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.

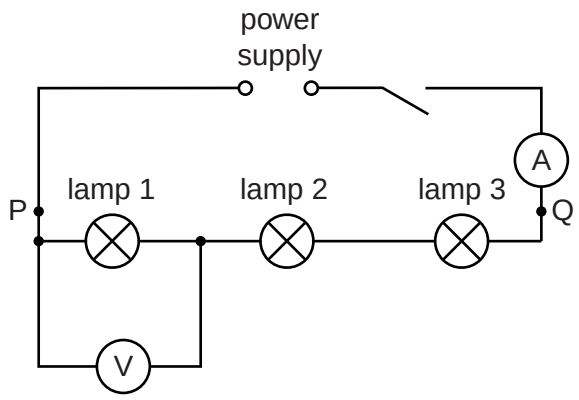


Fig. 3.1

(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.

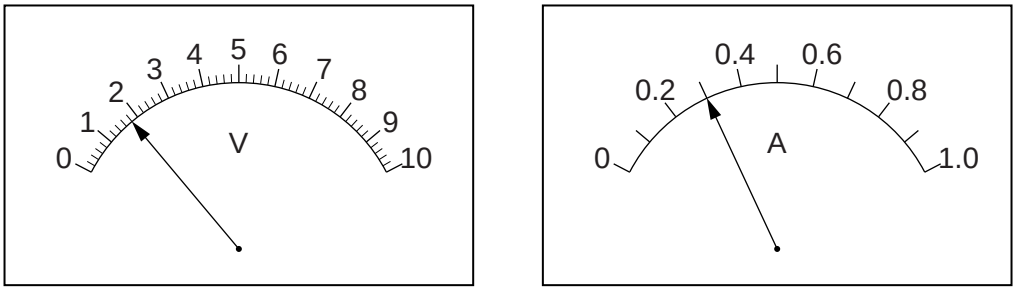


Fig. 3.2

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

V_1 = ...

I = ...

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

P_1 = ...

(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.

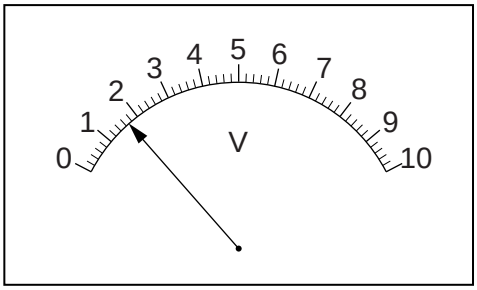


Fig. 3.3

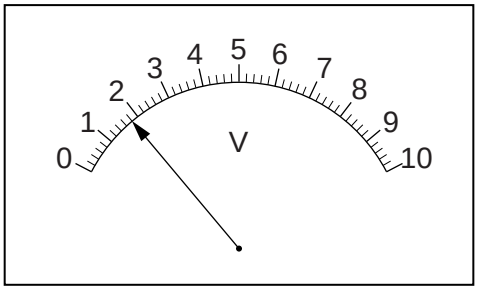


Fig. 3.4

V_2 = ... V_3 = ...

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

P_2 = ...

P_3 = ...
[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 = ... [1]

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

P = 1.61W .....

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.

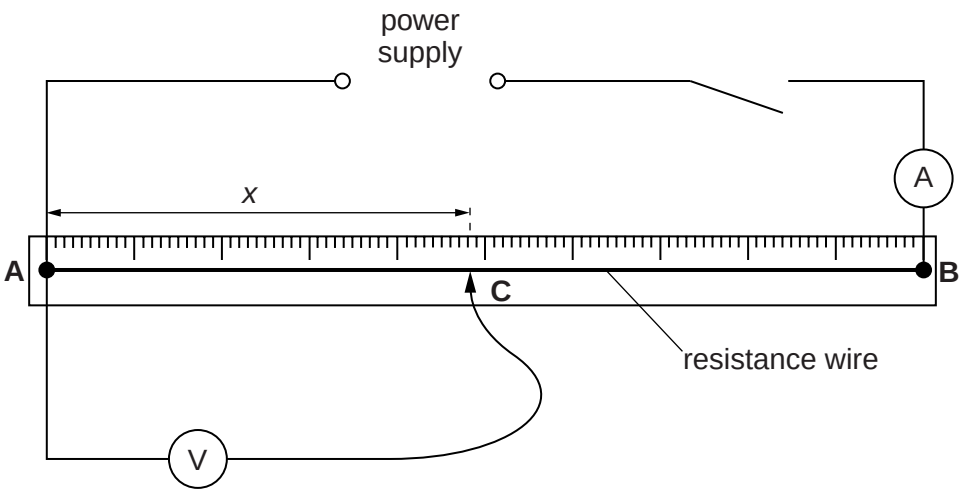


Fig. 3.1

(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.

