What is Gravity?

- Gravity is a force that occurs between all objects
- Gravity always acts to pull objects towards each other
- The bigger the mass of an object, the more gravity it has

Mass and Weight

- **Mass** is the amount of matter in an object and is measured in kilograms
- **Weight** is a force and is caused by the pull of gravity acting on a mass
- Weight is measured in **newtons** and has both magnitude and direction
- A newton meter is used to weight
- Gravity pulls the object downwards
- The amount the spring stretches tells us the force or weight

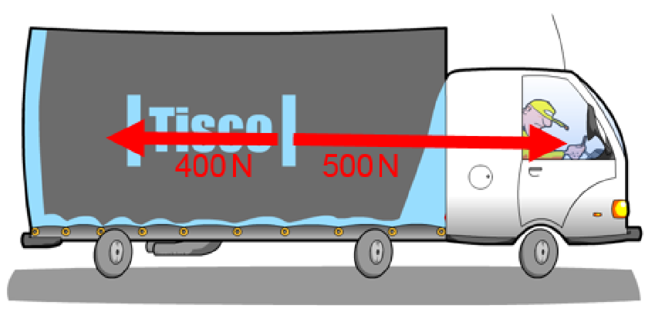
Keywords

Equilibrium - State of an object when opposing forces are balanced
Deformation -Changing shape due to a force
Linear relationship - When two variables are graphed and show a straight line which goes through the origin, and they can be called directly proportional.
Newton - Unit for measuring forces (N)
Resultant force - Single force which can replace all the forces acting on an object and have the same effect.
Friction - Force opposing motion which is caused by the interaction of surfaces moving over one another. It is called 'drag' if one is a fluid.
Tension - Force extending or pulling apart
Compression - Force squashing or pushing together
Contact force - One that acts by direct contact (friction)
Non Contact force – Exerted without touching (gravity)
Range -The maximum and minimum values of a variable.
Interval -The gap between the values of the independent variable.
Control group - Those that are not exposed to the factor being tested.
Repeatable - When repeat readings are close together
Balanced Force – Forces acting on a object are equal and opposite (no resultant force)
Streamlined - Shaped so that the flow of air around the body is made as smooth as possible

The sum effect of more than one force is called the **resultant force**.

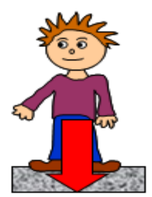
The resultant force is calculated by working out the difference between opposing forces in each direction. What is the resultant force on this truck?

A resultant force of 100 N is accelerating the truck.



What is a force?

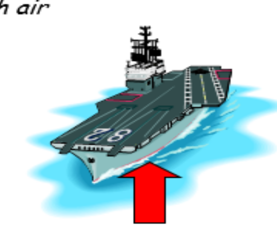
A force is a "push" or a "pull". Some common examples:



Weight – *pulls things downwards*

Air resistance (drag) – *acts against anything moving through air*

Friction – *acts against anything moving*

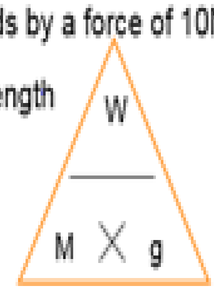


Upthrust – *keeps things afloat*

Weight vs. Mass

Earth's Gravitational Field Strength is 10N/kg. In other words, a 1kg mass is pulled downwards by a force of 10N.

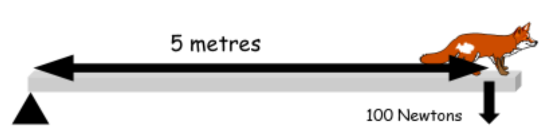
Weight = Mass x Gravitational Field Strength
(in N) (in kg) (in N/kg)



Moments

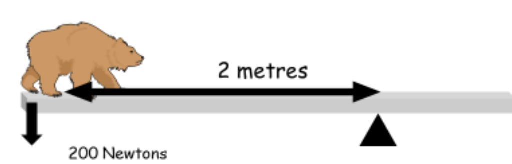
A moment is a "turning force", e.g. trying to open or close a door or using a spanner. The size of the moment is given by:

Moment (in Nm) = force (in N) x distance from pivot (in m)

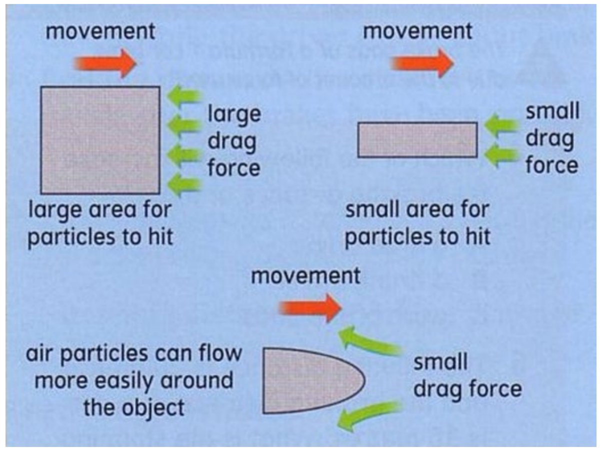


Turning force = 5m x 100N
= 500Nm

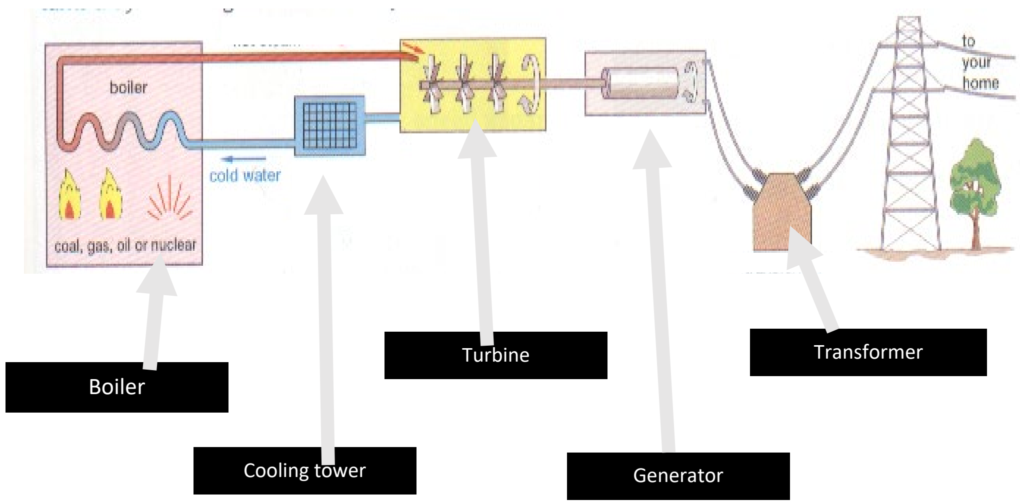
Turning force = 2m x 200N
= 400Nm



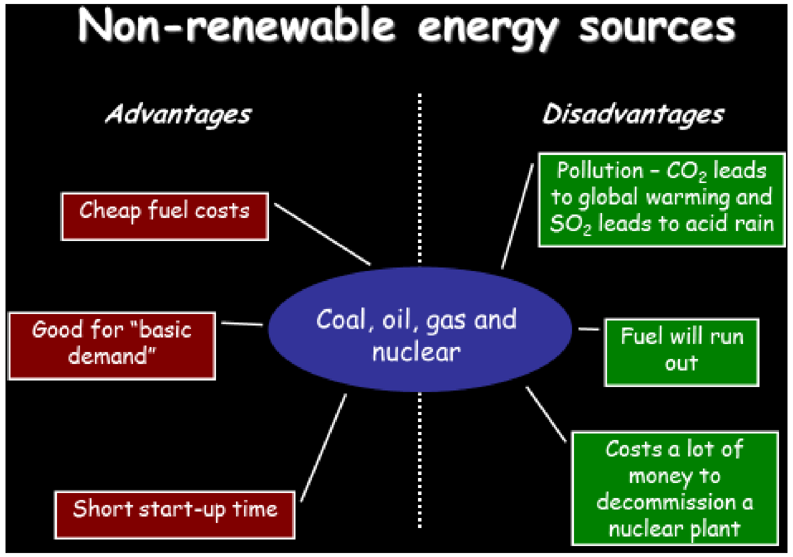
Rule 1 - If the object is **still**, or moving at a constant speed the forces are **balanced**. Rule 2 - If the object is **speeding up** or **slowing down**, the forces are **unbalanced**.

