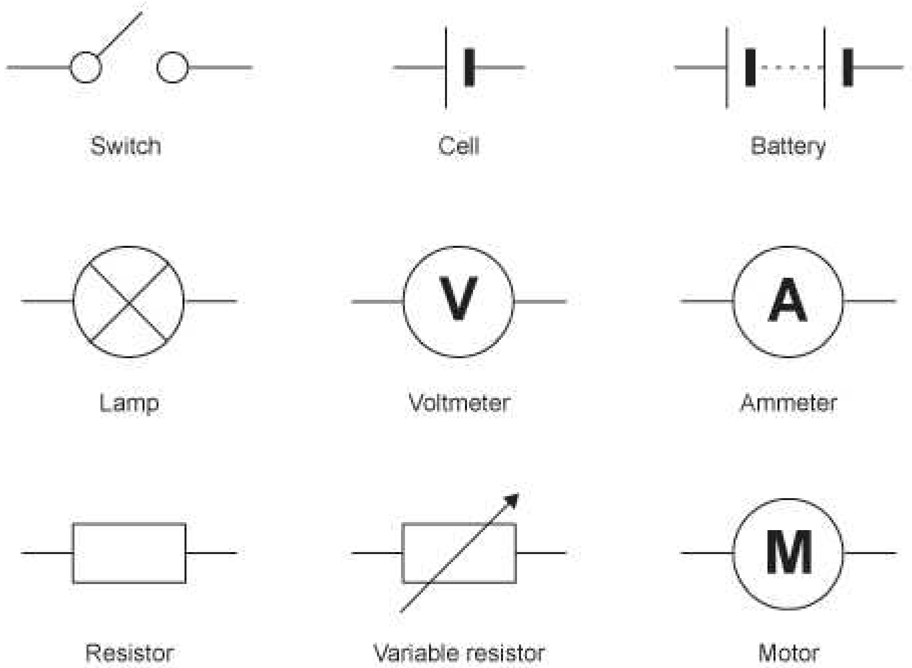
NAME

KS3 revision booklet
Physics



Use this booklet to help you revise the physics you have studied in Key Stage 3.

There are some ideas about how you can test yourself in the back of this booklet. Why not use BBC bitesize to help?
http://www.bbc.co.uk/bitesize/ks3/science/

Why not make a list of questions to test your friends with, or try and make a mind map of some of the key ideas?

Remember- a little and often is the best way to revise!

Contents

Forces

What are forces?

A force can be a push or a pull. For example, when you push open a door you have to apply a force to the door. You also have to apply a force to pull open a drawer.

You cannot see a force but often you can see what it does. Forces can change the speed of something, the direction it is moving in or its shape. For example, an elastic band gets longer if you pull it.

Measuring forces

A force meter is used to measure forces.

Forces can be measured using a force meter. Force meters contain a spring connected to a metal hook. The spring stretches when a force is applied to the hook. The bigger the force applied, the longer the spring stretches and the bigger the reading.

The unit of force is called the newton, and it has the symbol N. So 100 N is a bigger force

Balanced forces

Force diagrams

We can show the forces acting on an object using a **force diagram**. In a force diagram, each force is shown as a force arrow. An arrow shows:

- the size of the force (the longer the arrow, the bigger the force)
- the direction in which the force acts.

The arrow is usually labelled with the name of the force and its size in newtons. Text books often show a force with a thick coloured arrow, but it is best if you just use a pencil and ruler to draw an arrow with a single line.

Balanced forces

When two forces acting on an object are equal in size but act in opposite directions, we say that they are **balanced** forces.

If the forces on an object are balanced (or if there are no forces acting on it) this is what happens:

- **an object that is not moving stays still**
- **an object that is moving continues to move at the same speed and in the same direction**

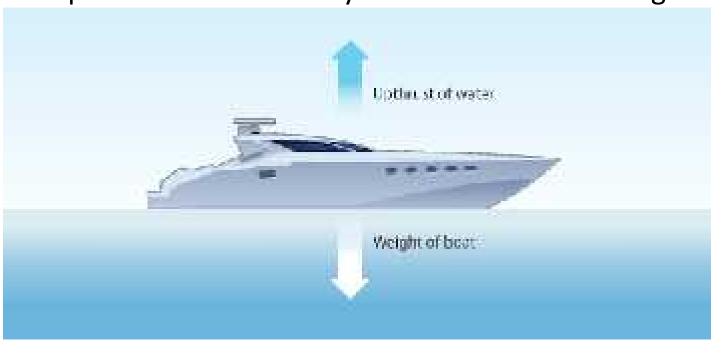
So notice that an object can be moving even if there are no forces acting on it.

Examples

Here are some examples of balanced forces.

Floating in water

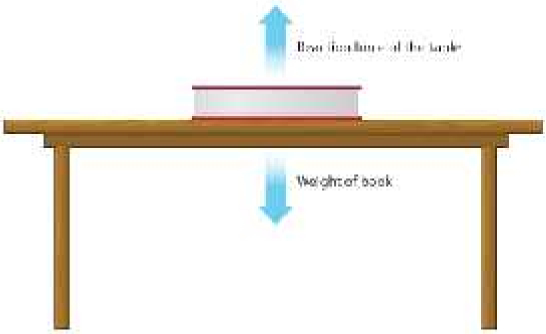
Objects float in water when their weight is balanced by the upthrust from the water. The object will sink until the weight of the water it pushes out of the way is the same as the weight of the object.



