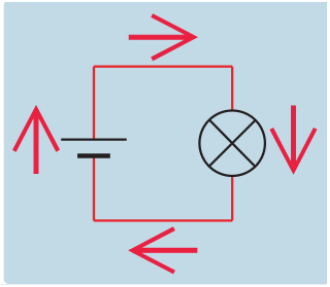
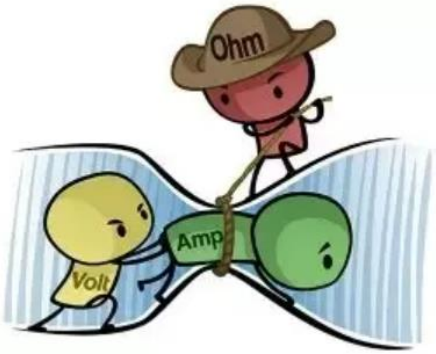
Electrical Current

Electric current is a flow of electrical charge. The size of the electric current is the rate of flow of electrical charge.

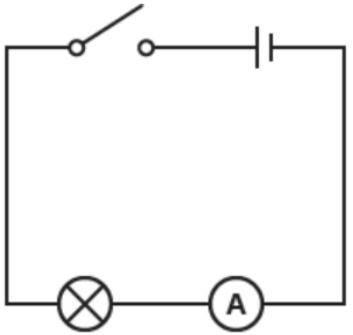


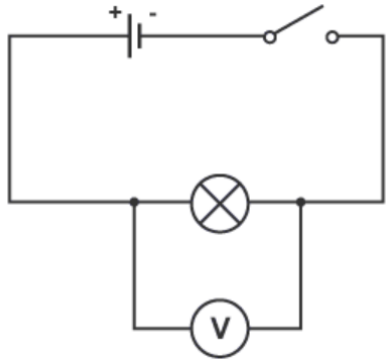
The current through a component depends on both the resistance of the component and the voltage across the component. The greater the resistance of the component the smaller the current for a given voltage across the component.

The resistance of a component is a measure of how difficult it is for an electric current to pass through it.



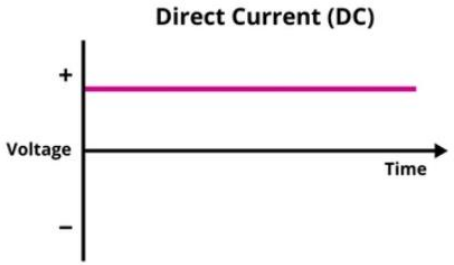
Electrical current is measured in amps using an ammeter. Voltage is measured in volts using a voltmeter.

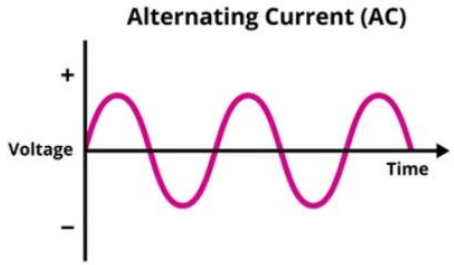




A complete circuit is necessary for a current to flow.

Cells and batteries supply current that always passes in the same direction. This is called direct current (d.c.).





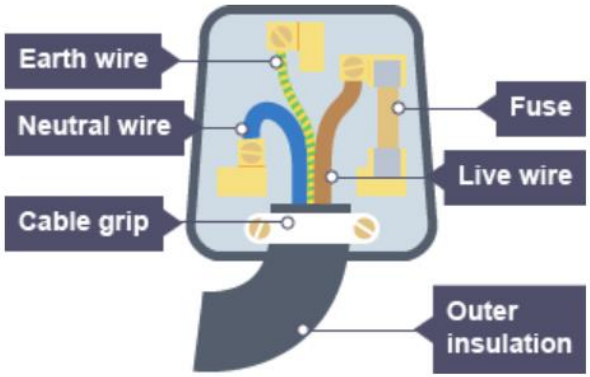
An alternating current (a.c.) is one that changes direction. Mains electricity is an a.c. supply. In the UK it has a frequency of 50 Hz and is 230 V.

Domestic Electricity

Most electrical appliances are connected to the mains using a three-core flex.

The insulation covering each wire in the flex is colour-coded for easy identification:

- live wire – brown
- neutral wire – blue
- earth wire – green and yellow stripes.



