

Electrical Circuits

Question Paper 4

Level	IGCSE
Subject	Physics
Exam Board	CIE
Topic	Electricity and Magnetism
Sub-Topic	Electrical Circuits
Paper Type	Alternative to Practical
Booklet	Question Paper 4

Time Allowed: 56 minutes

Score: /46

Percentage: /100

1 The IGCSE class is investigating the power of lamps in a circuit.

Fig. 3.1 shows the circuit used.

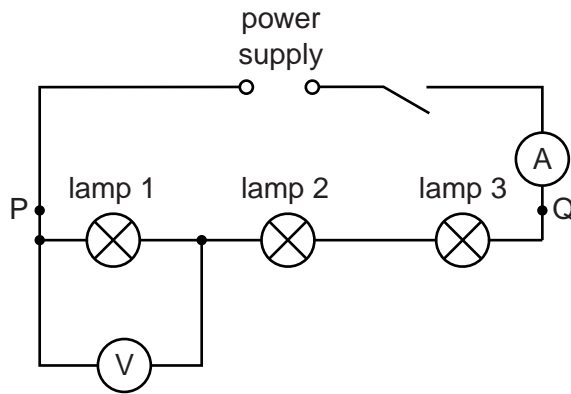


Fig. 3.1

(a) A student measures the potential difference V_1 across lamp 1 and the current I in the circuit. The meters are shown in Fig. 3.2.

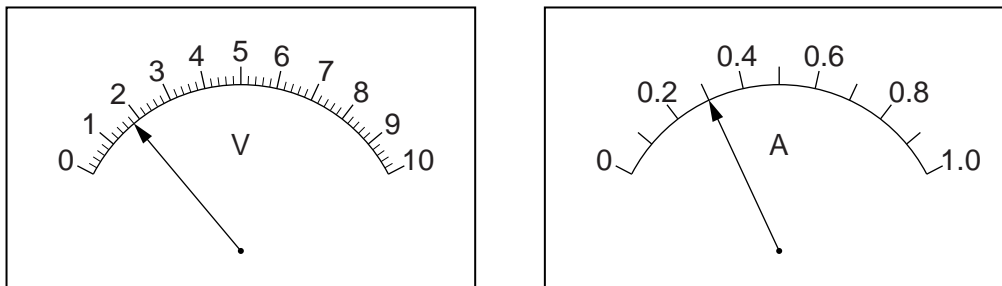


Fig. 3.2

(i) Write down the readings shown on the meters in Fig. 3.2.

$$V_1 = \dots\dots\dots$$

$$I = \dots\dots\dots$$

(ii) Calculate the power P_1 of lamp 1 using the equation $P_1 = IV_1$.

$$P_1 = \dots\dots\dots$$

- (iii) The student reconnects the voltmeter to measure the potential difference V_2 across lamp 2 and then V_3 across lamp 3.

Write down the readings shown on the meters in Figs. 3.3 and 3.4.

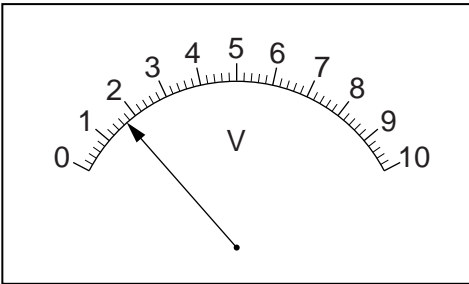


Fig. 3.3

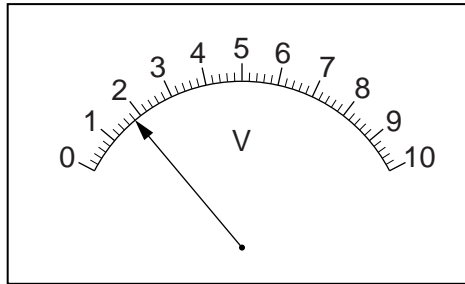


Fig. 3.4

$V_2 = \dots\dots\dots$

$V_3 = \dots\dots\dots$

- (iv) Calculate the power for each lamp using the equation $P = IV$.

