Electric Circuits & Electrical Safety

Question Paper

Course	CIE IGCSE Physics
Section	4. Electricity & Magnetism
Topic	Electric Circuits & Electrical Safety
Difficulty	Medium

Time Allowed 40

Score /29

Percentage /100

Question 1

A student investigates a wind turbine, which is an electrical generator driven by a propeller blade.

Plan an experiment which will enable him to investigate how the current in a resistor connected across the terminals of the turbine varies with the speed of the air flow through the turbine.

The apparatus available includes:

a model wind turbine as shown in Fig. 4.1

an electric fan to provide the moving air to turn the turbine

a device for measuring air speed.

In your plan, you should:

- list any additional apparatus needed
- complete the wind turbine circuit diagram on Fig. 4.1
- state the key variables to be kept constant
- explain briefly how to carry out the experiment, including how the speed of the air flow is to be changed
- explain how to use the readings to reach a conclusion.

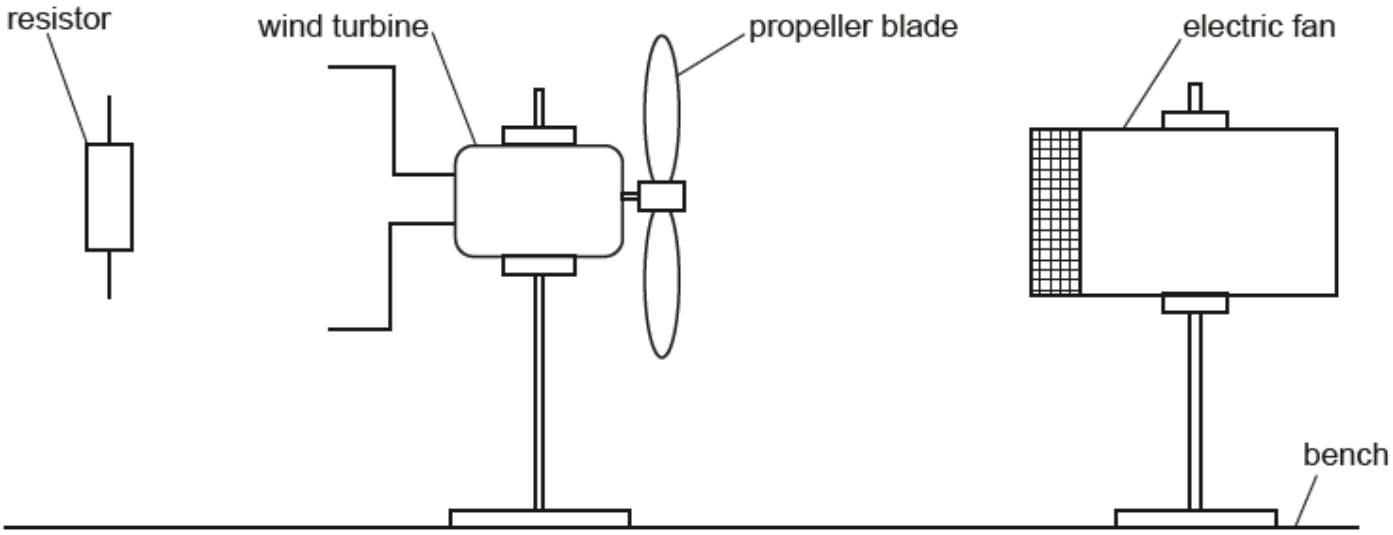

Fig. 4.1

[7 marks]

Question 2a

A student determines the resistances of some filament lamps.

Fig. 2.1 shows the first circuit she uses.

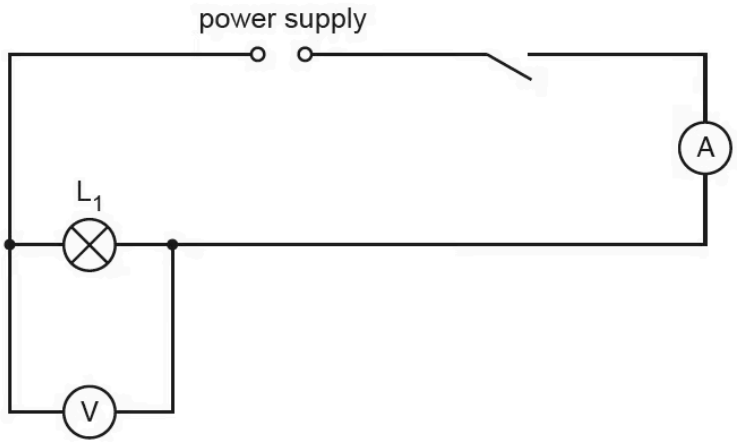

Fig. 2.1

(i) Record the potential difference V_1 across the lamp L_1, as shown on the voltmeter in Fig. 2.2.

