Electricity

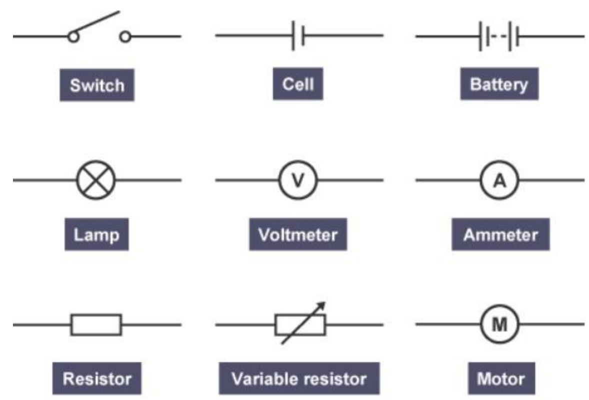
Keyword	Definition
Ammeter	A device used to measure electric charge.
Ampere	Unit of current. E.g. The current in the bulb is 4 amps or amperes (A).
Cell	A store of internal energy that can be transferred as an electric current in a circuit.
Conductor	A material which allows charge to move easily through it.
Electron	Sub atomic particle which flows in a circuit carrying a negative charge.
Series Circuit	A circuit connected in a way that the same current flows through each component in turn.
Parallel Circuit	In a parallel circuit, the current divides into two or more paths before recombining to complete the circuit.
Insulator	A material that does not allow charge or heat to pass through it easily.
Ohms	The unit of electrical resistance. Unit is **Ω**
Resistance	The opposition in an electrical component to the movement of electrical charge through it. Resistance is measured in ohms.
Potential Difference	The potential difference (or voltage) of a supply is a measure of the energy given to the charge carries in a circuit.
Volt	Unit of voltage. E.g. the voltage across the lamp was 6 volts (V).
Voltmeter	A device used to measure potential difference or voltage.

Further Reading:

https://www.bbc.co.uk/bitesize/guides/zsfgr82/revision/1

Use the following link to set up some circuits using the simulation.
https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab

Circuit Symbols



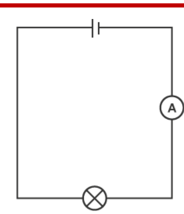
Electric Charge

Some particles carry an electric charge. In electric wires these particles are called electrons. An electric current is a flow of charge, and in a wire this will be a flow of electrons.
For an electric current to flow we need:

- Something to transfer the energy to the electrons, such as a cell, battery or power pack.
- A complete path for the electrons to flow through (a complete circuit).

Current

Current is measured in amperes (A). 20A is a bigger current that 10A. An ammeter is used to measure the current. The ammeter must be connected in series.



Equations To Remember

Current

$$\text{Current} = \frac{\text{Charge}}{\text{time}} \qquad I = \frac{Q}{t}$$

Current in Amps (A), Charge in Coulombs (C), Time in Seconds (s).

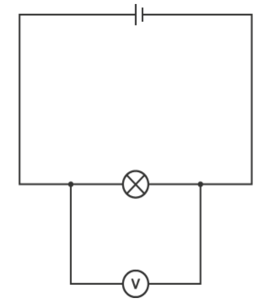
Potential Difference:

Potential Difference = Current x Resistance
V = I x R

Potential difference in Volts (V), Resistance in Ohms (**Ω**), Current in Amps (A)

Potential Difference

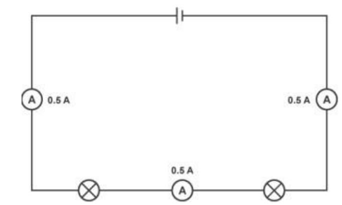
Potential difference is a measure of the difference in energy between two parts of a circuit. The bigger the difference in energy, the bigger the potential difference.
Potential difference is measured in volts. A 230V is a bigger potential difference than 12V.
A voltmeter is used to measure the potential difference, and must be in parallel.