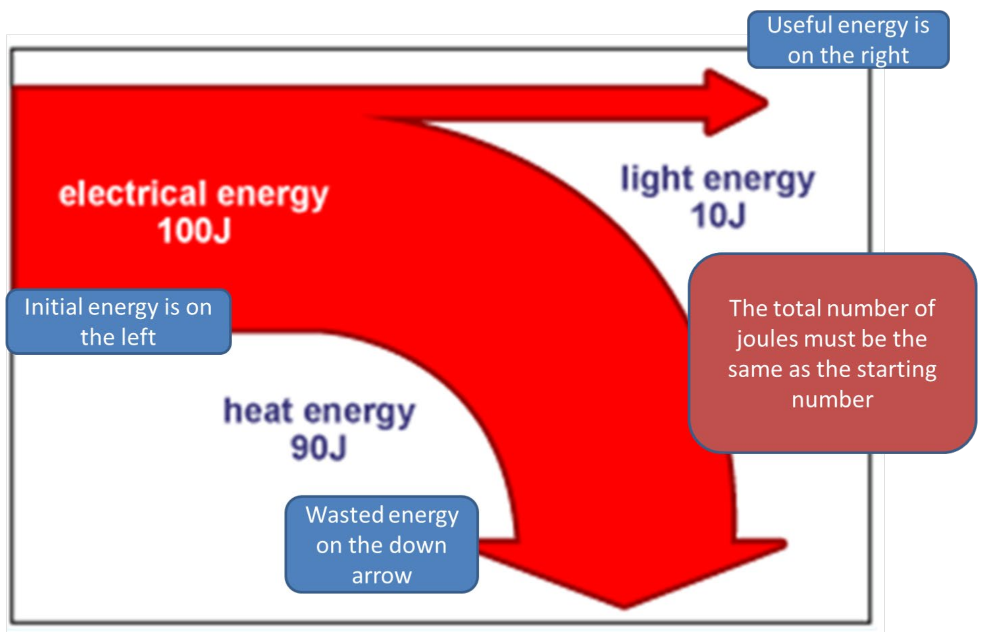


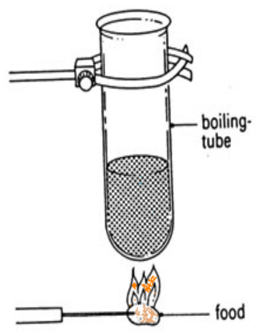
Air Resistance



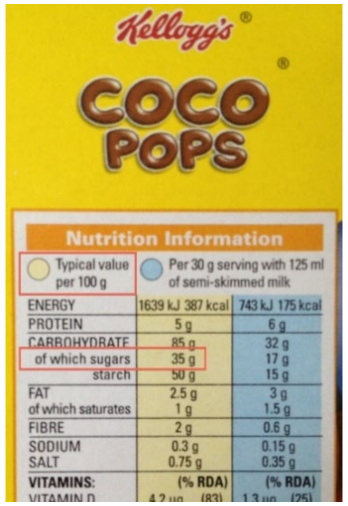
- **Power -** how quickly energy is transferred by a device (watts).
- **Energy resource** – something with stored energy that can be released in a useful way
- **Non-renewable** – an energy resource that cannot be replaced and will be used up.
- **Renewable** – an energy resource that can be replaced and will not run out. Examples are solar, wind, waves, geothermal and biomass.
- **Fossil fuels** – non- renewable energy resources formed from the remains of ancient plants or animals. Examples are, coal, crude oil and natural gas.







- When food burns, it releases chemical energy
- If the food is burned under a test tube containing water, chemical energy in the water is transferred to heat energy and the water heats up
- The hotter the water gets, the more energy there is in the food



Types of energy	Sources
Heat or thermal energy	Hot objects, e.g. fires
Light energy	The Sun, light, bulbs, fires, etc.
Sound energy	Vibrating objects e.g., Loudspeakers
Electrical energy	Available every time a current flows
Chemical energy	Food, fuels and batteries from chemical reactions.
Kinetic energy (the energy an object has because it is moving)	Flowing water, wind, etc.
Elastic potential energy	Objects such as springs and rubber bands that are stretched or twisted or bent
Gravitational potential energy	Objects that have a high position and are able to fall
Nuclear energy	Changes in the nucleus of certain heavy atoms e.g. Uranium.

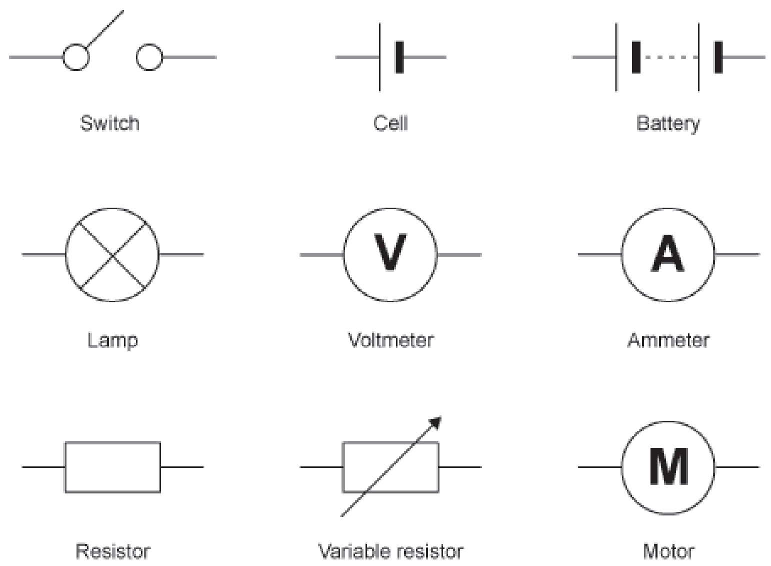
- **Thermal energy store:** Filled when an object is warmed up.
- **Chemical energy store:** Emptied during chemical reactions when energy is transferred to surroundings.
- **Kinetic energy store:** Filled when an object speeds up.
- **Gravitational potential energy store:** Filled when an object is raised.
- **Elastic energy store:** Filled when a material is stretched or compressed.
- **Dissipated:** Become spread out wastefully.

Voltage & Resistance and Current

Keywords:

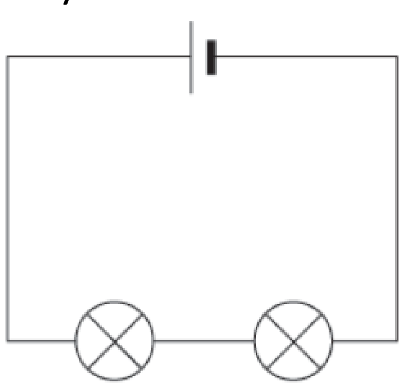
- **Potential difference (voltage)**: The amount of energy shifted from the battery to the moving charge, or from the charge to circuit components, in volts (V).
- **Resistance**: A property of a component, making it difficult for charge to pass through, in ohms (Ω).
- **Current**: Flow of electric charge, in amperes (A).
- **Electrical conductor**: A material that allows current to flow through it easily, and has a low resistance.
- **Electrical insulator**: A material that does not allow current to flow easily, and has a high resistance.

Circuit symbols:



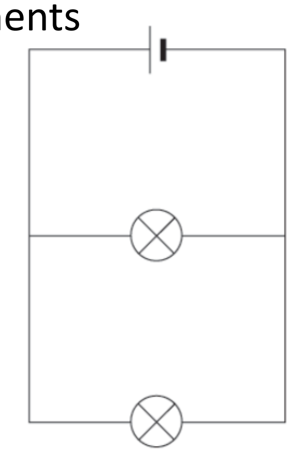
Series circuit: components on same loop

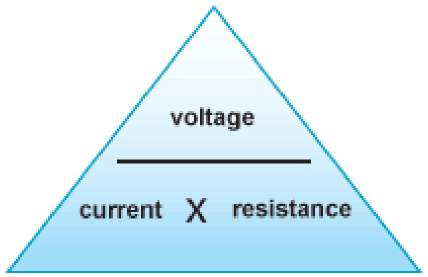
- Current constant all the way around

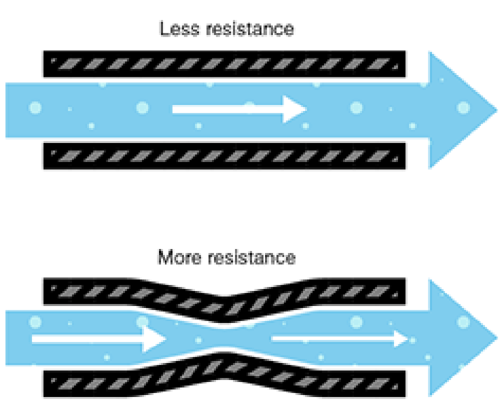


Parallel circuit: components on separate loops

- Current split between the components



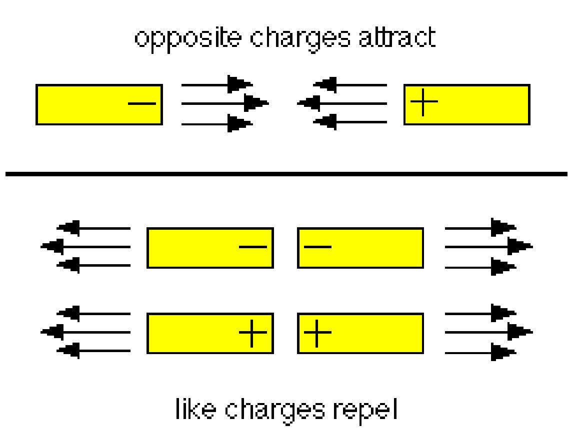


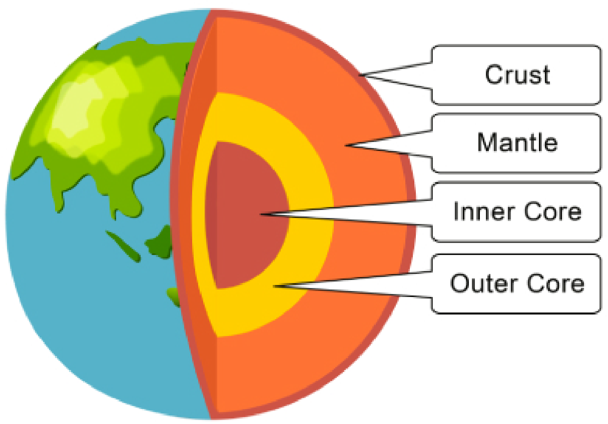


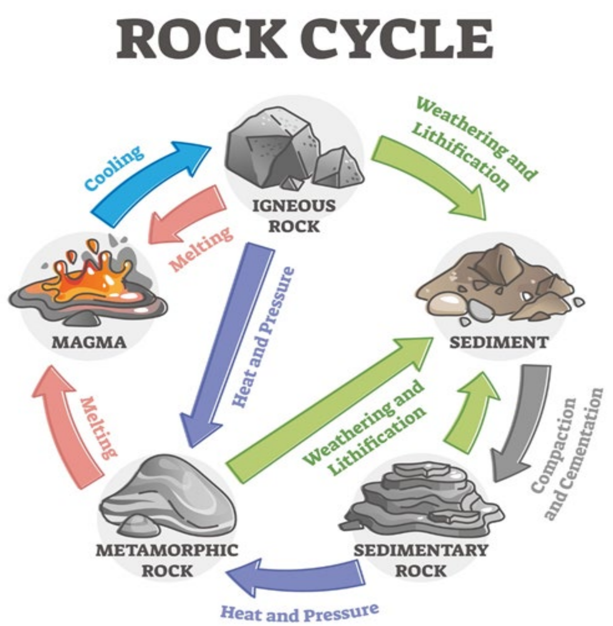
Electrons are tiny particles that carry a negative charge

