4.3 Resistance

Resistance is opposition to the flow of current. The greater the resistance of a device, the more energy the electrons lose in flowing through it. It is defined as:

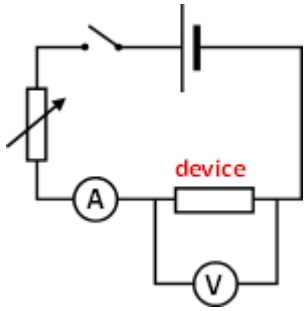
$$\text{resistance} = \frac{\text{p.d. across a device}}{\text{current through it}}$$

$$R = \frac{V}{I}$$

Resistance is measured in ohms (Ω). An ohm is a volt per ampere.

Measuring Resistance

The simple circuit opposite could be used to measure the resistance of a component. The ammeter, connected in series with the device, measures the current through it.
The voltmeter, connected in parallel with the device, measures the p.d. across it.
The variable resistor allows many values of V and I to be measured and a graph of V against I could be plotted. If the resistance of the device is constant, the graph will be a straight line through the origin.



Ohm's Law

- *For a metallic conductor, if the temperature is constant, the current flowing through it is proportional to the p.d. across it.*

Metals obeying Ohm's law are referred to as **ohmic conductors**.
Usually, as the current through a device increases, its temperature rises and its resistance will change. (R increases in a metal but decreases in a semiconductor).

Resistivity

For a uniform conductor at constant temperature, the resistance, R, is proportional to its length, L, and inversely proportional to its cross-sectional area, A. This can be summarised by the equation:

$$R = \frac{\rho L}{A}$$

where the constant of proportionality ρ is known as the **resistivity** of the material. Its units are ohm-metres, (Ωm).

Superconductors

Below a certain **critical temperature**, the resistance of certain materials falls to zero. Such materials are called superconductors. The resistivity of these materials varies with temperature, as shown in the graph opposite.