



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE/
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GRADE/GRAAD 11

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

NOVEMBER 2016

MEMORANDUM

MARKS/PUNTE: 150

**This memorandum consists of 14 pages.
*Hierdie memorandum bestaan uit 14 bladsye.***

QUESTION 1/VRAAG 1

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

QUESTION 2/VRAAG 2

2.1 The sum of two or more vectors ✓✓
Die som van twee of meer vektore
OR/OF
The single vector having the same effect as two or more vectors together.
Die enkele vektor wat dieselfde effek as twee of meer vektore saam het. (2)

2.2 The object is lifted/moved upwards. ✓
There will be a resultant/net force not equal to zero. ✓
Die voorwerp word opgelig/beweeg opwaarts
Dit sal 'n resultante/netto krag wees wat nie nul is nie. (2)

2.3.1 $F_y = F_A \sin 70^\circ$
 $= 730 \sin 70^\circ$ ✓
 $= 685,98 \text{ N}$ ✓ (2)

2.3.2 $F_x = F_A \cos 70^\circ$
 $= (730) \cos 70^\circ$ ✓
 $= 249,67 \text{ N}$ ✓ (2)

2.4 $F_y = F_B \cos 10^\circ$
 $= (1\,440) \cos 10^\circ$ ✓
 $= 1418,12 \text{ N}$ ✓

OR/OF

$F_y = F_B \sin 80^\circ$
 $= (1\,440) \sin 80^\circ$
 $= 1\,418,12 \text{ N}$

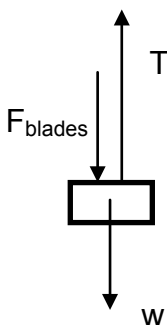
Maximum/Maksimum $w = F_{YA} + F_{YB}$
 $= 685,98 + 1418,12$ ✓
 $= 2\,104,1 \text{ N}$ ✓ (4)

2.5 If the distance x increases, the vertical components of the applied forces will decrease ✓ and then the system will possibly not be able to pick up the weight. ✓
Indien die afstand x vergroot, sal die vertikale komponente van die toegepaste krag verklein en dan sal die stelsel moontlik nie die gewig kan optel nie. (2)
[14]

QUESTION 3/VRAAG 3

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

3.2



(3)

Notes: Accepted Labels/Aanvaarbare Byskrifte		Mark/Punt
w	weight/ F_G/F_g <i>gewig/gravitasiekrag/swaartekrag</i>	✓
T	Tension/ $F_T/F_{\text{applied}}/F_A$ <i>Spanning/F_{toegepas}</i>	✓
F_{blades}	F of the blades/f/Air friction/Downward force of the blades <i>F van die lemme/f/Lugweerstand/Afwaartse krag van lemme</i>	✓
	Any additional force: deduct 1 mark (maximum $\frac{2}{3}$) <i>Enige addisionele krag: trek 1 punt af (maksimum $\frac{2}{3}$)</i>	
	Lines must touch object otherwise (maximum $\frac{2}{3}$) <i>Lyne moet voorwerp raak anders (maksimum $\frac{2}{3}$)</i>	

3.3 There is an extra downward force ✓✓ (on the container created by the blades of the helicopter)
Daar is 'n ekstra afwaartse krag (op die houer as gevolg van die lemme van die helikopter) (2)

3.4 $w = mg$
 $1\,960 = m(9,8)$ ✓
 $m = 200 \text{ kg}$ ✓ (2)

3.5 **POSITIVE MARKING FROM 3.4**
POSITIEWE NASIEN VAN 3.4

$F_{\text{net}} = ma$
 $T - F_g - F_{\text{blades}} = ma$ ✓
 $T - 1\,960 - 140$ ✓ = $(200)(0,13)$ ✓
 $T = 2\,126 \text{ N}$ ✓

OR/OF $T - 2\,100 = ma$
 $T - 2\,100 = (200)(0,13)$
 $T = 2\,126 \text{ N}$ (2)

3.6 2 100 N ✓ (1)
[14]

QUESTION 4/VRAAG 4

- 4.1 When a net force acts on an object, it will accelerate in the direction of the net force. The acceleration is directly proportional to the net force ✓ and inversely proportional to the mass of the object. ✓
Wanneer 'n netto krag op 'n voorwerp inwerk, sal dit in die rigting van die netto krag versnel. Die versnelling is direk eweredig aan die netto krag en omgekeerd eweredig aan die massa van die voorwerp.

