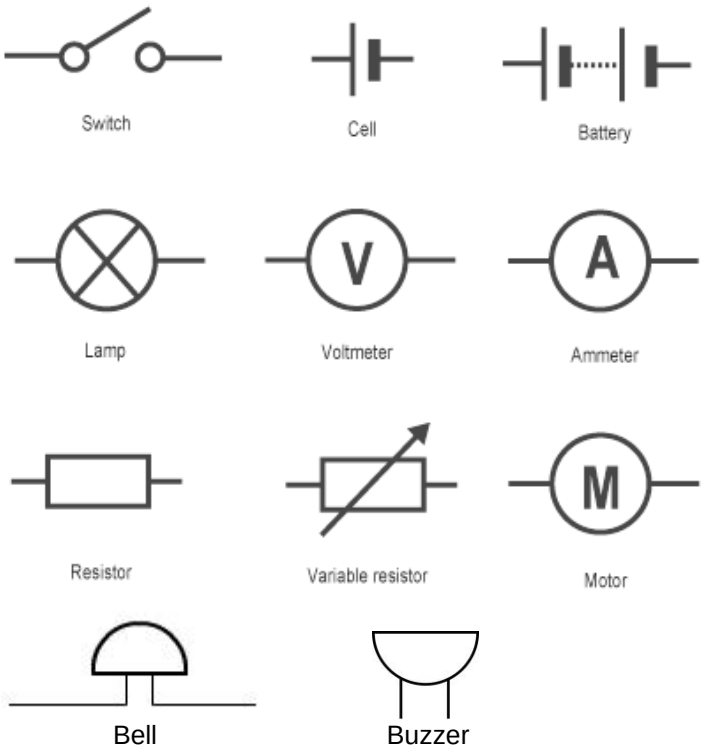
CfE Electricity

Components and Symbols

Components of electrical circuits are represented by symbols:



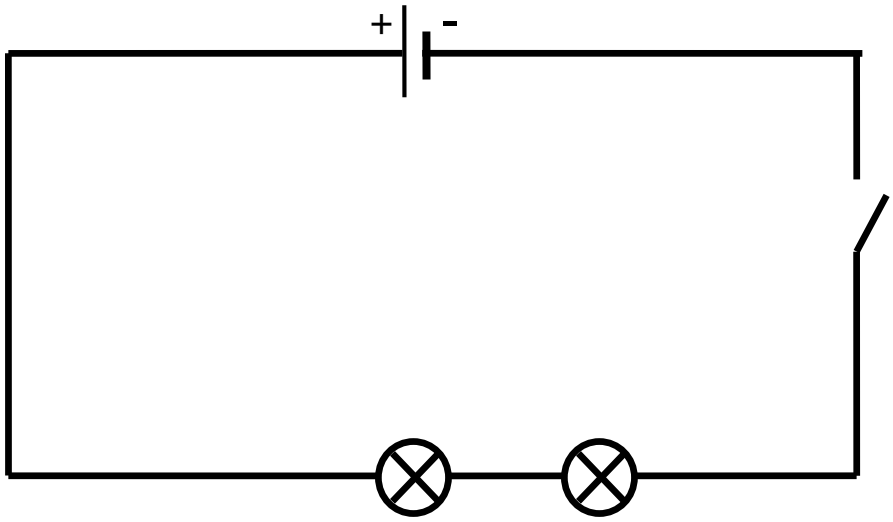
Electrical Circuits

There are 2 types of electrical circuits:

1. Series
2. Parallel

Series Circuit Diagrams

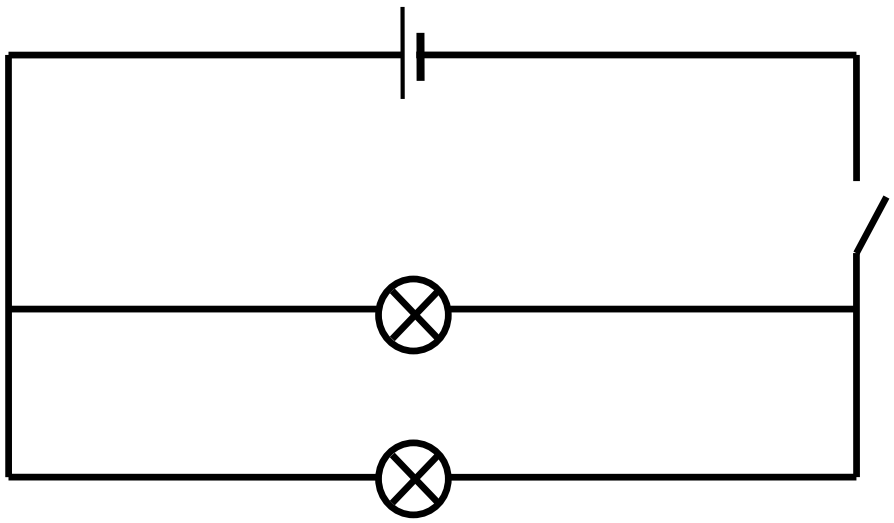
In a series circuit there is only one way round the circuit. There are no junctions or choices.



