

QUESTION 8 (Start on a new page.)

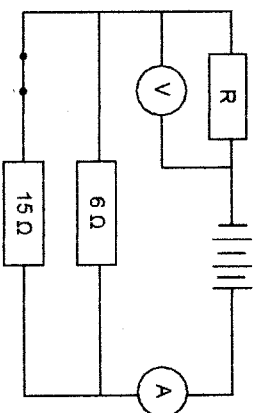
Two IDENTICAL point charges, X and Y, are placed 2 mm apart. Point P is 3 mm to the right of charge Y. The net electric field at point P is $5,44 \times 10^6 \text{ N}\cdot\text{C}^{-1}$ to the left.



- 8.1 Define the term *electric field* at a point. (2)
- 8.2 Are the charges **NEGATIVE** or **POSITIVE**? (1)
- 8.3 Draw the resultant electric field pattern for charges X and Y. (3)
- 8.4 Calculate the magnitude of the charge X. (5)
- 8.5 Charge Y is now replaced by an identical oppositely charged point charge.
How will the magnitude of the net electric field at point P be affected?
Choose from **INCREASE**, **DECREASE** or **REMAIN THE SAME**. (2)
Give a reason for the answer. [13]

QUESTION 10 (Start on a new page.)

10.1 The circuit below consists of a 6Ω and 15Ω resistor connected in parallel and an unknown resistor R, in series. An ammeter, a high-resistance voltmeter, a closed switch and battery are connected, as shown. The resistance of the battery and wires can be ignored.

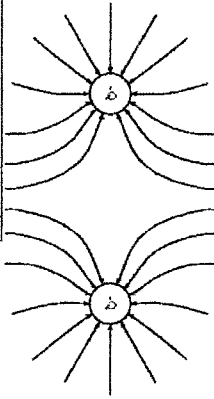


- The total power dissipated in the parallel part of the circuit is 50 W.
- 10.1.1 Define the term *power*. (2)
- 10.1.2 Calculate the effective resistance of the parallel combination. (2)
- 10.1.3 Calculate the potential difference across the resistors in parallel. (3)
- 10.1.4 Calculate the current through resistor R. (3)
- The switch in the circuit is now OPENED.
- 10.1.5 How will the reading on the voltmeter (V) be influenced?
Choose from **INCREASE**, **DECREASE** or **REMAIN THE SAME**. (1)
- 10.1.6 Explain the answer to QUESTION 10.1.5. (3)
- 10.2 A geyser labelled 2 000 W, is used for an average of 5 hours per day.
The cost of electricity is 80 cents per kWh.
- 10.2.1 Calculate the energy used by the geyser for 5 hours per day. (4)
- 10.2.2 Calculate the cost of electricity to operate the geyser for a month with 30 days. (2)
[20]

TOTAL: 150

QUESTION/VRAAG 8

- 8.1 Electric field at a point is the electrostatic force experienced per unit positive charge placed at that point. ✓✓
 Elektriese veld by 'n punt is die elektrostatiese krag wat per eenheid positiewe lading ondervind word by daardie punt. ✓✓ (2)
- 8.2 Negative ✓
 Negatief ✓ (1)
- 8.3 **POSITIVE MARKING FROM QUESTION 8.2**
POSITIEWE MARKING VANAF VRAAG 8.2 (1)



Criteria for marking/Markeringstreek	
Shape of the field	✓
Form van veld	✓
Direction of the field	✓
Rigting van veld	✓
Lines touch charge/line don't cross etc.	✓
Lyne raak lading/lyne kryis me ems	✓

8.4 $E_{net} = kQ_1 \frac{1}{r_1^2} + kQ_2 \frac{1}{r_2^2}$ ✓
 $5,44 \times 10^4 \text{ V} = \frac{9 \times 10^9 \text{ C}}{(5 \times 10^{-2})^2} + \frac{9 \times 10^9 \text{ C}}{(3 \times 10^{-2})^2}$ ✓
 $Q = 4 \times 10^4 \text{ C}$ ✓ (5)

8.5 Net electric field DECREASES ✓
 The positive charge on X will have a field in the opposite direction. The electric field (strength) being a vector will decrease because of opposite directions. ✓
 Netto elektriese veld NEM AF ✓
 Die positiewe lading op X het 'n veld in die teenoorgestelde rigting. Die elektriese veld (sterkte) is 'n vektor en dit sal die veld laat afneem as die rigting van die twee ladings se veld teenoorgesteld is. ✓ (2)