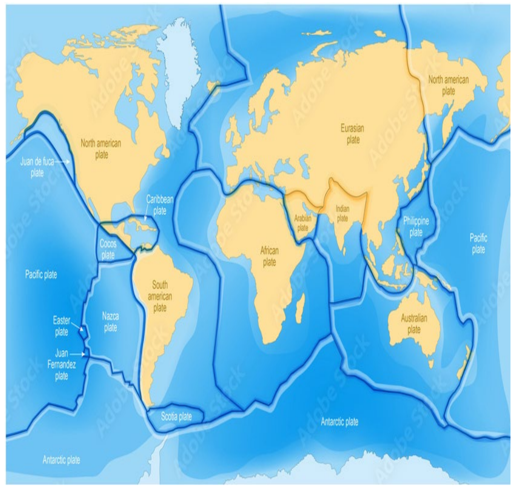
If an object:

- Gains electrons it becomes **negatively charged**
- Loses electrons it becomes **positively charged**

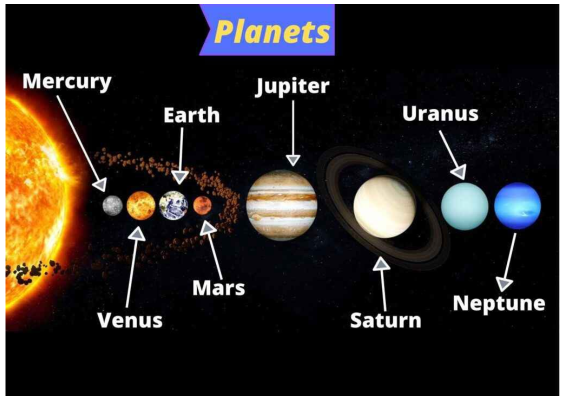


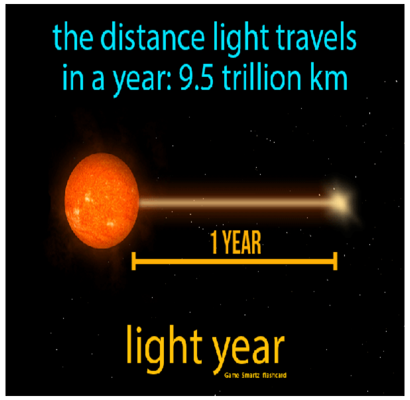


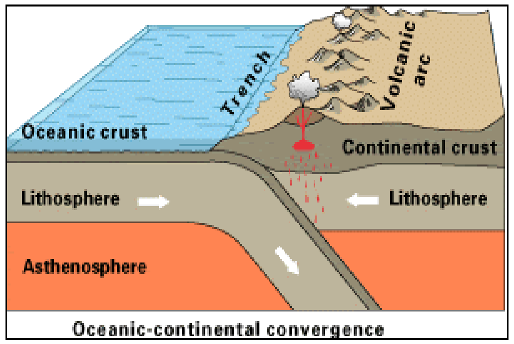


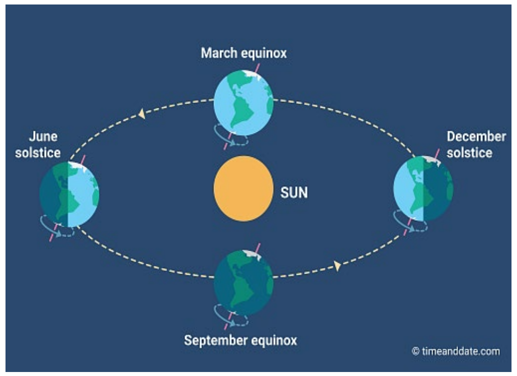


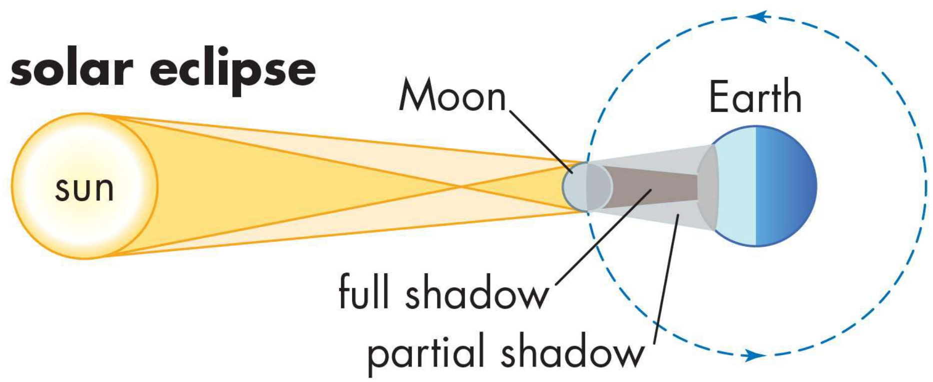
Earth and universe











Vibration: A back and forth motion that repeats.

Longitudinal wave: Where the direction of vibration is the same as that of the wave.

Transverse wave: Where the direction of the vibration is perpendicular to the direction of the wave.

Volume: How loud or quiet a sound is, in decibels (dB).

Pitch: How low or high a sound is. A low (high) pitch sound has a low (high) frequency.

Amplitude: The maximum amount of vibration, measured from the middle position of the wave, in metres.

Wavelength: Distance between two corresponding points on a wave, in metres.

Frequency: The number of waves produced in one second, in hertz.

Vacuum: A space with no particles of matter in it.

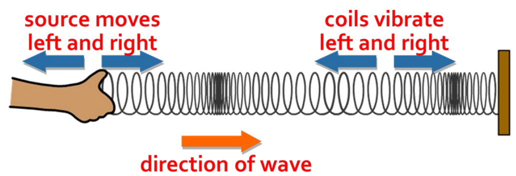
Oscilloscope: Device for viewing patterns of sound waves that have been turned into electrical current.

Absorption: When energy is transferred from sound to material.

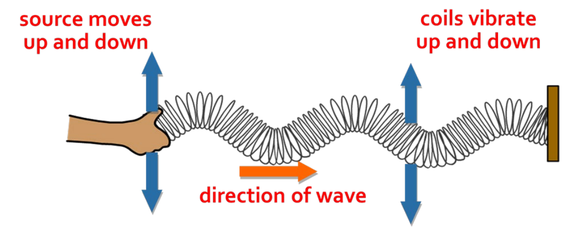
Auditory range: The lowest and highest frequencies that a type of animal can hear.

Echo: Reflection of sound waves from a surface back to a listener.

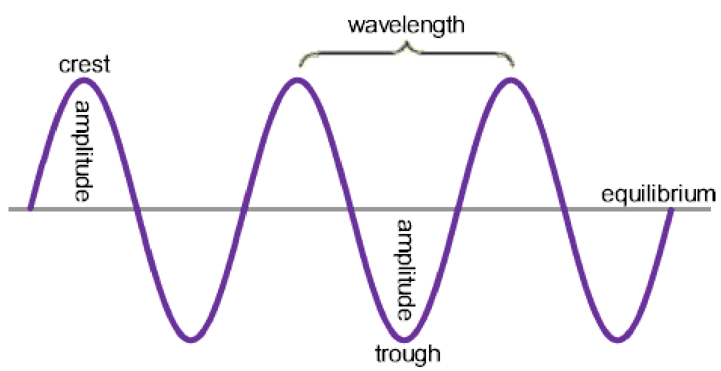
Sound is made when an object or material vibrates. When you sing it's your vocal chords or on a guitar it's the strings. Sound travels in waves caused by the vibrations. These pass through molecules (gas, liquid or solid) and reach our ears. Sound waves transfer energy not matter.