If one bulb goes out in a series circuit, **all other bulbs will go out**. If more bulbs are put in series, the brightness decreases.

Parallel Circuit Diagrams

In a parallel circuit there is more than one way round the circuit. There are junctions or choices for the electricity.

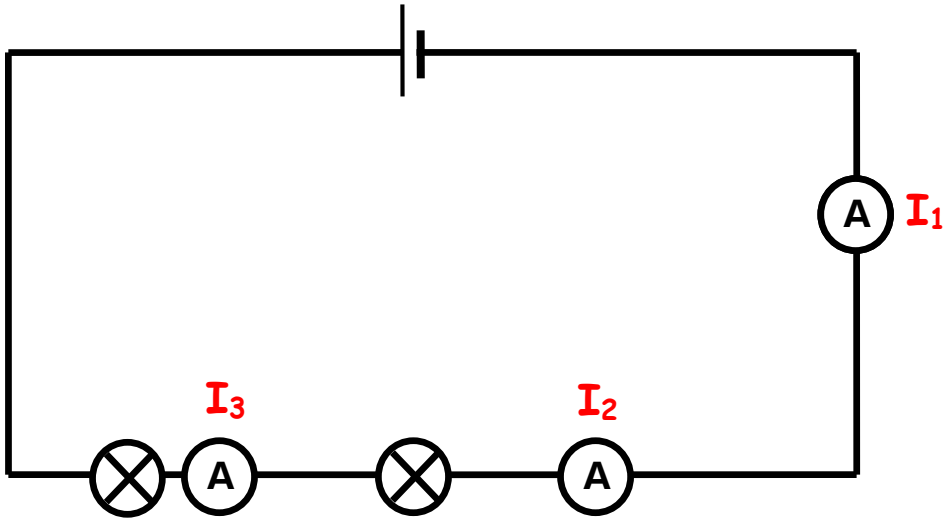


If one bulb goes out in a parallel circuit, the other bulbs in parallel **will not go out**. They also have the **same brightness**, no matter how many bulbs are in parallel.

Current (I)

Current is the flow of charge around a circuit. It is measured in units called Amperes (A).

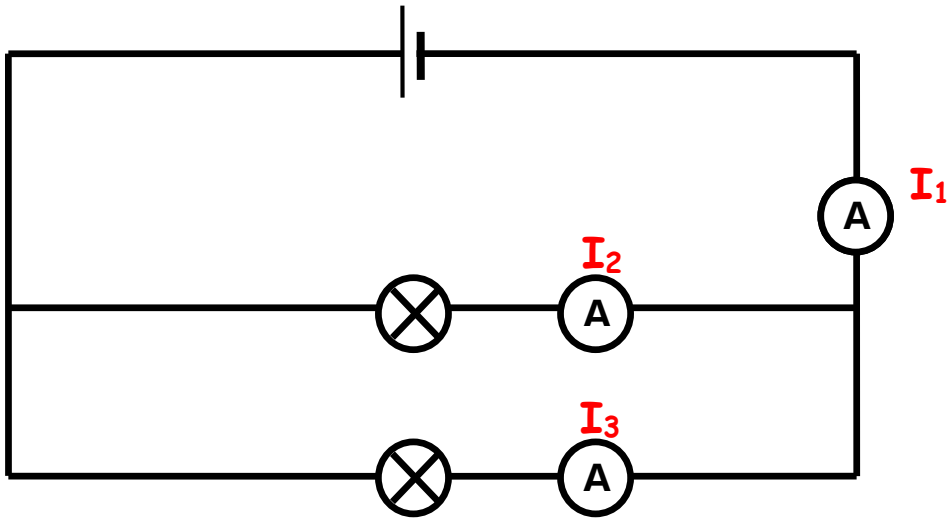
Current is measured using an ammeter, which is connected in series.