A boat floats because its weight is balanced by the upthrust from the water

Standing on the ground

When an object rests on a surface such as the ground, its weight is balanced by the reaction force from the ground. The ground pushes up against the object. The reaction force is what you feel in your feet as you stand still. Without this balancing force you would sink into the ground.



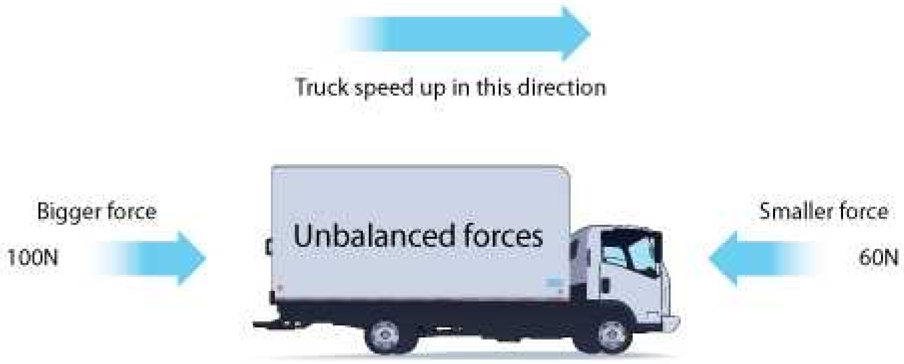
The weight of a book lying on a table is balanced by the reaction force from the table top
than 5 N.

<u>Unbalanced forces</u>

When two forces acting on an object are not equal in size, we say that they are **unbalanced** forces.

If the forces on an object are unbalanced this is what happens:

- **an object that is not moving starts to move**
- **an object that is moving changes speed or direction**



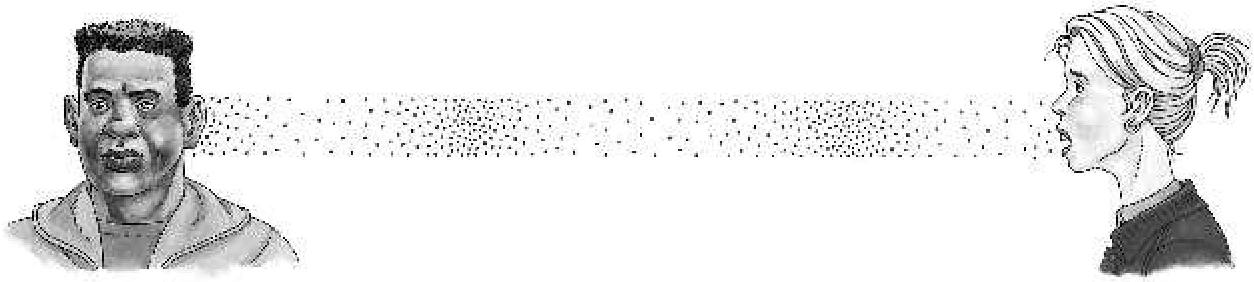
Unbalanced forces make the truck speed up.

Resultant forces

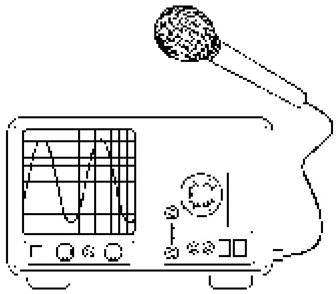
The size of the overall force acting on an object is called the **resultant force**. If the forces are balanced, this is zero. In the example above, the resultant force is the difference between the two forces, which is 100 - 60 = 40 N.

Sound vibrations and waves

Sound is a form of **energy**. Sounds are made when things **vibrate**. The vibrations are passed on by particles in solids, liquids or gases. Sound needs a substance to pass on the vibrations, so it can travel through solids, liquids and gases but not through a **vacuum**.



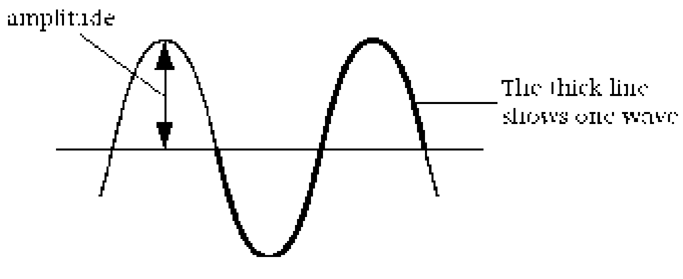
The speed of sound is faster through solids than liquids, and slowest through gases. This is because the particles are very close together in solids and so the energy is more likely to be passed from one particle to the next. The sound travels in all directions because the particles move in all directions unless something stops them.



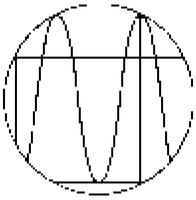
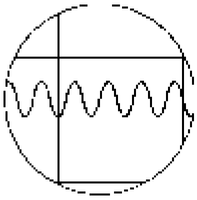
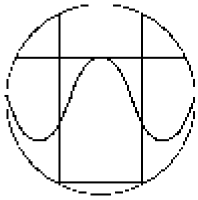
Sound waves can be shown on an oscilloscope.

The **frequency** of a wave is the number of vibrations each second. The unit for frequency is **hertz** (**Hz**). If you listen to a sound with a frequency of 100 Hz, one hundred waves reach your ear every second. High **pitched** sounds have a high frequency, and low pitched sounds have a low frequency.

The distance between the waves is called the **wavelength**. It can be measured between any point on a wave and the same point of the next wave. It is often more convenient to measure it between the top of one wave and the next.



Half the height of the wave is called the **amplitude**. The **loudness** of a sound depends on the amplitude. Louder notes have more energy and the wave has a bigger amplitude.

