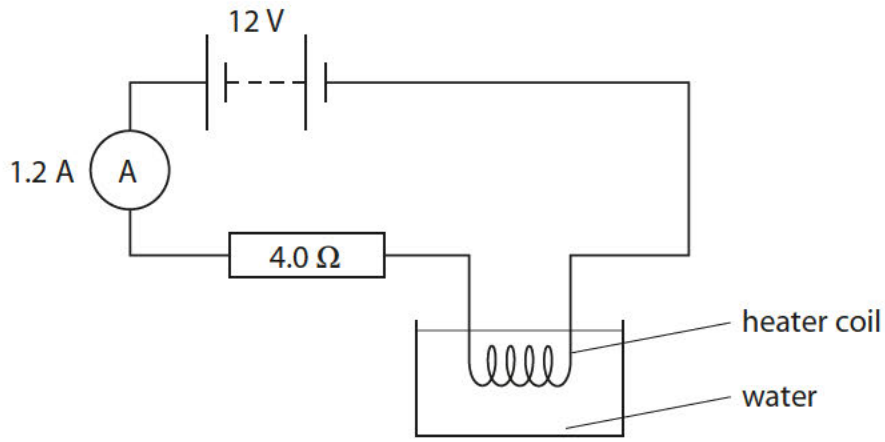
1 The diagram shows a heater coil and a resistor connected to a 12 V battery and an ammeter. The ammeter reading is 1.2 A.



(a) (i) State the equation linking voltage, current and resistance.

(1)

(ii) Calculate the voltage across the 4.0 Ω resistor.

(2)

Voltage = ... V

(iii) Show that the voltage across the heater coil is about 7 V.

(2)

(iv) Calculate the energy transferred to the heater coil in 5.0 minutes.

(3)

Energy transferred = ... J

(v) At first, the temperature of the water increases.

After a while, the temperature reaches a steady value below the boiling point of water.

Explain why the temperature reaches a steady value.

(2)

.....

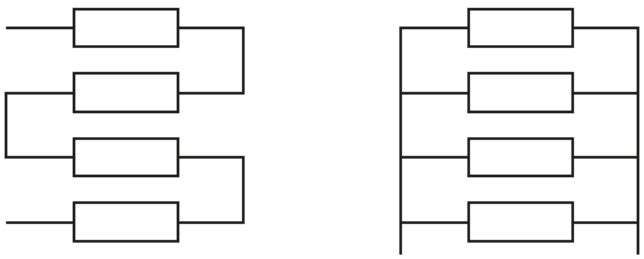
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(b) Resistors can be used as heating elements in the rear windows of cars.

The diagram shows two possible designs.



X **Y**

(i) Complete the table by placing a tick (✓) in the correct boxes.

(1)

Design	Series	Parallel
X		
Y		

(ii) Describe the advantages and disadvantages of design **X** when used as a heater in a car window.

(3)

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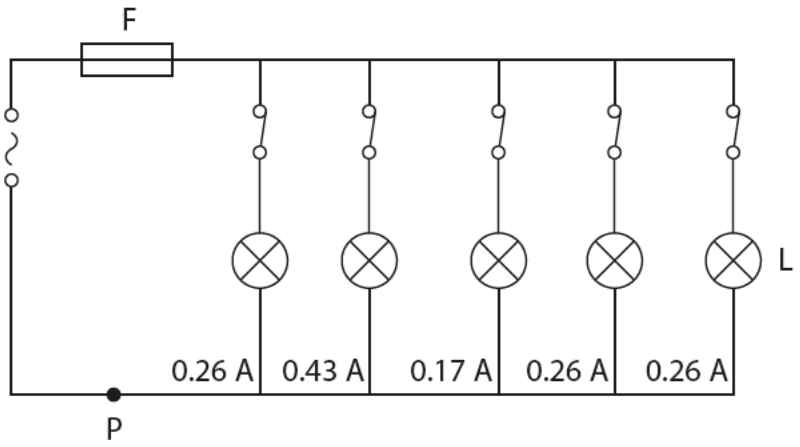
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(Total for Question 1 = 14 marks)

2 The diagram shows part of a lighting circuit in a house.

The circuit is protected by fuse F.



(a) Give two reasons why the lamps are wired in parallel.

(2)

1 .....

.....

.....

2 .....

.....

.....

(b) What is the current at P?

(1)

☒ **A** 0.17 A

☒ **B** 0.26 A

☒ **C** 0.43 A

☒ **D** 1.38 A

(c) Explain how the fuse protects the circuit.