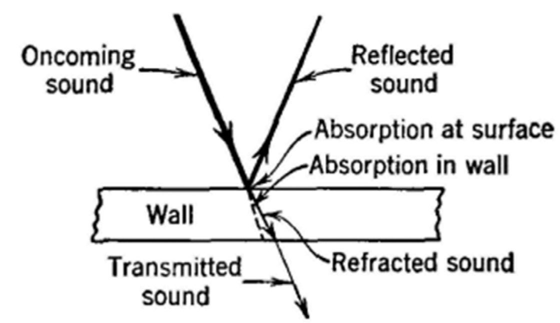


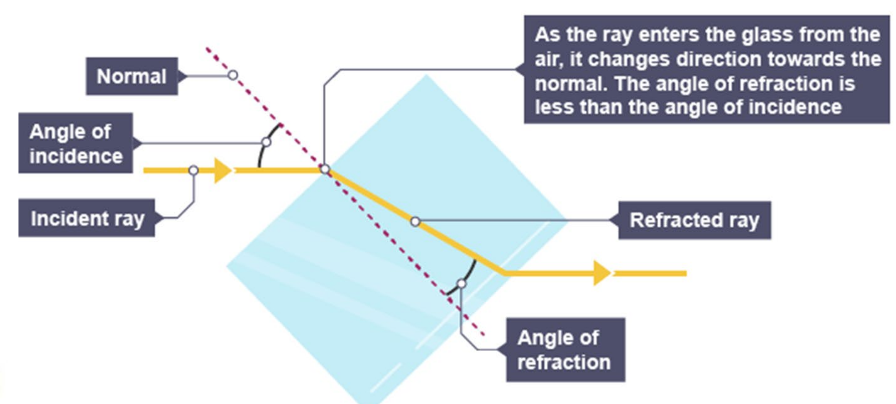
Sound travels in longitudinal waves

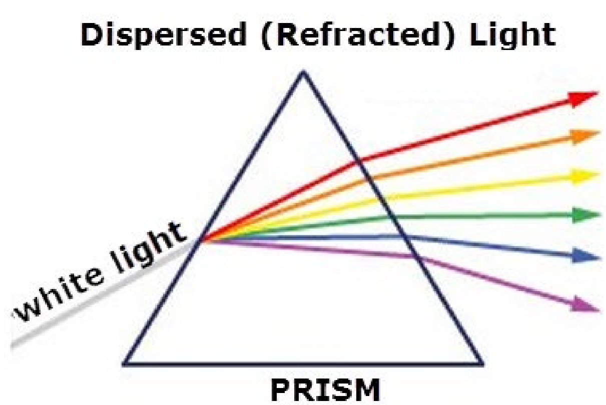


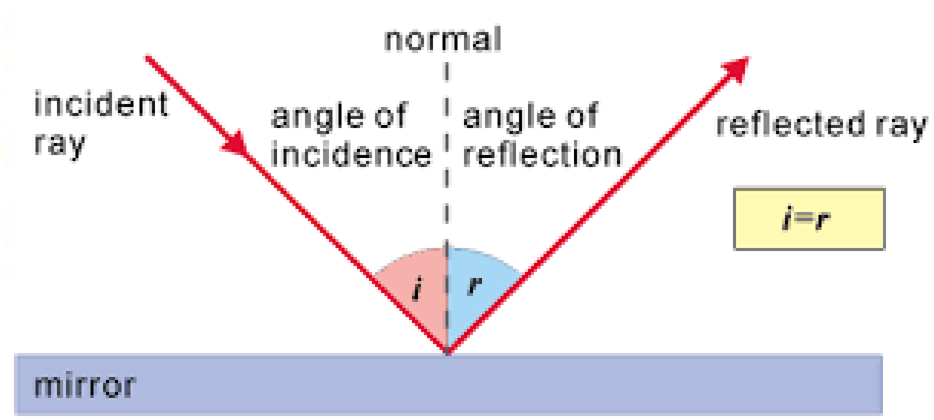
Light travels in transverse waves











Light: Electromagnetic radiation that can be detected by the human eye.

Ray: A narrow beam of light.

Medium: The substance the wave is travelling through, this could be a solid, liquid or gas.

Reflection: When light or any type of wave hits a new surface and returns in the direction it originated.

Refraction: The change in the direction of a wave when it passes from one medium into another.

Normal: A line drawn at 90° to the surface the ray of light is hitting.

Spectrum: The range of colours produced when white light passes through a prism.

Filter: Only allows certain wavelengths (colours) of light through, absorbing all others.

Transparent: A material that allows all light to pass through it.

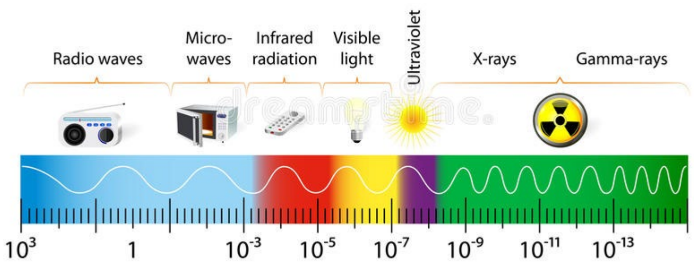
Translucent: A material that allows most light through but not enough to make out detailed shapes.

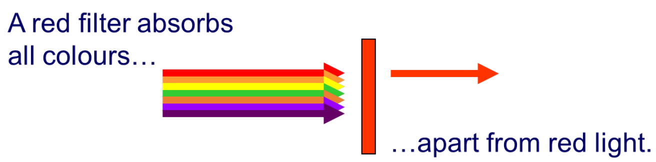
Opaque: An object that lets no light through.

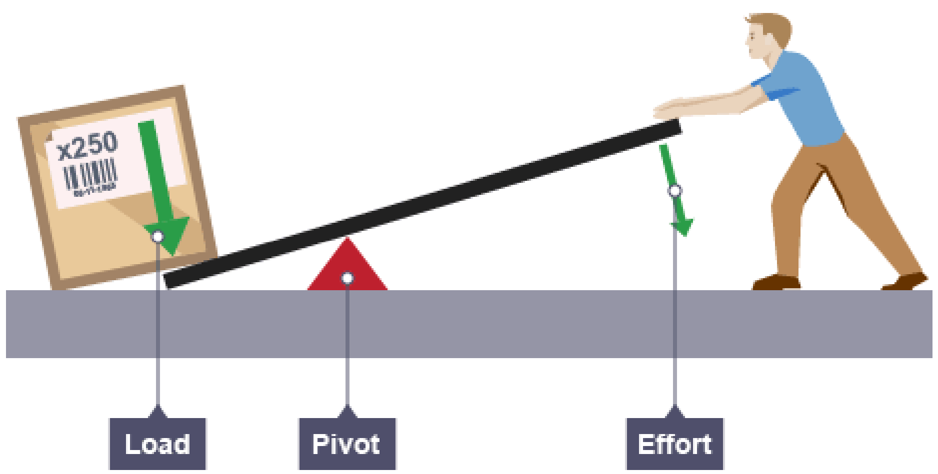
Dispersion: The splitting of white light into different wavelengths (colours)

Electromagnetic spectrum: range of frequencies of **electromagnetic** radiation and their respective wavelengths and photon energies.

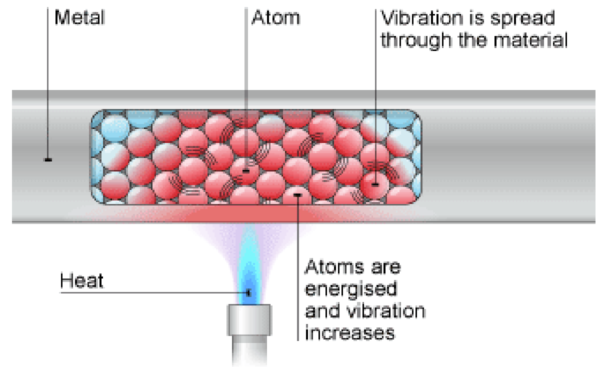
THE ELECTROMAGNETIC SPECTRUM



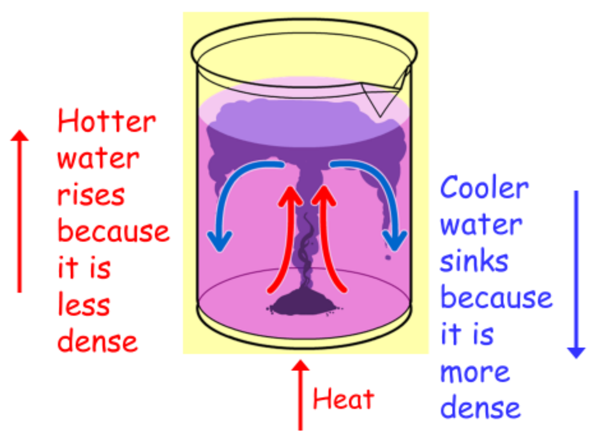




Conduction



Convection

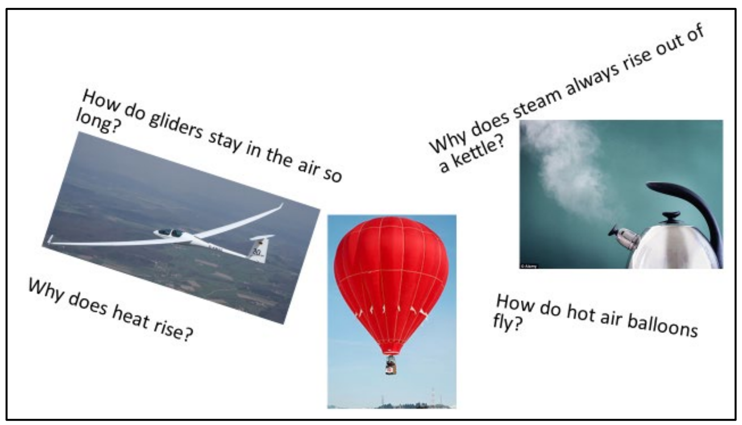


Key words

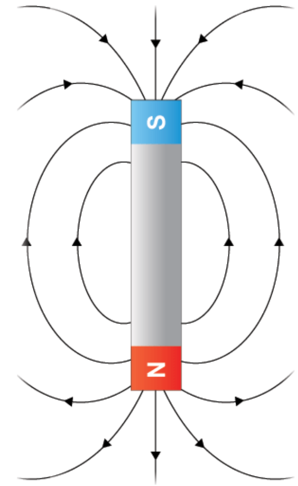
- **Thermal conductor** – material that allows heat to move through it
- **Thermal insulator** – material that only allows heat to move through it slowly
- **Temperature** – a measure of particle movement
- **Thermal energy** – amount of energy stored in a material due to particles vibrating
- **Conduction** – transfer of thermal energy by the vibration of particles
- **Convection** – transfer of thermal energy by particles rising
- **Radiation** - transfer of thermal energy as a wave