 Medium  frequency,  medium pitch

High frequency, high pitch Low frequency,Low pitch

High amplitude- Very loud Low amplitude- Low volume Medium amplitude

Hearing and the ear

Sound waves travel through the air and into the ear. They cause the eardrum to vibrate.
Sound can damage the ears if it is too loud or goes on for too long. Loud sounds can damage the eardrum or the cochlea. Unpleasant sound is often called **noise**.

We can measure how loud a sound is by using a **sound intensity meter**. This is an instrument which measures the loudness of a sound in **decibels** (**dB**). The **threshold of hearing** is the quietest sound we can hear and we say this is 0 dB.

Soft materials can **absorb** sound. Soft materials are used in **soundproofing** and for making ear protectors. Double glazed windows and soft materials like curtains help to reduce sound levels.

Sound and light
One major difference between **light** and **sound energy** is that light can travel through space (a vacuum) but sound cannot.

Light also travels much faster than sound. It is nearly a million times faster. Light travels at 300 million metres per second (or 300 000 km/s) and sound travels at about 330 metres per second.

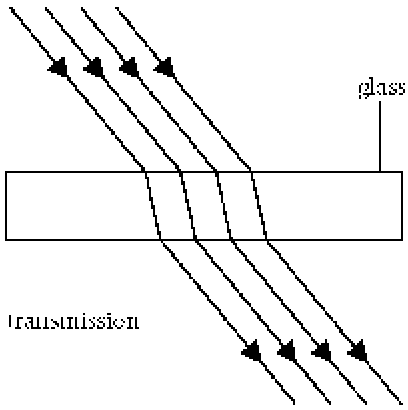
Both light waves and sound waves can be reflected. We hear a reflected sound wave as an **echo**.

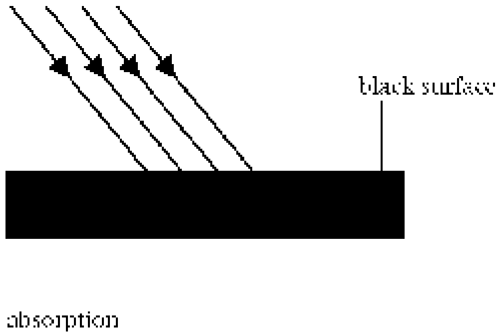
Light

Objects which create light are **luminous sources**. Light travels in *straight* lines. (Always draw rays of light with pencil and ruler- especially on TESTS!).

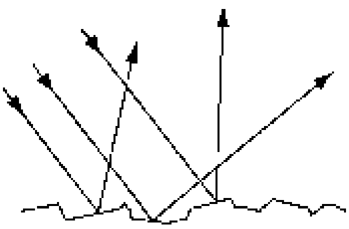
Light waves travel through **transparent** objects but not through **opaque** objects. **Shadows** are made because light cannot travel through opaque objects. **Translucent** objects show a glow of light through them.

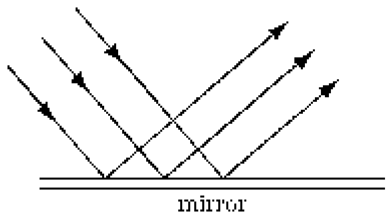
Transmission and absorption
Transparent materials let light pass straight through. We say they **transmit** light. Opaque surfaces can **absorb** light. Black surfaces absorb light very well and reflect very little. This is why they look so dark.



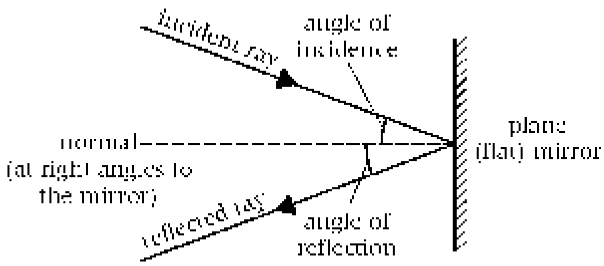


Reflection
Light rays are **scattered** by rough surfaces, and a **reflection** cannot be seen. A **plane** mirror is a flat mirror. Light is reflected evenly by a plane mirror.



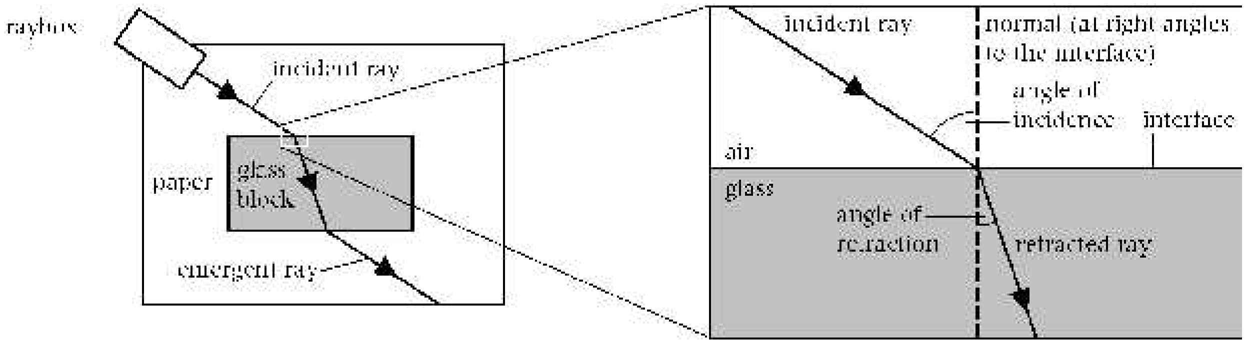


The **angle of incidence** is equal to the **angle of reflection**.
When light shines on to an object viewed in a mirror, the rays are **reflected** into the eye. They seem to come from a position behind the mirror. The **image** is the **same size** as the object and the **same distance** from the mirror. In the image left is right and right becomes left.