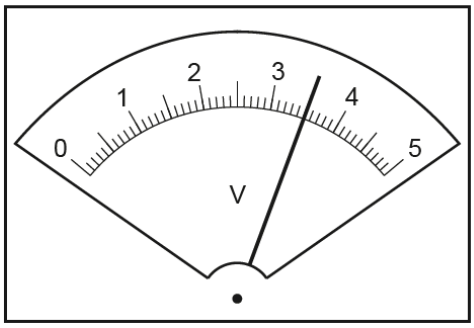

Fig. 2.2

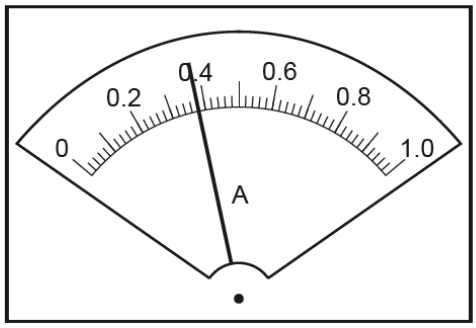

Fig. 2.3

V_1 = ... V [1]

(ii) Record the current I_1 in the circuit, as shown in Fig. 2.3.

I_1 = ... A [1]

(iii) Calculate the resistance R_1 of the filament of lamp L_1. Use the equation $R_1 = \frac{V_1}{I_1}$. Include the unit.

R_1 = ... [2]

[4 marks]

Question 2b

The student disconnects the voltmeter. She connects lamp L_2 in series with lamp L_1. She connects the voltmeter across lamp L_2.

She measures the current I_2 in the circuit and the potential difference V_2 across lamp L_2.

I_2 = ... 0.30 A .....
V_2 = ... 1.7 V .....

Calculate the resistance R_2 of the filament of lamp L_2. Use the equation $R_2 = \frac{V_2}{I_2}$.

R_2 = ...

The student disconnects the voltmeter. She connects lamp L_3 in series with lamps L_1 and L_2. She connects the voltmeter across lamp L_3.

She measures the current I_3 in the circuit and the potential difference V_3 across lamp L_3.

I_2 = ... 0.26 A .....
V_2 = ... 1.2 V .....

Calculate the resistance R_3 of the filament of lamp L_3. Use the equation $R_3 = \frac{V_3}{I_3}$.

R_3 = ...

[1 mark]

Question 2c

Calculate $R_1 + R_2 + R_3$. Give your answer to a suitable number of significant figures for this experiment.

$R_1 + R_2 + R_3$ = ...

[1 mark]

Question 2d

Some students make suggestions about the results of the experiment.

Suggestion **A**: $R_1 + R_2 + R_3$ should be equal to $3 \times R_1$

Suggestion **B**: $R_1 + R_2 + R_3$ should be less than $3 \times R_1$

Suggestion **C**: $R_1 + R_2 + R_3$ should be greater than $3 \times R_1$

State which suggestion **A**, **B** or **C** agrees with your results. Justify your answer by reference to your results.

[2 marks]

Question 2e

Draw a circuit diagram to show the circuit used in part (b) with all three lamps connected in series.

[3 marks]

Question 3a

A student is investigating a circuit containing different lamps.
She is using the circuit shown in Fig. 3.1.

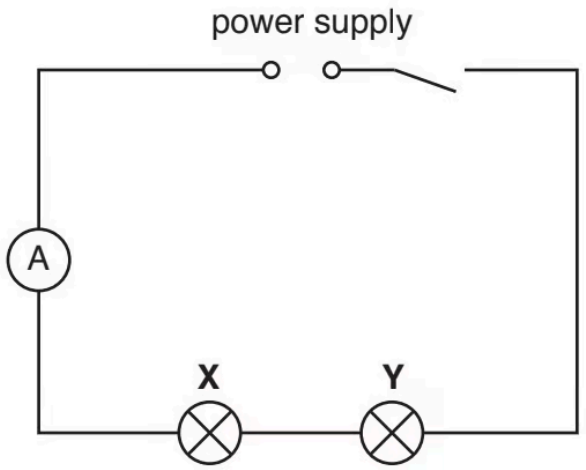

Fig. 3.1

On Fig. 3.1, draw a voltmeter connected so that it measures the potential difference (p.d.) across lamp **X**.

[1 mark]

Question 3b

The student uses the ammeter to measure the current in the circuit.

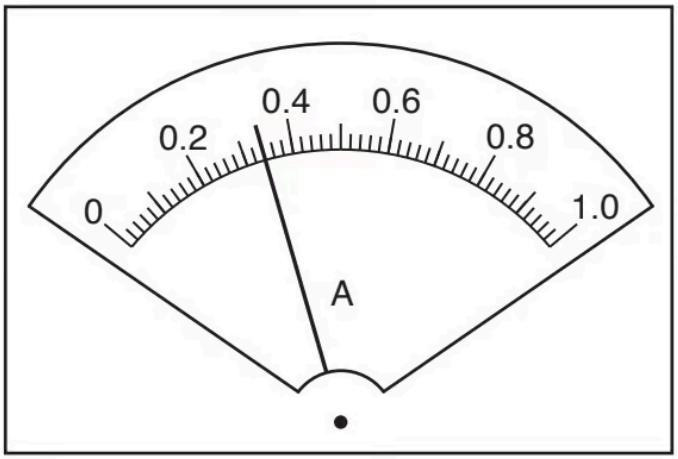

Fig. 3.2

Record the current I_S in the circuit, as shown in Fig. 3.2.

