NATIONAL SENIOR CERTIFICATE EXAMINATION

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2017

MEMORANDUM

MARKS/PUNTE: 150

This memorandum consists of 16 pages

Hierdie memorandum bestaan uit 16 bladsye

GENERAL GUIDELINES
1. CALCULATIONS

1.1   **Marks will be awarded for**: correct formula, correct substitution, correct answer with unit.
       Punte sal toegeken word vir: korrekte formule, korrekte substitusie, korrekte antwoord met eenheid.

1.2   **No marks** will be awarded if an **incorrect or inappropriate formula is used**, even though there may be relevant symbols and applicable substitutions.
       Geen punte sal toegeken word waar 'n **verkeerde of ontoepaslike formule gebruik** word nie, selfs al is daar relevante simbole en relevante substitusies.

1.3   When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.
       Wanneer 'n fout gedurende **substitusie in 'n korrekte formule** begaan word, sal 'n punt vir die korrekte formule en vir korrekte substitusies toegeken word, maar **geen verdere punte** sal toegeken word nie.

1.4   If **no formula** is given, but **all substitutions are correct**, a candidate will **forfeit one mark**.
       Indien **geen formule** gegee is nie, maar **al die substitusies is korrek**, **verloor** die kandidaat **een punt**.

1.5   **No penalisation if zero substitutions are omitted** in calculations where **formula**/principle is given correctly.
       Geen penalisering indien **nulwaardes nie getoon** word nie in berekeninge waar die **formule/beginsel korrek gegee is nie**.

1.6   Mathematical manipulations and change of subject of appropriate formulae carry no marks, but if a candidate starts off with the correct formula and then changes the subject of the formula incorrectly, marks will be awarded for the formula and the correct substitutions. The mark for the incorrect numerical answer is forfeited.
       Wiskundige manipulasies en verandering van die onderwerp van toepaslike formules tel geen punte nie, maar indien 'n kandidaat met die korrekte formule begin en dan die onderwerp van die formule verkeerd verander, sal punte vir die formule en korrekte substitusies toegeken word. Die punt vir die verkeerde numeriese antwoord word verbeur.

1.7   Marks are only awarded for a formula if a **calculation had been attempted**. i.e. substitutions have been made or a numerical answer given.
       Punte word slegs vir 'n formule toegeken indien 'n **poging tot 'n berekening aangewend is**, d.w.s. substitusies is gedoen of 'n numeriese antwoord is gegee.

1.8   Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.
       Punte kan slegs toegeken word vir substitusies wanneer waardes in formule ingestel is en nie vir waardes wat voor 'n berekening genoem is nie.

1.9   All calculations, when not specified in the question, must be done to two
        decimal places.
        Alle berekenings, wanneer nie in die vraag gespesifiseer word nie, moet tot twee
        desimale plekke gedoen word.

1.10   If a final answer to a calculation is correct, full marks will not automatically be
        awarded. Markers will always ensure that the correct/appropriate formula is
        used and that workings, including substitutions, are correct.
        Indien 'n finale antwoord tot 'n berekening korrek is, sal volpunte nie outomaties
        toegeken word nie.   Nasieners sal altyd verseker dat die korrekte/toepaslike
        formule gebruik word en dat bewerkings, insluitende substitusies korrek is.

1.11   Questions where a series of calculations have to be made (e.g. a circuit
        diagram question) do not necessarily always have to follow the same order.
        FULL MARKS will be awarded provided it is a valid solution to the problem.
        However, any calculation that will not bring the candidate closer to the answer
        than the original data, will not count any marks.
        Vrae waar 'n reeks berekenings gedoen moet word (bv. 'n stroomdiagramvraag)
        hoef nie noodwendig dieselfde volgorde te hê nie. VOLPUNTE sal toegeken word
        op voorwaarde dat dit 'n geldige oplossing vir die probleem is. Enige berekening
        wat egter nie die kandidaat nader aan die antwoord as die oorspronklike data bring
        nie, sal geen punte tel nie.

2. UNITS/EENHEDE

2.1   Candidates will only be penalised once for the repeated use of an incorrect
        unit **within a question or subquestion**.
        'n Kandidate sal slegs een keer gepenaliseer word vir die herhaaldelike gebruik
        van 'n verkeerde eenheid **in 'n vraag of subvraag**.