$P_2 = \dots\dots\dots$

$P_3 = \dots\dots\dots$

[3]

- (v) Calculate the total power P_T for the three lamps using the equation $P_T = P_1 + P_2 + P_3$.

$P_T = \dots\dots\dots$ [1]

- (b) The student connects the voltmeter across the three lamps and records the potential difference. He calculates the power P .

$P = \dots\dots\dots 1.61\text{ W}$

Another student suggests that P_T should be equal to P .

State whether the results support this suggestion and justify your answer by reference to the results.

statement

justification

..... [2]

(c) (i) Draw a circuit diagram, similar to that in Fig. 3.1, to show:

- a variable resistor in series with the power supply,
- three lamps in parallel with each other between **P** and **Q**,
- a voltmeter connected to measure the potential difference across the lamps.

Use standard symbols.

[2]

(ii) State the purpose of the variable resistor in this circuit.

.....

..... [1]

[Total: 9]

2 The IGCSE class is investigating the resistance of a wire.

The circuit used is shown in Fig. 3.1.

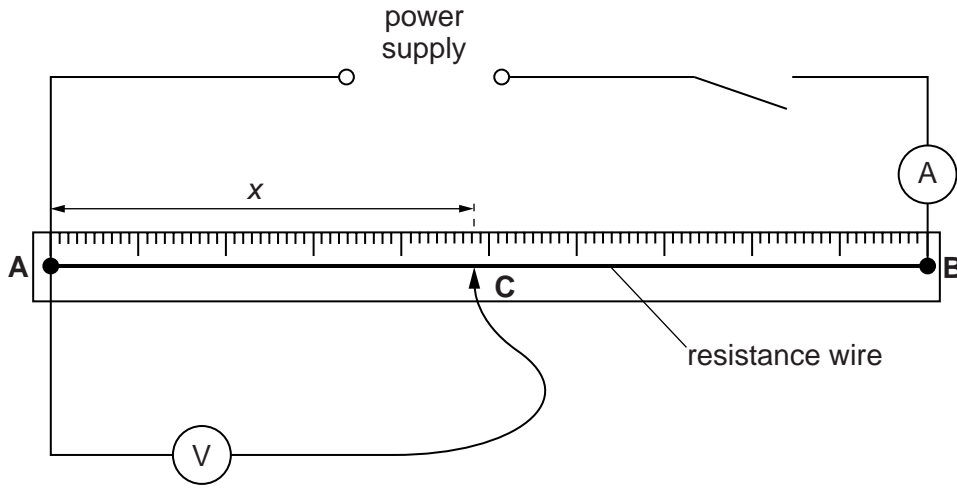


Fig. 3.1

(a) A student places the sliding contact **C** on the resistance wire **AB** at a distance x from **A**, where $x = 0.200\text{ m}$.

(i) He measures the current I in the wire. Fig. 3.2 shows the ammeter.

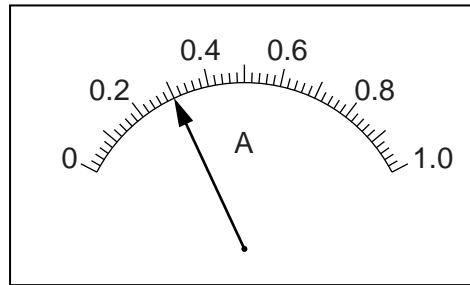


Fig. 3.2

Record the value of I .

$I = \dots\dots\dots [1]$

(ii) The student measures the potential difference V across the wire between **A** and **C**. Fig. 3.3 shows the voltmeter.

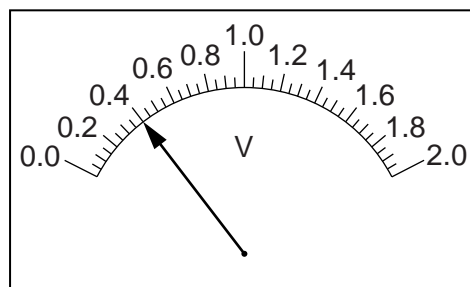


Fig. 3.3

In the first row of Table 3.1 record the value of V .

