✓
Can be recharged almost indefinitely
No spilling of dangerous chemicals

Verskaf elektriese energie vinniger
Kan feitlik onbeperk herlaai word
Geen mors van gevaarlike chemikalieë nie.

[12.3.2] (2)

10.6 The high voltage across plates can cause electric shock or even death when the capacitor discharges.

Die hoë potensiaalverskil oor die plate kan 'n elektriese skok of selfs die dood veroorsaak wanneer die kapasitor ontlaai.

[12.3.2] (2)
[15]

QUESTION 11 / *VRAAG 11*

11.1 11.1.1 Examples/*Voorbeelde:*
What is the relationship between the electric current and the potential difference?
OR
How does the electric current change when the potential difference changes?

Wat is die verwantskap tussen elektriese stroom en potensiaalverskil?
OF
Hoe verander die elektriese stroom indien die potensiaalverskil verander?

Checklist/*Kontrolelys* Criteria for investigative question/ *Kriteria vir ondersoekende vraag*	Marks/ *Punte*
Question that refers to dependent variable/ *Vraag wat na afhanklike veranderlike verwys*	✓
Question that refers to independent variable/ *Vraag wat na onafhanklike veranderlike verwys*	✓

[12.1.1] (2)

11.1.2 Any prediction that answers the investigative question / *Enige voorspelling what die ondersoekende vraag beantwoord:*

Checklist/*Kontrolelys* Criteria for hypothesis/ *Kriteria vir hipotese*	Marks/ *Punte*
Statement that can be proved true or false (not an aim) *Stelling wat reg of verkeerd bewys kan word (nie 'n doel nie)*	✓
Question refers to dependent and independent variables *Stelling verwys na afhanklike en onafhanklike veranderlikes*	✓

Examples/Voorbeelde

Electric current is directly proportional to potential difference/*Elektriese stroom is direk eweredig aan potensiaalverskil*
OR/*OF*
Electric current increases as the potential difference increases./*Elektriese stroom neem toe soos wat die potensiaalverskil toeneem.*
OR/*OF*
Electric current increases as the potential difference decreases./*Elektriese stroom neem toe soos wat die potensiaalverskil afneem.* [12.1.1] (2)

11.1.3 Temperature/*Temperatuur* ✓ [12.1.1] (1)

11.2 11.2.1 Method 1/*Metode 1:*
Torch batteries, ammeter, voltmeter, resistor e.g. nichrome wire (not a bulb), connecting wires/
Flitsbatterye, ammeter, voltmeter, weerstand bv. nichroomdraad (nie 'n gloeilamp nie), verbindingsdrade

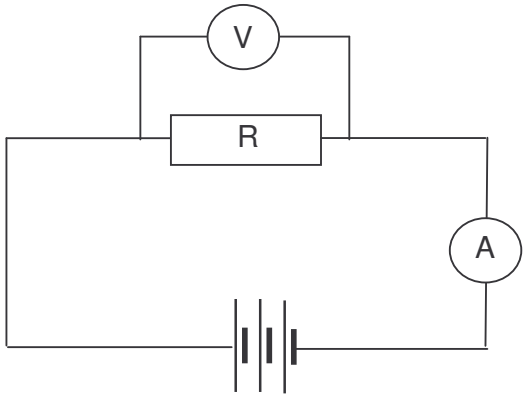
OR
Method 2/*Metode 2:*
Power source, rheostat, ammeter, voltmeter, resistor e.g. nichrome wire (not a bulb), connecting wires/
Kragbron, verstelbare weerstand, ammeter, voltmeter, weerstand bv. nichroomdraad (nie 'n gloeilamp nie), verbindingsdrade

Checklist/Kontrolelys **Criteria for keuse van apparaat/*Kriteria vir keuse van apparaat***	Marks/ *Punte*
Any source of electricity of which potential difference can be changed *Enige verstelbare bron van potensiaalverskil*	✓
Ammeter and/*en* voltmeter	✓
Resistor/Weerstand	✓