2.2   Units are only required in the final answer to a calculation.
        Eenhede word slegs in die finale antwoord tot 'n vraag verlang.

2.3   Marks are only awarded for an answer, and not for a unit *per se*. Candidates
        will therefore forfeit the mark allocated for the answer in each of the following
        situations:
        - Correct answer + wrong unit
        - Wrong answer + correct unit
        - Correct answer + no unit
        Punte word slegs vir 'n antwoord en nie vir 'n eenheid per se toegeken nie.
        Kandidate sal derhalwe die punt vir die antwoord in die volgende gevalle verbeur:
        - Korrekte antwoord + verkeerde eenheid
        - Verkeerde antwoord + korrekte eenheid
        - Korrekte antwoord + geen eenheid

2.4   SI units must be used except in certain cases, e.g. $V \cdot m^{-1}$ instead of $N \cdot C^{-1}$, and
        $cm \cdot s^{-1}$ or $km \cdot h^{-1}$ instead of $m \cdot s^{-1}$ where the question warrants this.
        SI-eenhede moet gebruik word, behalwe in sekere gevalle, bv. $V \cdot m^{-1}$ in plaas van
        $N \cdot C^{-1}$, en $cm \cdot s^{-1}$ of $km \cdot h^{-1}$ in plaas van $m \cdot s^{-1}$ waar die vraag dit regverdig.

3. GENERAL/ALGEMEEN

3.1   If one answer or calculation is required, but two given by the candidate, only the first one will be marked, irrespective of which one is correct. If two answers are required, only the first two will be marked, etc.

Indien een antwoord of berekening verlang word, maar twee word deur die kandidaat gegee, sal slegs die eerste een nagesien word, ongeag watter een korrek is. Indien twee antwoorde verlang word, sal slegs die eerste twee nagesien word, ens.

3.2   For marking purposes, alternative symbols (s,u,t, etc.) will also be accepted.

Vir nasiendoeleindes sal alternatiewe simbole (s, u, t, ens.) ook aanvaar word.

3.3   Separate compound units with a multiplication dot, not a full stop, for example, $m \cdot s^{-1}$. For marking purposes $m.s_{-1}$ and m/s will also be accepted.

Skei saamgestelde eenhede met 'n vermenigvuldigpunt en nie met 'n punt nie, byvoorbeeld, $m \cdot s^{-1}$. Vir nasiendoeleindes sal $m \cdot s^{-1}$ em m/s ook aanvaar word.

4. POSITIVE MARKING/POSITIEWE NASIEN

Positive marking regarding calculations will be followed in the following cases:
Positiewe nasien met betrekking tot berekenings sal in die volgende gevalle geld:

4.1   **Subquestion to subquestion:** When a certain variable is calculated in one subquestion (e.g. 3.1) and needs to be substituted in another (3.2 or 3.3), e.g. if the answer for 3.1 is incorrect and is substituted correctly in 3.2 or 3.3, **full marks** are to be awarded for the subsequent subquestions.

Subvraag na subvraag: Wanneer 'n sekere veranderlike in een subvraag (bv. 3.1) bereken word en dan in 'n ander vervang moet word (3.2 of 3.3), bv. indien die antwoord vir 3.1 verkeerd is en korrek in 3.2 of 3.3 vervang word, word **volpunte** aan die daaropvolgende subvraag toegeken.

4.2   **A multistep question in a subquestion**: If the candidate has to calculate, for example, current in the first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer will be forfeited.

'n Vraag met veelvuldige stappe in 'n subvraag: Indien 'n kandidaat byvoorbeeld, die stroom verkeerd bereken in 'n eerste stap as gevolg van 'n substitusiefout, verbeur die kandidaat die punt vir die substitusie sowel as die finale antwoord.

5. NEGATIVE MARKING/NEGATIEWE NASIEN

Normally an incorrect answer cannot be correctly motivated if based on a conceptual mistake. If the candidate is therefore required to motivate in question 3.2 the answer given to question 3.1, and 3.1 is incorrect, no marks can be awarded for question 3.2. However, if the answer for e.g. 3.1. is based on a calculation, the motivation for the incorrect answer in 3.2 could be considered.

'n Verkeerde antwoord, indien dit op 'n konsepsuele fout gebaseer is, kan normaalweg nie korrek gemotiveer word nie. Indien 'n kandidaat gevra word om in vraag 3.2 die antwoord op vraag 3.1 te motiveer en 3.1 is verkeerd, kan geen punte vir vraag 3.2 toegeken word nie. Indien die antwoord op bv. 3.1 egter op 'n berekening gebaseer is, kan die motivering vir die verkeerde antwoord in 3.2 oorweeg word.