- (iii) Calculate the resistance R of the section **AC** of the wire using the equation $R = \frac{V}{I}$.

Record R in the first row of the table.

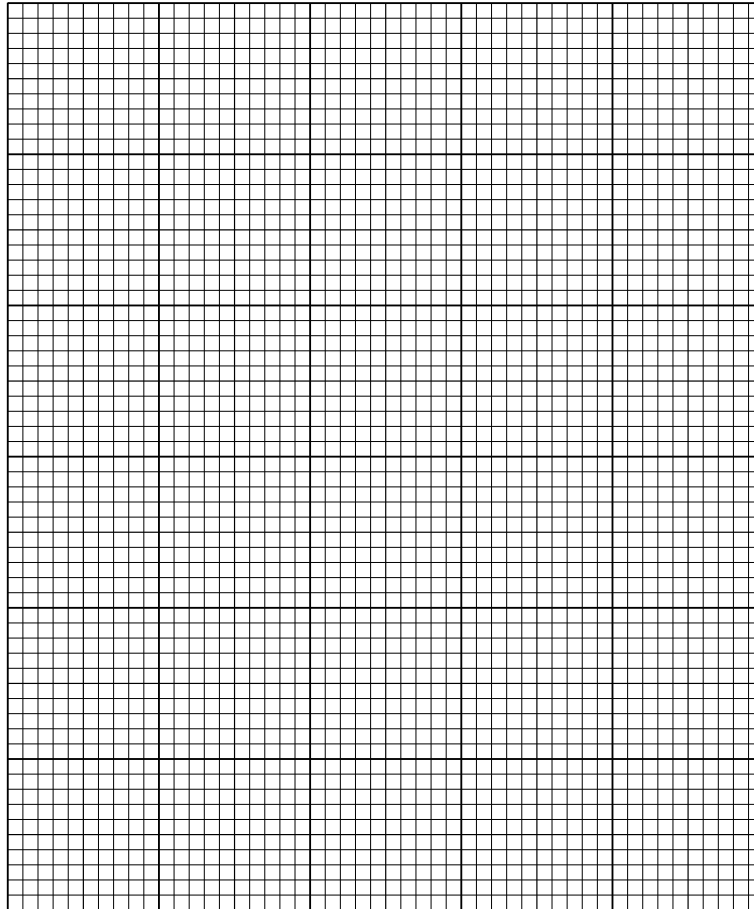
Table 3.1

x/m	V/V	R/Ω
0.200		
0.350	0.80	2.67
0.500	1.00	3.33
0.650	1.25	4.17
0.800	1.60	5.33

[2]

- (b) The student records the voltmeter readings using a range of x values. The readings are shown in Table 3.1.

Plot a graph of R/Ω (y -axis) against x/m (x -axis).



[5]

- (c) Using your graph, determine the length l of the resistance wire necessary to make a resistor of resistance $1.20\ \Omega$. Show clearly on your graph how you obtained the necessary information.

$l = \dots\dots\dots$ [1]

- (d) Predict the resistance Z of 1.50 m of the resistance wire. Show your working.

$Z = \dots\dots\dots$ [1]

[Total: 10]

- 3 IGCSE students are investigating the current and potential difference in an electrical circuit.
The circuit is shown in Fig. 3.1.

