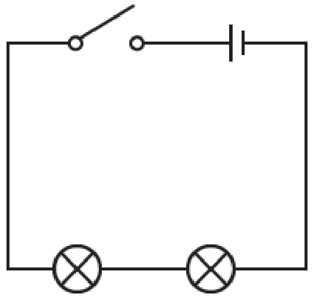
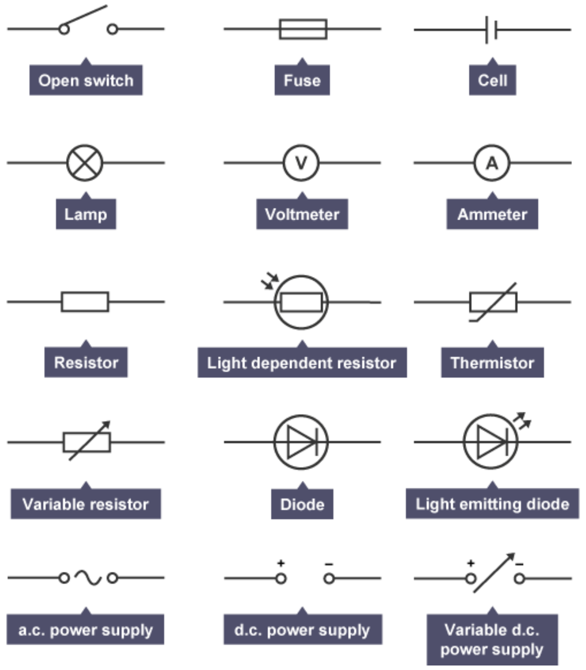
GCSE Science – Physics 1

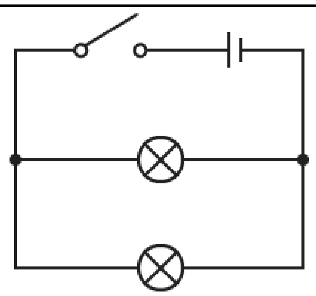
1.1 – Electrical circuits

Series circuits in which the current is the same throughout a circuit and voltages add up to the supply voltage.
If one component stops working the whole circuit will stop working



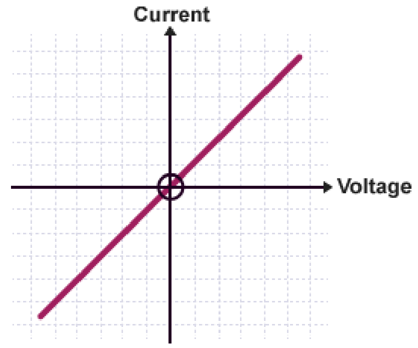


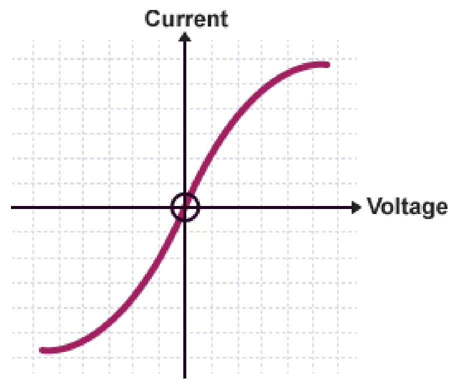
Parallel circuits in which the voltage is the same across each branch and the sum of the currents in each branch is equal to the current in the supply.



1.2 – Current voltage graphs

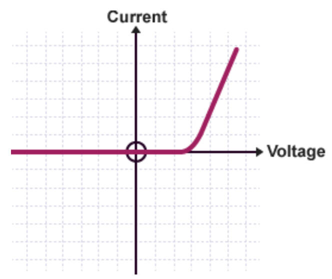
Resistor at constant temperature
The current flowing through a resistor at a constant temperature is directly proportional to the voltage across it. A component that gives a graph like this is said to follow **Ohm's Law**.





The filament lamp is a common type of light bulb. It contains a thin coil of wire called the filament. This heats up when an electric current passes through it and produces light as a result. The filament lamp does not follow Ohm's Law. Its resistance increases as the temperature of its filament increases.