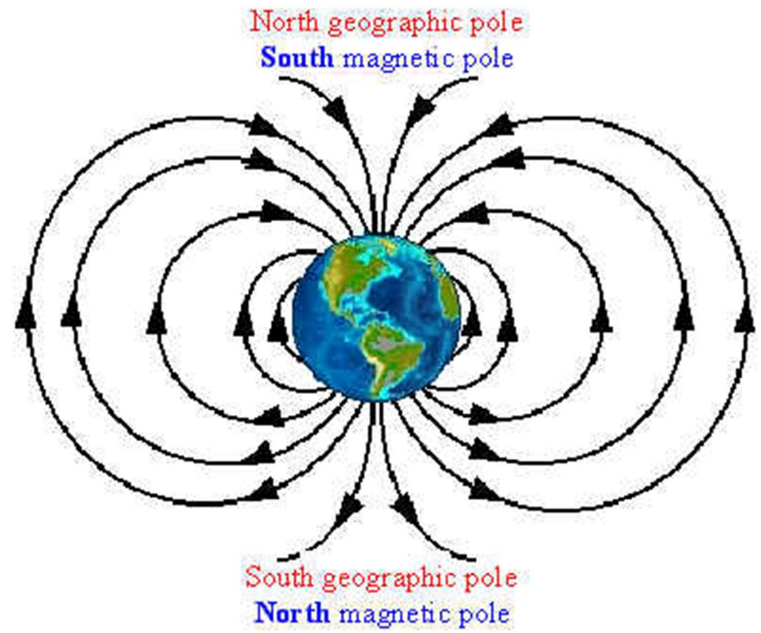
Radiation

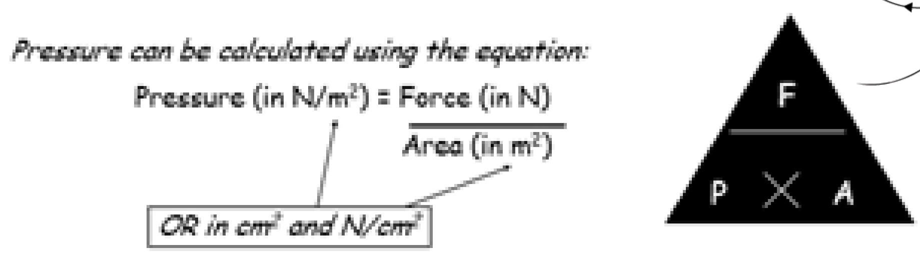
- Work done = force x distance **W = F x d**
- **W** is measures in joules.
- **F** is measure in newtons.
- **d** is measured in metres.
- **When work is done, energy is transferred**

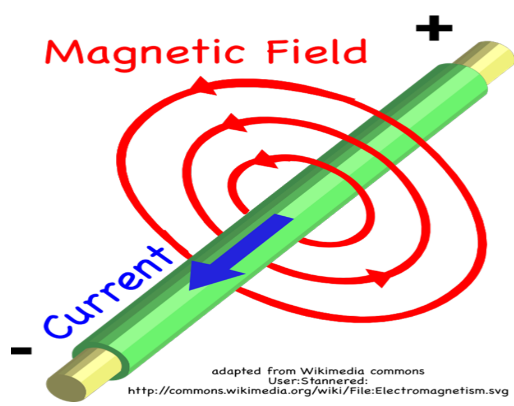


Speed – how much distance is covered on how much time.
Average speed – overall distance travelled divided by overall time.
Acceleration – how quickly speed increases.
Fluid – no fixed shape, gas or liquid.
Pressure – ratio of force to surface area in N/m^2



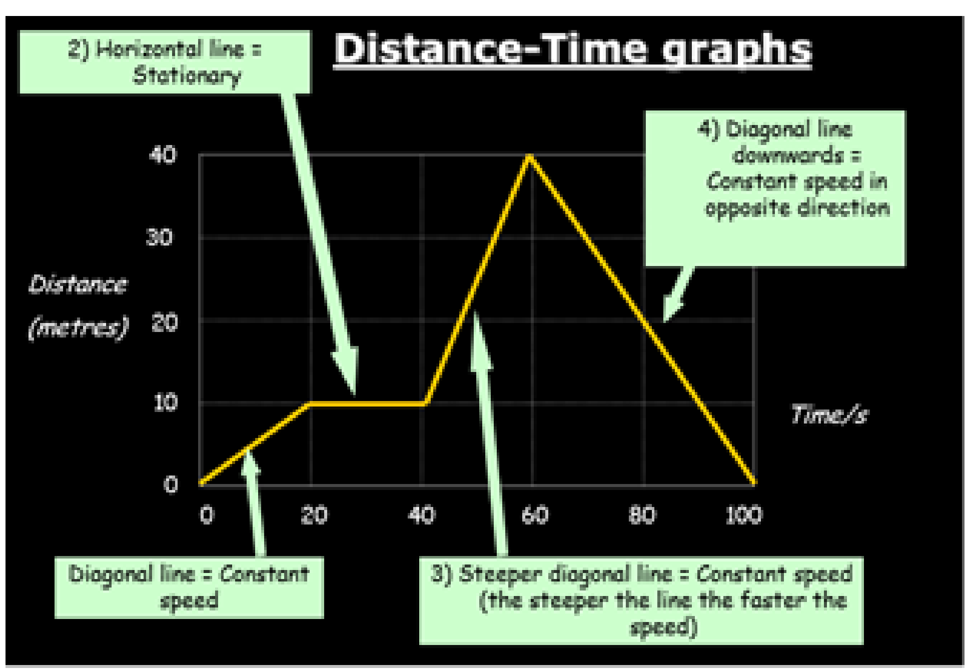






The magnetic field is strongest at the poles, where the field lines are most concentrated. Opposite poles attract, and like poles repel.

Iron, Nickel and Cobalt are magnetic metals



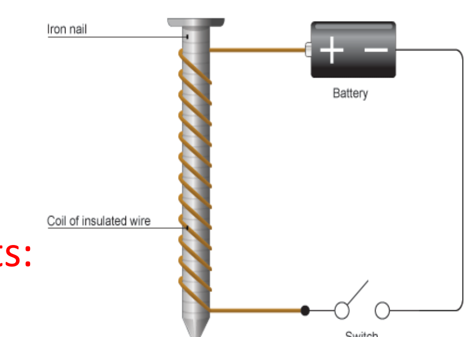
When an electric current flows in a wire, it creates a magnetic field around the wire. This effect can be used to make an electromagnet.

We can make an electromagnet stronger by:

- wrapping the coil around an iron core
- adding more turns to the coil
- increasing the current flowing through the coil.

Electromagnets have some advantages over permanent magnets:

- they can be turned on and off
- the strength and direction of the magnetic field can be varied

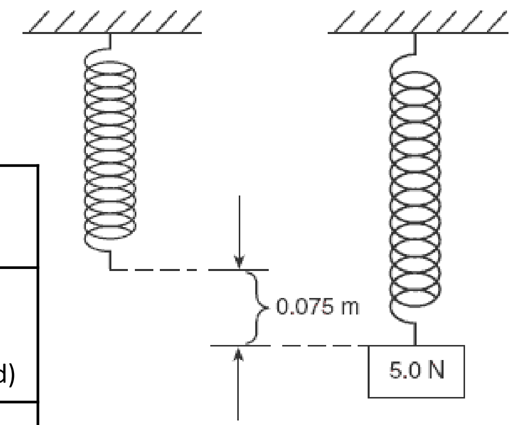


AQA ENERGY

Energy stores and changes

Mechanical	*Force acts upon an object*
Electrical	*Electric current flow*
Heat	*Temperature difference between objects*
Radiation	*Electromagnetic waves or sound*

Kinetic energy	*Energy stored by a moving object*	½ X mass X $(\text{speed})^2$ ½ mv^2
Elastic Potential energy	*Energy stored in a stretched spring, elastic band*	½ X spring constant X $(\text{extension})^2$ ½ ke^2 (Assuming the limit of proportionality has not been exceeded)
Gravitational Potential energy	*Energy gained by an object raised above the ground*	Mass X gravitational field strength X height mgh

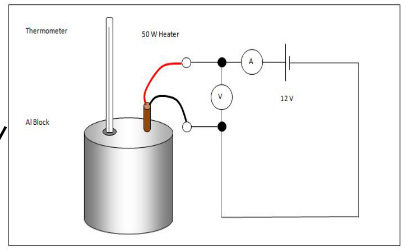


System	*An object or group of objects that interact together*	EG: Kettle boiling water.
Energy stores	*Kinetic, chemical, internal (thermal), gravitational potential, elastic potential, magnetic, electrostatic, nuclear*	Energy is gained or lost from the object or device.
Ways to transfer energy	*Light, sound, electricity, thermal, kinetic are ways to transfer from one store to another store of energy.*	EG: electrical energy transfers chemical energy into thermal energy to heat water up.
Unit	*Joules (J)*	

Power	*The rate of energy transfer*	1 Joule of energy per second = 1 watt of power	Power = energy transfer ÷ time P = E ÷ t Power = work done ÷ time, P = W ÷ t

Change in thermal energy = mass **X** specific heat capacity **X** temperature change

ΔE= m **X c X** Δθ



Specific Heat Capacity	*Energy needed to raise 1kg of substance by 1°C*	Depends on: mass of substance, what the substance is and energy put into the system.