In a **series** circuit, the current is the same at every point.

$$I_1 = I_2 = I_3$$

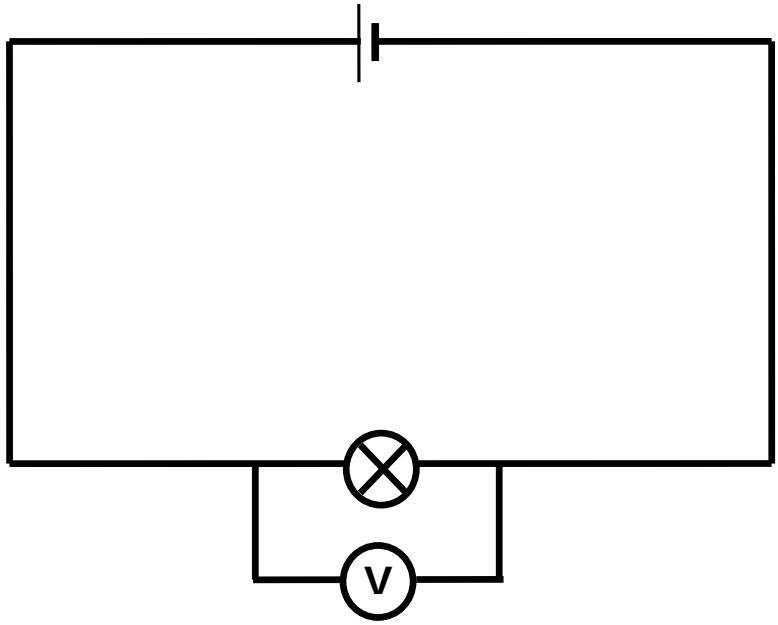
In a **parallel** circuit the current is split between the different routes.



$$I_1 = I_2 + I_3$$

Measuring Voltage (V)

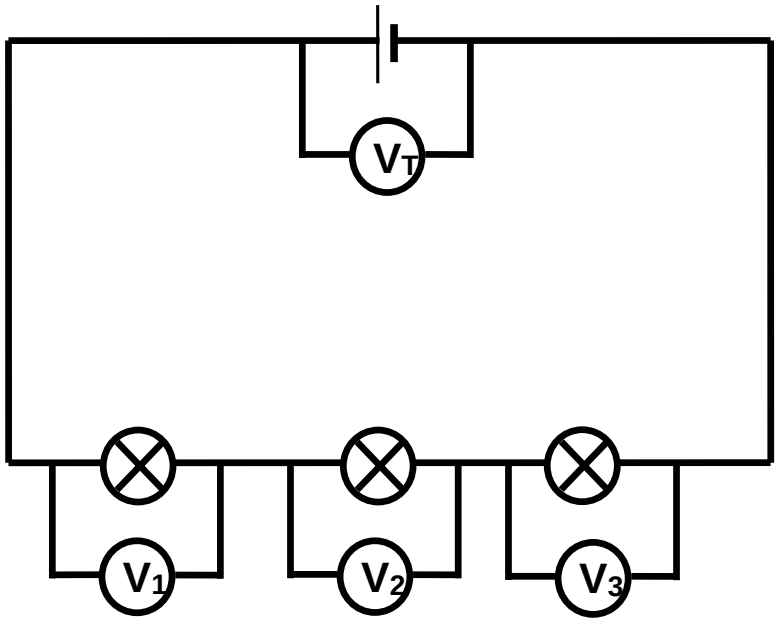
Voltage is a measure of the energy carried by the charge around a circuit. We measure voltage using a voltmeter. The units we measure voltage in are called volts (symbol V).



Voltmeters must be put in parallel with the component you are measuring.

Voltage in Series Circuits

The following circuit was set up and the voltages measured in the positions shown:

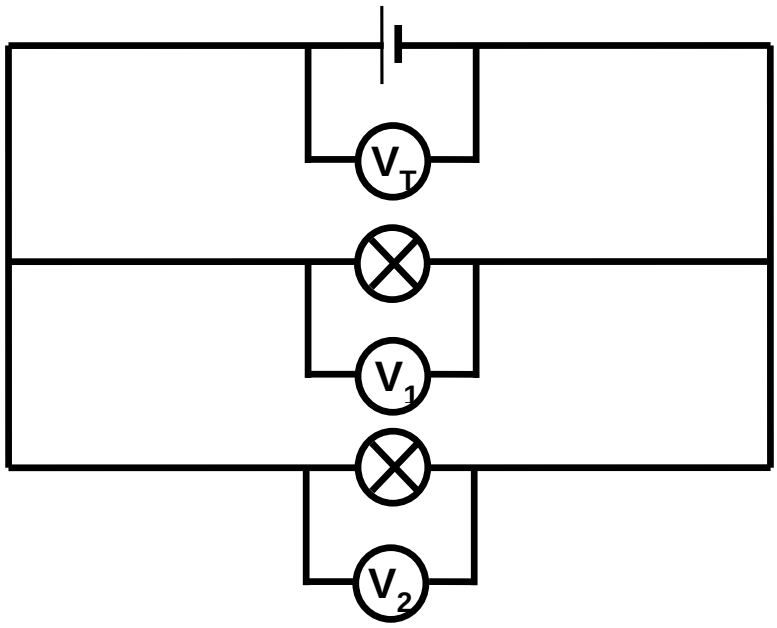


When more bulbs are placed in the circuit the voltage across each bulb decreases. The voltage is split between the components in a series circuit.