QUESTION/VRAAG 10

- 10.1.1 Power is the rate at which work is done or energy is transferred. ✓✓
 Drying is die tempo waaraan arbeid verrig of energie oorgedra word. ✓✓ (2)
- 10.1.2 **OPTION 1/OPSIE 1** $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$
 $\frac{1}{R_{eq}} = \frac{1}{6} + \frac{1}{15}$ ✓
 $R_{eq} = 4,29 \Omega$ ✓ (2)
- OPTION 2/OPSIE 2** $R_{eq} = R_1 \times R_2$
 $R_{eq} = \frac{6 \times 15}{6 + 15}$ ✓
 $R_{eq} = 4,29 \Omega$ ✓ (2)

10.1.3 **POSITIVE MARKING FROM QUESTION 10.1.2**
POSITIEWE MARKING VANAF VRAAG 10.1.2 (2)

$P = \frac{V^2}{R}$ ✓
 $50 = \frac{4,29^2}{R}$ ✓
 $V = 14,65 \text{ V}$ ✓ (3)

10.1.4 **POSITIVE MARKING FROM QUESTION 10.1.2 and 10.1.3**
POSITIEWE MARKING VANAF VRAAG 10.1.2 en 10.1.3 (3)

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$R = \frac{V}{I}$ ✓ $4,29 = \frac{14,65}{I}$ ✓ $I = 3,41 \text{ A}$ ✓	$P = VI$ ✓ $50 = (14,65)I$ ✓ $I = 3,41 \text{ A}$ ✓
OPTION 3/OPSIE 3	OPTION 4/OPSIE 4
$P = IR^2$ ✓ $50 = I^2(4,29)$ ✓ $I = 3,41 \text{ A}$ ✓	$V = IR$ ✓ $14,65 = I(5)$ ✓ $I = 2,93 \text{ A}$ ✓ $2,93 + 0,98 = 3,92 \text{ A}$ ✓

10.1.5 Decreases ✓
 Neëm af ✓ (1)

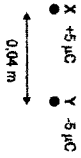
10.1.6 The total resistance increases ✓
 The current in the circuit decreases ✓
 The resistance of R is constant, then the potential difference across R decreases. ✓
 Totale weerstand neem toe ✓
 Die stroom in die stroomkring neem af ✓
 Die weerstand van R is konstant, so die potensiaalverskil oor resistor R sal afneem (3)

10.2.1 $P = \frac{W}{\Delta t}$ ✓
 $2000 = \frac{W}{10}$ ✓
 $W = 3,6 \times 10^4 \text{ J}$ ✓ (4)

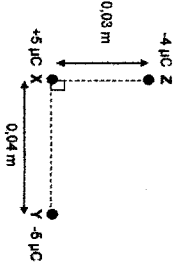
10.2.2 Cost = price x unit kWh / Koste = prys x eenheid kWh
 Cost = 80(2)(5)(30) ✓
 Cost = 24 000 cents = R240 ✓
 (answer can be given in rand or cents)
 (antwoord kan in rand of sent gegee word) (2)

QUESTION 8 (Start on a new page.)

Two charged spheres, X and Y, are placed in a vacuum at a distance of 0,04 m apart.



- 8.1 Draw the resulting electric field pattern between the two charges. (3)
- 8.2 Calculate the electrostatic force sphere X experiences due to the charge on sphere Y. (4)
- 8.3 If sphere Y is at a fixed position and sphere X is free to move, will the acceleration experienced by sphere X towards sphere Y be constant? Write down YES or NO. (1)
- 8.3.2 Explain the answer to QUESTION 8.3.1 by referring to the electric field and the force. (2)
- A third sphere, Z with a charge of $-4 \mu\text{C}$, is placed at right angles to sphere X and at a distance of 0,03 m from sphere X.



- 8.4 Calculate the magnitude of the net force on sphere X due to sphere Y and sphere Z. (4)

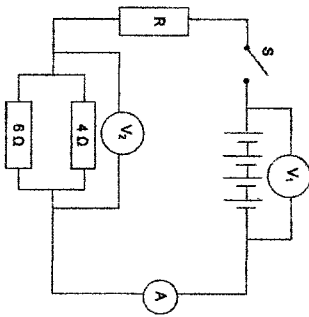


QUESTION 10 (Start on a new page.)

An experiment is done to verify that the potential difference across a conductor is directly proportional to the current in the conductor if the temperature stays constant.

Four cells, each with an emf of 1,5 V, are connected in series with an ammeter, switch S and a combination of a resistor R and resistors of 4 Ω and 6 Ω, as shown in the diagram.

Voltmeters V_1 and V_2 are connected across the battery and the parallel resistors respectively. The internal resistance of the battery and wires are negligible.