The diode has a very high resistance in one direction. This means that current can only flow in the other direction. This is the graph of current against voltage for a diode. Normally a diode will not conduct until a particular voltage is reached.

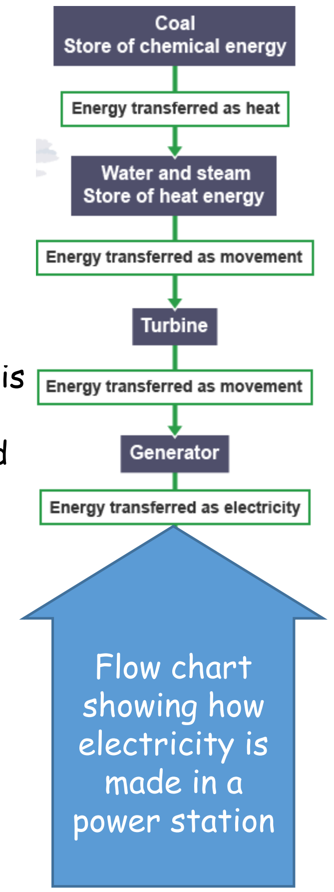


1.3 – Non-renewable energy

Fossil fuels are **non-renewable** because they will run out one day. Burning fossil fuels generates **greenhouse gases** and relying on them for energy generation is **unsustainable**.

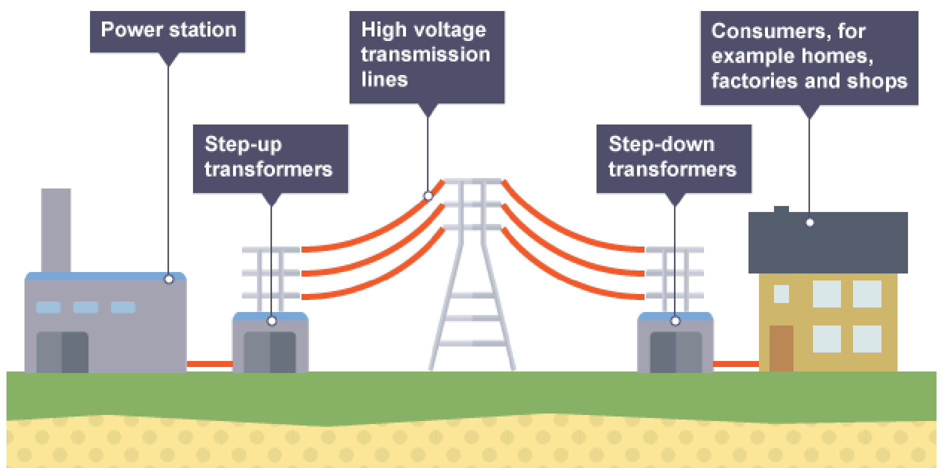
Advantages of using fossil fuels
- At the moment, fossil fuels are relatively cheap and easy to obtain. This may not always be the case.
- Much of our infrastructure is designed to run using fossil fuels.

Disadvantages of using fossil fuels
- Fossil fuels are non-renewable energy resources. Their supply is limited and they will eventually run out, whereas fuels such as wood can be renewed endlessly.
- Coal and oil release sulfur dioxide gas when they burn, which contributes to acid rain.
- Fossil fuels release carbon dioxide when they burn, which adds to the greenhouse effect and increases **global warming**



1.4 – National grid

The National Grid ensures a reliable supply of electricity. If one power station breaks down, the grid will continue to supply electricity from other power stations in the grid.