Energy Conservation and Dissipation

Dissipate	*To scatter in all directions or to use wastefully*	When energy is 'wasted', it dissipates into the surroundings as internal (thermal) energy.
Ways to reduce 'wasted' energy	*Energy transferred usefully*	Insulation, streamline design, lubrication of moving parts.
Principle of conservation of energy	*The amount of energy always stays the same.*	Energy cannot be created or destroyed, only changed from one store to another.

Efficiency	*How much energy is usefully transferred*

$$\text{Efficiency} = \frac{\text{Useful output energy transfer}}{\text{Total input energy transfer}}$$

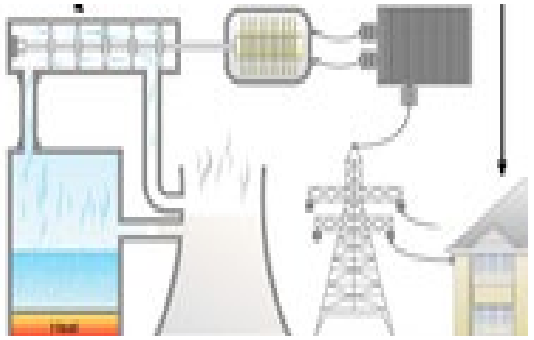
$$\text{Efficiency} = \frac{\text{Useful power output}}{\text{Total power input}}$$

	Units
Specific Heat Capacity	*Joules per Kilogram degree Celsius (J/Kg°C)*
Temperature change	*Degrees Celsius (°C)*
Work done	*Joules (J)*
Force	*Newton (N)*
Distance moved	*Metre (m)*
Power	*Watts (W)*
Time	*Seconds (s)*

	Units
Energy (KE, EPE, GPE, thermal)	*Joules (J)*
Velocity	*Metres per second (m/s)*
Spring constant	*Newton per metre (N/m)*
Extension	*Metres (m)*
Mass	*Kilogram (Kg)*
Gravitational field strength	*Newton per kilogram (N/Kg)*
Height	*Metres (m)*

Power station – NB: You need to understand the principle behind generating electricity. An energy resource is burnt to make steam to drive a turbine which drives the generator.

Power station	***Generates electricity***	Fuel burnt releasing thermal energy →	Water boils into steam →	Steam turns turbine →	Turbine turns generator →	Generator induces voltage
National Grid	***Transports electricity across UK***	Power station →	Step-up transformer →	Pylons →	Step-down transformer →	House, factory

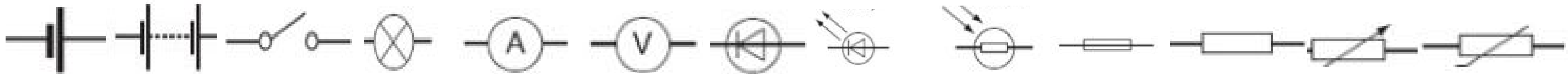


AQA ENERGY – Part 2

Global Energy Resources

National Grid

Energy resource	***How it works***	Uses	Positive	Negative
Fossil Fuels (coal, oil and gas)	***Burnt to release thermal energy used to turn water into steam to turn turbines***	Generating electricity, heating and transport	Provides most of the UK energy. Large reserves. Cheap to extract. Used in transport, heating and making electricity. Easy to transport.	Non-renewable. Burning coal and oil releases sulfur dioxide. When mixed with rain makes acid rain. Acid rain damages building and kills plants. Burning fossil fuels releases carbon dioxide which contributes to global warming. Serious environmental damage if oil spilt.
Nuclear	***Nuclear fission process***	Generating electricity	No greenhouse gases produced. Lots of energy produced from small amounts of fuel.	Non-renewable. Dangers of radioactive materials being released into air or water. Nuclear sites need high levels of security. Start up costs and decommission costs very expensive. Toxic waste needs careful storing.
Biofuel	***Plant matter burnt to release thermal energy***	Transport and generating electricity	Renewable. As plants grow, they remove carbon dioxide. They are 'carbon neutral'.	Large areas of land needed to grow fuel crops. Habitats destroyed and food not grown. Emits carbon dioxide when burnt thus adding to greenhouse gases and global warming.
Tides	***Every day tides rise and fall, so generation of electricity can be predicted***	Generating electricity	Renewable. Predictable due to consistency of tides. No greenhouse gases produced.	Expensive to set up. A dam like structure is built across an estuary, altering habitats and causing problems for ships and boats.
Waves	***Up and down motion turns turbines***	Generating electricity	Renewable. No waste products.	Can be unreliable depends on wave output as large waves can stop the pistons working.
Hydroelectric	***Falling water spins a turbine***	Generating electricity	Renewable. No waste products.	Habitats destroyed when dam is built.
Wind	***Movement causes turbine to spin which turns a generator***	Generating electricity	Renewable. No waste products.	Unreliable – wind varies. Visual and noise pollution. Dangerous to migrating birds.
Solar	***Directly heats objects in solar panels or sunlight captured in photovoltaic cells***	Generating electricity and some heating	Renewable. No waste products.	Making and installing solar panels expensive. Unreliable due to light intensity.
Geothermal	***Hot rocks under the ground heats water to produce steam to turn turbine***	Generating electricity and heating	Renewable. Clean. No greenhouse gases produced.	Limited to a small number of countries. Geothermal power stations can cause earthquake tremors.



Cell	Battery	Switch	Lamp	Ammeter	Voltmeter	Diode	LED	LDR	Fuse	Resistor	Variable resistor	Thermistor
Store of chemical energy	*Two or more cells in series*	*Breaks circuit, turning current off*	*Lights when current flows*	*Measures current*	*Measures potential difference*	*Current flows one way*	*Emits light when current flows*	*Resistance low in bright light*	*Melts when current is too high*	*Affects the size of current flowing*	*Allows current to be varied*	*Resistance low at high temp*

AQA Electricity

Current, potential difference and resistance

Current and Charge

Current	*Flow of electrical charge*	Ampere (A)
Potential difference (p.d.)	*How much electrical work is done by a cell*	Volts (V)
Charge	*Amount of electricity travelling in a circuit*	Coulombs (C)

Charge = Current X time

Q = I X t

Controlling current

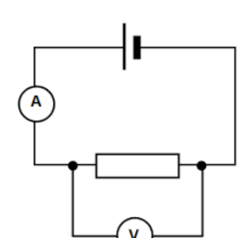
Changing current	*Change the p.d. of the cells*
	Add more components

Ammeter	*Set up in series with components*
Voltmeter	*Set up parallel to components*

Resistance (Ω)	*A measurement of how much current flow is reduced*
The higher the resistance, the more difficult it is for current to flow.	
Increasing resistance, reduces current.	
Increasing voltage, increases current.	

Resistance = Potential difference ÷ Current

R = V ÷ I



Series and parallel circuits

Electrons carry current. Electrons are free to move in metal.

Series circuit	Current is the same in all components.	Total p.d. from battery is shared between all the components.	Total resistance is the sum of each component's resistance.
Parallel circuit	Total current is the sum of each component's current.	p.d. across all components is the same.	Total resistance is less than the smallest resistance value of the individual resistor.

Energy transfers

Work is done when charge flowing.

Power (W) = potential difference X current — R = V X I

Power = (current)^2 X resistance — P = I^2 X R

Energy transferred = Power X time — E = P X t

Domestic uses and safety

Alternating current	Direct current
p.d. switches direction many times a second, current switches direction	*p.d. remains in one direction, current flows the same direction*
Generator.	Cell or battery.

Step-up transformers	Step-down transformers
Increase voltage, decrease current	*Decrease voltage, increase current*
Increases efficiency, reduces heat loss.	Makes safer for houses.

'Earthing' a safety device; Earth wire joins the metal case.

Mains supply
Frequency 50Hz, 230V

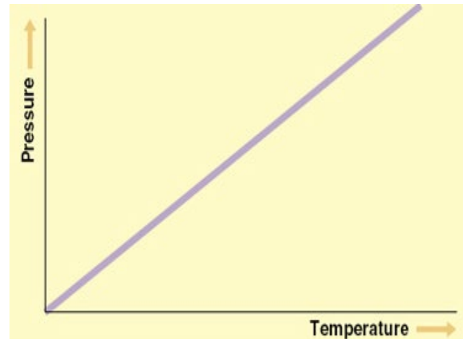
3 pin plug			
	Live - Brown	Carries p.d from mains supply.	p.d between live and earth = 230V
	Neutral - Blue	Completes the circuit.	p.d. = OV
	Earth – Green and Yellow stripes	Only carries current if there is a fault.	p.d. = 0V

AQA PARTICLE MODEL OF MATTER

Particle model

Kinetic theory of gases

Pressure of a fixed volume of gas increases as temperature increases (temperature increases, speed increases, collisions occur more frequently and with more force so pressure increases).



Temperature of gas is linked to the average kinetic energy of the particles.

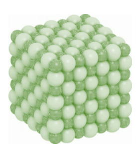
If kinetic energy increases so does the temperature of gas.

No kinetic energy is lost when gas particles collide with each other or the container.