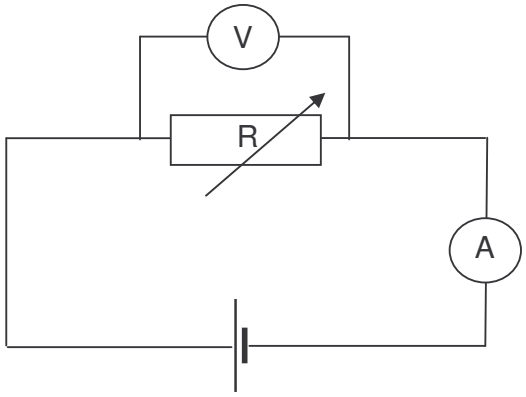
[12.1.1] (3)

11.2.2

Method 1/*Metode 1*



Method 2/*Metode 2*



Checklist/Kontrolelys **Criteria for circuit diagram/*Kriteria vir stroombaandiagram***	Marks/ *Punte*
Source of electricity correctly indicated/*Bron van elektrisiteit korrek aangedui*	✓
Resistor with voltmeter connected in parallel across resistor correctly indicated/*Weerstand met voltmeter in parallel oor weerstand korrek aangedui*	✓
Ammenter connected in series to measure current in resistor/*Ammeter in serie geskakel om stroom deur resistor the meet*	✓

[12.1.1] (3)

11.2.3 With one battery, measure the voltmeter reading and the ammeter reading.
Add another battery in series with the first and repeat the measurements.
Add a third battery in series with the first two and repeat the measurements.

Met een battery, meet die voltmeterlesing en die ammeterlesing.
Voeg 'n tweede battery in serie met die eerste en herhaal die metings.
Voeg 'n derde battery in serie met die eerste twee en herhaal die metings.

OR/*OF*

Adjust the rheostat connected in series to the power source and take the readings on the ammeter and voltmeter.
Increase/decrease the resistance of the rheostat and take a second set of readings.
Increase/decrease the resistance of the rheostat to take a third set of readings.

Verstel die verstelbare weerstand wat in serie met die kragbron geskakel is en neem die lesings op die ammeter en die voltmeter.
Verhoog/verlaag die weerstand en neem 'n tweede stel lesings.
Verhoog/verlaag die weerstand en neem 'n derde stel lesings.

Checklist/Kontrolelys **Criteria for method/*Kriteria vir metode:***	Marks/ *Punte*
Indicates that potential difference must be adjusted. / *Dui aan dat potensiaalverskil verstel moet word.*	✓
Indicates that voltmeter reading must be taken. / *Dui aan dat voltmeterlesing geneem moet word.*	✓
Indicates that ammeter reading must be taken. / *Dui aan dat ammeterlesing geneem moet word.*	✓

(3)
[12.1.1] **[14]**

QUESTION 12 / *VRAAG 12*

12.1 A: Slip rings ✓ B: Brushes ✓

A: Sleepringe B: Borsels [12.2.1] (2)

12.2 Anticlockwise ✓
Antikloksgewys [12.2.3] (1)

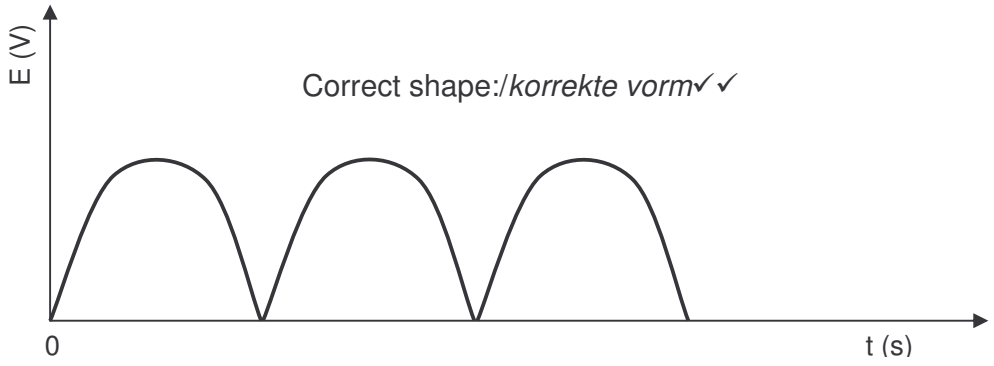
12.3 Any two:
Increase number of turns of coil ✓
Increase magnetic field strength (stronger magnets) ✓
Increase speed of rotation
Use horse-shoe magnet (to concentrate field)