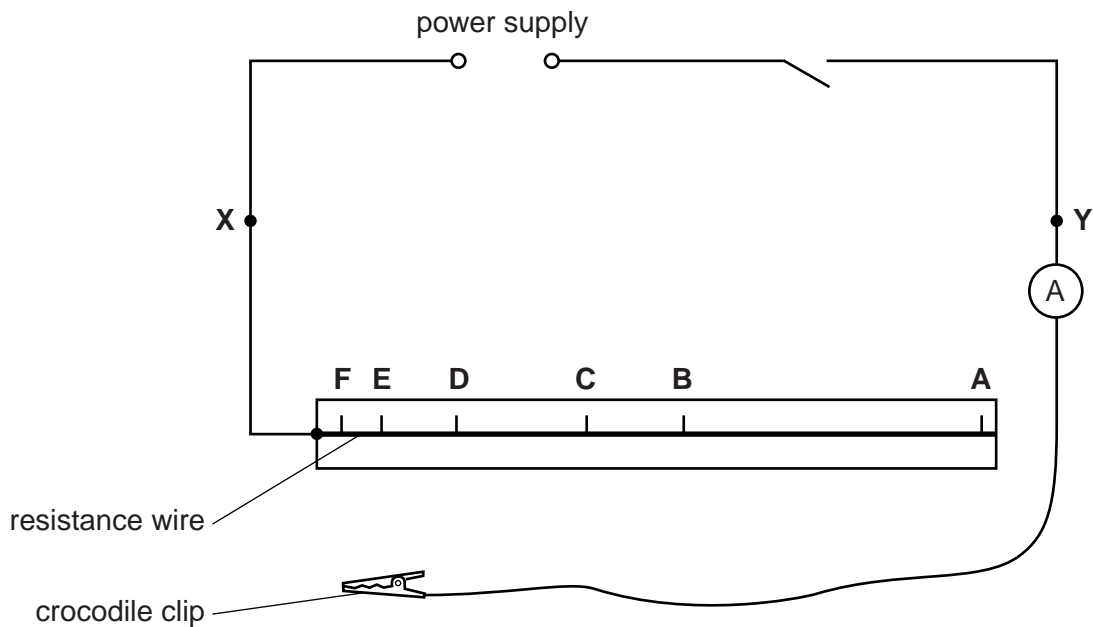


Fig. 3.1

- (a) The potential difference across part of the resistance wire, and the current in the circuit are to be measured.

On Fig. 3.1, use an appropriate circuit symbol to draw a voltmeter connected to measure the potential difference between X and Y.

[1]

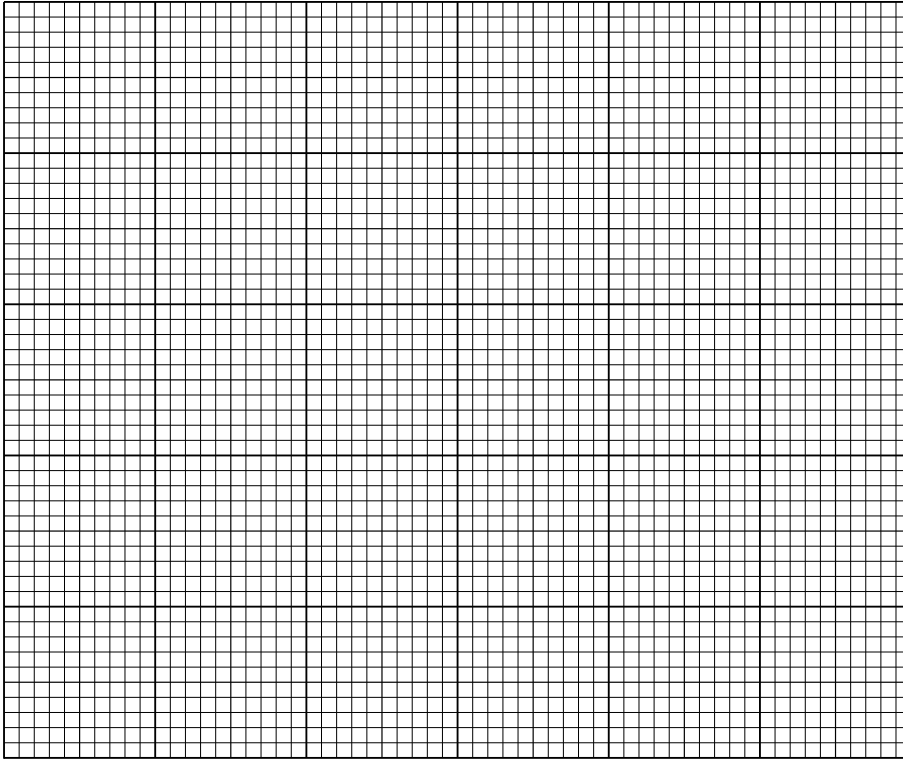
- (b) The crocodile clip is connected in turn to the resistance wire at points A, B, C, D, E and F.