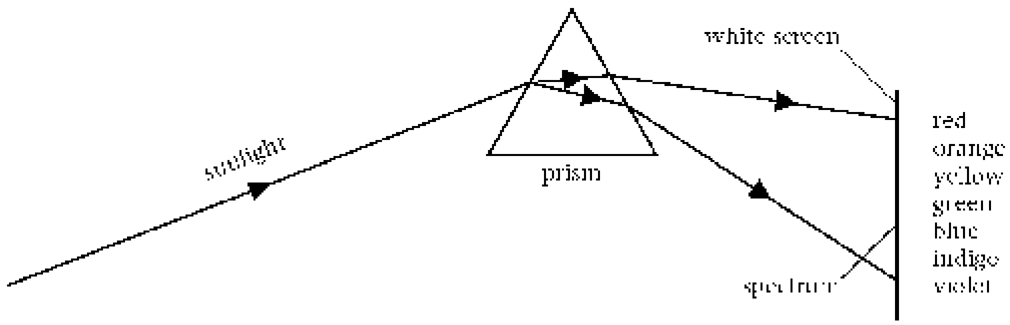
Refraction
When light hits something **transparent** it changes direction. This is called **refraction**.

Refraction takes place at the **interface** between two substances. When light is transmitted through glass it slows down and bends towards the **normal**. When it travels back out it speeds up again and bends away from the normal.



Colour
White light is a mixture of colours. White light can be split up using a **prism** to give a **spectrum** of seven colours (red, orange, yellow, green, blue, indigo, violet).

The splitting of colour into a spectrum is called **dispersion**.



A **rainbow** is produced when water droplets in the air refract sunlight.

Different colours can be made by mixing light of the three **primary colours** (red, green and blue).

Coloured light can be made using a **filter**. A red filter lets red light through, but **absorbs** all the other colours.

We are able to see colours because objects do not reflect all the colours in light:

White objects reflect all the colours.
A red object only reflects red and all other colours are absorbed.
This idea applies to all colours except black.
Black objects absorb all colours.

Energy and electricity

Nothing would happen without energy. Energy is needed to:

- keep our bodies working
- make machines work
- heat homes, schools and offices.

Energies in action

- heat energy
- light energy
- sound energy
- electrical energy
- kinetic (movement) energy.

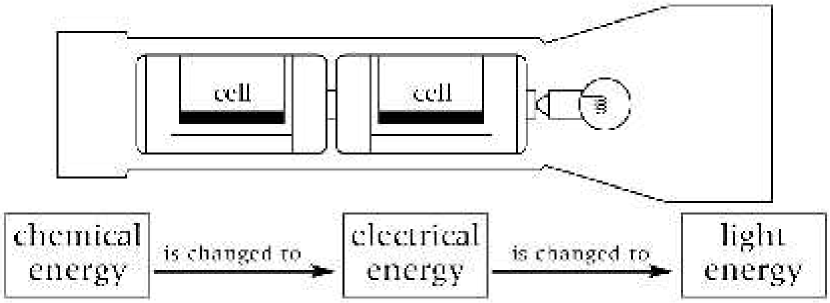
Stored energy

Some energy has to be stored so that it is ready for use when we need it.

- Chemical energy is stored in food, fuels and cells.
- Gravitational potential energy is stored in high up things.
- Strain energy is stored in stretched or squashed things.
- Nuclear energy is stored inside atoms.

Energy changes

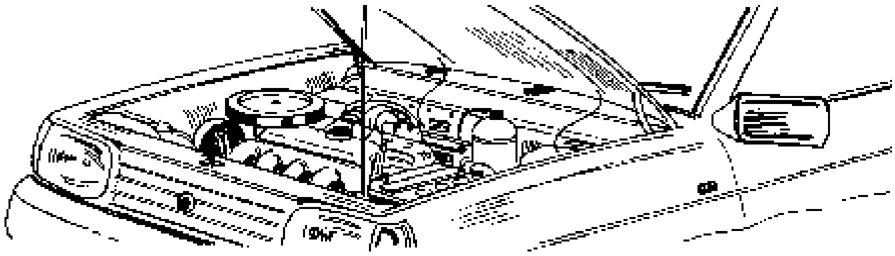
Energy needs to be changed to be useful.



in the cells | in the wires and bulb | in the bulb

An energy flow diagram.

Many energy changes take place in everyday life. Often wasted energy is produced in the forms of **heat** or **sound**.



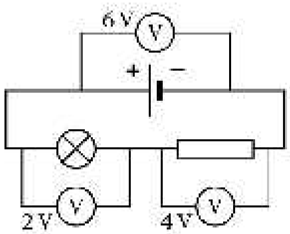
A car engine produces kinetic energy, which is useful. It also produces heat and sound

Energy cannot be made or destroyed, but can only be changed from one form to another. This is the **law of conservation of energy**.

Voltage

A circuit must have a cell or power supply to provide a **voltage**. The voltage pushes the **electrons** around the circuit and gives them energy. This electrical energy is **transferred** to other components in the circuit, which convert it to other forms of energy. For instance, a light bulb transfers electrical energy to heat and light energy.