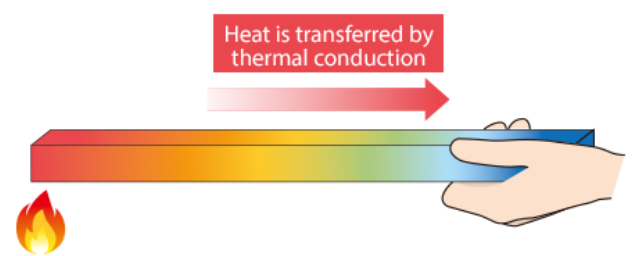
Step-up transformers increase voltage and decrease current – reducing energy losses in transmission lines making distribution more efficient.
Step-down transformers reduce voltage to safer levels for consumers.

power = voltage × current

1.5 – Conduction

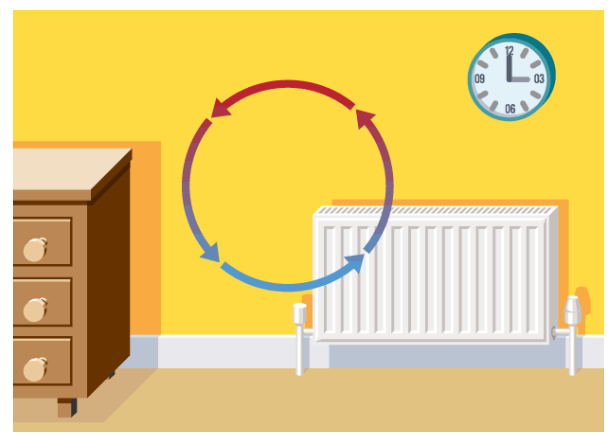
- Conduction occurs in solids.
- Metals are good conductors.
- Non-metals and gases are usually poor conductors.
- Poor conductors are called insulators.
- Heat energy is conducted from the hot end of an object to the cold end.

The **electrons** in a piece of metal can leave their atoms and move about in the metal as free (or de-localised) electrons. The parts of the metal atoms left behind are now positively charged metal **ions**. The ions are packed closely together and they vibrate continually. The hotter the metal, the more kinetic energy these vibrations have. This kinetic energy is transferred from hot parts of the metal to cooler parts by the free electrons.



1.6 – Convection

Heat can be transferred from one place to another by convection in liquids and gases (fluids).
- Liquids and gases expand when they are heated.
- Particles in liquids and gases move faster when they are heated than they do when they are cold.
- the particles take up more volume. This is because the gaps between particles increase, while the particles themselves stay the same size.
- liquid or gas in hot areas is less **dense** than the liquid or gas in cold areas, so it rises into the cold areas. The denser cold liquid or gas falls into the warm areas. In this way, **convection currents** that transfer heat from place to place are set up.



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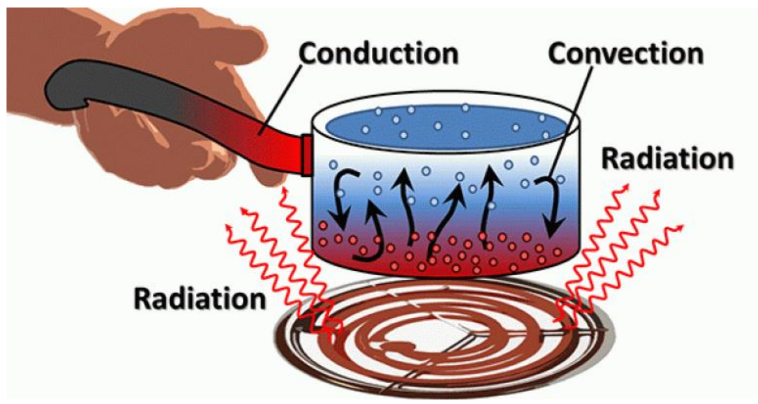
1.7 – Radiation

Heat can be transferred by **infrared** radiation. Because no particles are involved, radiation can even work through the **vacuum** of space. This is why we can still feel the heat of the Sun even though it is 150 million kilometers from the Earth.

