Electrical Circuits

Question Paper 3

Level	IGCSE
Subject	Physics
Exam Board	CIE
Topic	Electricity and Magnetism
Sub-Topic	Electrical Circuits
Paper Type	Alternative to Practical
Booklet	Question Paper 3

Time Allowed: **54 minutes**

Score: **/45**

Percentage: **/100**

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

Fig. 3.1 shows the circuit used.

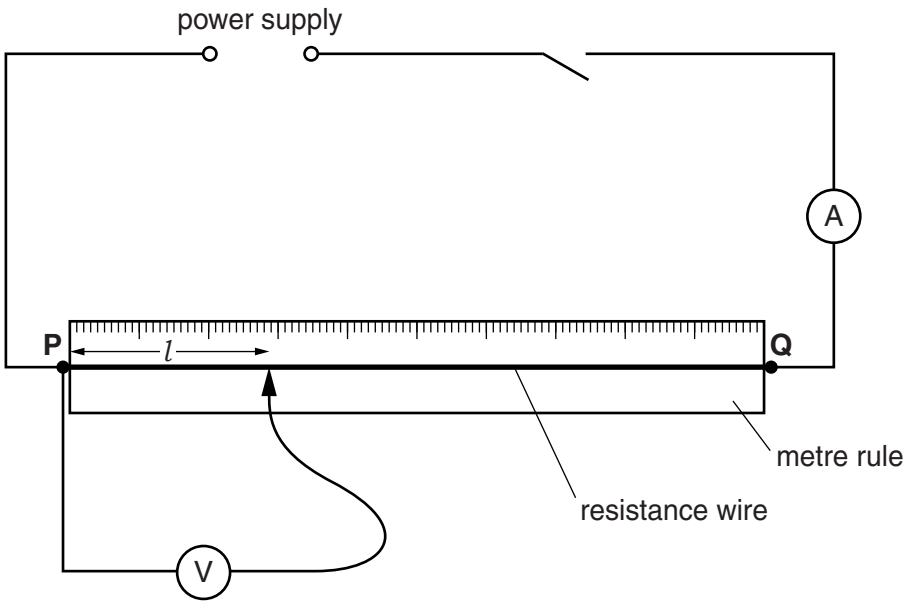


Fig. 3.1

(a) A student measures the current I in the circuit and the p.d. V across a length $l = 0.250\,\text{m}$ of the wire **PQ**.

He repeats the readings using a range of different lengths of the wire. The readings are shown in Table 3.1.

Table 3.1

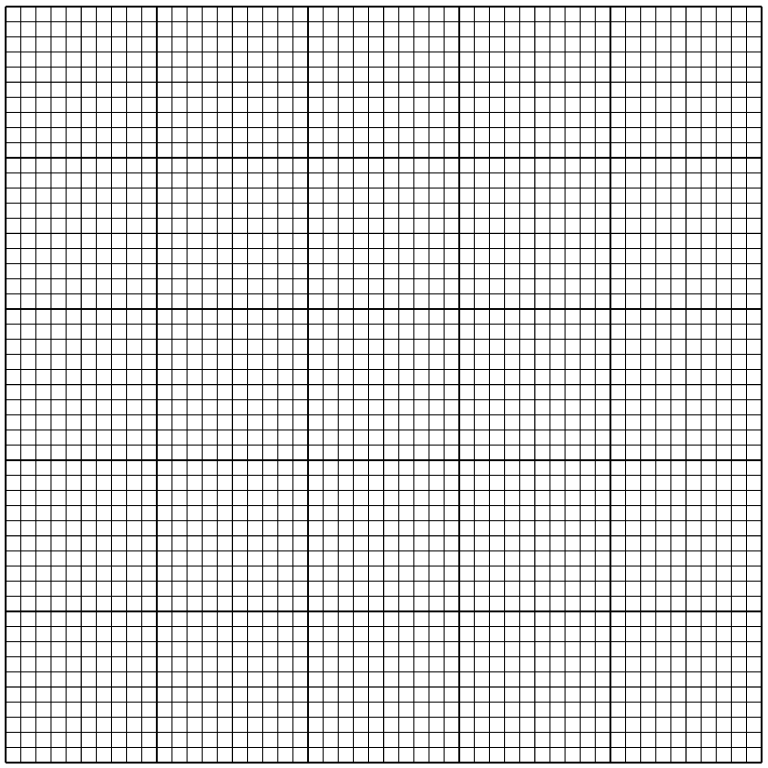
l/	V/	I/	R/
0.250	0.50	0.33	
0.350	0.69	0.36	
0.450	0.90	0.32	
0.550	1.11	0.34	
0.650	1.32	0.35	
0.750	1.50	0.33	

(i) Calculate the resistance R of each length l of wire using the equation $R = \frac{V}{I}$. Record the values of R in the table.