Series Circuit

In series circuits:

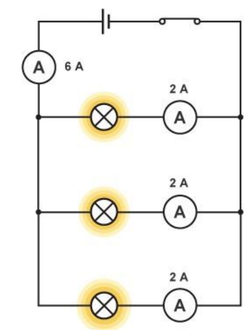
- You get several components one after another.
- If a component breaks, the circuit is broken and all the other components stop working.
- The current is the same everywhere in a series circuit no matter where you put the ammeter – it will give the same reading.



Parallel Circuit

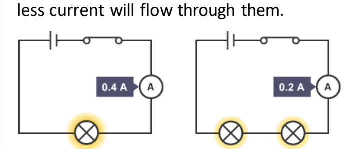
In parallel circuits:

- Different components are connected on different braches.
- If a component breaks, the components on the different braches keep working.
- Unlike series, the lamps stay bright If you add more lamps in parallel.
- Current is shared between the components.



Resistance

The wires and other components in a circuit reduce the flow of charge through them – this is resistance.
The resistance increases when you add more components in series.
The resistance of two lamps is greater than the resistance of one lamp, so less current will flow through them.



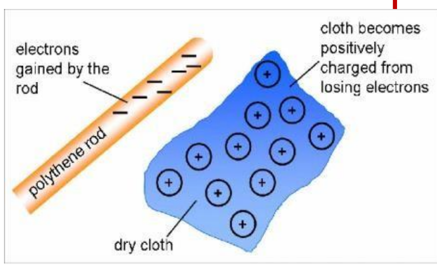
Electrcity

Key Terms	Definitions
Potential Difference	The difference in energy between two points in an electric circuit
Current	The number of electrons flowing past a point in 1 second
Resistance	Something that resists the flow of an electric charge
Electron	A charged particle which flows in an electric circuit
Conductor	A material which allows the flow of electric charge
Insulator	A material that slows the flow of electric charge

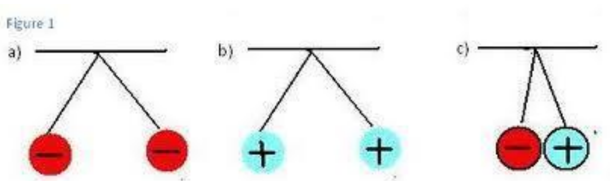
Some particles are electrically charged e.g. electrons, these can therefore carry an **electric charge**. There are two types of electricity

1. Static Electricity
2. Current Electricity

In static electricity, when **two insulators are rubbed together,** electrons are transferred, causing an electric charge to build up.

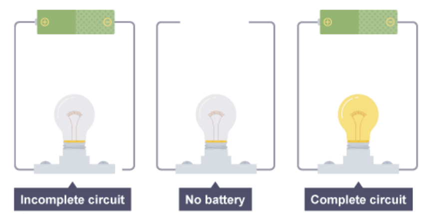


When this happens one object has a positive charge and one will have a negative charge, **like charges repel and opposite charges attract.**



Current Electricity

Current electricity occurs in conductors, for example metals, where the electrons can flow. Electric current is how **many electrons are flowing in one second measured in Amps (A).** For electric current to flow, we require a complete circuit.

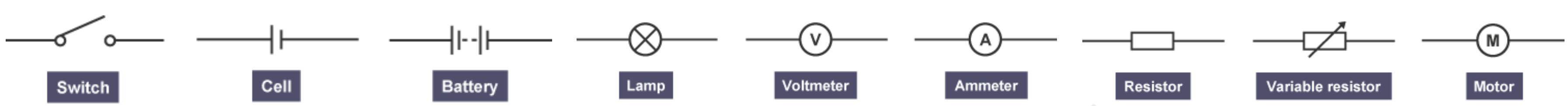


The **potential difference** in an electric circuit is the difference in energy between two different parts of the circuit. This is measured in **volts (V)**. Sometimes people call potential difference **voltage** and it is still measured in volts**.**

Resistance in an electric circuit is anything which slows the flow of electric charge**, resistance is measure in Ohms (Ω).**

Circuit Symbols

When drawing an electric circuit, we use different symbols to represent different components, the symbols you need to memorise are:



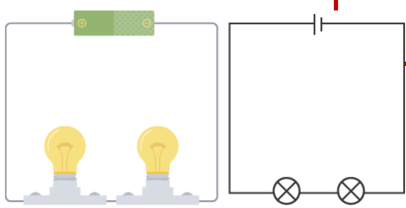
Electricity

Key Terms	Definitions
Series Circuit	A circuit where all the components are in the same loop.
Parallel Circuit	A circuit where the components are in different loops in the circuit.
Ammeter	An electrical component that measures the size of electric current, it is connected in series in a circuit.
Voltmeter	An electrical component that measures the size of the potential difference, it is connected in parallel.

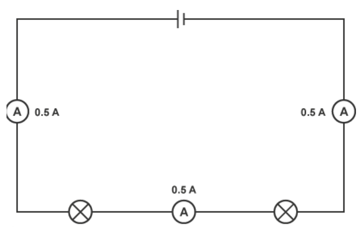
Circuits can be connected in two ways:

1. Series Circuits
2. Parallel Circuits

In a series circuit all of the components are in the same loop, below is an example of two lamps in **a series circuit.** If either of the lamps were to break the circuit would not be complete and the light bulb would go out.



The current is the **same** at any point in a series circuit as current is always conserved in a circuit.

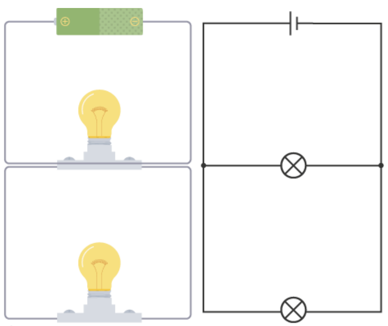


Measuring Current and Voltage

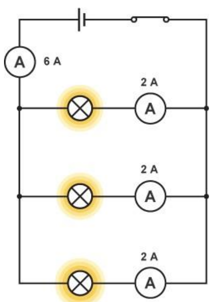
	Current	Potential difference
Unit	ampere, A	volt, V
Measuring device	Ammeter in series	Voltmeter in parallel
Circuit symbol of measuring device		

Parallel Circuits

In a parallel circuit components are in more than one loop. Lights in a house are connected in parallel, when one light bulb breaks the whole circuit is not broken so the other light bulb will stay alight.



In a parallel circuit the current **splits at junctions,** see the example. The current on the different branches of the circuit must add up to the total current.



Magnets

Key Terms	Definitions
Ohm's Law	A mathematical law that links current, voltage and resistance
Electromagnet	A magnet created by the flow of electricity in a wire
Magnetic Field	The area around a magnet, where the magnetic field acts

KPI 3: Explain the difference between bar magnets and electromagnets.

Bar Magnets

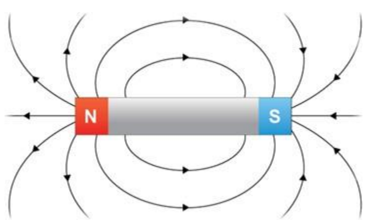
Bar magnets have two poles, a North pole (N) and a South pole (S), **opposite poles attract and like poles repel.**

Magnets create magnetic fields. These cannot be seen. They fill the space around a magnet where the magnetic forces work, where they can attract or repel magnetic materials.

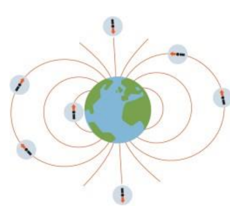
Although we cannot see magnetic fields, we can detect them using iron filings. The tiny pieces of iron line up in a magnetic field. We can draw simple magnetic field line diagrams to represent this. In the diagram, note that:

- **field lines have arrows on them**
- **field lines come out of N and go into S**
- **field lines are more concentrated at the poles.**

The **magnetic field is strongest at the poles**, where the field lines are most concentrated.



The Earth has a magnetic field because the core rotates, it acts like a giant bar magnet.