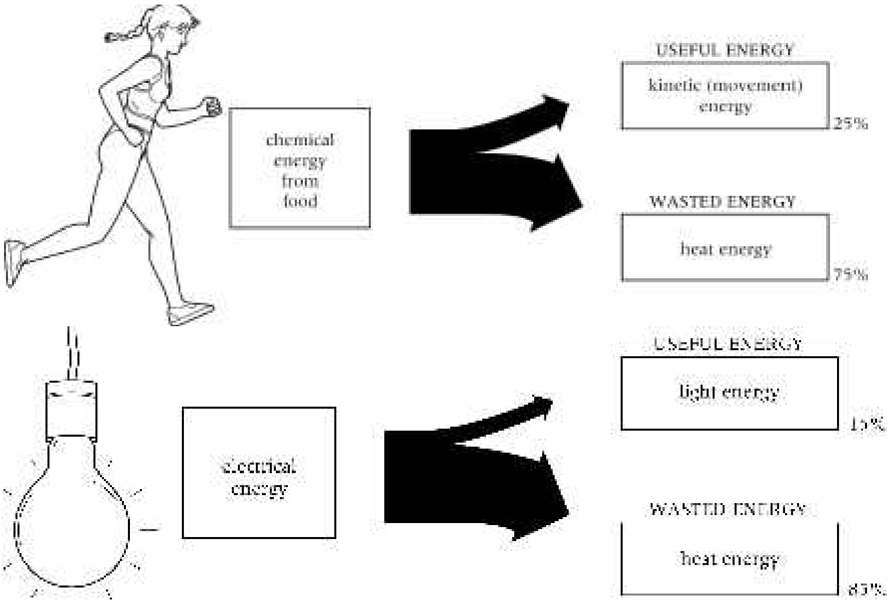
The voltage of a cell can be measured using a **voltmeter**. The units for voltage are **volts** (**V**).The voltage across a component is a way of measuring how much energy the component is transferring. The voltage across all the components in a series circuit adds up to the voltage across the cell.



Wasting energy

Energy cannot be made or destroyed, but it can be changed to different forms. Not all energy is turned into a form that we want. Often it is turned into heat that we do not need. This is wasted energy. A car engine produces kinetic energy, which is useful. It also produces heat and sound which are wasted forms of energy.

The percentage of useful energy produced by something is known as its **efficiency**. The human body is 25% efficient.



Series & parallel circuits

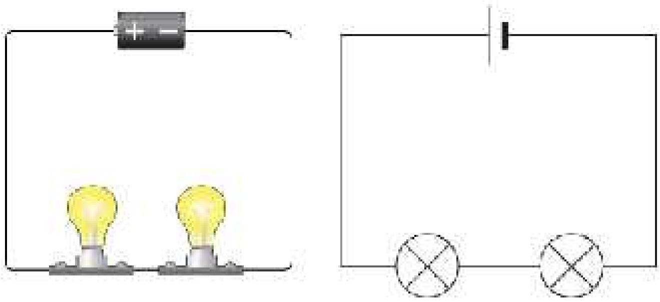
There are two types of circuit we can make, called series and parallel.
The components in a circuit are joined by wires.

- if there are no branches then it's a series circuit
- if there are branches it's a parallel circuit

Series circuits

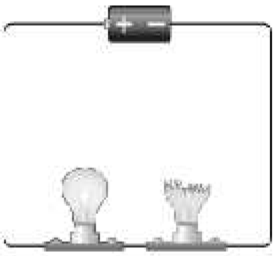
In a television series, you get several episodes, one after the other. A series circuit is similar. You get several components one after the other.

If you follow the circuit diagram from one side of the cell to the other, you should pass through all the different components, one after the other, without any branches.



If you put more lamps into a series circuit, the lamps will be dimmer than before.

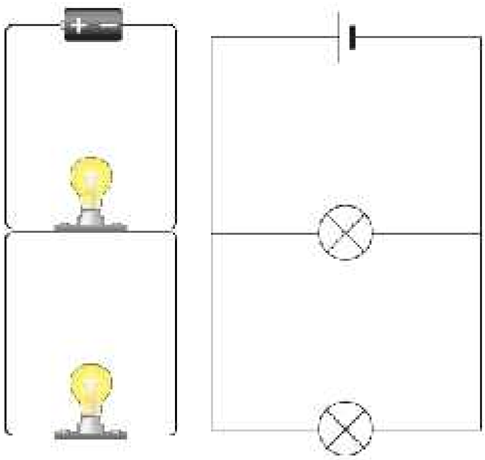
In a series circuit, if a lamp breaks or a component is disconnected, the circuit is broken and all the components stop working.



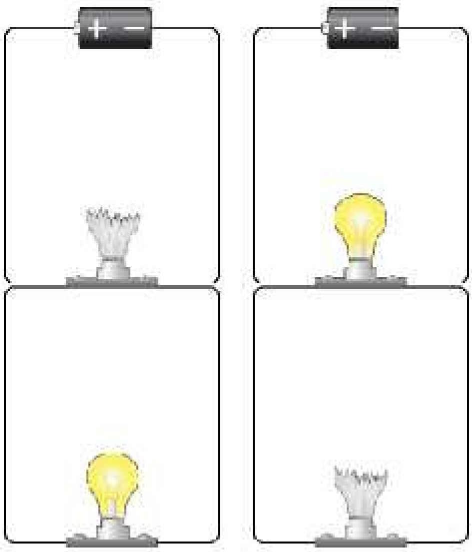
Series circuits are useful if you want a warning that one of the components in the circuit has failed. They also use less wiring than parallel circuits.

Parallel circuits

In parallel circuits different components are connected on different branches of the wire. If you follow the circuit diagram from one side of the cell to the other, you can only pass through all the different components if you follow all the branches.