(ii) Complete the heading for each column of the table.

[1]

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



[4]

(c) Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

G = ... [2]

(d) Predict the value of the resistance R_1 of 1.00 m of the resistance wire connected between **P** and **Q**. Give your answer to a number of significant figures that is suitable for this experiment.

R_1 = ... [2]

[Total: 9]

2 Some IGCSE students are finding the resistance of a lamp in two different electrical circuits.

(a) Circuit 1 is shown in Fig. 5.1.

circuit 1

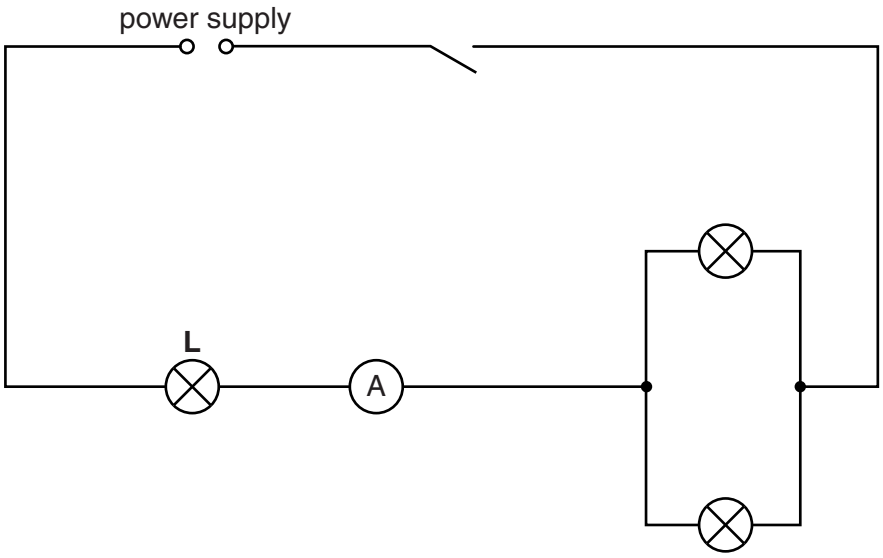


Fig. 5.1

On Fig. 5.1, draw a voltmeter connected to measure the potential difference across lamp **L**. [1]

(b) The switch is closed.

Fig. 5.2 shows the readings on the voltmeter and ammeter measuring the potential difference and the current for lamp **L**.

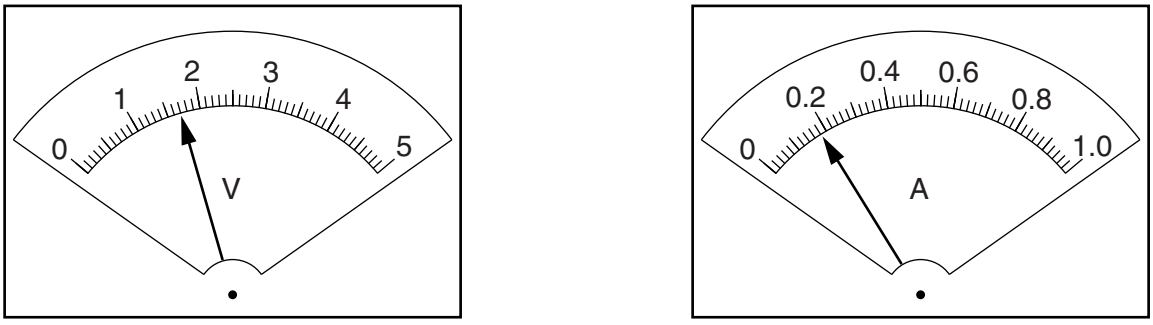


Fig. 5.2

Read, and record in Table 5.1, the potential difference V and the current I.

