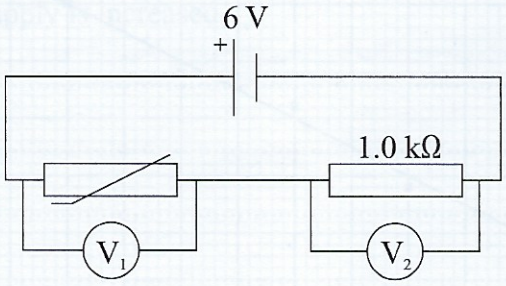
Circuits

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

Figure 1



1.1 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]

1.2 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.
Give your answer to three significant figures.

Resistance = ... Ω
[6]

1.3 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.

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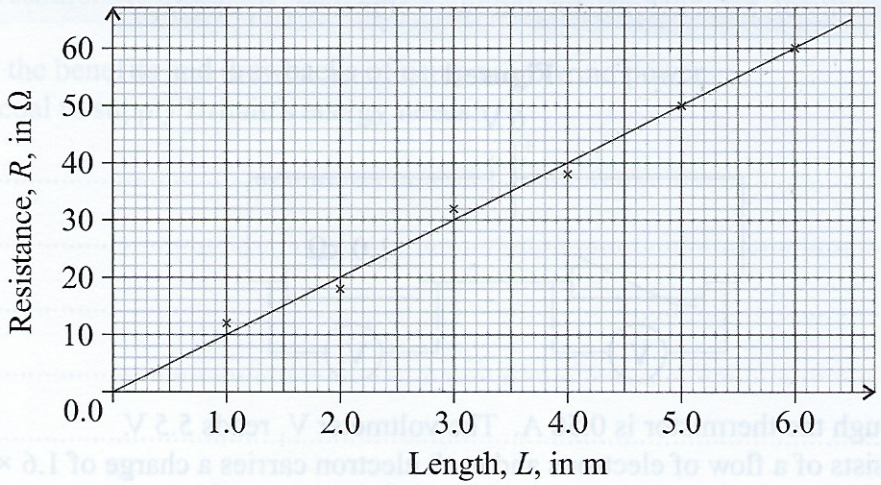
[3]

[Total 12 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



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

Equation: .....

[2]

2.2 A 0.375 m length of this wire is used in a circuit.
A potential difference of 500 mV is applied across the wire.
Calculate the current that flows through the wire. Give your answer to three significant figures.

Current = ... A

[5]

2.3 The resistance of a wire is inversely proportional to its cross-sectional area.
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**, what would be the resistance of a 1.2 m length of this second wire?
Tick **one** box.

24 Ω ☐

12 Ω ☐

3 Ω ☐

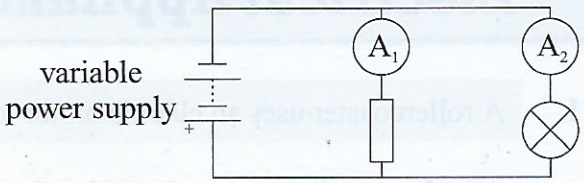
48 Ω ☐

[1]

[Total 8 marks]

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

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.

3.1* 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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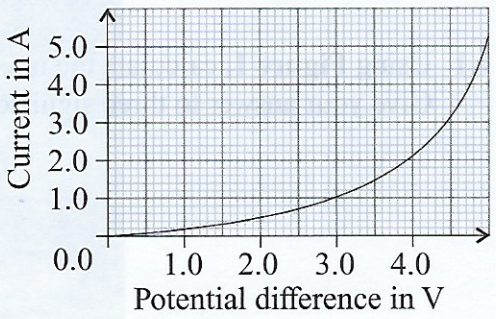
[4]

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



3.2 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]

Score: ____ / **26**