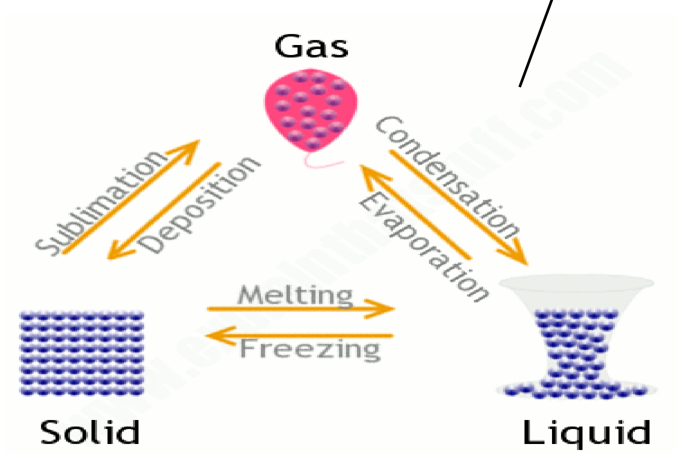
Gas particles are in a constant state of random motion.

P = m ÷ V

Density = mass ÷ volume.



Density	***Mass of a substance in a given volume***



	Units
Density	***Kilograms per metre cubed (kg/m^3)***
Volume	***Metres cubed (m^3)***
Energy needed	***Joules (J)***
Specific latent heat	***Joule per kilogram (J/kg)***
Change in thermal energy	***Joules (J)***
Pressure	***Pascals (Pa)***

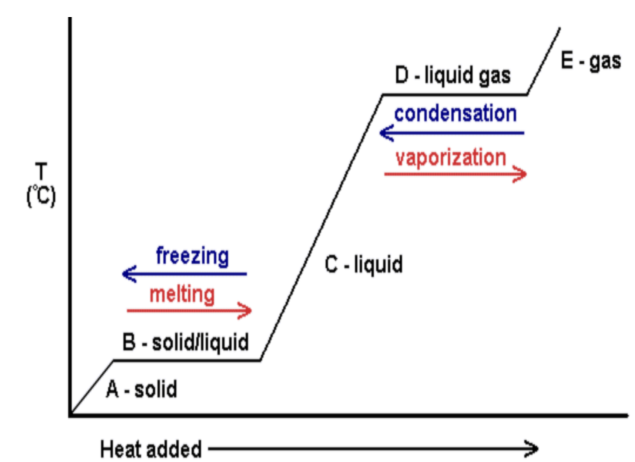
Internal energy and energy transfers

Specific Heat Capacity	***Energy needed to raise 1kg of substance by 1°C***	Depends on: • Mass of substance • What the substance is • Energy put into the system.

Change in thermal energy = mass **X** specific heat capacity **X** temperature change.

$\Delta E = m \times c \times \Delta\theta$

Internal energy	***Energy stored inside a system by particles***	Internal energy is the total kinetic and potential energy of all the particles (atoms and molecules) in a system.
	Heating changes the energy stored within a system	Heating causes a change in state. As particles separate, potential energy stored increases. Heating increases the temperature of a system. Particles move faster so kinetic energy of particles increases.



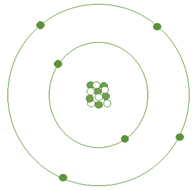
Specific Latent Heat	***Energy needed to change 1kg of a substance's state***
Specific Latent Heat of Fusion	***Energy needed to change 1kg of solid into 1 kg of liquid at the same temperature***
Specific Latent Heat of Vaporisation	***Energy needed to change 1kg of liquid into 1 kg of gas at the same temperature***

Energy needed = mass **X** specific latent heat.

$\Delta E = m \times L$

AQA ATOMIC STRUCTURE

Radius of an atom
1 X 10^{-10}m



Electrons gained → Negative ion

Electrons lost → Positive ion

Atom	*Same number of protons and electrons*
Ion	*Unequal number of electrons to protons*
Mass number	*Number of protons and neutrons*
Atomic number	*Number of protons*

Particle	*Charge*	*Size*	*Found*
Neutron	*None*	*1*	*In the nucleus*
Proton	*+*	*1*	*In the nucleus*
Electron	*-*	*Tiny*	*Orbits the nucleus*

Democritus	Suggested idea of atoms as small spheres that cannot be cut.
J J Thomson (1897)	Discovered electrons– emitted from surface of hot metal. Showed electrons are negatively charged and that they are much less massive than atoms.
Thomson (1904)	Proposed *'plum pudding'* model – atoms are a ball of positive charge with negative electrons embedded in it.
Geiger and Marsden (1909)	Directed beam of alpha particles (He^{2+})at a thin sheet of gold foil. Found some travelled through, some were deflected, some bounced back.
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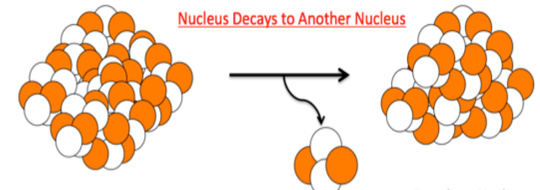
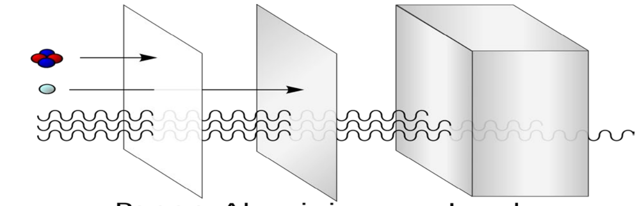
Chadwick (1932)	Discovered neutrons in nucleus – enabling other scientists to account for mass of atom.

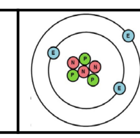
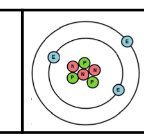
Atoms and Nuclear Radiation





Decay	*Range in air*	*Ionising power*	*Penetration power*
Alpha	Few cm	Very strong	Stopped by paper
Beta	Few m	Medium	Stopped by Aluminium
Gamma	Great distances	Weak	Stopped by thick lead

Radioactive decay	*Unstable atoms randomly emit radiation to become stable*
Detecting	*Use Geiger Muller tube*
Unit	*Becquerel*
Ionisation	*All radiation ionises*

Isotope	$^{6}_{3}Li$		$^{7}_{3}Li$	
Different forms of an element with the same number of protons but different number of neutrons				

Decay	*Emitted from nucleus*	*Changes in mass number and atomic number*	
Alpha (α)	*Helium nuclei ($^{4}_{2}He$)*	*-4*	*-2*
Beta (β)	*Electron ($^{0}_{-1}e$)*	*0*	*+1*
Gamma (γ)	*Electromagnetic wave*	*0*	*0*
Neutron	*Neutron*	*-1*	*0*

$^{238}_{92}U \rightarrow ^{234}_{90}Th + ^{4}_{2}He$

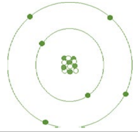
$^{14}_{6}C \rightarrow ^{14}_{7}N + ^{0}_{-1}e$

$^{99}_{43}Tc \rightarrow ^{99}_{43}Tc + \gamma$

AQA ATOMIC STRUCTURE (Separates)

Atom structure

Radius of an atom	1×10^{-10} m



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Negative ion	Positive ion

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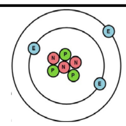
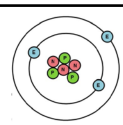
Isotope	$^{6}_{3}$Li		$^{7}_{3}$Li	
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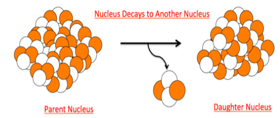
Atoms and Isotopes

Atoms and Nuclear Radiation



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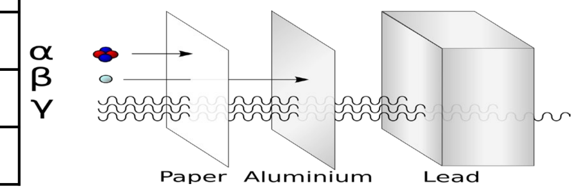

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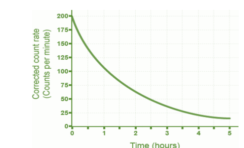
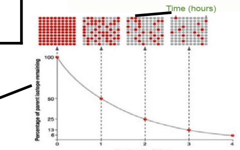
Gamma (γ)	*Electromagnetic wave*	*0*	*0*	$^{99}_{43}Tc \rightarrow ^{99}_{43}Tc + \gamma$
Neutron	*Neutron*	*-1*	*0*	

Hazards and uses of Radioactive emissions and of background radiation

Contamination	*Unwanted presence of radioactive atoms*
Irradiation	*Person is in exposed to radioactive source*



Half life	*The time taken to lose half of its initial radioactivity*



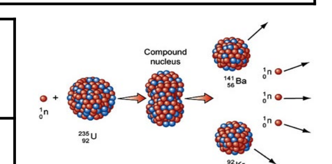
Sievert	*Unit measuring dose of radiation*
Background	*Constant low level environmental radiation, e.g. from nuclear testing, nuclear power, waste*

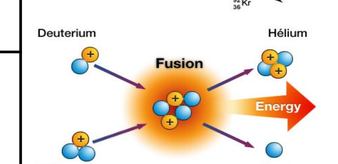
Uses	*Different isotopes have different half lives*	Short half-lives used in high doses, long half lives used in low doses.
Tracers	*Used within body*	Isotope with short half life injected, allowed to circulate and collect in damaged areas. PET scanner used to detect emitting radiation. Must be beta or gamma as alpha does not penetrate the body.
Radiation therapy	*Used to treat illnesses e.g. cancer*	Cancer cells killed by gamma rays. High dose used to kill cells. Damage to healthy cells prevented by focussed gamma ray gun.