(3)

(d) (i) State the equation linking power, current and voltage.

(1)

(ii) Calculate the power of lamp L.
[assume the mains voltage is 230 V]

(2)

power = ... W

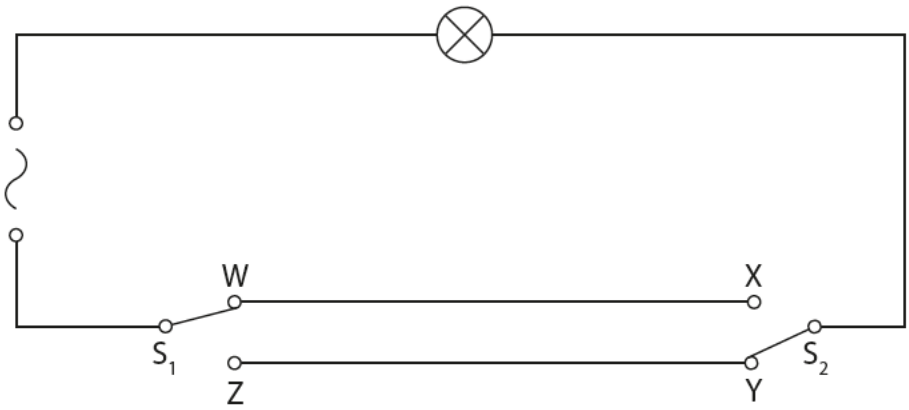
(iii) Calculate the amount of energy transferred by lamp L in 3 minutes.

Give the unit.

(3)

energy transferred = ... unit .....

(e) This diagram shows another lighting circuit.



(i) Complete the table by putting a tick (✓) in the box if the lamp is lit and a cross (✗) in the box if the lamp is not lit.

(2)

S_1 position	S_2 position	lamp lit (✓ or ✗)
W	X	
W	Y	
Z	X	
Z	Y	

(ii) Suggest where this circuit would be useful in a house.

(1)

.....

.....

(Total for Question 2 = 15 marks)

3 A student investigates how the resistance of a thermistor varies with temperature.

(a) Draw the circuit symbol for a thermistor.

(1)

(b) The student uses voltmeter and ammeter readings to find the resistance at each temperature.

One set of readings is shown below.

temperature in °C	voltmeter reading in V	ammeter reading in mA
80	13.2	2.60

(i) State the equation linking voltage, current and resistance.

(1)

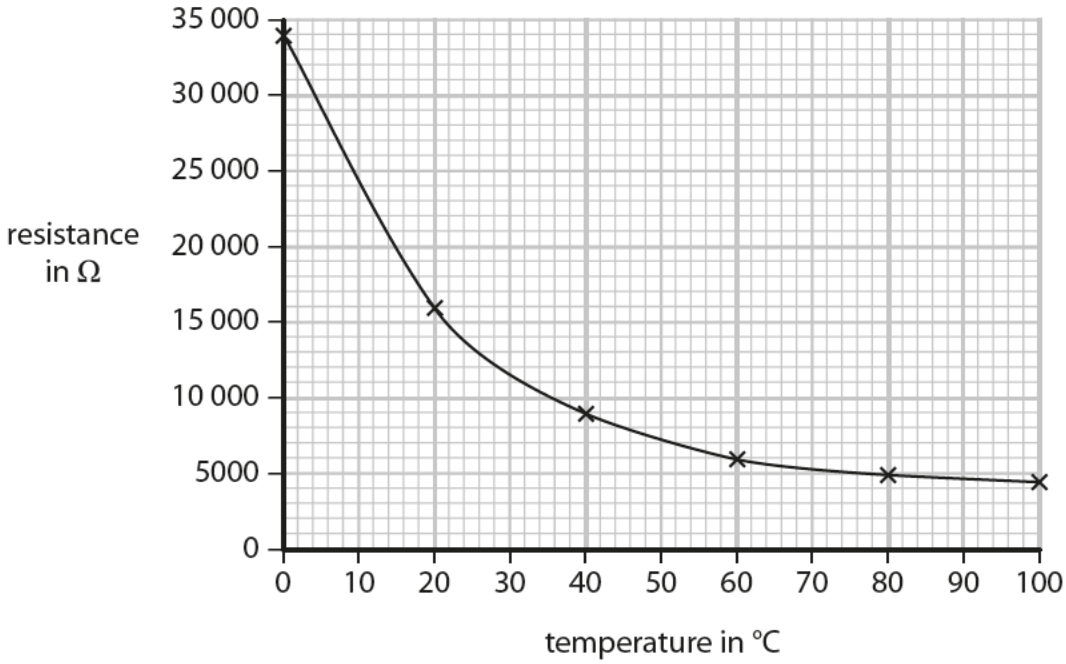
(ii) Show that the resistance of the thermistor at 80 °C is about 5000 Ω.