QUESTION 1 / VRAAG 1

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

QUESTION 2 / VRAAG 2

2.1

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

(2)

2.2

Accepted labels / Aanvaarde benoemings	
W	Fg / Fw/force of earth on block/weight / 49 N / mg / gravitational force
T_1	Tension in rope 1 / F_{T1}
T_2	Tension in rope 2 / F_{T2}
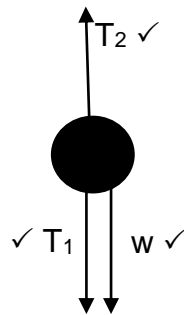
(3)

Notes/Aantekeninge:
- Any additional forces: deduct 1 mark: max $^2/_3$
- No arrows: $^0/_3$
- Force(s) not touching object: deduct 1 mark: max $^2/_3$

2.3 T_2 ✓   (1)

2.4	For 5 kg block:
	F_{net} = ma ✓
	T_2 + ($-F_g$) + ($-T_1$) = ma
	✓ $\underline{120 – 5(9,8) – T_1}$ = 5a
	71 – T_1 = 5a
	
	For 3 kg block:
	F_{net} = ma
	T_1 + ($-F_g$) = ma
	✓ $\underline{T_1 - 3(9,8)}$ = 3a
	T_1 – 29,4 = 3a
		Any one: 5a or 3a ✓	OPTION 2: Systems approach: Max $^4/_6$
			F_{net} = ma ✓
			120-8(9,8) = 8a
			a = 5,2 m·s^{-2}
			
			T_1 -3(9,8) =3a
			    T_1 = $\underline{3(9,8) + 3(5,2)}$ ✓
			    T_1 = 45 N ✓
			
			String will NOT break ✓

	OR		

	71-29,4 = 8a
	a = 5,2 m·s^{-2}
	
	T_1 = 29,4 + 3(5,2)
	    = 45 N ✓
	
	String will NOT break ✓
		71 – T_1 = 5a …….i
		T_1 – 29,4 = 3a …..ii
		
		i×3: 213-3T_1 = 15a
		$\underline{ii×5: 5T_1-147=15a}$
		    -8T_1 = -360
		    T_1 = 45 N ✓
		
		String will NOT break ✓	

(6)

2.5   Remains the same ✓ / Bly dieselfde   (1)

[13]

QUESTION 3

3.1   Motion under the influence of the force of gravity only. ✓✓
        Beweging as slegs gravitasiekrag op die voorwerp inwerk.   (2)

3.2.1 $F_{net} = (0,5)(9,8) = \underline{4,9\ N}$ ✓   (1)

3.2.2   Downwards ✓   (1)

3.3.1	**Upwards positive:**	**Downwards positive:**	
	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓	
	-21✓ $= \underline{v_i(2,88) + \frac{1}{2}(-9,8)(2,88)^2}$✓	21✓ $= \underline{v_i(2,88) + \frac{1}{2}(9,8)(2,88)^2}$✓	
	$v_i = 6,82\ m\cdot s^{-1}$ ✓	$v_i = -6,82$	
		$v_i = 6,82\ m\cdot s^{-1}$ ✓	(4)

3.3.2	**POSITIVE MARKING FROM Q3.3.1**		
	Upwards positive:	**Downwards positive:**	
	$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓	
	$\underline{0^2 = (6,82)^2 + 2(-9,8)\ \Delta y}$ ✓	$\underline{0^2 = (-6,82)^2 + 2(9,8)\ \Delta y}$ ✓	
	$\Delta y = \underline{2,37}\ m$	$\Delta y = -2,37\ m$	
	Max height= $\underline{2,37 + 21+0,6}$✓= 23,97 m✓	Max height= $\underline{2,37 + 21+0,6}$✓= 23,97 m✓	(4)