Total V (batteries) = V_1 + V_2 + V_3

Voltage in Parallel Circuits

The following circuit was set up:



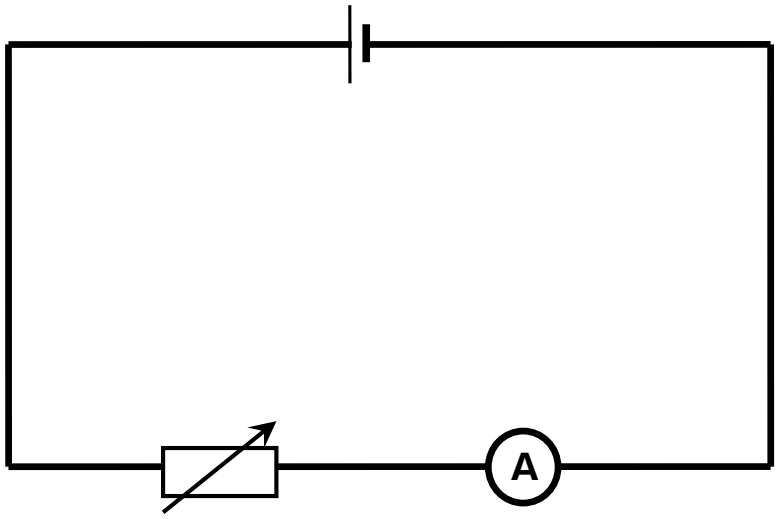
Total V (batteries) = V_1 = V_2

Summary of Voltage and Current

	Series Circuit	Parallel Circuit
Current	Stays the same	Splits up
Voltage	Splits up	Stays the same

Resistance (Ω)

Resistance is the opposition to the flow of current. It is measured in ohms (Ω) using an ohmmeter.



When the resistance is increased the current decreases.

What factors affect Resistance?

The resistance of a wire:

- increases as its length increases.
- increases as its thickness decreases.
- depends on the type of material.

Uses of Resistance

In a component with resistance, electrical energy is changed into heat energy.

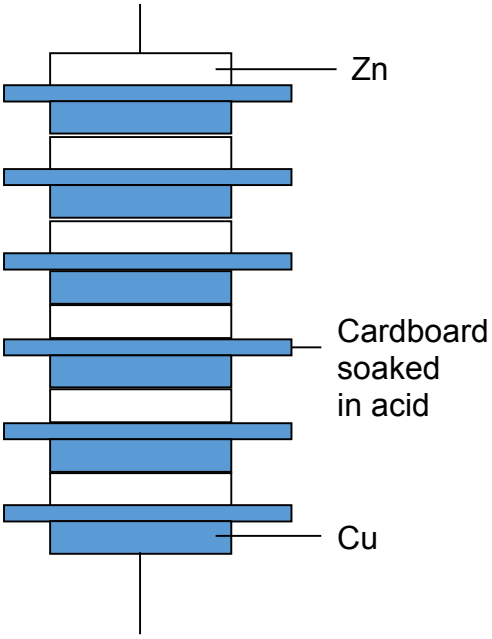
A fuse is a thin piece of wire with high resistance. This is used as a safety device to protect valuable equipment.

If too much electricity goes into a fuse, it heats up and melts. This breaks the circuit so the electricity does not get into the equipment.

Metal wires of high resistance are also used in electric fires, toasters and kettles.

Making Electricity

Electricity can be made by a chemical reaction between 2 metals separated by an **electrolyte** (salt solution). This was developed by Alessandro Volta who made the first battery, known as a voltaic pile.

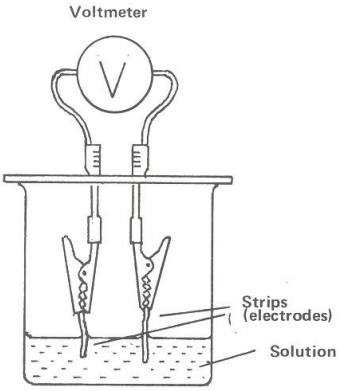


The Electrochemical Series

Lithium
Potassium
Calcium
Sodium
Magnesium
Aluminium
Zinc
Iron
Nickel
Tin
Lead
Copper
Silver
Mercury
Gold

The voltage is dependent on the positions of the 2 metals in the Electrochemical Series. The **further apart** they are, the **bigger** the voltage.

The Effect of Electrolyte (Salt) Concentration in a Cell



As the concentration of the electrolyte **increases**, the current **increases**.