The earth wire is a safety wire to stop the appliance becoming live and the fuse contains a thin piece of wire, which melts if the current becomes too large, thereby cutting off the supply.

Fuses in plugs are made in standard ratings. The most common are 3 A, 5 A and 13 A. The fuse should be rated at a slightly higher current than the device needs:

- if the device works at 3 A, use a 5 A fuse
- if the device works at 10 A, use a 13 A fuse

A 13 A fuse contains a low melting point wire

Some appliances do not have an earth wire because they are double insulated. This means that they are plastic on the outside.

Everyday electrical appliances are designed to bring about energy transfers.

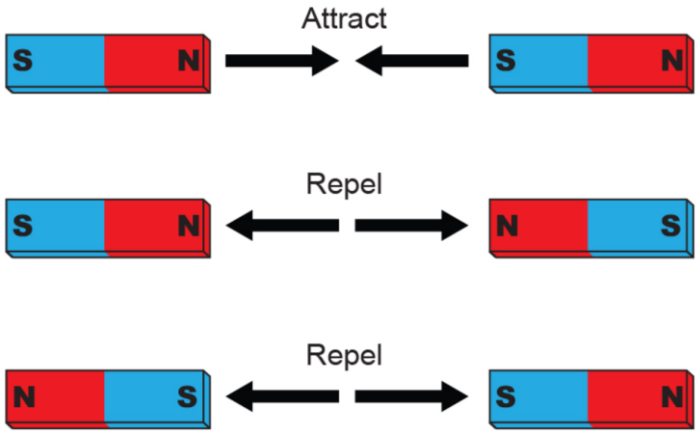
The amount of energy an appliance transfers depends on how long the appliance is switched on for and the power of the appliance.

This can be calculated using:

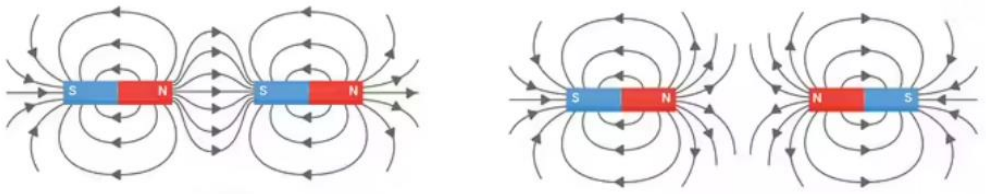
energy (kWh) = power (kW) x time (h)

Magnetism and Electromagnetism

The poles of a magnet are the places where the magnetic forces are strongest. When two magnets are brought close together they exert a force on each other. Two like poles repel each other. Two unlike poles attract each other. Attraction and repulsion between two magnetic poles are examples of non-contact force.



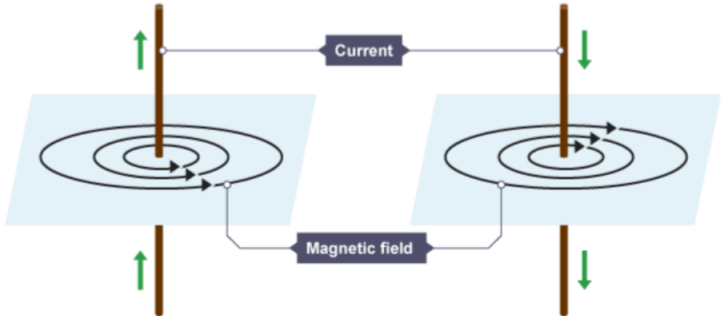
The pattern of the magnetic field looks like:



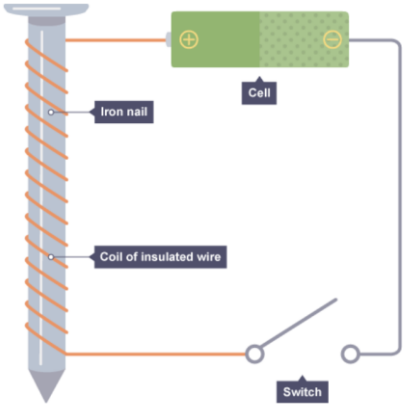
Attract repel

When a current flows through a conducting wire a magnetic field is produced around the wire.

The strength of the magnetic field depends on the current through the wire and the distance from the wire.