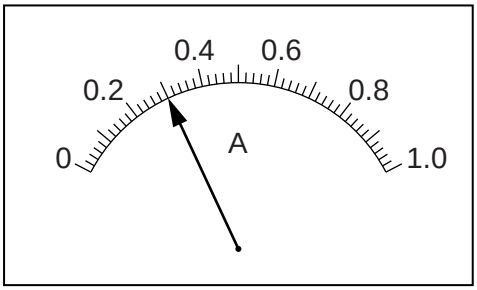


Fig. 3.2

Record the value of I.

I = ...[1]

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

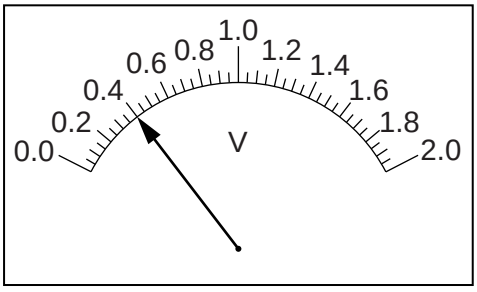


Fig. 3.3

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.

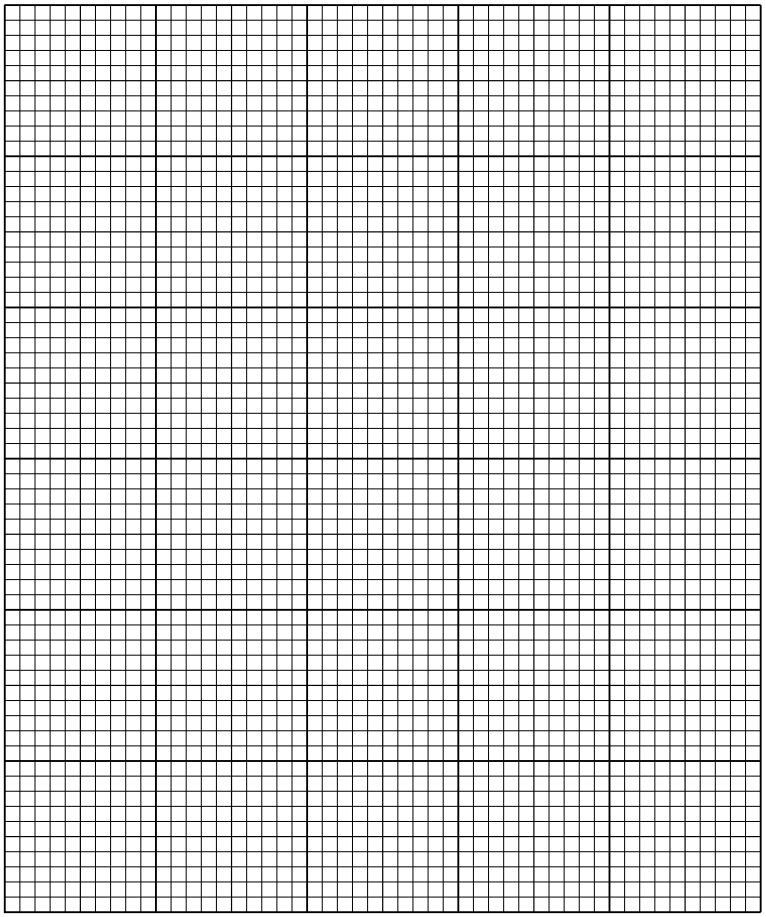
Table 3.1

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 Ω. Show clearly on your graph how you obtained the necessary information.

l = ... [1]

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

Z = ... [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.

