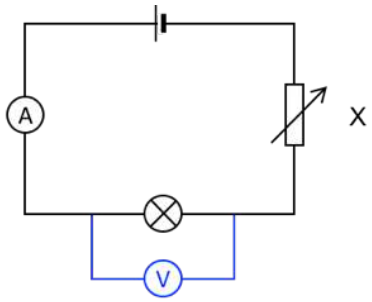
0 1

Pauline sets up the below circuit in order to investigate the electrical behaviour of a filament bulb. She wants to plot a graph of current against potential difference for the bulb.



0 1 . 1

One more component must be added to the circuit to enable her to plot a graph of current against voltage for the bulb. Add this component (using the appropriate circuit symbol) to the appropriate location in the diagram.

0 1 . 2

Identify component X in the above circuit diagram.

Variable resistor (accept rheostat or potentiometer) [1]

0 1 . 3

Describe the steps which Pauline should follow to collect the data which she will need in order to plot a current-voltage graph for the bulb.

Set variable resistor to maximum resistance [1]
Measure and record I (current through bulb) and V (p.d. across bulb) [1].
Set variable resistor to at least six additional values and repeat [1].
(Finish with variable resistor at minimum resistance.)

0 1 . 4

When the p.d. across the bulb is 2 V, the current flowing through it is 1 A.
When the p.d. is 10 V, the current is 2 A.

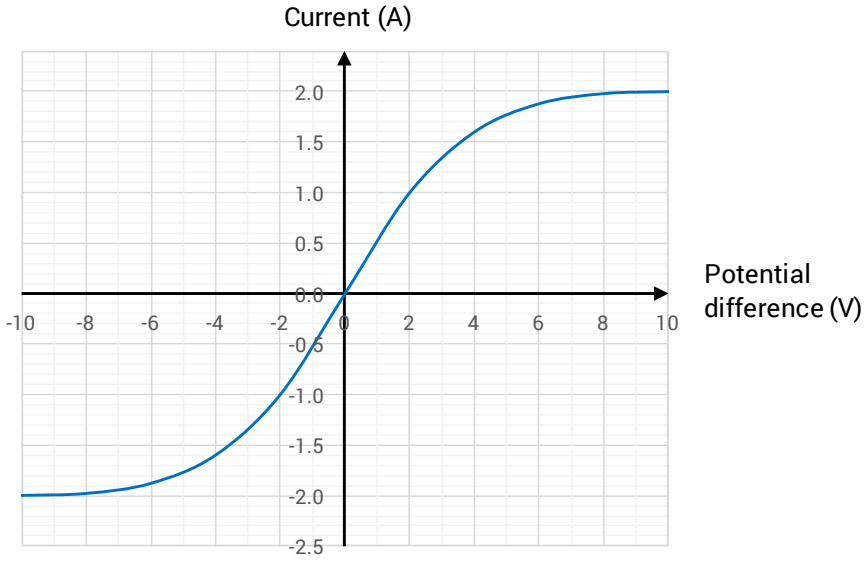
Calculate the resistance of the bulb at each of these p.d. values.

Resistance at 2 V: R = V ÷ I = 2 ÷ 1 = **2 Ω**

Resistance at 10 V: R = V ÷ I = 10 ÷ 2 = **5 Ω**

0 1 . 5

Pauline plots the below graph from her experimental results.



On seeing the graph, Frank says that the bulb "clearly exhibits ohmic behaviour". Do you agree with his statement? Explain your answer.

No [1], because I is not proportional to V for the bulb (or because the graph is not a straight line) [1].

0 1 . 6

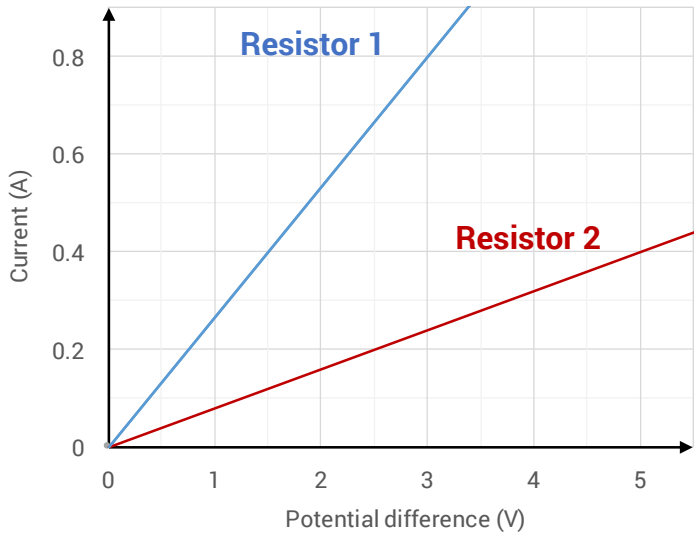
Explain the shape of the above graph for the filament bulb. Why does the current through the bulb depend on the p.d. across it in this way?