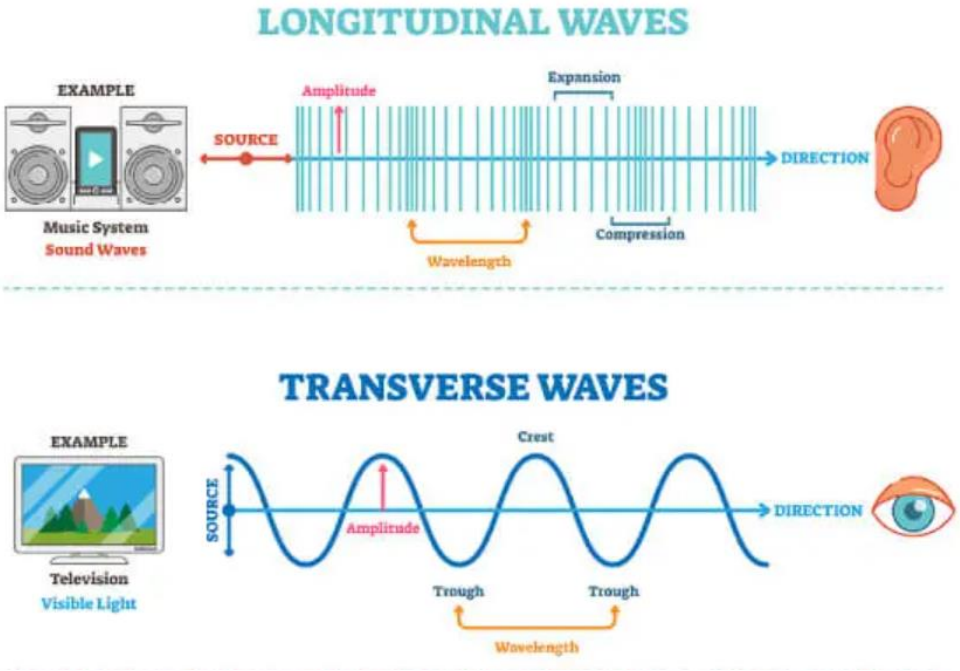
Shaping a wire to form a solenoid increases the strength of the magnetic field created by a current through the wire. Adding an iron core increases the magnetic field strength of a solenoid. An electromagnet is a solenoid with an iron core.



Common uses of electromagnets are in scrapyard cranes and relays.

Different Types of Waves

Waves may be either transverse or longitudinal.



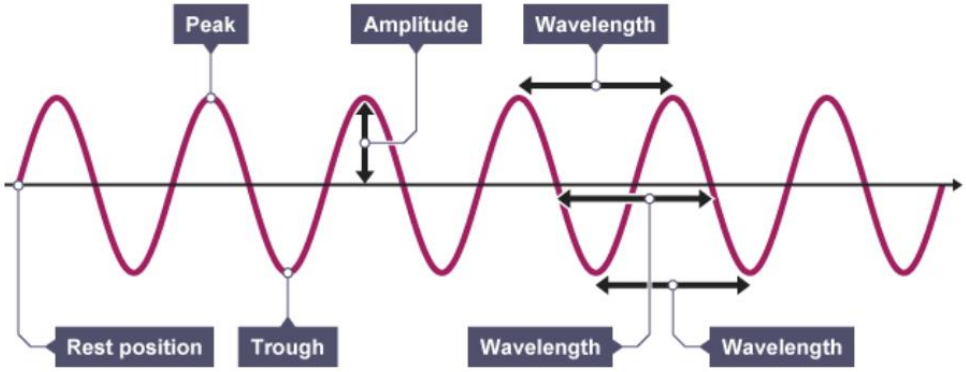
In a transverse wave the oscillations are perpendicular to the direction of energy transfer. The ripples on a water surface are an example of a transverse wave.

In a longitudinal wave the oscillations are parallel to the direction of energy transfer. Longitudinal waves show areas of compression and rarefaction. Sound waves travelling through air are longitudinal.

Waves are described by their amplitude, wavelength and frequency.

The amplitude of a wave is the maximum displacement of a point on a wave away from its undisturbed position.

The wavelength of a wave is the distance from a point on one wave to the equivalent point on the adjacent wave.