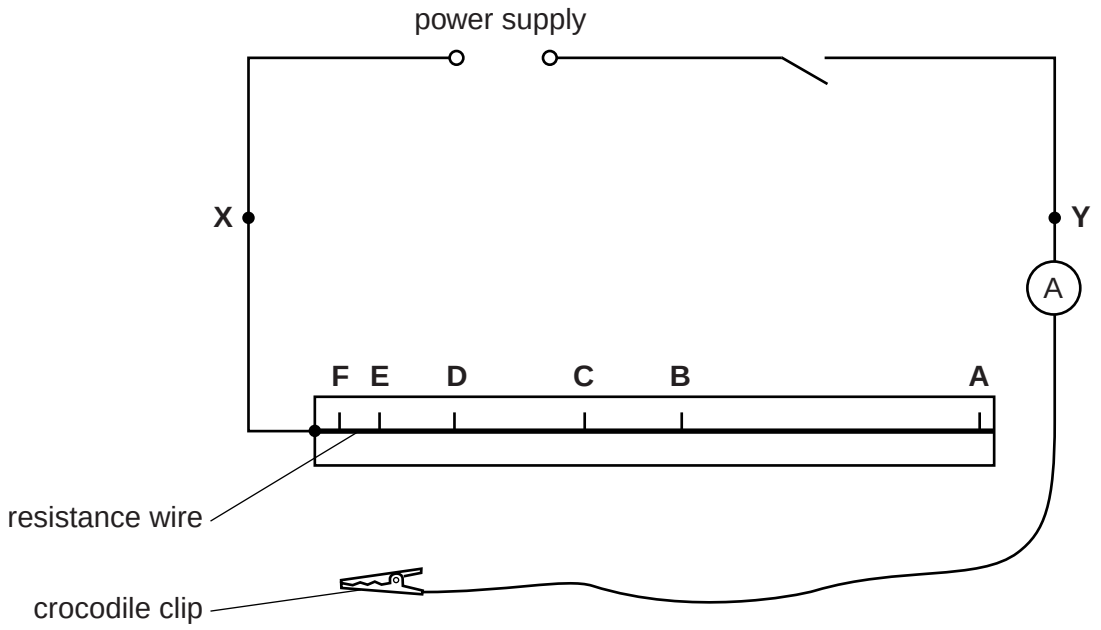


Fig. 3.1

(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]

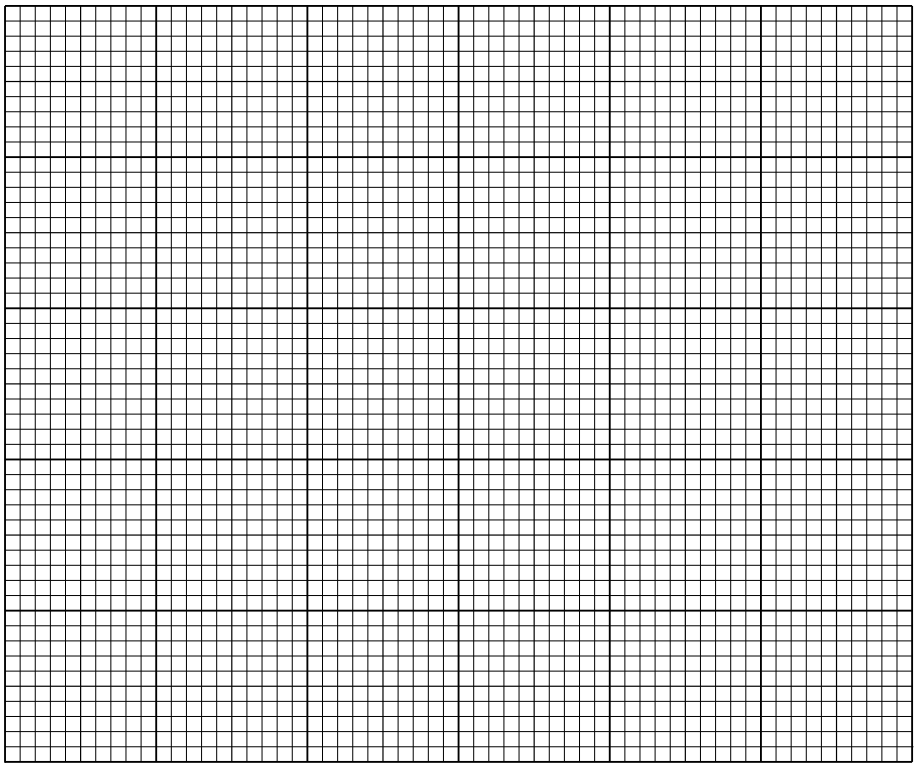
(b) The crocodile clip is connected in turn to the resistance wire at points **A**, **B**, **C**, **D**, **E** and **F**.

