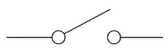
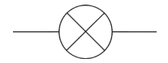
KS3 Electricity and Magnetism **Knowledge Organiser**

Key Words

potential difference	The amount of push (energy) provided by the battery to a moving charge.
current	The flow of electric charge.
resistance	The measure of how difficult it is for a flow of charge to pass through a component.
independent variable	The variable you change in an investigation to see how it affects the dependent variable.
dependent variable	The variable you measure or observe.
control variable	A variable that could affect the dependent variable so must be kept the same.

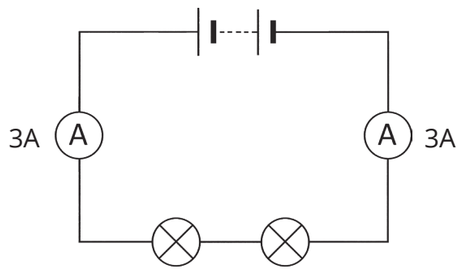
Circuit Diagrams

Electrical circuits are often represented by **circuit diagrams**. They are simple and easy to interpret. **Circuit symbols** are used to represent the **components** used in a circuit.

switch (open)	
switch (closed)	
bulb	
cell	
battery	
ammeter	
voltmeter	
resistor	
motor	

Series Circuits

In a series circuit, the components are connected end to end in a loop as shown in the diagram below. If one bulb breaks, none of the bulbs will be lit as the circuit is no longer complete.



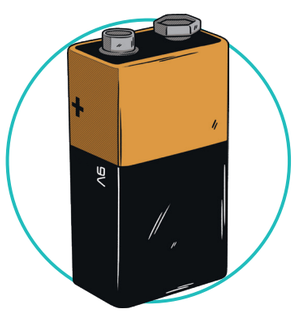
The **current is the same** everywhere in a series circuit. It doesn't matter where you put the ammeter, it will always show the same reading. The more cells or batteries you add, the greater the current. Current is **not** used up.

Batteries

Batteries store **chemical energy** and transfer it as electric current in a circuit.

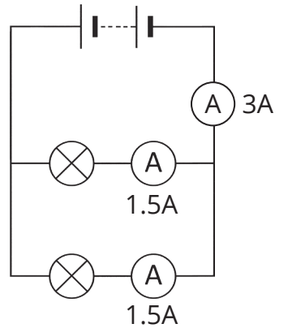
The potential difference of a battery tells us how much **energy** it provides to the components in the circuit.

Batteries contain an **electrolyte** and **two electrodes**. One of the electrodes is **positively charged** and the other is **negatively charged**. A chemical reaction between the two electrodes creates a flow of electrical energy to the circuit.



Parallel Circuits

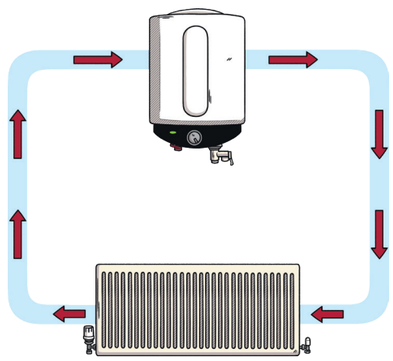
In a parallel circuit, the components are connected on separate branches as shown in the diagram below. This gives the current several different paths to flow down. If one bulb stops working, the other bulbs will remain lit as the circuit is still complete.



The **current is split** between the branches in a parallel circuit.

Modelling Circuits

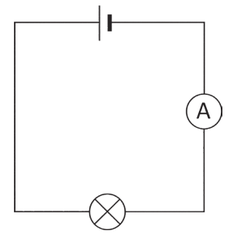
Scientists often use models to help them to explain difficult concepts. Some models are better than others.



In the boiler and radiator model, the pump pushes the water around the system. It does a similar job to a **battery** pushing the **charges** around a circuit. The pipes carry the flow of water around the system, like the **charge** flowing through wires in a circuit. The radiator is similar to a bulb because it transfers **energy** supplied by the system to the surroundings.

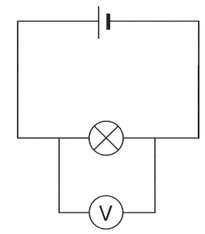
Current

Current is the flow of electrical charge around a circuit. The faster the flow of charge, the higher the current. Current is measured in **amps (A)** using an **ammeter**. An ammeter is connected in **series** with the component.



Potential Difference

Potential difference tells us how hard the battery 'pushes' the electrons around the circuit: the larger the potential difference, the bigger the 'push'. Potential difference is measured in **volts (V)** using a **voltmeter**. A voltmeter is connected in **parallel** with the component.



Resistance

Resistance is a measure of how difficult it is for the current to flow around a circuit.

The **higher the resistance**, the less current will flow around the circuit. The **lower the resistance**, the more current will flow around the circuit.

Resistance is measured in **ohms (Ω)**.

Resistance can be calculated using the equation:

resistance (Ω) = potential difference (V) ÷ current (A)

Resistance

Factors that can affect the resistance through a wire include:

- temperature
- width of wire
- length of wire
- type of material

- As **temperature increases, resistance increases**. This is because the metal ions have more kinetic energy so they vibrate more, making it more difficult for electrons to flow.
- As the **width of the wire increases, resistance decreases** because there is more space for the electrons to flow.
- As the **length of the wire increases, resistance increases** because the electrons collide with more metal ions as they flow through the wire.
- Some materials are better **conductors** of electricity than others; they have **lower resistance** so they allow electrons to flow more easily.

