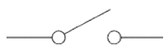
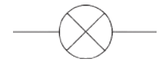
# KS3 Electricity and Magnetism **Knowledge Organiser**

## 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. |

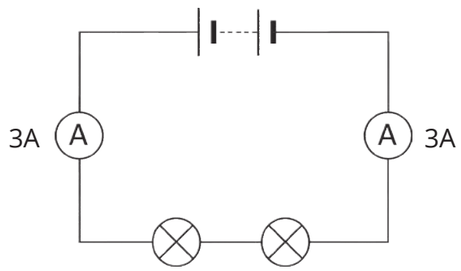
## Circuit Diagrams

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.



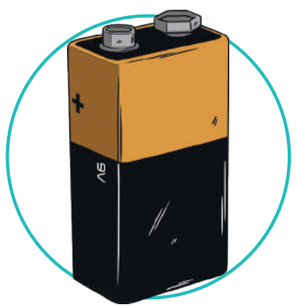

The **current is the same** everywhere in a series circuit. It doesn't matter where you put the ammeter, it will always show the same reading. The more cells or batteries you add, the greater the current. Current is **not** used up.

## Batteries

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

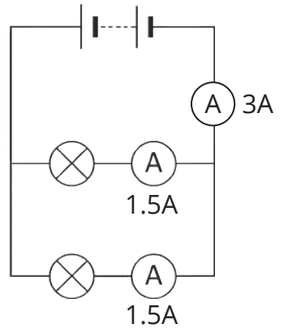
The potential difference of a battery tells us how much **energy** it provides to the components in the circuit.

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

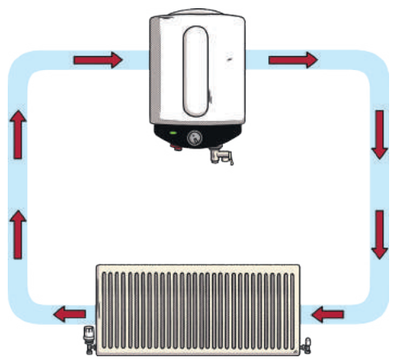
In a parallel circuit, the components are connected on separate branches as shown in the diagram below. This gives the current several different paths to flow down. If one bulb stops working, the other bulbs will remain lit as the circuit is still complete.




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

## Modelling Circuits

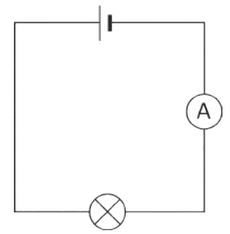
Scientists often use models to help them to explain difficult concepts. Some models are better than others.



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.

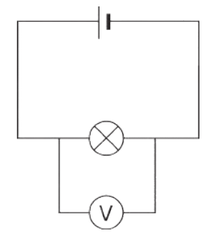
## Current

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)**

KS3 Electricity and Magnetism **Knowledge Organiser**

## 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**.

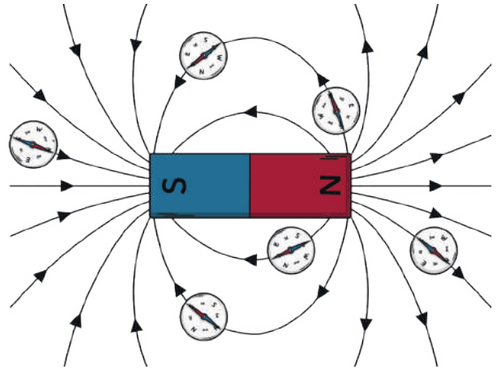
Like poles repel. This means that the two poles push each other away.


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


## Magnetic Field Lines

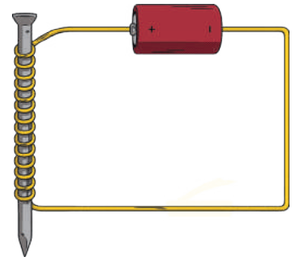
The magnetic field around a magnet can be shown as a series of lines around the magnet. The magnetic field lines can be plotted using a plotting compass.