- 10.1 Which law is represented by the underlined phrases above? (1)



The switch is now closed and six resistors (R_1 – R_6), each with a different resistance, are placed in the place of R, one at a time. The voltmeter and ammeter readings are recorded. The results are as follows:

RESISTORS AT R	READING ON VOLTMETER V_1 (V)	READING ON AMMETER (A)
R_1	1,2	0,9
R_2	1,4	0,6
R_3	1,9	0,8
R_4	2,4	1
R_5	2,9	1,2
R_6	3,8	1,5

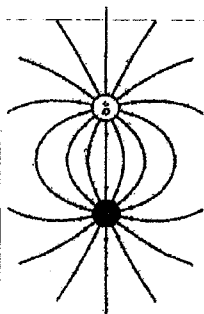
- 10.2 Use the attached graph paper and draw a graph of potential difference versus current using the data in the table. (4)
- 10.3 What does the gradient of the graph represent? (1)
- 10.4 If voltmeter V_2 is only connected across the 4 Ω resistor, how will the gradient of the graph change? Write down only INCREASES, DECREASES or STAYS THE SAME. (1)
- 10.5 If the 4 Ω resistor is removed, how will the gradient of the graph change? Write down only INCREASES, DECREASES or STAYS THE SAME. (1)
- 10.6 Calculate the resistance of resistor R_6 using the values in the table. (2)
- 10.7 Calculate the energy dissipated in resistor R_4 in 10 seconds. (3)

TOTAL: 160



QUESTION 8/VRAAG 8

8.1



Shape/Form	✓
Direction/Rigting	✓
Touching the charges, no crossing lines, etc.	✓
Reak aan die teken/Reak aan die teken, ens.	✓

(3)

8.2

$$F = \frac{kQ_1Q_2}{r^2} \quad ✓$$

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

$$F_{\text{net } x} = 140,63 \text{ N} \quad ✓ \quad (\text{right/regs} \quad \text{accept attraction/aanwaser aantrekkend})$$

(4)

8.3.1

No

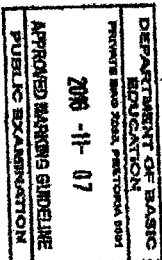
Yes

(1)

8.3.2

The electric field is stronger closer to the charges / not a uniform field/ not constant ✓ which means the force will not be constant/ increases ✓
 Die elektriese veld is sterker nader aan die ladinge/ nie 'n uniforme veld nie/ nie konstant nie wat beteken die krag sal ook nie konstant wees nie/ toename

(2)



8

8.4

POSITIVE MARKING FROM 8.2
 POSITIEWE NASIEN VAN 8.2

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

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

$$F_{Z \text{ net } x} = 200 \text{ N}$$

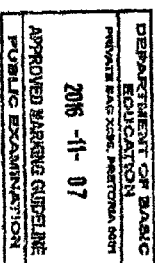
$$(F_{\text{net}})^2 = (F_{Z \text{ net } x})^2 + (F_{Z \text{ net } y})^2$$

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

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

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

(4)
 114



8

10.6

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2	OPTION 3/OPSIE 3
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ $\frac{1}{R_p} = \frac{1}{4} + \frac{1}{6}$ $R_p = 2,4 \Omega$ $R_{tot} = \frac{V}{I}$ $R_{tot} = \frac{6}{0,8}$ $R_{tot} = 7,5 \Omega$ $R = R_{tot} - R_p$ $= 7,5 - 2,4$ $= 5,1 \Omega$	$V_{tot} = 6V$ $V_R = V_{tot} - V_2$ $= 6 - 1,9$ $= 4,1V$ $R = \frac{V}{I}$ $R = \frac{4,1}{0,8}$ $R = 5,13 \Omega$	$R_p = 2,4 \Omega$ $V_R : V_2 = 4,1 : 1,9$ $R_1 : R_2 = 4,1 : 1,9$ $R_p : 2,4 = 4,1 : 1,9$ $R_p = 5,18 \Omega$
<p>Mark allocation/Puntetoekening: Formula/formule ✓ 2 for substitution/2 vir invervanging ✓ Subtraction/Aftek ✓ Answer/antwoord ✓</p>	<p>Mark allocation/Puntetoekening: Formula/formule ✓ 2 for substitution/2 vir invervanging ✓ Subtraction/Aftek ✓ Answer/antwoord ✓</p>	<p>Mark allocation/Puntetoekening: Formula/formule ✓ 2 for substitution/2 vir invervanging ✓ Ratio/verhouding ✓ Answer/antwoord ✓</p>