The potential difference V and current I are measured for each position and recorded in Table 3.1.

Table 3.1

position	V/V	I/A
A	1.3	0.20
B	1.2	0.35
C	1.1	0.46
D	0.9	0.74
E	0.8	0.87
F	0.6	1.13

- (i) Plot a graph of V/V (y-axis) against I/A (x-axis).



[4]

- (ii) Determine the gradient M of the graph. Show clearly on the graph how you obtained the necessary information.

$M = \dots\dots\dots$ [2]

- (iii) The gradient M is numerically equal to the resistance R of the power supply.

Write down the resistance R to a number of significant figures suitable for this experiment.

$R = \dots\dots\dots$ [2]

[Total: 9]

4 The IGCSE class is investigating resistor combinations in circuits.

The first circuit used is shown in Fig. 3.1.

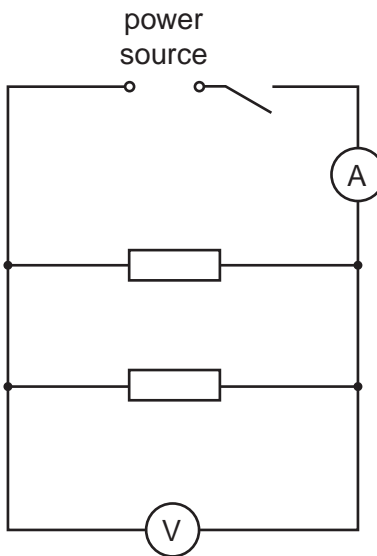


Fig. 3.1

(a) A student measures the potential difference V_1 across the resistors and the current I_1 in the circuit. The readings are shown in Figs. 3.2 and 3.3.

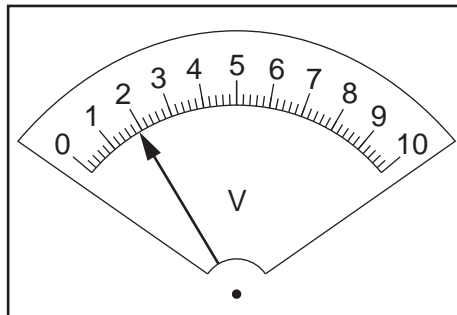


Fig. 3.2

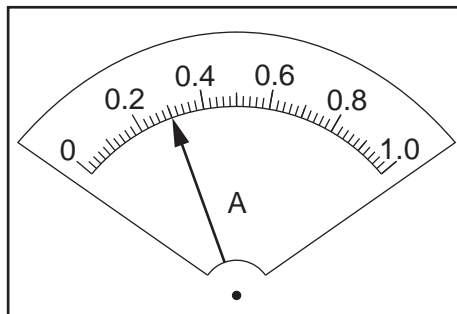


Fig. 3.3

(i) Record the potential difference V_1 and the current I_1 .

$V_1 = \dots\dots\dots$

$I_1 = \dots\dots\dots$

- (ii) Calculate the total resistance R_p of the combination of the two resistors arranged in parallel using the equation $R_p = \frac{V_1}{I_1}$.

$R_p = \dots\dots\dots$

- (iii) Calculate $4R_p$.

$4R_p = \dots\dots\dots$ [2]

- (b) The student rearranges the circuit so that the two resistors are connected in **series** and the voltmeter is connected to measure the potential difference across **both** resistors.

The new potential difference and current readings are $V_2 = 1.9\text{V}$ and $I_2 = 0.08\text{A}$.

Calculate the total resistance R_s of the combination of the two resistors arranged in series using the equation $R_s = \frac{V_2}{I_2}$.