Table 5.1

circuit	*V*/	*I*/	*R*/	appearance of lamp **L**
1				bright
2	0.91	0.12		dim

(c) The circuit is reconnected as shown in Fig. 5.3.

circuit 2

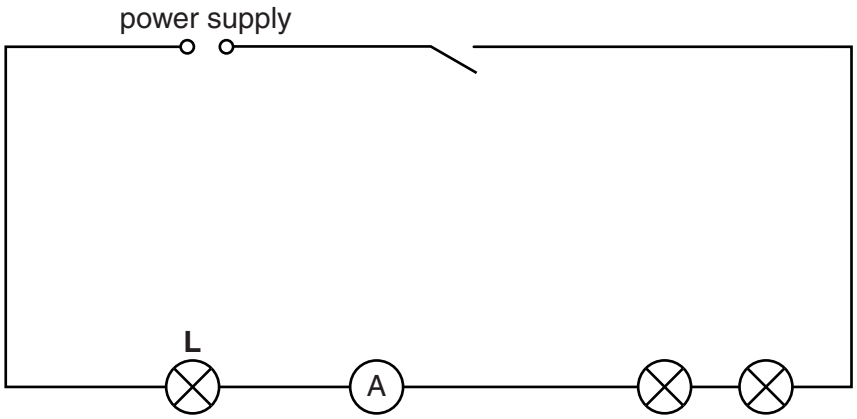


Fig. 5.3

The potential difference *V* and the current *I* for lamp **L** in this circuit are shown in the table.

(i) Using the equation $R = \frac{V}{I}$, calculate and record in the table the resistance *R* of lamp **L** when connected in each circuit.

(ii) Complete the column headings in the table.

[4]

(d) A student suggests that, as the same lamp **L** is used throughout the experiment, its resistance in each circuit should be the same.

State whether the findings agree with this idea. Justify your answer by reference to the results.

statement .....

.....

justification .....

.....

.....

[1]

(e) Theory suggests that the resistance of a lamp increases when its temperature rises.

Explain whether the observations in Table 5.1 support this.

.....

.....

..... [1]

(f) It is possible to change the current in this type of experiment by using a variable resistor rather than rearranging the circuit.

In the space below, draw a circuit with a power supply, a lamp, an ammeter and a variable resistor used for this purpose.

[2]

[Total: 9]

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

The circuit used is shown in Fig. 3.1.

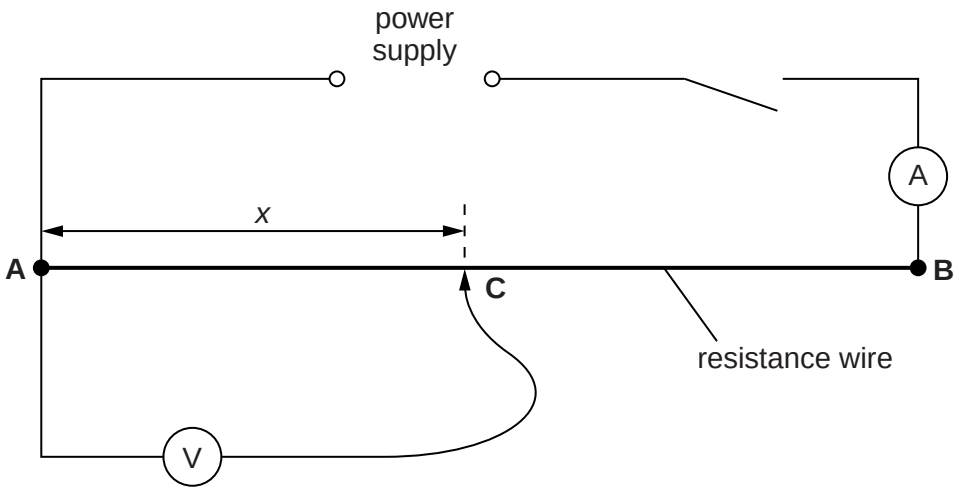


Fig. 3.1

A student moves contact **C** to give a range of values of the length *x*. For each length *x*, the current *I* and potential difference *V* are measured and recorded in Table 3.1.

(a) (i) Calculate the resistance *R* of 10.0 cm of the resistance wire using the equation $R = \frac{V}{I}$. Record this value of *R* in the table.

(ii) Repeat step **(i)** for each of the other values of *x*.