(3)

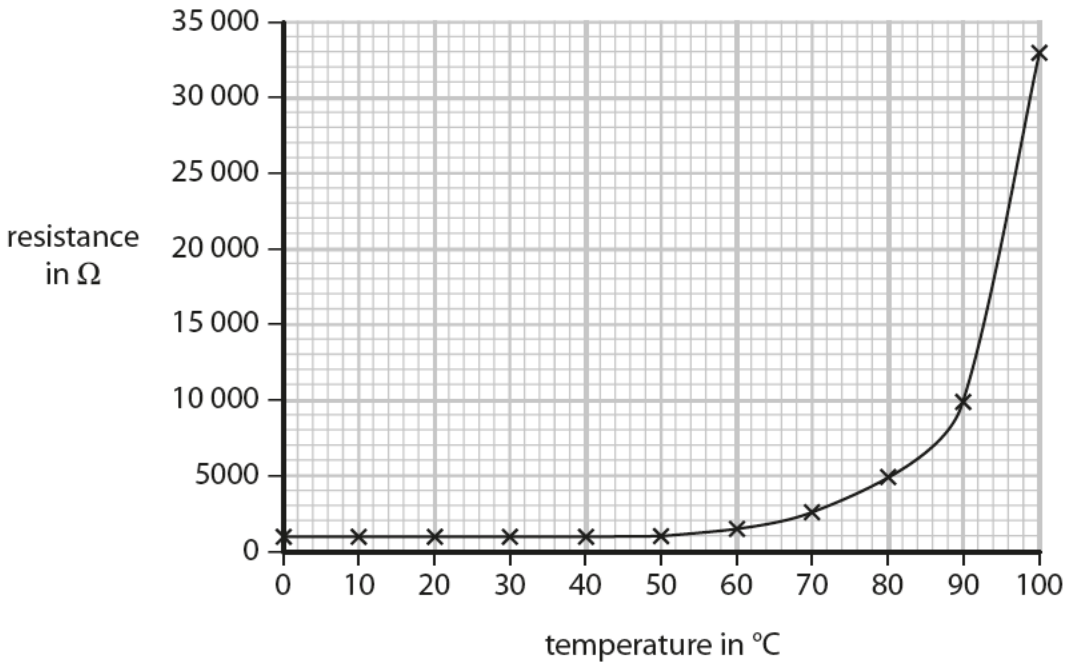
(c) Another student takes measurements for two more components, A and B.

The graphs show the results.

Component A



Component B



Compare the results for component A and component B.

(5)

(Total for Question 3 = 10 marks)

4 (a) A student investigates the resistance of a lamp.

(i) The student uses a circuit that contains an ammeter, a battery, a lamp and a voltmeter to determine the resistance of the lamp.

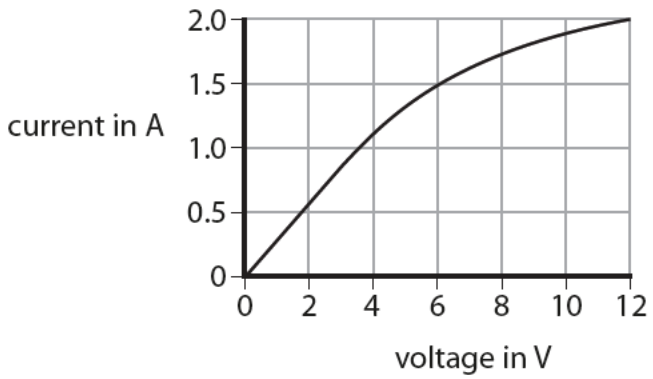
Draw a circuit diagram to show how he should connect the apparatus.

(3)

(ii) State the relationship between voltage, current and resistance.

(1)

(iii) The student obtains this graph for a filament lamp.



Calculate the resistance of the lamp when the voltage is 6.0 V.

Give the unit.