In a parallel circuit, if a lamp breaks or a component is disconnected from one parallel wire, the components on different branches keep working. And, unlike a series circuit, the lamps stay bright if you add more lamps in parallel.



Parallel circuits are useful if you want everything to work, even if one component has failed. This is why our homes are wired up with parallel circuits.

Gravity and space

Mass and weight

The **mass** of something is the amount of substance or ‘matter’ it contains. It is measured in **kilograms** (**kg**). Weight is the force of **gravity** pulling on a mass. It is a force, so it is measured in **newtons** (**N**).

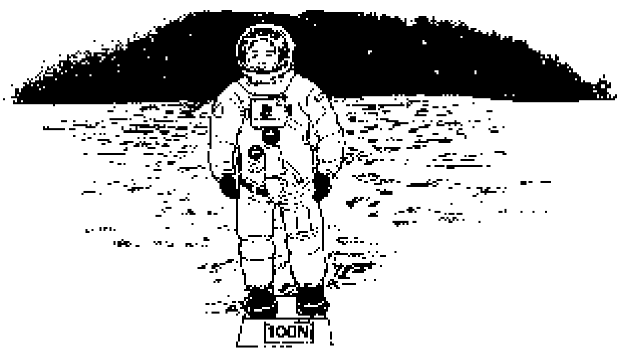
Gravity

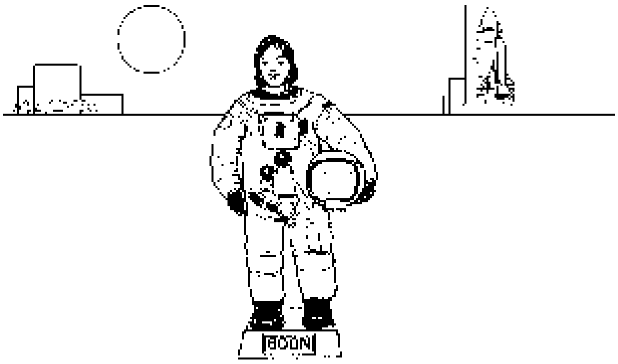
Gravity is the force of attraction between two masses. The force of gravity is stronger if:

- the objects have large masses
- the objects are close together.

On Earth, the gravity pulls on every kilogram of mass with a force of 10 N.

Gravity is not as strong on the Moon, because the Moon has a much smaller mass than the Earth. If you went to the Moon your mass would not change, but your weight would be less than on Earth because the Moon’s gravity is weaker.





If a rocket travels away from the Earth, the force of gravity gets less and less as it gets further from Earth. If it is heading for the Moon, it will eventually reach a place where the Earth’s gravity is cancelled out by the Moon’s gravity. After that, the Moon’s gravity will be pulling it towards the Moon.

The Sun’s gravity keeps all the planets moving in **elliptical orbits** around it. If there was no gravity from the Sun, the planets would all fly off into space. The Earth’s gravity keeps the Moon in orbit around the Earth.

Satellites

A **satellite** is anything that orbits around a planet. The Moon is the only **natural satellite** of the Earth.

Artificial satellites can be put into orbit around the Earth. They can be used for **communications** (transmitting telephone calls or television programmes), for navigation, or to take pictures of the Earth or the planets and stars.

Satellites can also be put into orbit around other planets. They can take pictures and take measurements, and send all the information back to Earth.

Changing ideas about the Solar System

People have known that the Earth is spherical for thousands of years, but they have only believed that the Sun is at the centre of the Solar System for about 500 years.

Early ideas had the Earth in the centre of the Solar System, with the Sun, the planets and the stars moving in circular orbits around the Earth. These ideas were used to make predictions about where the planets would be in the sky, but the predictions were not very accurate.

Copernicus suggested that the Sun was in the centre of the Solar System, but his model still had the planets moving in circular orbits. The predictions made using this model were a bit more accurate, but there were still errors.

Kepler suggested that the planets actually move in elliptical orbits around the Sun. His model could be used to make very accurate predictions. After Newton had worked out how Kepler's model could be explained using his ideas about gravity, most scientists accepted that this was the correct way of thinking about the Solar System.

Pressure and moments

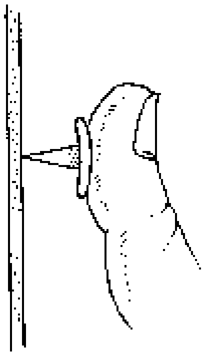
Pressure on solids

A

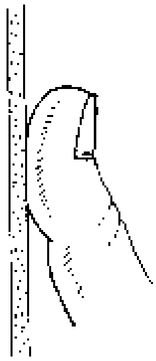
The thumb is putting a force onto the head of the pin. The force is transferred to the

B

The thumb is putting a force on the board. The area of the thumb is much larger than

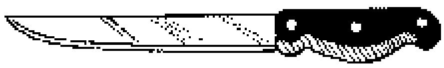


point of the pin. This is a very small area, so there is a very large **pressure** on the board, and the pin goes in.



the area of the pin point, so there is only a small pressure on the board. The thumb does not go into the board.

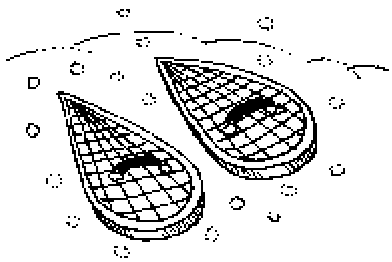
Examples of a small area giving a large pressure:



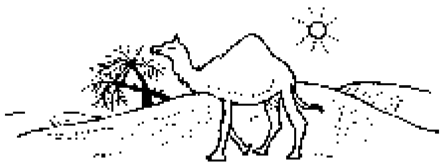
Sharp knife.