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 = ... [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 = ... [2]

[Total: 9]

4 The IGCSE class is investigating resistor combinations in circuits.

The first circuit used is shown in Fig. 3.1.

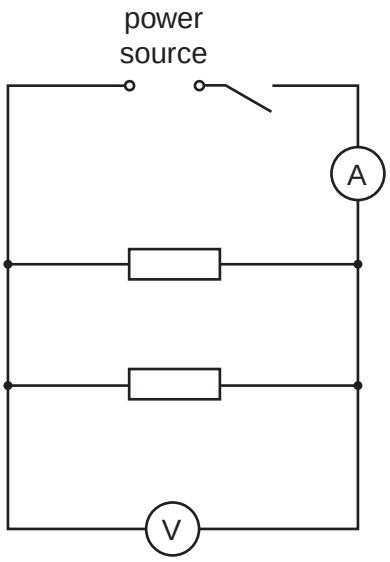


Fig. 3.1

(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.

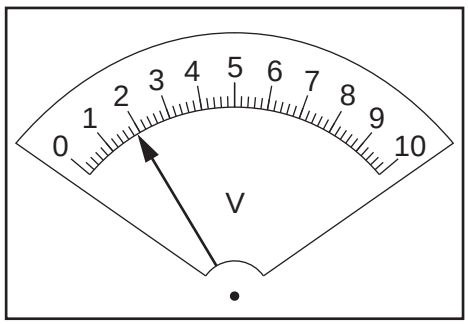


Fig. 3.2

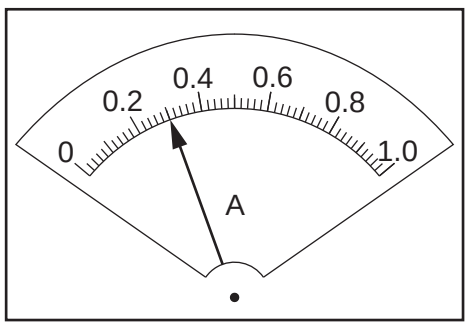


Fig. 3.3

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

V_1 = ...

I_1 = ...

[3]

(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 = ...

(iii) Calculate $4R_P$.

$4R_P$ = ...
[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 $V_2 = 1.9\,V$ and $I_2 = 0.08\,A$.

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 = ...[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.

[1]

(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.

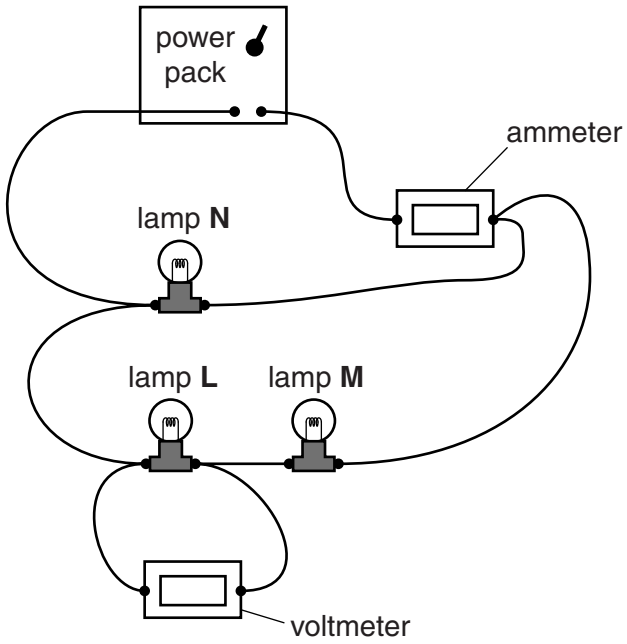


Fig. 3.1

(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 = ... 0.65 A .....

V_L = ... 0.9 V .....

V_M = ... 1.0 V .....

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

V_A = ...

(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 = ...
[2]

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

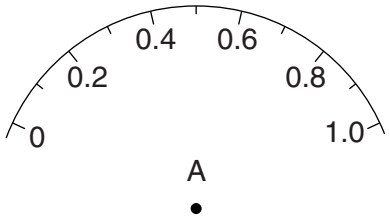


Fig. 3.2 [1]

(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 = 0.6V

V_M = 0.7V

V_N = 0.7V

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

V_B = ...

(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]

[Total: 8]