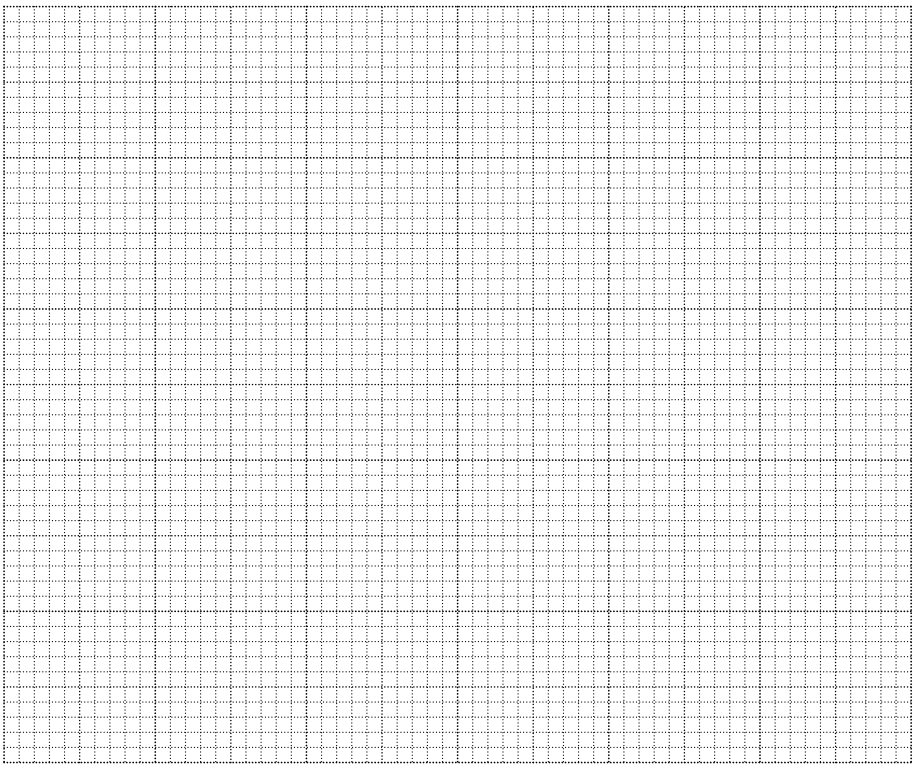
(iii) Complete the column headings in the table.

Table 3.1

x /	*V* /	*I* /	*R* /
10.0	0.20	0.33	
30.0	0.60	0.33	
50.0	1.01	0.32	
70.0	1.41	0.33	
90.0	1.81	0.33	

[3]

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



[5]

(c) Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

G = ...[3]

[Total: 11]

4 The IGCSE class is investigating resistor combinations in circuits.

The first circuit used is shown in Fig. 3.1.

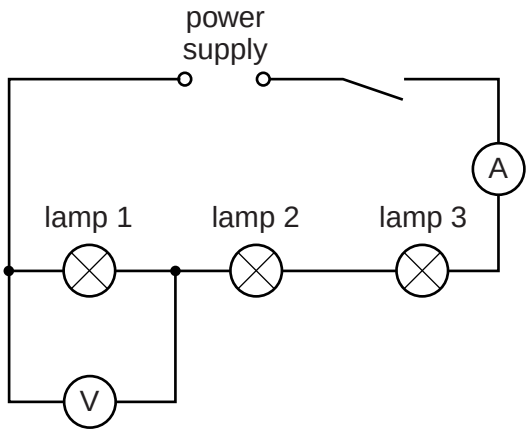


Fig. 3.1

A student measures the potential difference V_1 across lamp 1 and the current I in the circuit.

(a) (i) Using Fig. 3.2, record the student's readings.

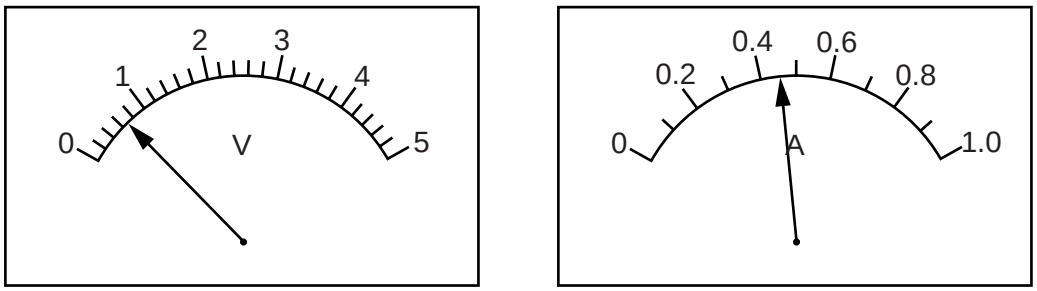


Fig. 3.2

V_1 = ...