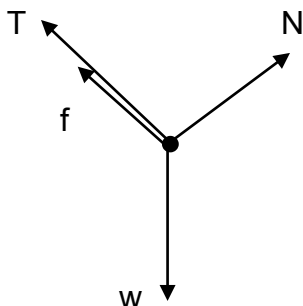
OR/OF

$$F_{net} \propto a \text{ and } a \propto \frac{1}{m}$$

$$F_{net} \propto a \text{ en } a \propto \frac{1}{m}$$

(2)

- 4.2



Notes: Accepted Labels/Aanvaarbare byskrifte		MARK/PUNT
N	Normal force/ F_N <i>Normaalkrag</i>	✓
w	Weight/ F_G/F_g <i>Gewig/Gravitasiekrag/Swaartekrag</i>	✓
T	Tension/ F_T <i>Spanning</i>	✓
f	Friction/ F_f <i>Wrywingskrag</i>	✓
	Any additional force: deduct 1 mark maximum (maximum $\frac{3}{4}$) <i>Enige addisionele krag: trek 1 punt af (maksimum $\frac{3}{4}$)</i>	
	Lines must touch dot otherwise (maximum $\frac{3}{4}$) <i>Lyne moet kolletjie raak anders (maksimum $\frac{3}{4}$)</i>	
	Do not penalise if angle is shown/not shown <i>Moenie penaliseer as hoek getoon/nie getoon is nie.</i>	

(4)

- 4.3 $f_k = \mu_k N$ ✓
 $f_k = 0,2(4)(9,8)\cos 40^\circ$ ✓
 $f_k = 6,01 \text{ N}$ ✓ up the slope/teen die helling op ✓

(4)

4.4 **POSITIVE MARKING FROM 4.3**
POSITIEWE NASIEN VAN 4.3

$$F_{\text{net}} = ma \checkmark$$

For the 8 kg box:

Vir die 8 kg-blok:

$$T - f = ma$$

$$T - 0,2(8)(9,8) \checkmark = 8a \checkmark$$

$$T = 8a + 15,68 \dots(1)$$

For the 4 kg box:

Vir die 4 kg-blok:

$$F_{\text{gll}} - T - f = ma$$

$$\frac{4(9,8) \sin 40^\circ - T - 6,01}{25,2 - 6,01 - T} = 4a \checkmark$$

$$19,19 - 4a = T \dots(2)$$

Combining equations (1) and (2):

Kombineer vergelykings (1) en (2)

$$4(9,8) \sin 40^\circ - 6,01 - 4a = 0,2(8)(9,8) + 8a \checkmark$$

$$a = 0,29 \text{ m}\cdot\text{s}^{-2} \checkmark$$

OR/OF

$$8a + 15,68 = 19,19 - 4a$$

$$a = 0,29 \text{ m}\cdot\text{s}^{-2}$$

(6)

4.5 Greater than \checkmark

Groter as

Explanation:/*Verduideliking:*

The component parallel to the slope increases \checkmark

The tension in the rope stays the same \checkmark

The net force increases \checkmark

Die komponent parallel (ewewydig) aan die helling vergroot

Die spanning in die tou bly dieselfde

Die netto krag vergroot

OR/OF

For the 8 kg box:

Vir die 8 kg-blok:

$$8(9,8) \sin 40^\circ - (0,2)(8)(9,8) \cos 40^\circ - T = 8a \checkmark$$

$$50,39 - 12,01 - T = 8a \dots(1)$$

$$50,39 - 12,01 - 8a = 4a + 7,84$$

$$a = 2,545 \text{ m}\cdot\text{s}^{-2} \checkmark$$

For the 4 kg box:

Vir die 4 kg-blok:

$$T - 0,2(4)(9,8) = 4a \checkmark$$

$$T - 7,84 = 4a \dots(2)$$

(4)
[20]

QUESTION 5/VRAAG 5

5.1 Every body in the universe attracts every other body with a force that is directly proportional to the product of their masses ✓ and inversely proportional to the square of the distance between their centres. ✓

Elke liggaam in die heelal trek elke ander liggaam aan met 'n krag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul middelpunte. (2)

5.2 Weightlessness is the sensation experienced when all contact forces are removed. ✓✓

Gewigloosheid is die sensasie wat ervaar word wanneer alle kontakkragte verwyder word. (2)

5.3
$$F = G \frac{m_1 m_2}{r^2} \text{ OR/OF } F = G \frac{M_E m}{R_E^2} \checkmark$$

$$= 6,67 \times 10^{-11} \times \frac{(5,98 \times 10^{24})(3800)}{[6,38 \times 10^6 + 25 \times 10^6]^2} \checkmark = 1\,539,23 \text{ N} \checkmark$$
 (4)

5.4 **OPTION 1/OPSIE 1**

Greater than ✓
the mass is greater ✓
and for the same force ✓ the distance must also be greater ✓
(because the product of the masses is directly proportional to the square of the distance between the centres.)

*Groter as
Die massa is groter
en vir dieselfde krag moet die afstand ook groter wees
(omdat die produk van die massas direk eweredig is aan die kwadraat van die afstand tussen die middelpunte)*

OPTION 2/OPSIE 2

POSITIVE MARKING FROM 5.3

POSITIEWE NASIEN VAN 5.3

Greater than ✓

Groter as

$$F = G \frac{m_1 m_2}{R^2}$$

$$1539,23 = 6,67 \times 10^{-11} \times \frac{(5,98 \times 10^{24})(4500)}{R^2}$$

$$F = \frac{G m_1 m_2}{r^2} \checkmark$$

$$R = 3,41 \times 10^7 \text{ m}$$

Distance above the surface of the Earth

Afstand bo oppervlak van Aarde

$$D = 3,41 \times 10^7 - 6,38 \times 10^6 \checkmark$$

$$D = 2,78 \times 10^7 \text{ m} \checkmark \text{ (or } 27\,768\,214,93 \text{ m)}$$

OPTION 3/OPSIE 3

Greater than ✓

Groter as

$$G \frac{m_1 m_2}{R_1^2} = G \frac{m_1 m_2}{R_2^2}$$

$$\frac{m_1}{R_1^2} = \frac{m_2}{R_2^2}$$

$$\frac{3800}{R_1^2} = \frac{4500}{R_2^2} \checkmark$$

$$R_2^2 = \frac{4500}{3800} R_1^2$$

$$R_2^2 = 1,0882... (25 \times 10^6 + 6,38 \times 10^6)$$

$$R_2 = 3,41 \times 10^7$$

$$D = 3,41 \times 10^7 - 6,38 \times 10^6 \checkmark$$

$$D = 2,78 \times 10^7 \text{ m} \checkmark$$

OR/OF

$$D = 1,0882... (25 \times 10^6)$$

$$D = 2,78 \times 10^7 \text{ m}$$

(4)
[12]