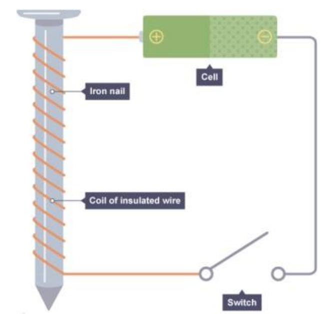


Electromagnets

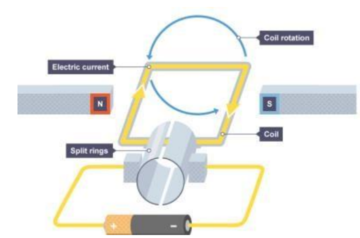
When an electric current flows through a wire, it creates a magnetic field, this can be used to make **an electromagnet,** by making the wire into a coil.

You can increase the strength of an electromagnet by doing three things:

1. Increase the number of coils
2. Increase the current
3. Add a soft iron core



The motor effect: A simple electric motor can be built using a coil of wire that is free to **rotate between two opposite** magnetic poles. When an electric current flows through the coil, the coil experiences a force and moves. This is called the motor effect.



Light &

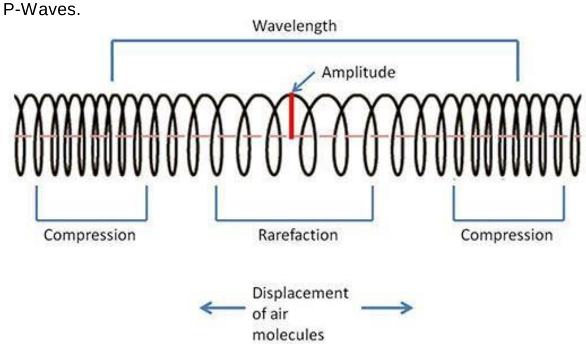
Keyword	Definition
Angle of Incidence	Angle between the normal and incident ray.
Angle of reflection	The angle between the reflected ray and the normal.
Diffuse Scattering	When light is reflected off a surface in all directions.
Dispersion	Spreading out of the different wavelengths of light, caused by refraction of light as it passes through a prism.
Frequency	The number of waves produced each second. The unit of frequency is hertz (Hz).
Amplitude	The maximum height of a wave from the middle of the wave to its peak or trough.
Wavelength	The length of a single wave, measured from one wave peak to the next.
Pitch	The frequency of a sound. Sounds with a high pitch have a high frequency.
Incident Ray	Light ray moving towards a surface or boundary.
Reflected Ray	Light ray leaving a surface or boundary.
Law of reflection	In reflection at a surface, the angle of incidence equals the angle of reflection.
Spectrum	A series of similar waves arranged in order of wavelength or frequency.
Echo	A sound caused by the reflection of a sound wave from a smooth surface back to the listener.

Further Reading:

https://www.bbc.com/bitesize/guides/zq7thyc/revision/1
https://www.bbc.com/bitesize/guides/z8d2mp3/revision/1

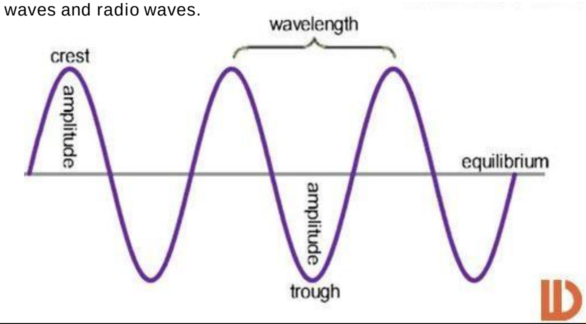
Longitudinal Waves

In longitudinal waves, the vibrations are parallel to the direction of wave travel. Examples are: Sound Waves, Ultrasound Waves, Seismic P-Waves.



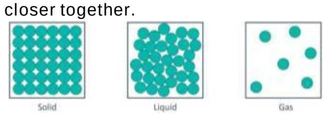
Transverse Waves

In transverse waves, the vibrations are at right angles to the direction of wave travel.
Examples include: Ripples on water, vibrations on a guitar string and a Mexican Wave. Electromagnetic waves such as light waves, micro waves and radio waves.