Magnetism

Magnetism is a **non-contact force**. Magnetic materials can be magnetised or will be attracted to a magnet. There are three magnetic metals: **iron, nickel** and **cobalt**. Steel is also magnetic because it contains iron.

A bar magnet is a permanent magnet. It has a **north pole** and a **south pole**.

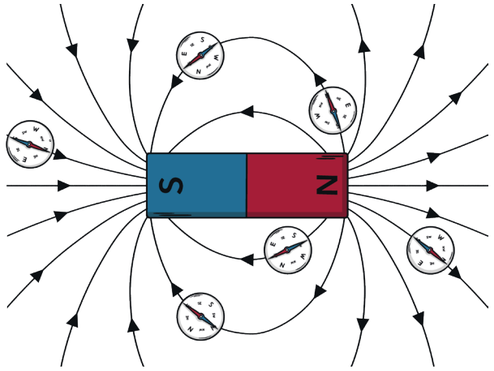
Like poles repel. This means that the two poles push each other away.

Opposite poles **attract**. This means that the invisible magnetic force between the magnets pulls the poles towards each other.

Magnetic Field Lines

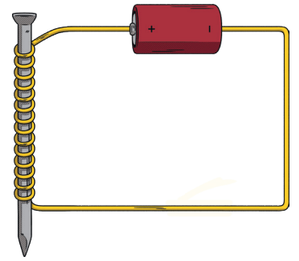
The magnetic field around a magnet can be shown as a series of lines around the magnet. The magnetic field lines can be plotted using a plotting compass.

The compass will always point towards to the south pole, wherever the compass is placed near the magnet. The arrows show the direction of the magnetic field.



Electromagnets

When electrical charge flows in a wire, a magnetic field is created around the wire. The larger the current, the stronger the electromagnet. The strength of the magnetic field can be increased by wrapping the wire around a magnetic material, such as iron.

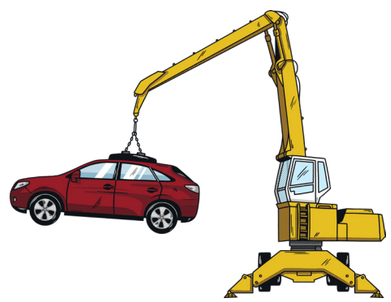


The strength of an electromagnet can be changed by changing the number of coils of wire around the iron core. This can be measured by counting the number of paperclips that become attracted to the electromagnet.

Independent variable – number of coils of wire
Dependent variable – number of paperclips picked up
Control variables – current supplied to the circuit, core material, width of wire, length of wire, potential difference of the battery or power pack

The **greater the number of coils**, the **stronger the electromagnet** and the more paperclips it will pick up.

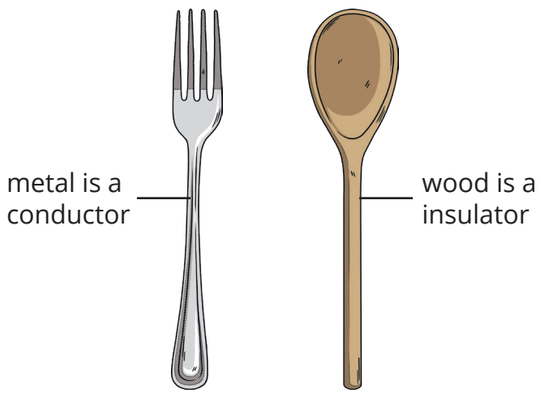
Electromagnets are useful because they can be switched on and off. This makes them suitable for sorting scrap metal at a recycling centre.



Resistance

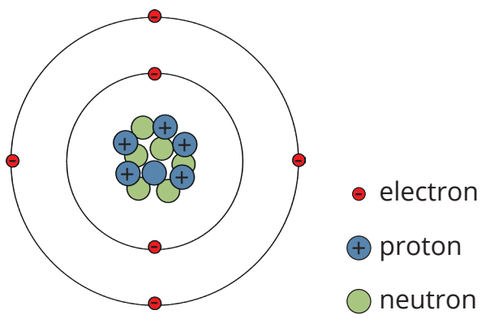
Conductors have **low resistance** so they allow current to pass through them easily.

Insulators have **high resistance** so it is difficult for current to flow through them.



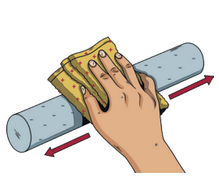
Atomic Structure

There are two types of charge: positive (+) and negative (-).
All objects are made up of atoms. Atoms are made up of three different types of particle: a positive particle (**proton**), a negative particle (**electron**) and a particle with no charge (**neutron**). Atoms contain an equal number of protons and electrons. The number of positive and negative charges are balanced so an atom has **no overall charge**.

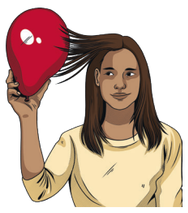


Static Electricity

Static electricity occurs when a material either loses or gains **electrons**. Electrons are negatively charged, so objects that **lose** electrons become **positively charged** overall, while objects that **gain** electrons become **negatively charged** overall.



When a polythene strip is rubbed with a cloth, electrons move from the cloth to the strip. The strip becomes negatively charged and the cloth becomes positively charged.



When you rub a balloon against your hair, electrons are transferred from your hair to the balloon. The balloon and your hair have opposite charges so your hair is attracted to the balloon, making it stand on end.