I = ...
[2]

(ii) Calculate the resistance R_1 of lamp 1 using the equation $R_1 = \frac{V_1}{I}$.

R_1 = ...[1]

(b) The student uses the voltmeter to measure the potential difference V_2 across lamp 2, and the potential difference V_3 across lamp 3.

(i) Using Fig. 3.3, record the student's reading of V_2.

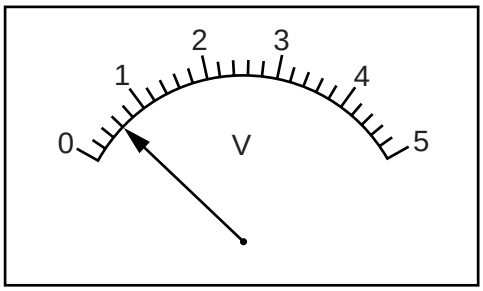


Fig. 3.3

V_2 = ...

(ii) Using Fig. 3.4, record the student's reading of V_3.

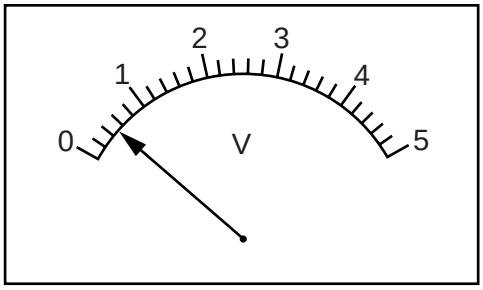


Fig. 3.4

V_3 = ...
[1]

(c) Calculate the total potential difference V_T across the three lamps using the equation $V_T = V_1 + V_2 + V_3$.

V_T = ...[1]

(d) The student rearranges the circuit so that the lamps are in parallel with each other and the ammeter is connected to measure the total current I_T in the circuit.

He connects the voltmeter to measure the potential difference V_P across the lamps.

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

[2]

(e) The student measures the potential difference V_P and the current I_T, and calculates the total resistance R_P of the lamps arranged in parallel.

R_P = ... 2.1 Ω .....

The student suggests that R_P should be equal to $\frac{R_1}{3}$.

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

statement .....

justification .....

.....

[1]

(f) Another student suggests that R_P should not be equal to $\frac{R_1}{3}$ because the lamp filaments are hotter when the lamps are connected in parallel than when the lamps are connected in series.

State one piece of evidence, that you would see during the investigation, that shows that the lamp filaments are hotter in the parallel circuit.

.....

..... [1]

[Total: 9]

5 Students in the IGCSE class are investigating the resistance of electric circuits with parallel branches.

The apparatus has been set up as shown in Fig. 3.1.

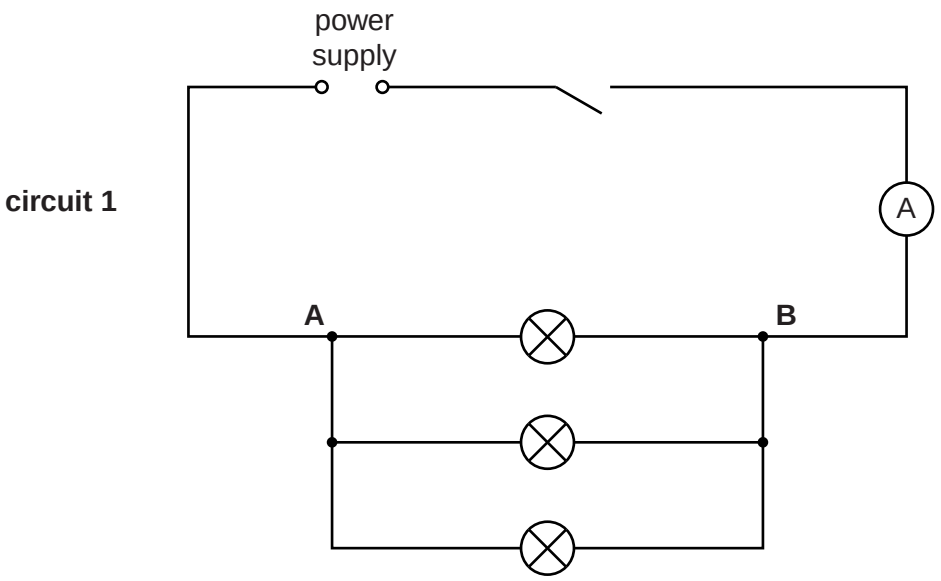


Fig. 3.1

The current in the circuit and the potential difference across the combination of lamps connected between **A** and **B** are to be measured.