When the current through the bulb is lower (at low p.d. values), the amount of electrical energy converted to thermal energy inside the filament is low [1]. This means that the operating temperature of the filament is low, which means that its resistance is low too [1].

When the current through the bulb increases (when the p.d. is increased), so too does its temperature, which increases the resistance of the filament [1].

0 2

The below graph shows the current-voltage characteristics of two different fixed resistors.



0 2 . 1

Calculate the resistance of both resistors.

Resistor 1: R = V ÷ I = 3 ÷ 0.8 = **3.75 Ω**

Resistor 2: R = V ÷ I = 5 ÷ 0.4 = **12.5 Ω**

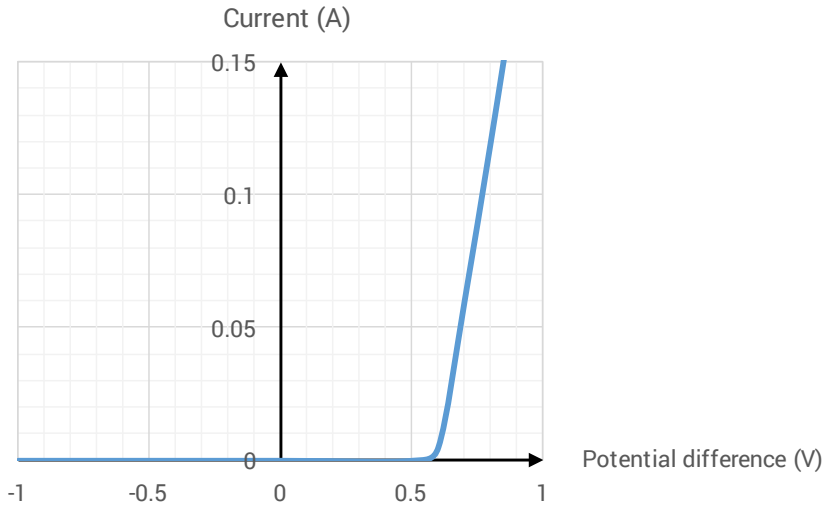
0 2 . 2

Both resistors may be described as being *ohmic*.
Explain the meaning of this statement.

The current through an ohmic component is proportional to the p.d. (applied) across it [1], provided the physical conditions (e.g. temperature) remain constant [1].

We can tell that both resistors are ohmic from the above graph, because both lines are straight ($I \propto V$ for both resistors) [1].

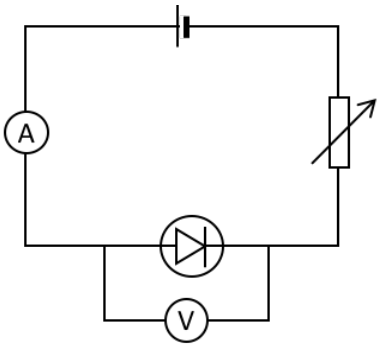
0 3 The current-voltage graph for an electrical component is displayed below.



0 3 . 1 What is the name of this component?

Diode.

0 3 . 2 Draw a circuit diagram which could be used to obtain the data which was used to plot the above graph.



- Correct symbol for diode [1].
- Use of variable resistor (or variable power supply or potential divider method) [1].
- Ammeter connected in series with diode, voltmeter in parallel [1]

0 3 . 3 Describe a suitable method for collecting the current-voltage data from which the above graph was plotted.

Diode forward-biased [1]. Measure I and V values for at least six settings of the variable resistor (starting from its maximum and finishing on its minimum resistance) [1]. Reverse current direction (by swapping connections to either diode or cell) and repeat [1].