(3)

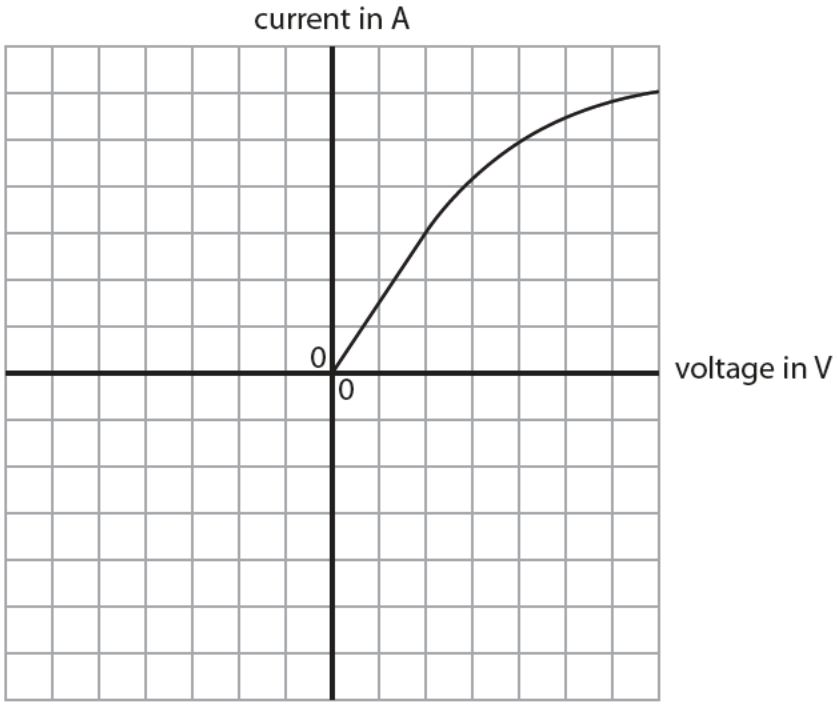
resistance = ... unit .....

(iv) The student reverses the battery connections and then repeats his measurements.

On the axes below, sketch the graph that he would obtain.

Part of the graph has been done for you.

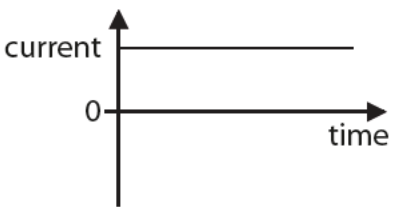
(2)



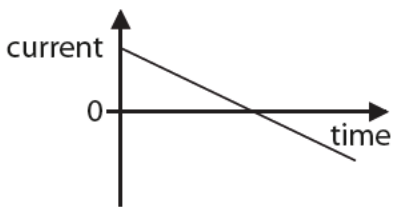
(b) The student replaces the filament lamp with a light emitting diode (LED).
He notices that there is no current in the diode when the battery is reversed.
He replaces the battery with an a.c. supply.

Which graph shows how the current in the diode varies with time?

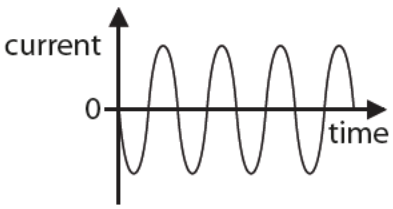
(1)



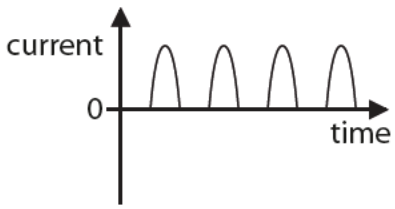
☒ **A**



☒ **B**



☒ **C**

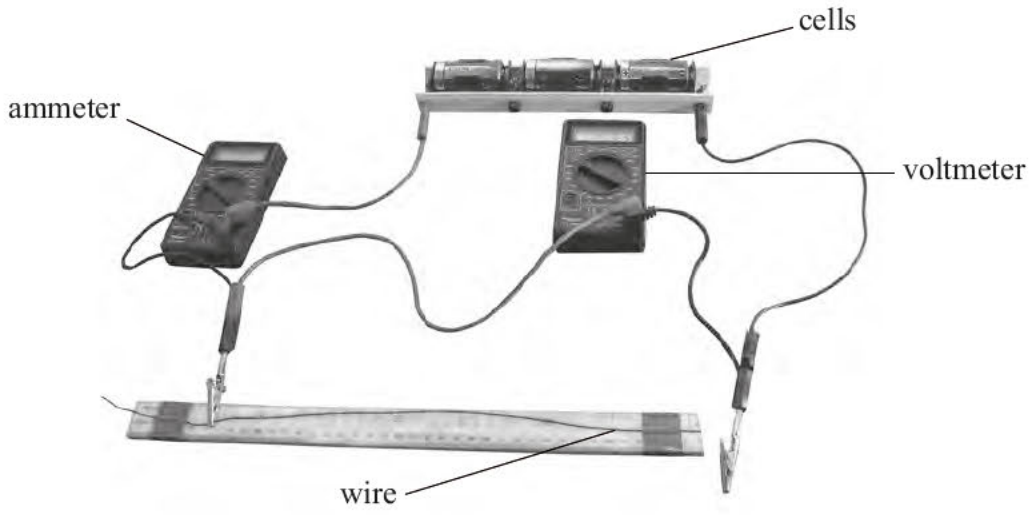


☒ **D**

(Total for Question 4 = 10 marks)