QUESTION 6/VRAAG 6

- 6.1 The refractive index is the ratio between the speed of light in a vacuum ✓ and the speed of light in a medium. ✓
Die brekingsindeks is die verhouding tussen die spoed van lig in 'n vakuum en die spoed van lig in 'n materiaal/medium. (2)
- 6.2 $n = \frac{c}{v}$ ✓
 $1,47 = \frac{3 \times 10^8}{v}$ ✓
 $v = 2,04 \times 10^8 \text{ m} \cdot \text{s}^{-1}$ ✓ (3)
- 6.3 $n_i \sin \theta_i = n_r \sin \theta_r$ ✓
 $1,33 \sin 37^\circ$ ✓ = $1,47 \sin \theta$ ✓
 $\theta = 32,99^\circ$ ✓ (4)
- 6.4 Olive oil has a higher optical density than water ✓✓
Olyfolie het 'n groter optiese digtheid as water (2)
- 6.5.1 Away from the normal ✓
Weg van die normale (1)
- 6.5.2 The speed of light in air is faster than the speed of light in oil ✓ because the refractive index in oil is higher than in air. ✓ (When a light ray speeds up it refracts away from the normal.)
Die spoed van lig in lug is vinniger as die spoed van lig in olie omdat die brekingsindeks in olie groter is as in lug. (Wanneer die ligstraal vinniger beweeg breek dit weg van die normale.) (2)
- 6.6.1 Oil and air
Olie en lug (1)
- 6.6.2 One of the conditions for total internal reflection is that the light has to travel from a medium with high optical density ✓ to a medium of lower optical density. ✓
Een van die voorwaardes vir totale interne weerkaatsing is dat die lig van 'n medium met 'n hoë optiese digtheid na 'n medium met 'n laer optiese digtheid moet beweeg. (2)
- 6.7 Wavelength ✓
Golflengte (1)
- [18]

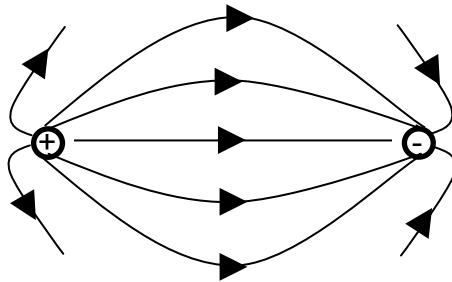
QUESTION 7/VRAAG 7

- 7.1 Every point of a wave front serves as a point source of spherical, secondary waves. ✓✓ The positions of the new wave front will be that of the surface tangent to the secondary waves.
Elke punt van 'n golffront dien as 'n puntbron van sferiese, sekondêre golwe. Die posisies van die nuwe golffront sal dié van die oppervlakraaklyn tot die sekondêre golwe wees.. (2)
- 7.2.1 Slit width ✓
Spleetwydte (1)
- 7.2.2 Degree of diffraction ✓
Mate van diffraksie (1)
- 7.2.3 Wavelength/Frequency/Colour of light ✓
Golflengte/Frekwensie/Kleur van lig (1)
- 7.3 The greater the width of the slit, the less the degree of diffraction ✓✓
Hoe groter die wydte van die spleet, hoe kleiner die mate van diffraksie
OR/OF
The smaller the width of the slit, the greater the degree of diffraction ✓✓
Hoe kleiner die spleetwydte, hoe groter die mate van diffraksie (2)
- 7.4.1 The bright, central band will increase ✓
The coloured bands will be red instead of green ✓
Die helder, sentrale band sal vergroot/toeneem
Die gekleurde bande sal rooi in plaas van groen wees (2)
- 7.4.2 If the wavelength increases, the degree of diffraction will increase. ✓
Indien die golflengte vergroot/toeneem, sal die mate van diffraksie vergroot/toeneem
OR/OF
Degree of diffraction is directly proportional to wavelength. ✓
Die mate van diffraksie is direk eweredig aan die golflengte (1)

[10]

QUESTION 8/VRAAG 8

8.1



Shape/Vorm	✓
Direction/Rigting	✓
Touching the charge, no crossing lines, etc.	✓
<i>Raak aan die lading/geen lyne wat kruis, ens.</i>	

(3)

8.2

$$F = \frac{kQ_1Q_2}{r^2} \quad \checkmark$$

$$F = \frac{9 \times 10^9 (5 \times 10^{-6})(5 \times 10^{-6})}{(0,04)^2} \quad \checkmark$$

$$F_{Y \text{ on } X} = 140,63 \text{ N right/regs} \quad \checkmark$$

(4)

8.3.1

No ✓
 Nee

(1)

8.3.2

The electric field is stronger closer to the charges (not a uniform field) and therefore not constant ✓ which means the force will not be constant ✓
Die elektriese veld is sterker nader aan die ladings (nie 'n uniforme veld nie) en daarom nie konstant nie wat beteken die krag sal ook nie konstant wees nie