Ice skates.

Examples of a large area giving a small pressure:

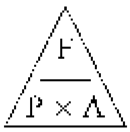


Snow shoes.



Camel on sand.

We can work out the pressure on something by using this formula:



pressure = force ÷ area

Pressure can be measured in:

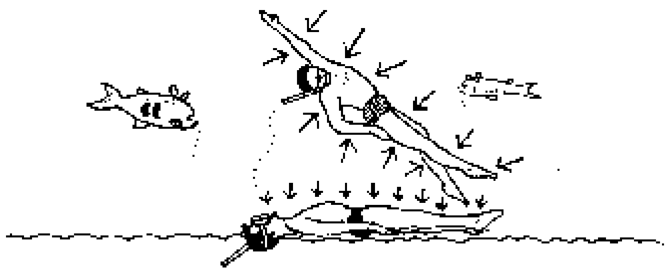
- newtons per square metre (N/m^2)
- newtons per square centimetre (N/cm^2)
- pascals (Pa).

1 Pa = 1 N/m^2

Pressure in liquids and gases

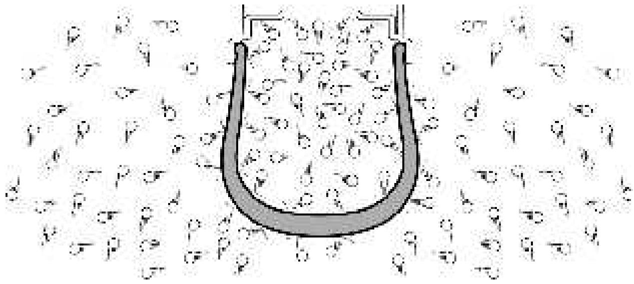
Both gases and liquids are **fluids**. Fluids can flow. Pressure in fluids acts in all directions. The particles in fluids are moving all the time and hitting the walls of containers or other things they come into contact with. The force of the collisions causes pressure which acts in all directions.

The swimmer is floating because pressure in the water provides a force called **upthrust**, which balances the force of **gravity**. As you go deeper into the sea, pressure increases because there is more water above you pressing down. Dams are made with thicker walls at the bottom to withstand the



pressure.

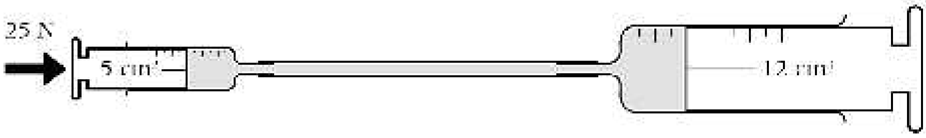
Uses of pressure in liquids and gases



Gases can be **compressed**. The pressure in a compressed gas is higher because there are more molecules moving around and hitting the walls of the container. **Pneumatic** tyres contain compressed air and this keeps the tyre inflated and helps to soften a bumpy ride.

Liquids cannot be compressed. Liquids are used in **hydraulic systems** which can be used to increase the size of a force. Hydraulics are used in car braking systems.

Example



Pressure = force ÷ area

The pressure on the water is $\frac{25\text{ N}}{5\text{ cm}^2}$.

This is 5 N/cm^2.

The area at the end of the other syringe is 12 cm^2.

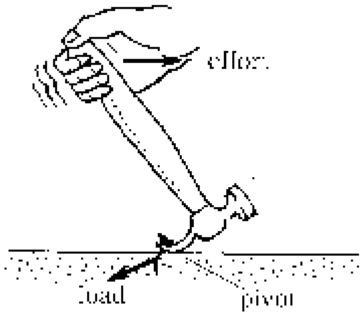
Force = pressure x area

The output force is 5 N/cm^2 x 12 cm^2 = 60 N.

Levers

Forces can be used to turn objects around **pivots**. A pivot is also known as a **fulcrum**.

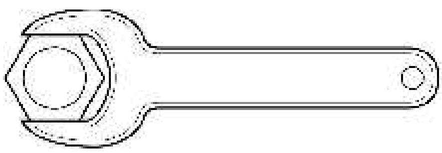
Levers work by magnifying the force that is put in or the distance it moves.



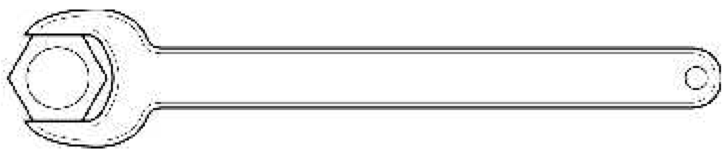
*The hammer is acting as a **force multiplier**.*

Moments

A **turning force** is called a **moment**. Moments are measured in newton centimetres (N cm) or newton metres (N m).



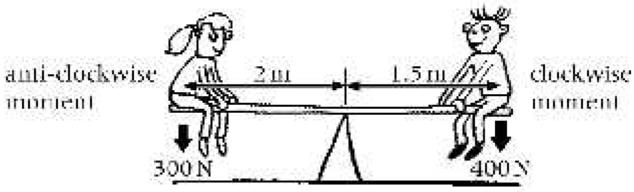
Small moment.



Big moment.

The longer the distance the greater the moment. It is easier to turn the long spanner than the short one.

When an object is balanced, the anticlockwise moment = the clockwise moment.