Speed of Light
300,000km/s
Speed of Sound (air)
343m/s

Light can travel through a vacuum but sound cannot. Sound needs a medium to travel through either a solid, liquid or gas. Sound travels fastest in a solid because the particles are closer together.



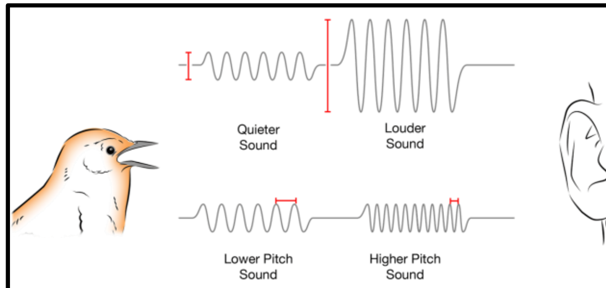
Calculating Wave Speed

$$v = f\lambda$$

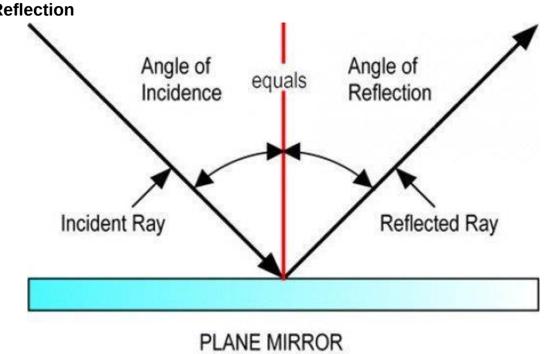
v = velocity
f = frequency
λ = wavelength

Calculating Speed

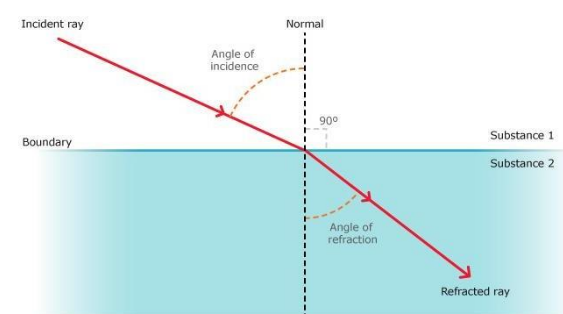
$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$



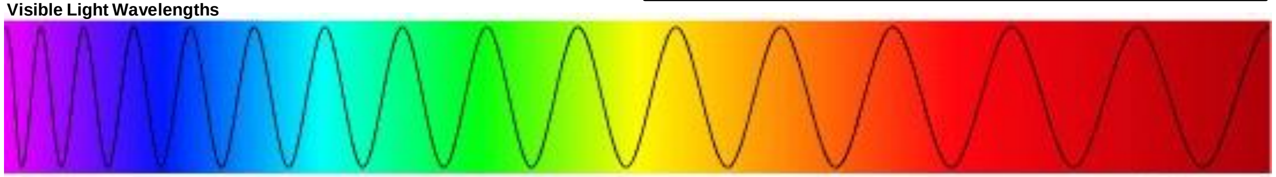
Reflection



Refraction



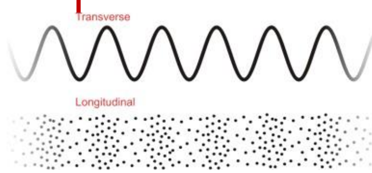
Visible Light Wavelengths



Light and sound waves

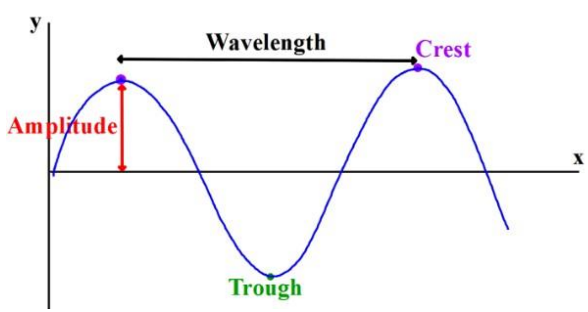
Waves

Waves carry **energy** from a **source** to an **absorber** and can also carry information.
Waves can be either **transverse** or **longitudinal**.



