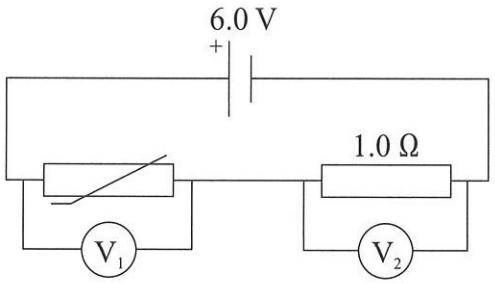
Circuits

1 A student has connected a circuit, shown in **Figure 1**. The circuit contains a 6.0 V cell, a thermistor, a 1.0 Ω resistor and two voltmeters, V_1 and V_2.

Figure 1



a) The current through the thermistor is 0.50 A. The voltmeter V_1 reads 5.5 V.
The current consists of a flow of electrons and each electron carries a charge of 1.6×10^{-19} C.
Calculate the number of electrons that will flow through the thermistor in 2.0 hours.

Number of electrons = ...
[3]

b) The circuit is moved to a different room, where the temperature is 16 °C.
The reading on V_1 is now 0.25 V.
Calculate the resistance of the thermistor when the external temperature is 16 °C.
Assume that the change in temperature does not affect the resistance of the 1.0 Ω resistor.

Resistance = ... Ω
[5]

c) The student wants to connect a heater in parallel with one of the components, so that when the external temperature decreases, the potential difference across the heater increases and it gets hotter.
Explain which component the heater should be connected across in order for this to work.
Assume the resistance of the heater remains constant.

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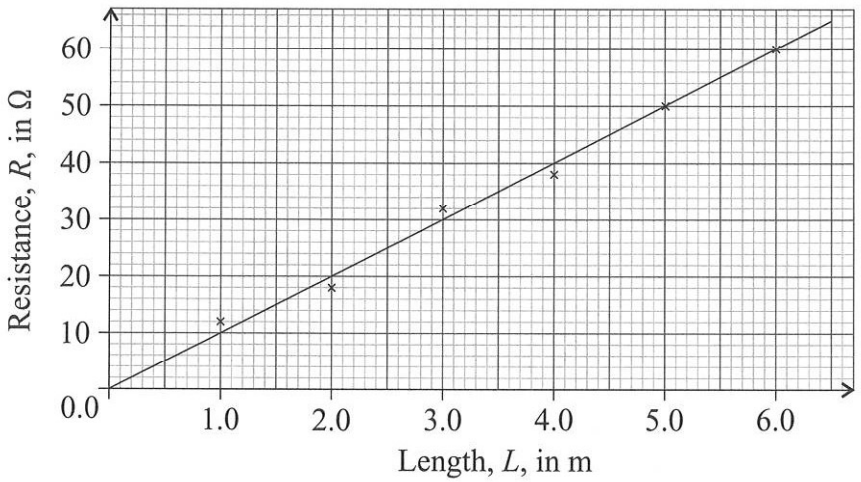
[3]

[Total 11 marks]

2 A student conducts an experiment to find how the length of a wire affects its resistance. The graph of her results is shown in **Figure 2**.

Figure 2



a) i) Determine the equation of the line of best fit in **Figure 2**, in terms of resistance, R, and length, L.

Equation: .....

[2]

ii) A 0.375 m length of this wire is used in a circuit.
A potential difference of 0.500 kV is applied across the wire.
Calculate the current that flows through the wire. Give your answer to three significant figures.

Current = ... A

[5]

b) The resistance, R, of a given length of wire is related to its cross-sectional area, A, by the equation:

$$R = \frac{k}{A}$$

where k is a constant for wires of the material used.
The wire the student used in her experiment has a cross-sectional area of 0.11 mm^2.
A second wire made from the same material has a cross-sectional area of 0.44 mm^2.
By considering **Figure 2**, calculate the resistance of a 1.2 m length of this second wire.

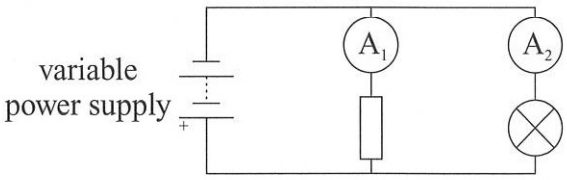
[5]

[Total 12 marks]

3 A student builds the circuit shown in **Figure 3**.

The resistor has a constant resistance of 1.6 Ω. The power supply initially supplies a potential difference of 1.0 V. At this point, the bulb has a resistance of 1.0 Ω.

Figure 3



a) Explain how the reading on ammeter A_1 compares to the reading on ammeter A_2 as the potential difference of the power supply is increased.

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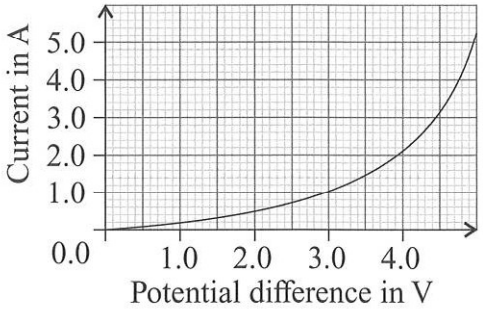
[4]

The student creates a new circuit containing the variable power supply, the resistor and component X connected in series. The *I-V* characteristic of component X is shown in **Figure 4**.

Figure 4



b) Using **Figure 4**, explain how the total resistance of the circuit changes as the potential difference of the power supply is increased.

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[3]

[Total 7 marks]

Exam Practice Tip

If a question tells you to use a figure (e.g. a graph), you'll need to explicitly refer to that figure in your answer. That's easy enough if you're asked to do a calculation, but when writing an explanation make sure you stay focused on the information and don't start talking about the topic too generally.

Score: ☐ / **30**