3.4	**POSITIVE MARKING FROM Q3.3.1**		
	Upwards positive:	**Downwards positive:**	
	$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$	
	$= \underline{6,82 + (-9,8)(2,88)}$ ✓	$= -6,82 + (9,8)(2,88)$ ✓	
	$= -21,40\ m\cdot s^{-1}$ Both formulae ✓	$= 21,40\ m\cdot s^{-1}$ Both formulae ✓	
	$F_{net}\cdot\Delta t = mv_f - mv_i$	$F_{net}\cdot\Delta t = mv_f - mv_i$	
	$\underline{(N-Fg)\ (0,1)}$ ✓ $= \underline{0,5(18)-0,5(-21,40)}$ ✓	$\underline{(Fg-N)\ (0,1)}$✓ $= \underline{0,5(-18) - 0,5(21,40)}$ ✓	
	$N-(0,5)(9,8) = 197$	$(0,5)(9,8) - N = -197$	
	$N = 201,9\ N$ ✓	$N = 201,9\ N$ ✓	
			(5)

[17]

QUESTION 4 / VRAAG 4

4.1   The energy that an object has due to its height above the ground / a reference point ✓✓
Die energie wat 'n voorwerp het as gevolg van die hoogte bo die grond / bo 'n verwysingspunt. (2)

4.2.1 $E_p = mgh$ ✓
= (5,05)(9,8)(0,06) ✓
= 2,97 J ✓ (3)

4.2.2

USE ENERGY PRINCIPLES ONLY. ANY OTHER METHOD: $^0/_4$	
POSITIVE MARKING FROM Q4.2 $(mgh + \frac{1}{2}mv^2)_R = (mgh + \frac{1}{2}mv^2)_S$ ✓ $0 + \frac{1}{2}(5,05)v^2$ ✓ $= 2,97$ ✓ $+ 0$ $v = 1,08$ m·s^{-1} ✓	$W_{net} = \Delta E_k$ ✓ (5,05×9,8)(0,06)Cos180°✓=0-½(5,05)v^2 ✓ $v = 1,08$ m·s^{-1} ✓

(4)

4.2.3

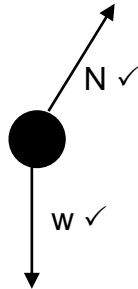| **POSITIVE MARKING FROM Q4.3** |
|---|
| $\Sigma p_i = \Sigma p_f$
 $(mv_i)_1 + (mv_i)_2 = (m_1+m_2)v_f$ } Any one ✓
$(0,05)v_i + 0$✓$= (5,05)(1,08)$ ✓
$v_i = 109,08$ m·s^{-1} ✓ |

(4)
[13]

QUESTION 5 / VRAAG 5

5.1 The <u>contact force which a surface exerts on an object</u> ✓ and <u>which is perpendicular to the surface</u>. ✓
Die <u>kontakkrag wat 'n oppervlak op 'n voorwerp uitoefen</u> en <u>wat loodreg op die oppervlak is</u>. (2)

5.2

(2)

Accepted labels / Aanvaarde benoemings	
w	Fg / Fw/force of earth on block/weight / 49 N / mg / gravitational force
N	Normal force / F_N / Force of incline on trolley

5.3 **OPTION 1**
$(mgh + ½mv^2)_X = (mgh + ½mv^2)_Y$ ✓
$\underline{(76)(9,8)(1,5) + ½(76)(3)^2}$ ✓ $= \underline{0} + ½(76)v^2$ ✓
$v = 6,2 \text{ m·s}^{-1}$ ✓

OPTION 2
$W_{net} = \Delta E_k$ ✓
$W_w = ½mv_f^2 - ½mv_i^2$
$\underline{(76×9,8)(1,5)Cos\ 0°}$✓ $= ½(76)v_f^2 - ½(76)(3)^2$✓
$v_f = 6,2 \text{ m·s}^{-1}$ ✓

OPTION 3
$W_{nc} = \Delta E_k + \Delta E_p$ ✓
$0 = (½mv_f^2 - ½mv_i^2) + (mgh_f - mgh_i)$
$0 = [½(76)v_f^2 - ½(76)(3)^2]$ ✓ $+ [0 - \underline{(76)(9,8)(1,5)}]$ ✓
$v_f = 6,2 \text{ m·s}^{-1}$ ✓

(4)

5.4 $f_k = \mu_k·N$ ✓
$= \mu_k·mg\ Cos\ \Theta$
$= \underline{(0,21)(76×9,8×Cos\ 10°)}$ ✓
$= 154,03 \text{ N}$ ✓ (3)

5.5 The normal force is perpendicular to the dispacement / motion. ✓
OR
$\Theta = 90° \rightarrow Cos\ 90° = 0$ ✓
OR
$W_N = N\Delta x\ Cos90° = 0$ ✓ (1)