(2)

8.4

POSITIVE MARKING FROM 8.2
POSITIEWE NASIEN VAN 8.2

$$F = \frac{kQ_1Q_2}{r^2}$$

$$F = \frac{9 \times 10^9 (4 \times 10^{-6})(5 \times 10^{-6})}{(0,03)^2} \quad \checkmark$$

$$F_{Z \text{ on } X} = 200 \text{ N upwards} \quad \checkmark$$

$$(F_{\text{net}})^2 = (F_{Y \text{ on } X})^2 + (F_{Z \text{ on } Y})^2$$

$$(F_{\text{net}})^2 = 140,63^2 + 200^2 \quad \checkmark$$

$$F_{\text{net}} = \sqrt{140,63^2 + 200^2}$$

$$F_{\text{net}} = 244,49 \text{ N} \quad \checkmark$$

(4)
[14]

QUESTION 9/VRAAG 9

9.1 $\Phi = BA \cos \theta$ ✓
 $\Phi = (3,2)\pi(0,04)^2 \cos 0^\circ$ ✓
 $\Phi = 0,016 \text{ Wb}$ ✓ (or 0,02 Wb) (3)

9.2 **POSITIVE MARKING FROM 9.1**
POSITIEWE NASIEN VAN 9.1

$$\varepsilon = \frac{N\Delta\Phi}{\Delta t}$$

✓
 $2,8 = \frac{-250(0,016 \cos 25^\circ - 0,016 \cos 0^\circ)}{\Delta t}$ ✓
 $\Delta t = 0,13 \text{ s}$ ✓ (0,17 s if 0,02 Wb was used/ gebruik was) (4)

9.3 Faraday's law. ✓ The magnitude of the induced emf across the ends of a conductor is directly proportional to the rate of change in the magnetic flux linkage with the conductor. ✓
Faraday se wet. Die grootte van die geïnduseerde emk oor die ente van 'n geleier is direk eweredig aan die tempo van verandering in die magnetiese vloedkoppeling met die geleier. (2)

9.4.1 Smaller ✓
Kleiner as (2)

9.4.2 The area of a square is smaller than the area of a circle with the radius equal to the side length of the square ✓
Die oppervlakte van 'n vierkant is kleiner as die oppervlakte van 'n sirkel met die radius gelyk aan die sylengte van die vierkant.

OR/OF

$0,04^2 < \pi \times 0,04^2$ area of square is smaller than area of circle.

$0,04^2 < \pi \times 0,04^2$ oppervlakte van vierkant is kleiner as oppervlakte van sirkel.