Enige twee:
Verhoog die aantal windings op die spoel
Verhoog die sterkte van die magneetveld
Verhoog die rotasiespoed
Gebruik 'n hoefystermagneet (om veld te konsentreer) [12.2.1] (2)

12.4 Use split ring commutators instead of slip rings ✓
Add a battery to provide electrical energy to drive motor. ✓

Gebruik 'n splitring kommutator in plaas van sleepringe
Voeg 'n battery by om elektriese energie te verskaf om die motor aan te dryf [12.2.3] (2)

12.5



Correct shape:/*korrekte vorm*✓✓

[12.1.2] (2)

12.6 Any two:
(i) easier to generate and transmit from place to place ✓
(ii) easier to convert from a.c. to d.c. than the reverse ✓
(iii) voltage can be easily changed by stepping it up or down
(iv) high frequency used in a.c. make it more suitable for electric motors

Enige twee
(i) makliker om op te wek en van een plak na 'n ander oor te dra
(ii) makliker om vanaf ws na gs om te skakel as die omgekeerde
(iii) potensiaalverksil kan maklik verander word deur dit te verhoog of te verlaag
(iv) hoë frekwensie gebruik in ws maak dit meer geskik vir elektriese motors

[12.3.2] (2)
[12]

QUESTION 13 / *VRAAG 13*

13.1 $I = I_0 \sin\omega t$ ✓✓ or $I = I_0 \sin 2\pi ft$ [12.1.2] (2)

13.2 $I_{rms} = \frac{I_0}{\sqrt{2}}$ ✓✓ [12.2.1] (2)

13.3 $V_0 = \sqrt{2}\, V_{rms}$ ✓= 1,414 x 240 ✓ = 339, 36 V ✓ [12.2.3] (3)

13.4 The average value of the current over the cycle is zero and no useful power is delivered.✓✓
Die gemiddelde waarde van die stroom oor die siklus is nul en geen bruikbare drywing word gelewer nie.

[12.1.2] (2)
[9]

QUESTION 14 / *VRAAG 14*

14.1 Incoming incident photon collides with electron. ✓
Electron is excited to a higher energy level. ✓
The unstable electron returns to the lower energy level, ✓ emitting two photons. ✓

Invallende foton bots met die electron.✓
Elektron word opgewek na hoër energievlak.✓
Die onstabiele elektron keer na laer energievlak terug ✓ *en stel twee fotone vry.*✓ [12.1.2] (4)

14.2 *Any two:/ Enige twee*:
Laser beam is: / *Laser straal is*:
Monochromatic / *Monochromaties* ✓
Coherent / *Koherent* ✓
Unidirectional / *In een rigting gekonsentreer* [12.2.1] (2)

14.3 A flash light gives a broad beam that sweeps a wider area. ✓
A laser beam is narrow. ✓

'n Flitslig verskaf 'n breë straal lig wat 'n groter area dek
'n Laserstraal is nou [12.3.2] (2)

14.4 Less damage to eye tissue✓
Less scarring/ More precision cut ✓

Minder skade aan die oogweefsel
Minder littekens/Meer akkurate snit [12.3.2] (2)
[11]

GRAND TOTAL = 150
GROOTTOTAAL = 150