5.6　**POSITIVE MARKING FROM Q5.3**

$W_{net} = \Delta E_k$ ✓

$W_{w//} + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$\underline{(76 \times 9,8 \times Sin10°)(\Delta x)\ Cos0°}$ ✓ $+ \underline{(154)(\Delta x)\ Cos180°}$ ✓ $= \underline{0 - \frac{1}{2}(76)(6,2)^2}$ ✓

　　　　$129,33\Delta x - 154\Delta x = -1460,72$

$\Delta x = 59,22$ m

$h = \Delta x\ Sin10°$

　$= 59,22\ Sin10°$ ✓

　$= 10,28$ m ✓　　　　　　　　　　　　　　　　　　　　　　　　　　　(6)

5.7　Remains the same ✓　　　　　　　　　　　　　　　　　　　　　　(1)

[19]

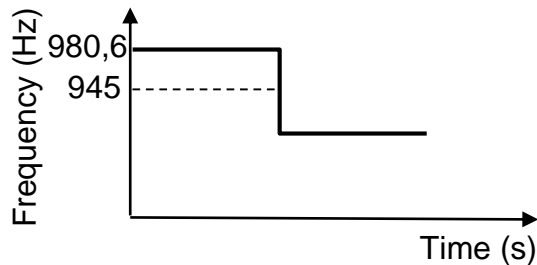　　　　　　　Please turn over/*Blaai om asseblief*

QUESTION 6

6.1 The <u>number of waves that passes a fixed point</u> ✓ per second ✓
Die aantal golwe wat per sekonde by 'n vaste punt verby beweeg (2)

6.2 Wavelength (λ) in front of source decreases ✓
<u>More waves per second</u> reaches the listener ✓
Frequency will increase (2)

6.3
$$f_L = \frac{v \pm v_L}{v \pm v_S} f_S \checkmark$$

$980,6 \checkmark = \frac{340}{340 - v_s} (945) \checkmark$

$v_s = 12,34 \text{ m·s}^{-1} \checkmark$ (4)

6.4

Criteria for graph

Horizontal line at 980,6 Hz	✓
Horizontal line below 945 Hz	✓
945 Hz correctly indicated	✓

(3)

[11]

QUESTION 7 / VRAAG 7

7.1 The magnitude of the <u>electrostatic force</u> exerted by one point charge (Q_1) on another point charge (Q_2) is <u>directly proportional to the product of the magnitudes of the charges</u> ✓ and <u>inversely proportional to the square of the distance (r) between them</u> ✓

Die grootte van die <u>elektrostatiese krag</u> wat een puntlading (Q_1) op 'n ander puntlading (Q_2) uitoefen, is <u>direk eweredig aan die produk van die groottes van die ladings</u>✓ en <u>omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle</u>. ✓ (2)

7.2 $Q = \dfrac{Q_1 + Q_2}{2}$

$= \dfrac{20 + 0}{2}$ ✓

$= 10 \ \mu C$ ✓ (10×10^{-6} C) (2)

7.3 Weight (F_g / w) ✓
Electrostatic force ✓ (2)

7.4.1 **POSITIVE MARKING FROM Q7.2**

$F = \dfrac{kQ_1Q_2}{r^2}$ ✓

$= \dfrac{\left(9 \times 10^9\right)\left(10 \times 10^{-6}\right)\left(10 \times 10^{-6}\right)✓}{(0,7)^2 ✓}$

$F = 1,84$ N ✓ (4)

7.4.2 **POSITIVE MARKING FROM 7.4.1**

$F_E = mg \tan 7°$ ✓
$1,84 = m(9,8) \tan 7°$ ✓
$m = 1,53$ kg ✓
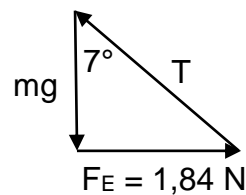
(3)
[13]

QUESTION 8

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

8.2   Smaller than ✓ / $A_2 > A_1$
A_2 is in the series circuit and reads the total current, while A_1 is in a parallel branch of the circuit and reads only a fraction of the total current. ✓   (2)

8.3.1 $P = I^2 R$ ✓
$\underline{64 = (2^2)\,R}$ ✓
$R = 16\ \Omega$ ✓   (3)