$R_s = \dots\dots\dots$ [1]

- (c) Theory suggests that $R_s = 4R_p$ if the two resistors have the same value. State whether your results indicate that the resistors have the same value. Justify your answer with reference to the results.

statement

justification

..... [1]

- (d) Using the circuit described in (b), the student replaces the two series resistors with two lamps.

In the space below, draw a circuit diagram of the new circuit using standard symbols.

(e) A student suggests repeating the experiment described in parts **(a)** to **(c)**. He connects a variable resistor between the power source and the switch.

(i) State the function of the variable resistor.

.....

(ii) Explain why you might want to use a variable resistor in this way.

.....

.....

[2]

[Total: 10]

5 The IGCSE class is investigating the potential differences across circuit components.

Fig. 3.1 shows the apparatus used.

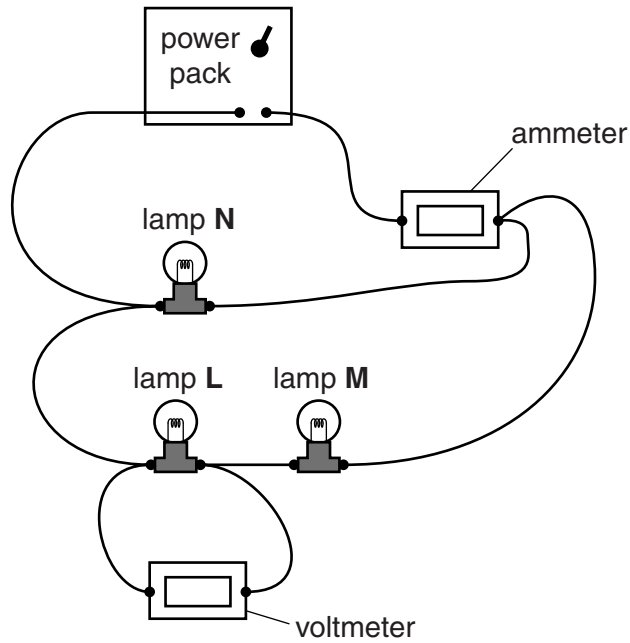


Fig. 3.1

(a) Draw a circuit diagram of the circuit shown in Fig. 3.1, using standard symbols.

[3]

(b) A student records the current I_A , the potential difference V_L across lamp **L** and the potential difference V_M across lamp **M**.

$$I_A = \dots\dots\dots 0.65 \text{ A}$$

$$V_L = \dots\dots\dots 0.9 \text{ V}$$

$$V_M = \dots\dots\dots 1.0 \text{ V}$$

(i) Calculate the potential difference V_A across lamps **L** and **M** using the equation $V_A = V_L + V_M$.

$$V_A = \dots\dots\dots$$

- (ii) Calculate R_A , the combined resistance of lamps **L**, **M** and **N**, using the equation

$$R_A = \frac{V_A}{I_A}$$

$$R_A = \dots\dots\dots [2]$$

- (iii) On Fig. 3.2, draw a pointer showing the current $I_A = 0.65 \text{ A}$.

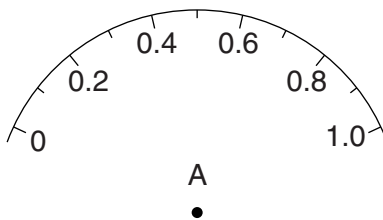


Fig. 3.2 [1]

- (c) The student rearranges the circuit so that the three lamps are in **series** with each other. He records the potential difference across each lamp in turn.

$$V_L = \dots\dots\dots 0.6\text{V}$$

$$V_M = \dots\dots\dots 0.7\text{V}$$

$$V_N = \dots\dots\dots 0.7\text{V}$$

Calculate the potential difference V_B across the three lamps using the equation $V_B = V_L + V_M + V_N$.

$$V_B = \dots\dots\dots$$

- (d) A student suggests that V_A should be equal to V_B .

State whether the results support this suggestion and justify your answer with reference to the results.

statement

justification

..... [2]