OR/OF

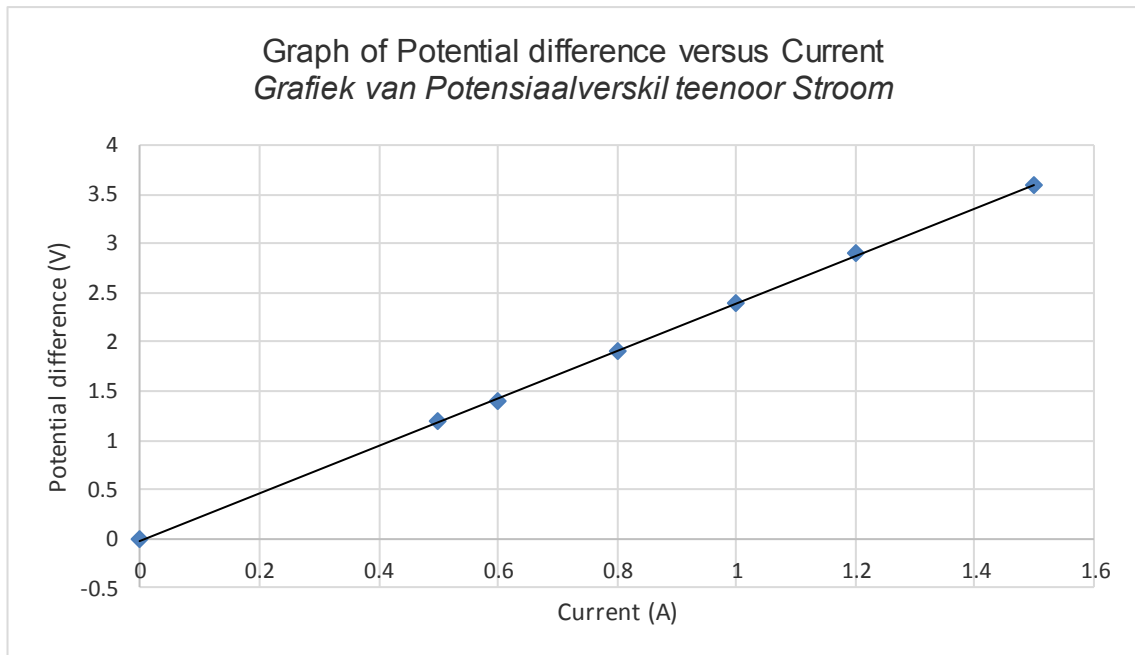
ε directly proportional to A ✓

ε direk eweredig aan A

(2)
[12]

QUESTION 10/VRAAG 10

- 10.1 Ohm's law ✓
Ohm se wet (1)
- 10.2 Graph/Grafiek



Marking criteria for graph Nasienkriteria vir grafiek	
Axes with correct/appropriate scale <i>Asse met korrekte en toepaslike skaal</i>	✓
5 or more of the 6 coordinates correctly plotted (3–4 one mark only) <i>5 of meer van die 6 koördinate korrek gestip</i> <i>(3–4 slegs een punt)</i>	✓✓
Drawing a line of best fit <i>Teken 'n lyn van beste passing</i>	✓

- 10.3 Resistance of the parallel connection ✓
Weerstand van die parallel kombinasie (1)
- 10.4 Stay the same ✓
Bly dieselfde (1)
- 10.5 Increase ✓
Toeneem (1)

10.6

OPTION 1/OPSIE 1

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \quad \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \quad \checkmark$$

$$\frac{1}{R_p} = \frac{1}{4} + \frac{1}{6} \quad \frac{1}{R_p} = \frac{1}{4} + \frac{1}{6} \quad \checkmark \quad \checkmark$$

$$R_p = 2,4 \, \Omega$$

$$R_{\text{tot}} = \frac{V}{I}$$

$$R_{\text{tot}} = \frac{V}{I}$$

$$R_{\text{tot}} = \frac{6}{0,8} \quad \checkmark$$

$$R_{\text{tot}} = \frac{6}{0,8}$$

$$R_{\text{tot}} = 7,5 \, \Omega$$

$$R = R_{\text{tot}} - R_{\text{par}} \\ = 7,5 - 2,4 \quad \checkmark \\ = 5,1 \, \Omega \quad \checkmark$$

(5)

OPTION 2/OPSIE 2

$$V_{\text{tot}} = 6 \, \text{V}$$

$$V_R = V_{\text{tot}} - V_2 \\ = 6 - 1,9 \quad \checkmark \\ = 4,1 \, \text{V} \quad \checkmark$$

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

$$R = \frac{4,1}{0,8} \quad \checkmark \quad R_{\text{tot}} = \frac{6}{0,8}$$

$$R = 5,1 \, \Omega \quad \checkmark$$

(5)