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

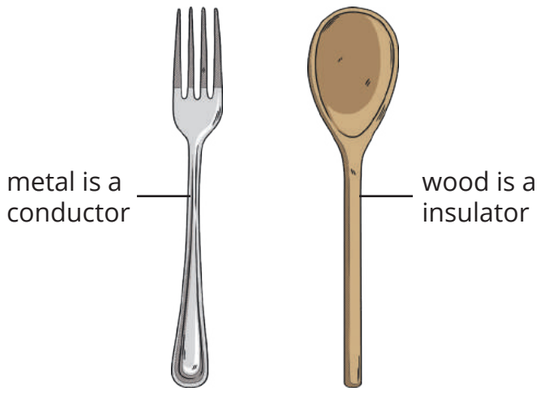
The **greater the number of coils**, the **stronger the electromagnet** and the more paperclips it will pick up.

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

## Resistance

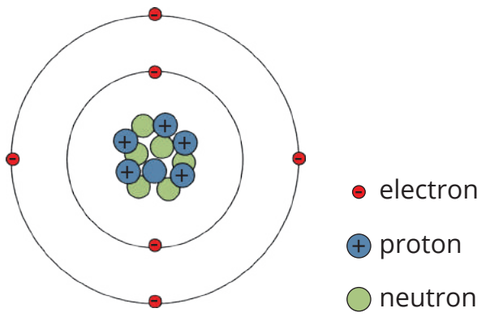
**Conductors** have **low resistance** so they allow current to pass through them easily.

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



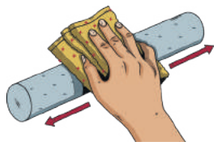

## Atomic Structure

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**.

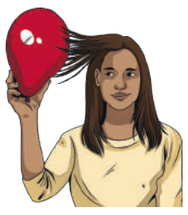



## Static Electricity

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.

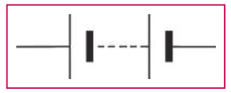
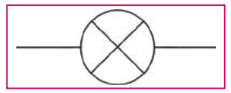
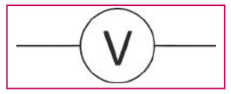
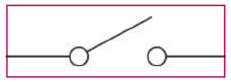


When you rub a balloon against your hair, electrons are transferred from your hair to the balloon. The balloon and your hair have opposite charges so your hair is attracted to the balloon, making it stand on end.

# KS3 Electricity and Magnetism (Foundation) **Revision Mat**

**a**

Draw a line from the name of each component to the correct circuit symbol.

| | |
|---|---|
| ammeter |  |
| battery |  |
| bulb |  |
| cell |  |
| switch (open) |  |
| voltmeter |  |

**b**

Write down the unit of measurement for:

current _____

resistance _____

potential difference _____

What are the following components used to measure in a circuit?

ammeter _____

voltmeter _____

Complete the equation used to calculate resistance.

resistance = _____ ÷ _____

**c**

Give the key word from its definition.

The flow of electric charge. _____

A material that has low resistance and allows current to flow through it easily. _____

A material that has high resistance and does not allow current to flow through it. _____

The amount of push (energy) provided by the battery to a moving charge. _____

A measure of how difficult it is for a flow of charge to pass through a component. _____

**d**

Complete the sentences to describe the difference between series and parallel circuits.

Choose answers from the box.

| blows | branches | complete | series | parallel | current |
|---|---|---|---|---|---|

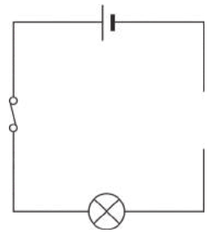
In a _____ circuit, the components are connected end to end in a loop. If one bulb breaks, none of the bulbs will light because the circuit is no longer _____ .

In a _____ circuit, the components are connected on separate _____. This gives the _____ several different paths for it to flow around. If one bulb _____ , the other bulbs will remain lit as the circuit is still complete.

**e**

For each of the following circuits, predict whether the bulb will light and explain why.

**Circuit A**

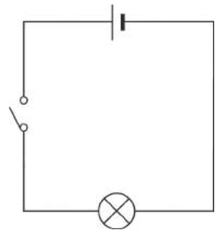


The bulb will/will not light because _____

_____

_____

**Circuit B**

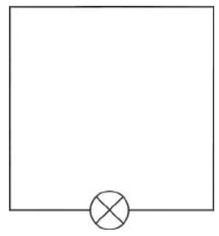


The bulb will/will not light because _____

_____

_____

**Circuit C**



The bulb will/will not light because _____

_____

_____

**f**

Match the name of each variable with the correct definition.

| | |
|---|---|
| independent variable | This is a variable that must be kept the same. |
| dependent variable | This is the variable that you change or select the values for. |
| control variable | This is the variable that is measured in the investigation. |

**g**

Draw a series circuit containing one bulb, a battery, an ammeter and a switch.