Surface	Absorption	Emission
Dull, matt or rough, dark coloured	Good	Good
Shiny, light coloured	Poor	Poor



1.8 – Electricity in the home

The amount of electrical energy transferred to an appliance depends on its power, and on the length of time it is switched on for. The kilowatt hour (kWh) is used as a unit of energy for calculating electricity bills.

$$\text{energy transferred (kilowatt/hour, kWh)} = \text{power (kilowatt, kW)} \times \text{time (hour, h)}$$

To convert from W to kW you must divide by 1,000.
To convert from seconds to hours you must divide by 3,600.

$$\text{units used (kWh)} = \text{power (kW)} \times \text{time (h)}$$

The energy in joules is equal to the power in watts × time in seconds.

$$\text{energy (J)} = \text{power (W)} \times \text{time (s)}$$

1.9 – Ring main

The function of the live wire is to carry current to the house/appliance at a high voltage.
The neutral wire completes the circuit and carries current away at low/zero voltage.
The earth wire is a safety wire that can carry current safely into the ground if a fault develops in a metal framed appliance. Appliances with metal cases are usually earthed.
If the casing becomes live, a large current can flow along the low resistance earth wire and this high current will "blow" a fuse or trip a mcb.
Switches and fuses are placed into the live wire.
The ring main is a looped parallel circuit.

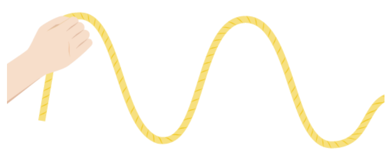
There are several advantages of using a ring main circuit:

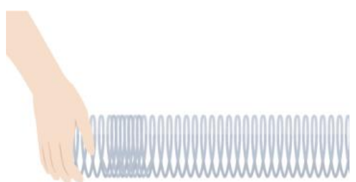
- The cables can be made thinner because there are two paths for the current;
- Each part of the cable carries less current because the current flows two ways;
- A ring main circuit is more convenient since sockets can be placed anywhere on the ring;
- Each socket has 230V applied and they can be operated separately.

1.10 – Waves

In transverse waves, the **oscillations** are at right angles to the direction of travel and energy transfer.
Examples of transverse waves include:

- all types of electromagnetic waves
- water waves
- seismic **S waves**



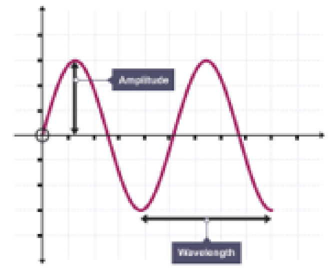


Longitudinal waves show areas of **compression** and **rarefaction**.
Examples of longitudinal waves include:

- sound waves
- seismic **P waves**

1.11 – More waves

Amplitude – As waves travel, they set up patterns of disturbance. The amplitude of a wave is its maximum disturbance from rest.



Wavelength (λ) – of a wave is the distance between a point on one wave and the same point on the next wave. It is often easiest to measure this from the crest (top) of one wave to the crest of the next wave or the trough (bottom) of one wave to the trough of the next wave.

Frequency – The frequency of a wave is the number of cycles of a wave that occur in one second. relationship between wavelength and frequency i.e. inversely proportional and between amplitude and energy.

$$\text{wave speed} = \text{wavelength} \times \text{frequency}$$

1.12 – EM Spectrum

Electromagnetic radiation	Uses	Energy	Frequency	Wavelength
Radio waves 	Broadcasting and communications – their longer wavelength means they travel further in the Earth's atmosphere, reflecting off hills and the upper atmosphere.	Lowest	Lowest	Longest
Microwaves 	Cooking food – microwaves are absorbed by water molecules causing them to vibrate (heat up). Satellite transmissions – their wavelength penetrates our atmosphere.			
Infrared 	Heater and night vision equipment – all objects, including people, give out infrared rays which can be detected even at night. It's also used for television remote controls.			
Visible light 	Human vision, photography and optical fibres – it's the only part of the spectrum we can see.			
Ultraviolet 	Fluorescent lamps – they have chemicals inside them which absorb ultraviolet rays and convert the energy to visible light.			
X-rays 	Medical equipment – they enable us to see the internal structure of objects and materials by passing through some substances (eg body tissue) but being absorbed by others (eg bone).			
Gamma rays 	Sterilising food and medical equipment – they are highly penetrative and can kill. micro-organisms.	Highest	Highest	Shortest