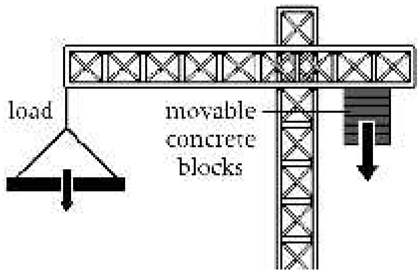


In the example above:

the anticlockwise moment	= 300 N x 2 m
	= 600 Nm
the clockwise moment	= 400N x 1.5 m
	= 600 Nm

The clockwise and anticlockwise moments are the same, so the seesaw is **balanced** or **in equilibrium**.

Cranes use the principle of moments. The moment from the load is balanced by the moment from the concrete blocks to stop the crane toppling over.



Magnets and electromagnets

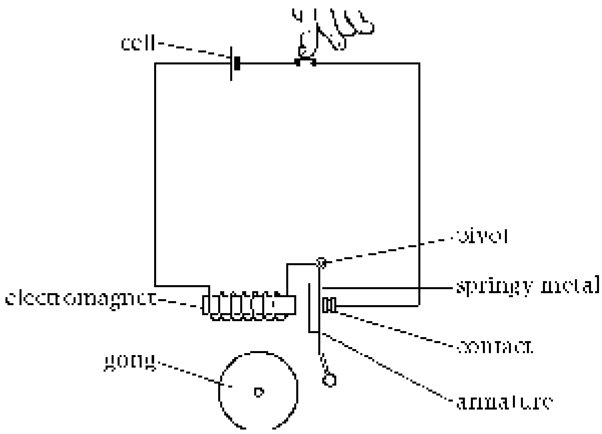
A wire with electricity flowing through it has a magnetic field around it. An **electromagnet** is a coil of wire with an electric current flowing through it.

You can make an electromagnet stronger by:

- increasing the number of coils of wire
- increasing the size of the current (by increasing the voltage)
- using an iron core.

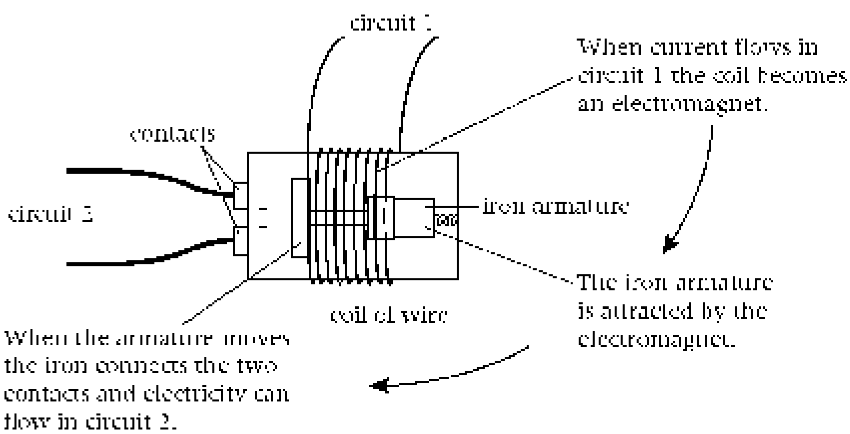
Electromagnets can be used for lifting things. They are also used in electric bells, relays and in video and music recording.

Electromagnets are used to make bells work.



A **reed switch** has two thin pieces of iron inside it. If a magnet is held near the switch, the pieces of iron are magnetised and touch each other. A reed switch can also be switched on using an electromagnet. Any switch that is worked by electricity is called a **relay**.

Relays are used to make things safer. For example, the starter motor in a car uses a high current and needs thick wires for the current to flow through. A relay is used in a car so that the driver does not have to touch any part of the circuit that has a high current.



Forces and motion	
Balanced and unbalanced forces	*Explain the affect of forces on an object.* *Name 3 forces* *Work out the size of a force from how an object is moving.*
Speed	*Recall the formula that links speed, distance and time* *Calculate speed e.g. if an object takes 30 seconds to travel 90 metres what is the average speed?*
Friction	*Describe two ways of reducing friction* *Explain how a parachute works.*
Pressure	*Recall the formula that links pressure, force and area.* *How do snowshoes help you walk on snow?*
Moments	*Recall the formula that links turning force with distance and force.* *State the law of moments.* *Why do we use a spanner not our fingers to unscrew a nut?*
The earth and beyond	
The planets	*Name the planets in order* *Link the planets temperature and orbital time to its distance from the sun.*
Day, Night and Seasons	*Explain why we have day and night* *Explain why we get seasons*
Satellites	*Describe what satellites are used for.* *Why don't satellites fly of into space?*
Sound and light	
Sound	*What causes sound?* *Draw sound waves showing loud or high-pitched sounds.* *What do amplitude, frequency and wavelength mean?*
Light	*Draw ray diagrams showing reflection and refraction.* *Name the primary and secondary colours of light.* *What happens when white light shines onto a red filter?* *Explain why a green cap looks black in blue light.*
Electricity and magnetism	
Electricity	*Draw circuit symbols and simple series and parallel circuits correctly.* *Identify materials as conductors and insulators.* *State some reasons why a circuit wouldn't work.*
Magnetism	*Explain what happens when you put two north poles together.* *Draw a magnetic field.* *Describe how to increase the strength of an electromagnet.* *Write down three uses of electromagnets.*
Energy resources and transfers	
Energy resources	*Where does most of the earth's energy come from?* *What are fossil fuels?* *Name three renewable energy resources.* *Draw a diagram to show how energy is generated from coal.*
Energy transfers	*List 5 different forms of energy.* *State the energy transformation for a television.* *Describe how energy is lost from a house.* *Explain why energy conservation is important*