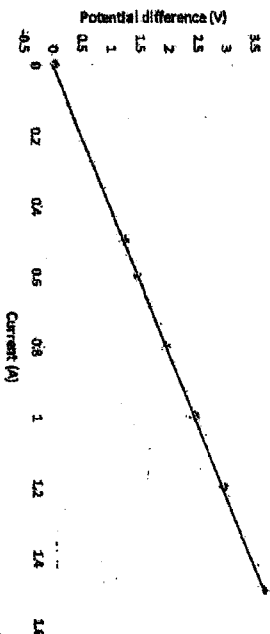
(5)

(5)

QUESTION 10/ VRAAG 10

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

Graph of Potential difference versus Current
Grafiek van Potensiaalverskil teenoor Stroom



(1)

Marking criteria for graph Metskermerke vir grafiek	
Axes with correct/appropriate scale (It must be possible to plot ALL the coordinates on the graph and the divisions must be evenly spaced. If an inappropriate scale is used maximum 1/4)	✓
Asses met korrekte en toepaslike skaal (Dit moet moontlik wees om AL die koördinate op die grafiek te plot en die verdeling moet eweredig gespaseer wees. Indien nie-toepaslike skaal gebruik word, maksimum 1/4)	✓✓
5 or more of the 6 coordinates correctly plotted (3-4 one mark only)	✓✓
5 of meer van die 6 koördinate korrek geplot (3-4 stappe een punt)	✓✓
Drawing a line of best fit Teken 'n lyn van beste passing	✓

(4)

- 10.3 Resistance of the parallel connection ✓
Weerstand van die parallel koppelingsreël ✓
- 10.4 Stay the same ✓
Bly dieselfde ✓
- 10.5 Increase ✓
Toeneem ✓

(1)

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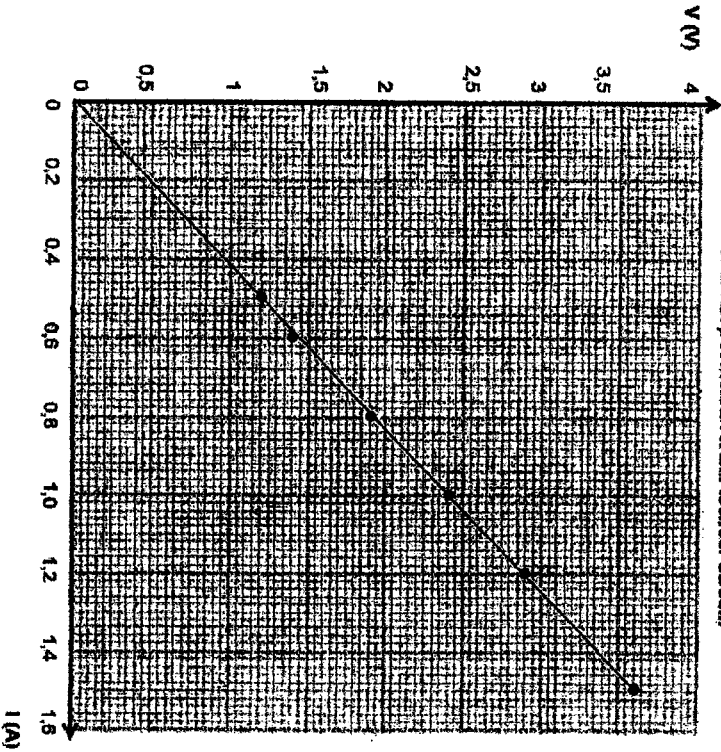
DEPARTMENT OF BASIC EDUCATION
Pretoria
2018 -11- 07
APPROVED MARKING SCHEME
PUBLIC EXAMINATION

8

8

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 ANTWOORDBOEK IN.

Graph of potential difference versus current
Grafiek van potensiaalverskil teenoor stroom



TOTAL TOTAL: 150

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8.

10.7

OPTION 1/OPSIE 1
$V_A = 6 - 2,4 = 3,6 \text{ V}$
$W = VIAt$ ✓
$W = (3,6)(0)(10)$ ✓
$W = 36 \text{ J}$ ✓
OPTION 2/OPSIE 2
$V_A = 6 - 2,4 = 3,6 \text{ V}$
$R = \frac{V}{I}$
$R = \frac{3,6}{1}$
$R = 3,6 \Omega$
(The above calculation need not be shown/Bogancende berekening hoef nie getoon te word nie)
$W = \frac{V^2 R t}{R}$ ✓
$W = \frac{(3,6)^2 (10)}{3,6}$ ✓
$W = 36 \text{ J}$ ✓
OPTION 3/OPSIE 3
$W = I^2 R t$ ✓
$W = (1)^2 (3,6)(10)$ ✓
$W = 36 \text{ J}$ ✓

(3)
(16)

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