(a) On Fig. 3.1, draw the symbol for a voltmeter, connected to measure the potential difference *V* between **A** and **B**.

[1]

(b) The values of potential difference *V* across AB and current *I* for **circuit 1** are recorded in Table 3.1.

The lamps are then reconnected as shown in Fig. 3.2 and then Fig. 3.3 and the experiment is repeated.

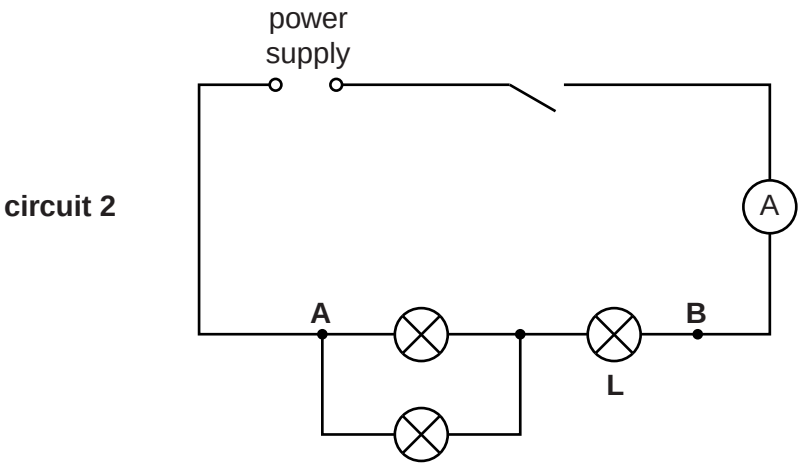


Fig. 3.2

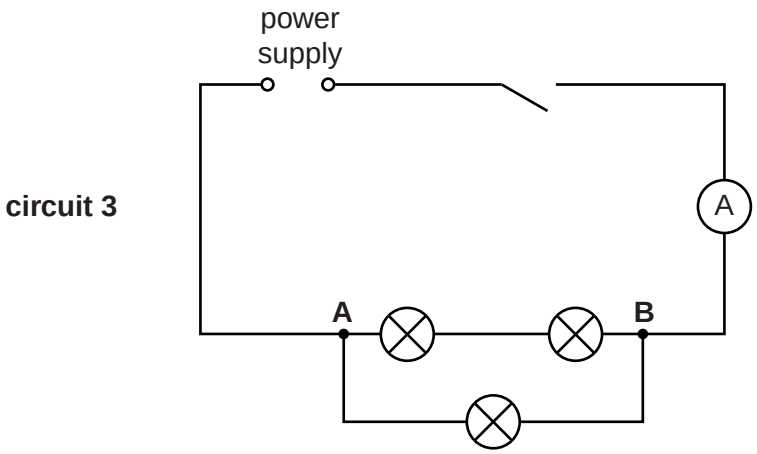


Fig. 3.3

(i) Calculate, and record in the table, the total resistance *R* of each combination of lamps, using the equation $R = \frac{V}{I}$.

[2]

(ii) Complete the column headings in the table. [1]

Table 3.1

circuit	*V* /	*I* /	*R* /
1	1.81	0.70	
2	1.76	0.22	
3	1.72	0.44	

(c) If each of the lamps had the same resistance, the total resistance of the lamps in circuit 3 would be twice the total resistance of the lamps in circuit 1.

State whether the results in the table show this to be the case. Justify your answer by reference to the results.

statement .....

.....

justification .....

.....

.....

.....

[2]

(d) An IGCSE student wants to measure the potential difference across the lamp marked **L** in **circuit 2**.

On the diagram for **circuit 2**, Fig. 3.2, show how a voltmeter should be connected to measure this potential difference. [1]

[Total: 7]