I_S = ...

[1 mark]

Question 3c

(i) The student uses the voltmeter to measure the p.d. V_X across lamp **X** and then reconnects the voltmeter to measure the p.d. V_Y across lamp **Y**.

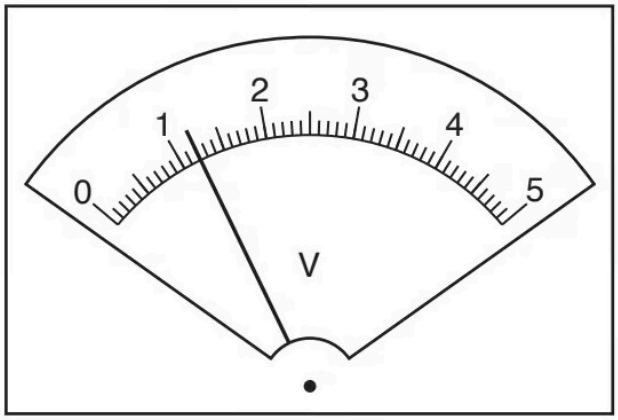

Fig. 3.3

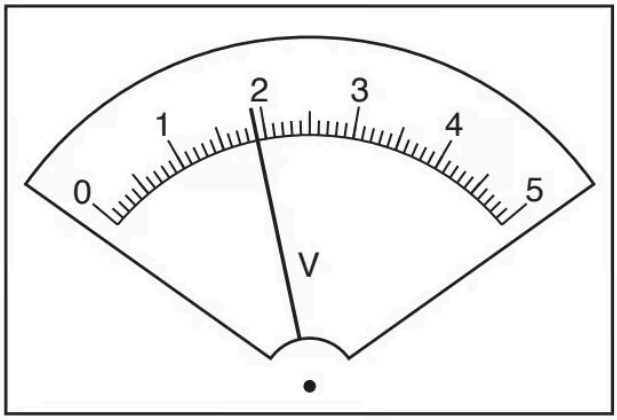

Fig. 3.4

Record the value of the p.d. V_X across lamp **X**, shown in Fig. 3.3.

V_X = ...

Record the value of the p.d. V_Y across lamp **Y**, shown in Fig. 3.4.

V_Y = ...

[1]

(ii) She then measures the p.d. V_S across both lamps in series.

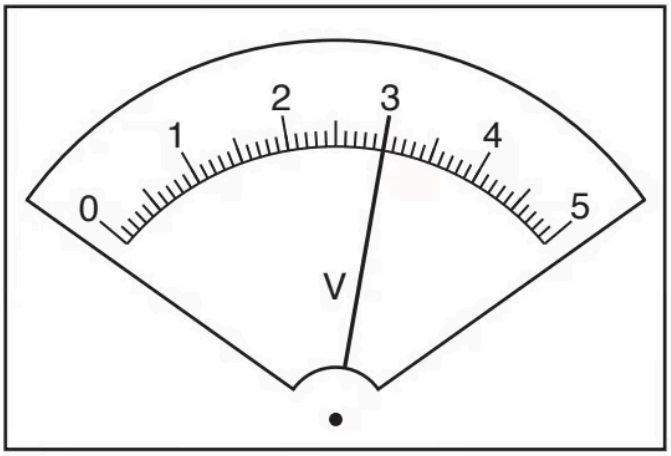

Fig. 3.5

Record the value of the p.d. V_S across both lamps in series, shown in Fig. 3.5.

V_S = ...[1]

(iii) A student suggests that V_S should be equal to $(V_X + V_Y)$.
State whether the readings support this suggestion. Justify your statement with reference to the results.

[2]

[4 marks]

Question 3d

Calculate the resistance R_1 of lamp **X**. Use the readings from **(b)** and **(c)(i)** and the equation

$$R_1 = \frac{V_X}{I_S}$$

R_1 = ...Ω

[1 mark]

Question 3e

Extended tier only

(i) The circuit components are to be rearranged so that

- lamps **X** and **Y** are connected in parallel
- the ammeter measures the current in lamp **X** only
- the voltmeter measures the p.d. across the lamps.

Draw a circuit diagram of this arrangement.

[2]

(ii) The student sets up the circuit as described in **(e)(i)**.

She measures and records the current in lamp **X** and the p.d. across the lamps.

She then calculates a new resistance R_2 for lamp **X** in this parallel circuit.

$$R_2 = 8.3\,\Omega$$

The student notices that lamp **X** is very bright in this parallel circuit, but it was dim in the series circuit in **(a)**.

Suggest how temperature affects the resistance of a lamp.
Justify your suggestion by reference to the value of R_1 from **(d)** and the value of R_2.

[2]

[4 marks]