5 A student investigates how the resistance of a wire depends on its length.

The photograph shows the circuit that the student uses.



(a) Draw a circuit diagram to show how the components in the photograph are connected.

(3)

(b) (i) Complete the table by naming the key variables in this investigation.

(1)

independent variable	
dependent variable	

(ii) Describe the method the student should use for this investigation.

(5)

(c) The table shows the student's measurements.

Length of wire in cm	Voltage in V	Current in A	Resistance of wire in Ω
20	4.5	3.6	1.3
40	4.5	1.8	2.5
60	4.5	1.2	3.8
80	4.5	0.9	5.0
100	4.5	0.7	

(i) State the equation linking voltage, current and resistance.

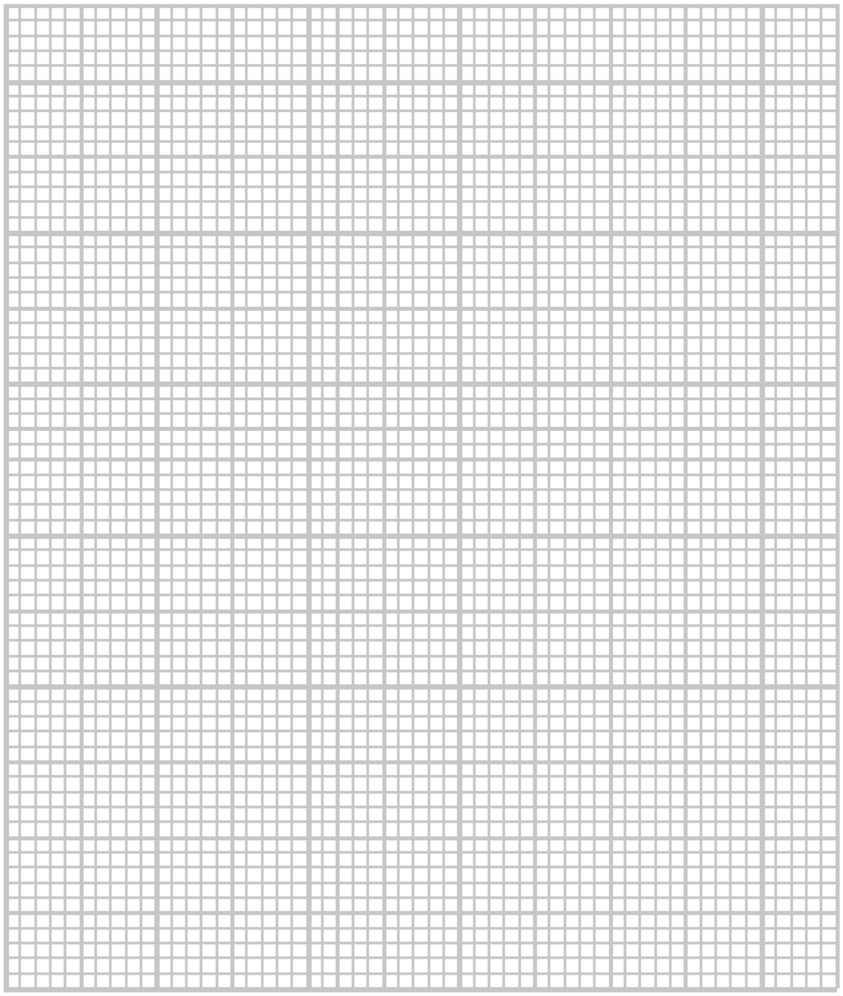
(1)

(ii) Complete the table by calculating the missing value of resistance.

(1)

(d) (i) Use the results from the table opposite to plot a graph of resistance (y-axis) against length of wire (x-axis) and draw the line of best fit.

(5)



(ii) Write a conclusion for the investigation.

(1)

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(iii) Explain how the graph supports this conclu

(2)

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(Total for Question 5 19 marks)