10.7

$$V_R = 6 - 2,4 = 3,6 \, \text{V}$$

$$W = \frac{V^2 \Delta t}{R} \quad \checkmark$$

$$W = (3,6)(1)(10) \quad W = \frac{(3,6)^2 10}{2,4} \quad \checkmark$$

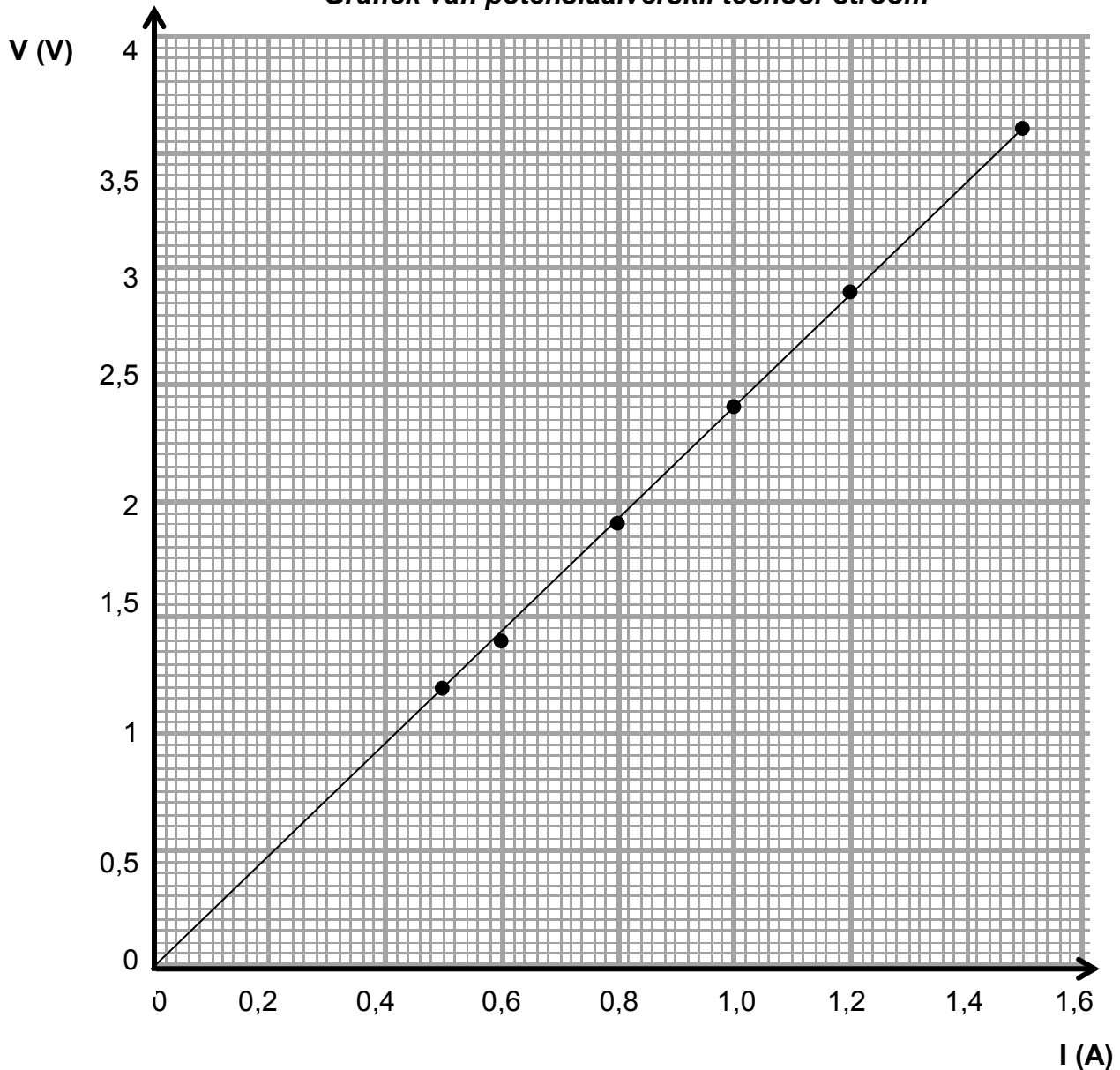
$$W = 36 \, \text{J} \quad \checkmark$$

(3)
[16]

ANSWER SHEET FOR QUESTION 10.2/ANTWOORDBLAD VIR VRAAG 10.2

**HAND IN THIS ANSWER SHEET TOGETHER WITH THE ANSWER BOOK./
LEWER HIERDIE ANTWOORDBLAD SAAM MET DIE ANTWOORDEBOEK IN.**

**Graph of potential difference versus current
Grafiek van potensiaalverskil teenoor stroom**



TOTAL/TOTAAL: 150