**h**

Draw a parallel circuit containing two bulbs, a battery and a switch that would allow both bulbs to be turned on.

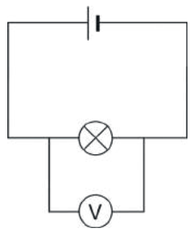
i

Complete the sentences.
Choose answers from the box.

| | | | |
|---|---|---|---|
| ammeter | amps | charge | electrons |
| parallel | voltmeter | volts | series |

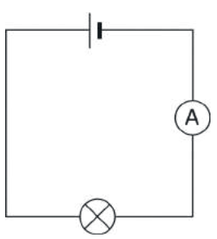
Potential difference tells us how hard a battery pushes the _____ around a circuit: the higher the potential difference, the bigger the push.

Potential difference is measured in _____ using a _____ connected in _____ with the component.




Current is the flow of _____ around a circuit. The higher the current, the faster the electrons move.

Current is measured in _____ using an _____ connected in _____ with the component.




j

Tick the correct box to show if each statement is true or false.

| | True | False |
|---|---|---|
| All metals are magnetic. | ☐ | ☐ |
| All magnets have a north pole and a south pole. | ☐ | ☐ |
| The Earth has its own magnetic field. | ☐ | ☐ |
| Opposite poles repel. | ☐ | ☐ |

Circle **three** magnetic metals in the list below.

| | | |
|---|---|---|
| aluminium | cobalt | copper |
| gold | iron | nickel |

k

Tick the correct box to show if each statement is true or false.

| | True | False |
|---|---|---|
| An atom has an equal number of protons and electrons. | ☐ | ☐ |
| An atom has an overall positive charge. | ☐ | ☐ |
| Neutrons are negatively charged. | ☐ | ☐ |
| If a material gains electrons, it becomes positively charged. | ☐ | ☐ |

Explain why a person's hair stands on end if they touch the dome of a Van de Graaff generator.

_____

_____

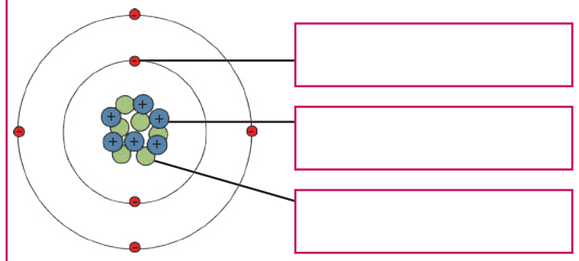
_____

l

Label the diagram of an atom.

Choose answers from the box.

| | | |
|---|---|---|
| electron | neutron | proton |



Match the name of each subatomic particle to its charge.

| | |
|---|---|
| electron | +1 |
| neutron | 0 |
| proton | -1 |

m

Complete the sentences.
Choose answers from the box.

| | | |
|---|---|---|
| coils | electromagnet | less |
| more | stronger | weaker |

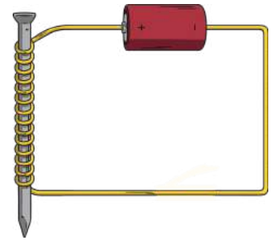
The strength of an _____ can be changed by changing the number of _____ of wire around an iron core.

The greater the number of coils, the _____the electromagnet. The stronger the electromagnet, the _____ paperclips it will pick up.

n

Use the key words to explain what the diagram below shows.

| |
|---|
| current |
| iron core |
| electromagnet |
| coil of wire |



_____

_____

_____

_____

_____

Identify the variables in the electromagnet investigation.

independent variable

_____

dependent variable

_____

control variable

_____

o

Complete the table.

| Length of wire (cm) | Potential Difference (V) | Current (A) | Resistance (Ω) |
|---|---|---|---|
| 30 | 10 | 5 | |
| 60 | 10 | 2 | |

Describe how the length of a wire affects its resistance.

_____

_____