8.3.2

OPTION 1

$P = VI$
$64 = V(2)$ ✓
$V = 32\ V$

$V_{2\Omega} = IR$
   $= (2)(2)$
   $= 4\ V$

$V_{//} = 4 + 32 = 36\ V$

$V_{12\Omega} = IR$ ✓
$\underline{36 = I(12)}$ ✓
$I_{12\Omega} = 3\ A$

$I_{TOT} = 2+3 = 5\ A$ ✓

OPTION 2

$R_{//1} : R_{//2}$
  18 : 12 ✓
   3 : 2

$I_1 : I_2$
  2 : 3 ✓
2 A : 3 A

$I_{TOT} = 2+3$ ✓ $= 5\ A$ ✓

       (4)

8.3.3

POSITIVE MARKING FROM Q8.3.1+Q8.3.2

OPTION 1		OPTION 2
$\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$ ✓ $\quad = \dfrac{1}{18} + \dfrac{1}{12}$ ✓ $R_p = 7{,}2\ \Omega$ $R_e = \underline{7{,}2 + 2{,}5}$ ✓ $= 9{,}7\ \Omega$ $V_1 = V_e = IR$ $\quad = \underline{(5)(9{,}7)}$ ✓ $\quad = 48{,}5\ V$ ✓	$R_p = \dfrac{R_1 R_2}{R_1 + R_2}$ ✓ $\quad = \dfrac{(18)(12)}{18+12}$ ✓ $\quad = 7{,}2\ \Omega$ $R_e = \underline{7{,}2 + 2{,}5}$ ✓ $= 9{,}7\ \Omega$ $V_1 = V_e = IR$ $\quad = \underline{(5)(9{,}7)}$ ✓ $\quad = 48{,}5\ V$ ✓	$V_{//} = IR$ ✓ $\quad = (5)(7{,}2)$ ✓ $\quad = 36\ V$ $V_{2{,}5\Omega} = IR$ $\quad = (5)(2{,}5)$ ✓ $\quad = 12{,}5\ V$ $V_1 = \underline{12{,}5 + 36} = 48{,}5\ V$ ✓

       (5)

8.4   Voltmeter ✓
A voltmeter has a very high resistance and doesn't allow any flow of current through it ✓   (2)
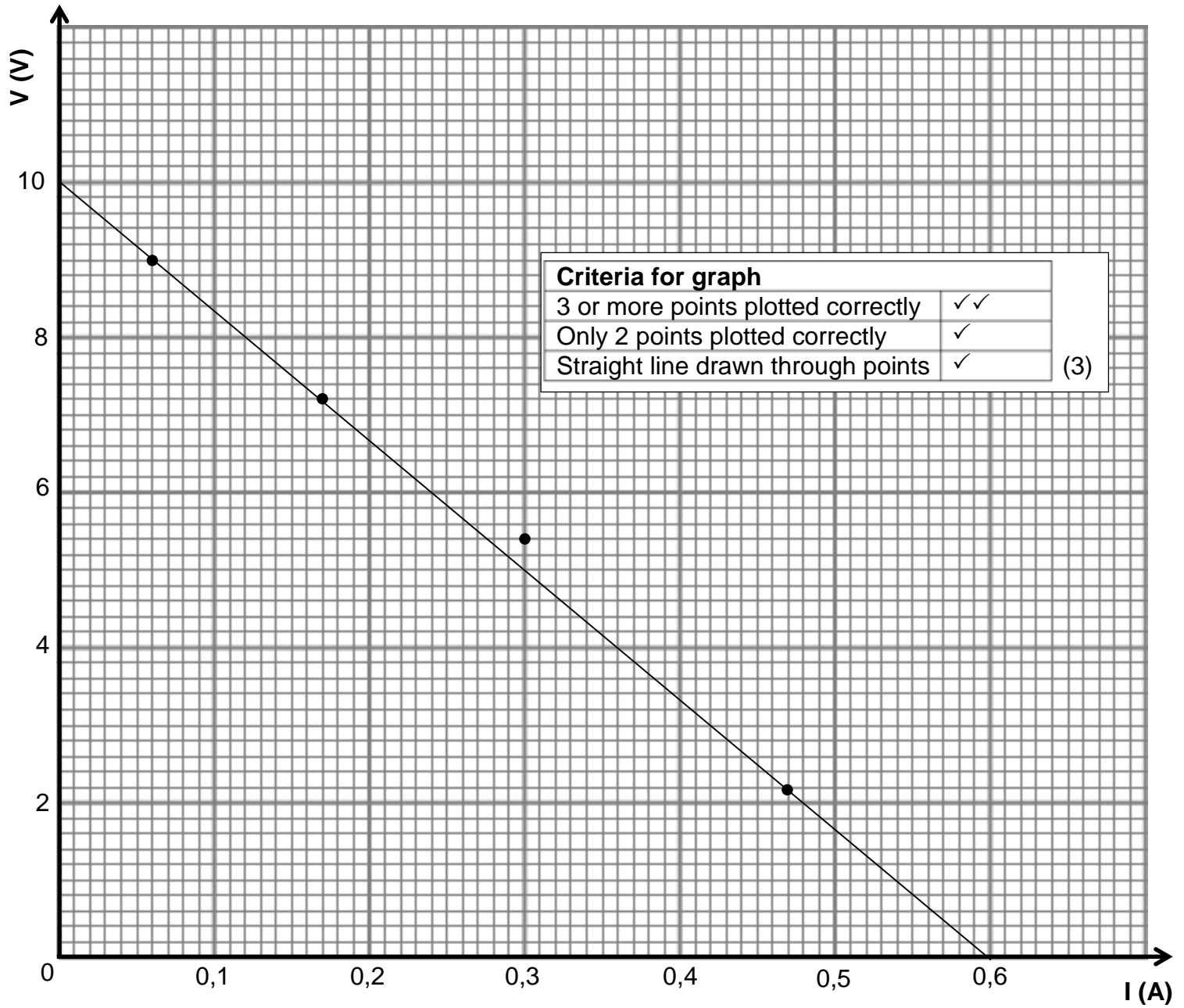
[18]