You can calculate the wave speed using:

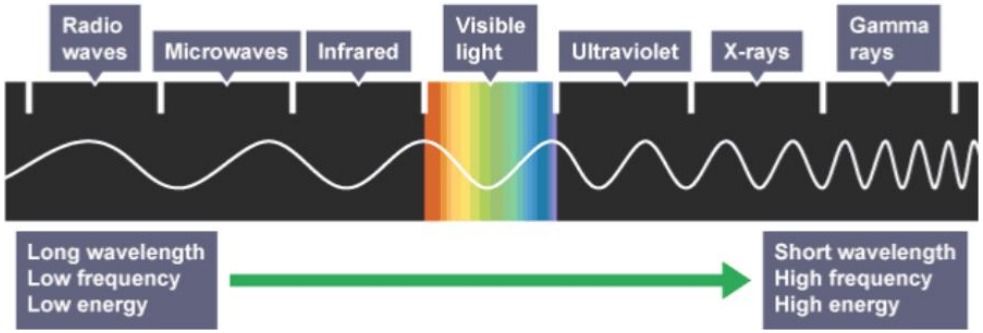
wave speed (m/s) = frequency (Hz) x wavelength (m)

The frequency of a wave is the number of waves passing a point each second.

Electromagnetic waves

Electromagnetic waves are transverse waves that transfer energy from the source of the waves to an absorber. Electromagnetic waves form a continuous spectrum and all types of electromagnetic wave travel at the same velocity through a vacuum (space) or air.

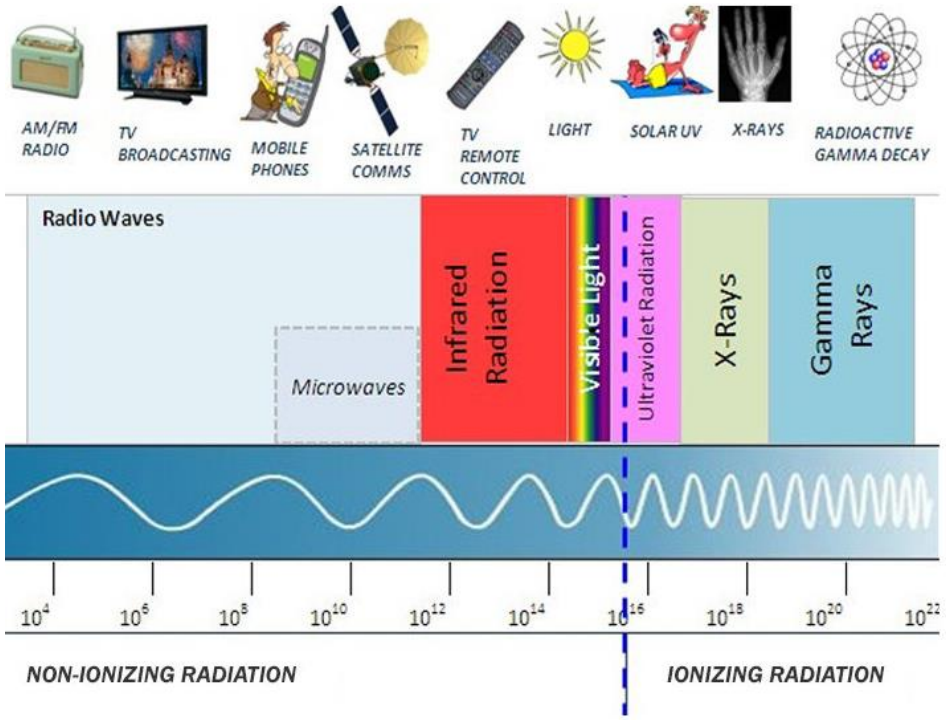
The waves that form the electromagnetic spectrum are grouped in terms of their wavelength and their frequency.



Going from long to short wavelength (or from low to high frequency) the groups are:

- radio
- microwave
- infrared
- visible light (red to violet)
- ultraviolet
- X-rays
- gamma rays.

Ultraviolet waves, X-rays and gamma rays can have hazardous effects on human body tissue. The effects depend on the type of radiation and the size of the dose.



Electromagnetic waves have many practical applications, eg:

- radio waves – television and radio (including Bluetooth)
- microwaves – satellite communications, cooking food
- infrared – electrical heaters, cooking food, infrared cameras
- visible light – fibre optic communications
- ultraviolet – energy efficient lamps, sun tanning
- X-rays – medical imaging and treatments
- gamma rays – for sterilising.