Water waves are transverse waves, as are light waves. Sound travels as a longitudinal wave.
Waves can be **reflected**, **refracted**, **absorbed**, **transmitted** or **scattered**.

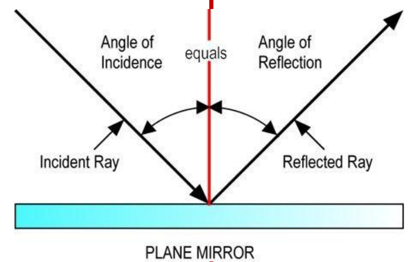
The **frequency** of a wave is the number of waves per second, and is measured in **hertz**, **Hz**.

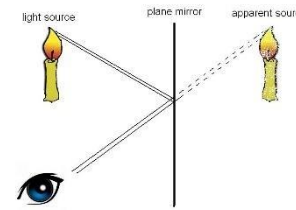


Wave speed = frequency x wavelength

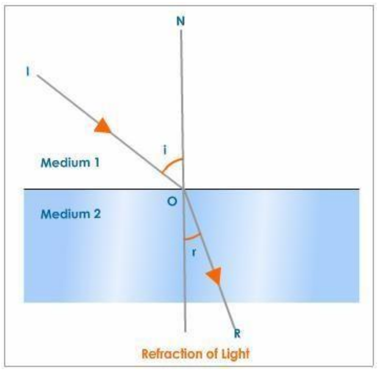
Light waves

Light waves can be **reflected**, for example in a mirror.





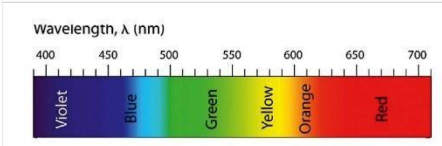
Light can also be **refracted** at the boundary between two different mediums.



When it travels through a medium, the speed of light is 300,000,000 m/s.

Light does not need a **vacuum** to travel through. It can travel through **translucent** and **transparent** materials.

White light is a **mixture** of many different colours, each with a different **frequency**. White light can be split up into a **spectrum** of these colours using a prism, a triangular block of glass or Perspex.



Light and waves

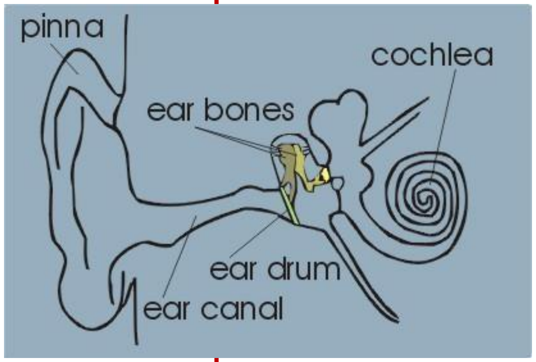
Sound waves

Sound travels as a **longitudinal** wave. Sound is produced by the **vibrations** of objects. Sound can be **reflected** (we hear this as an echo) or it can be **absorbed** by a material. Hard, smooth surfaces are the best reflectors of sound.

Sound does require a **medium** to travel. The speed that sound travels depends upon the medium it is travelling through.

The **amplitude** of a sound wave determines the **volume** of the sound (how loud or quiet the sound is). The **frequency** of the sound wave determines the **pitch** (how high or low the sound is).

Our **ears** help us to detect sound.



Different animals have a different **auditory range** – the range of frequencies that can be detected. Humans can detect frequencies between 20 to 20,000 Hz. Frequencies above this are called **ultrasound**. Dogs and bats are able to hear ultrasound. Ultrasound can be used for **cleaning** and **physiotherapy**, as well as **medical imaging** – ultrasound scans can show images of inside the body.

Microphones can also **detect** sound. Sound waves are then converted to electrical signals which can then be used to transfer information. **Loudspeaker** can use the electrical signals to **generate** sound waves.