QUESTION 9 / VRAAG 9

9.1   The resistance against the flow of charge through the battery ✓   (1)

9.2

Criteria for graph	
3 or more points plotted correctly	✓✓
Only 2 points plotted correctly	✓
Straight line drawn through points	✓

(3)

9.3.1   10 V ✓
OR
Value for y-intercept from graph   (1)

9.3.2   Use ANY 2 points *ON THE LINE*:

Gradient = $\frac{\Delta V}{\Delta I}$
$$= \frac{7,2 - 9}{0,17 - 0,06} ✓$$
$$= -16,36 ✓ \quad (2)$$

9.3.3   **POSITIVE MARKING FROM 9.3.2**
r = 16,36 Ω ✓ (Positive answer of 9.3.2)   (1)
[8]

QUESTION 10 / VRAAG 10

10.1   (Split ring) Commutator ✓   (1)

10.2   Replace commutator with (two) slip rings ✓   (1)

10.3.1 $I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓ $= \frac{6,43}{\sqrt{2}}$ ✓ $= 4,55$ A ✓   (3)

10..3.2   **POSITIVE MARKING FROM Q10.3.1**
OPTION 1
$I_{rms} = \frac{V_{rms}}{R}$ ✓

$\therefore 4,55 = \frac{V_{rms}}{48,4}$ ✓

$V_{rms} = 220,22$ V

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

$220,22 = \frac{V_{max}}{\sqrt{2}}$ ✓

$V_{max} = 311,44$ V ✓

OPTION 2
$V_{max} = I_{max}R$ ✓✓
$= (6,43)$ ✓ $(48,4)$ ✓
$= 311,21$ V ✓   (5)
[10]

QUESTION 11 / VRAAG 11

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

11.2.1
$$E = \frac{hc}{\lambda} \quad ✓$$
$$= \frac{(6{,}63\times10^{-34})(3\times10^{8})}{(260\times10^{-9})} \quad ✓$$
$$= 7{,}65\times10^{-19} \text{ J} \quad ✓ \tag{3}$$

11.2.2 **POSITIVE MARKING FROM Q11.2.1**
$E = W_o + E_{k(max)}$ ✓
$7{,}65\times10^{-19} = hf_0 + \frac{1}{2}mv^2$
$\underline{7{,}65\times10^{-19} = (6{,}63\times10^{-34})f_0 + \frac{1}{2}(9{,}11\times10^{-31})(5\times10^{5})^2}$ ✓
$f_0 = 9{,}82\times10^{14}$ Hz ✓   (3)

[8]

TOTAL/TOTAAL: 150