Nuclear fission and fusion

Fuel rods	Made of U-238, 'enriched' with U-235 (3%). Long and thin to allow neutrons to escape, hitting nuclei.
Control rods	Made of Boron. Controls the rate of reaction. Boron absorbs excess neutrons.
Concrete	Neutrons hazardous to humans – thick concrete shield protects workers.

Nuclear fission	*One large unstable nucleus splits to make two smaller nuclei*	Neutron hits U-235 nucleus, nucleus absorbs neutron, splits emitting two or three neutrons and two smaller nuclei. Process also releases energy.	Process repeats, chain reaction formed Used in nuclear power stations
Nuclear fusion	*Two small nuclei join to make one larger nucleus*	Difficult to do on Earth – huge amounts of pressure and temperature needed.	Occurs in stars





AQA FORCES – Foundation

Observing and recording motion

Speed of sound 330m/s.

Speed = distance ÷ time — $v = s \div t$

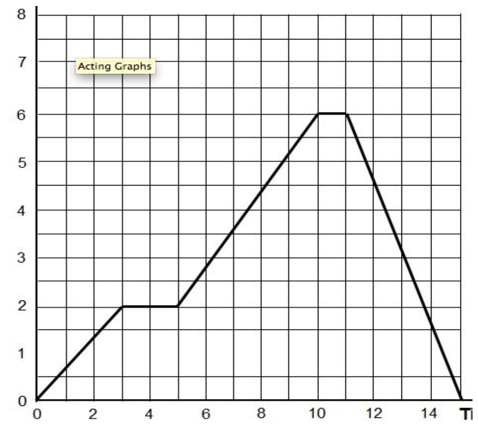
Speed	***How fast an object moves***	Scalar
Displacement	***Includes the distance and direction an object moves***	vector
Distance	***How far an object moves***	scalar

Speed is rarely constant.

Car on motorway	***30m/s***
Train	***60m/s***
Jet plane	***200m/s***

Walking	***1.5m/s***
Running	***3m/s***
Cycling	***6m/s***

Describing motion



Distance-time graph	***Shows how far an object moves along a straight line***
Speed of object	***Use the gradient of graph***

Forces and braking

Frictional forces decelerate a moving object and bring it to rest.

Speed affects both thinking and braking distances.

Typical reaction time = 0.7s

Thinking distance	***Distance travelled whilst the driver reacts***
Braking distance	***Distance travelled whilst the car is stopped by the brakes***
Stopping distance	***Total thinking and braking distances***

Factors affecting stopping distances	***Drivers reaction times***	Drinking alcohol, taking drugs, tired.
	Braking distances	Weather conditions, worn brakes or tyres, road surface, size of braking force.

Braking and kinetic energy	***Work done by braking force, reduces kinetic energy***	Kinetic energy decreases, temperature of brakes increases due to frictional forces.

Forces and their interactions

Contact and Resultant forces

Resultant force	***The overall effect of all of the forces acting upon an object***	Two forces acting in the same direction are added.
		Two forces acting in the opposite direction are taken away.

Unit	***Newton (N)***	1N
Kilo	***Kilonewton (KN) = 1000***	$1X 10^3$
Mega	***Meganewton (MN) = 1000,000***	$1 X 10^6$

Centre of mass	***The weight of an object acts through a single point***

Scalar and vector quantities

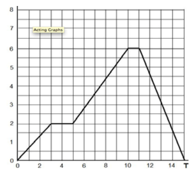
Scalar	***A quantity that only has magnitude (size)***	e.g. mass, time, speed, temperature, energy,
Vector	***A quantity that only has magnitude and direction***	e.g. force, velocity, momentum

An arrow can be used to show vectors	***Length of arrow = magnitude of vector***
	Direction of arrow = direction of vector

Velocity	***Speed + direction***	The speed of a car is 30m/s. A car moves forward with a velocity of 30m/s
Distance	***How far***	The table is 1m long
Displacement	***Distance + direction***	The beach is 1km due east of the town

AQA FORCES – Higher

Gradient = vertical ÷ horizontal



Describing motion

Distance travelled	***Area under the graph shape***
Velocity-time graph	***Shows speed of an object***

Accelerating	***Object getting faster***
Decelerating	***Object slowing down***

Acceleration = change in velocity ÷ time taken

Acceleration	***Change in velocity***	Vector

Accelerating objects	***It takes time for objects to reach top speed***	Draw a tangent to the curve, work out gradient.

Distance-time graph	***Shows how far an object moves along a straight line***
Speed of object	***Use the gradient of graph***

Changing velocity	***Objects in a circular motion, change direction but keep a constant speed, e.g. satellite, car on a bend, plane***

Velocity	***The speed of an object with direction***	Vector

Speed of sound 330m/s.

Constant acceleration

(final velocity) ^{2} – (initial velocity) ^{2} = 2 X acceleration X distance

$V^2 - u^2 = 2 \times a \times s$

Falling objects

Falling objects accelerate due to gravity.	In no air resistance, objects accelerate at $9.8 m/s^2$	Air resistance slows falling objects down.

Terminal velocity	***Weight of an object is balanced by resistive forces***	Object moves at a constant velocity. Resultant force = 0.

Inertia

Speed or direction only changes if a resultant force acts on the object

Inertia	***When objects continue in the same state of motion***

Newton's Laws

Acceleration is proportional to resultant force.

Acceleration is inversely proportional to mass.

Newton's first Law	***Balanced forces***	When the resultant force on an still object = 0, the object is stationary.
		When the resultant force on a moving object = 0, the object is at a constant speed.
Newton's second Law	***Unbalanced forces***	When the resultant force is greater than 0, the object accelerates. It could speed up, slow down or change direction.
Newton's third Law	***Equal and opposite forces***	When two objects interact the forces exerted are equal and in an opposite direction.

Forces and braking

Frictional forces decelerate a moving object and bring it to rest.

Force = mass X acceleration

F = m X a

Thinking distance	***Distance travelled whilst the driver reacts***
Braking distance	***Distance travelled whilst the car is stopped by the brakes***
Stopping distance	***Total thinking and braking distances***

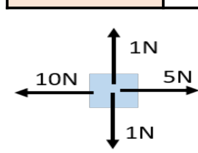
Inertial mass	***How difficult it is to change the velocity of an object***
Inertial mass = force ÷ acceleration	
If the mass is large, to change velocity a big force is needed.	

Factors affecting stopping distances	***Drivers reaction times***	Drinking alcohol, taking drugs, tired.
	Braking distances	Weather conditions, worn brakes or tyres, road surface, size of braking force.

Braking and kinetic energy	***Work done by braking force, reduces kinetic energy***	Kinetic energy decreases, temperature of brakes increases due to frictional forces.

Resultant force	***The overall effect of all of the forces acting upon an object***	Two forces acting in the same direction are added.
		Two forces acting in the opposite direction are taken away.

Free body diagram	***Show magnitude and direction of all forces upon an object***



Object moves left with a force of 5N

Scalar and vector quantities

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Vector	***A quantity that only has magnitude and direction***	e.g. force, velocity, momentum

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Velocity	***Speed + direction***	The speed of a car is 30m/s. A car moves forward with a velocity of 30m/s
Distance	***How far***	The table is 1m long
Displacement	***Distance + direction***	The beach is 1km due east of the town

Pressure

Pressure and depth
Pressure on divers depends on weight of water above

Upthrust
Resultant force exerted by a fluid

Atmospheric pressure
Caused by billions of air particles colliding with a surface.

Hydraulic machine	***Use liquids to transmit pressure***

Pressure = height X density X gfs

AQA FORCES – (Separates Part 1)

Forces and their interactions

Scalar and vector quantities

Scalar	***A quantity that only has magnitude (size)***	e.g. mass, time, speed, temperature, energy,
Vector	***A quantity that only has magnitude and direction***	e.g. force, velocity, momentum

An arrow can be used to show vectors	***Length of arrow = magnitude of vector***
	Direction of arrow = direction of vector

Velocity	***Speed + direction***	The speed of a car is 30m/s. A car moves forward with a velocity of 30m/s
Distance	***How far***	The table is 1m long
Displacement	***Distance + direction***	The beach is 1km due east of the town

Contact and Resultant forces

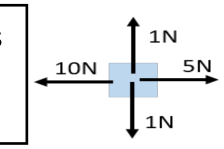
Resultant force	***The overall effect of all of the forces acting upon an object***	Two forces acting in the same direction are added.
		Two forces acting in the opposite direction are taken away.

Resolving forces	***An object pulled with a force at an angle***	A single force can be split into two components acting at right angles to each other.

The component forces combined have the same effect.

Free body diagram	***Show magnitude and direction of all forces upon an object***

Object moves left with a force of 5N



Forces and elasticity

One force	***The object changes speed or direction***
More than one force	***The object changes shape***

Two balanced forces can stretch a object.

Two balanced forces can compress an object.

Three balanced forces can bend an object.

Elastic deformation	***The object has been stretched but returns to its original length***
Inelastic deformation	***The object has been stretched but does not return to its original length***
Extension	***The difference between stretched and unstretched lengths***

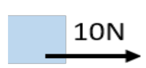
Limit of proportionality
Beyond this point the spring is permanently deformed

Stretching a spring	Force = spring constant X extension, $F = k \times e$
	EPE = ½ X spring constant X $(\text{extension})^2$, $EPE = \frac{1}{2} ke^2$

Elastic Potential energy (EPE)	***Energy stored in a stretched spring***

Force	***Newton (N)***
Spring constant	***Newton per metre (N/m)***
Extension	***Metres (m)***
EPE	***Joules (J)***

Moments, levers and gears



$M = F \times d$

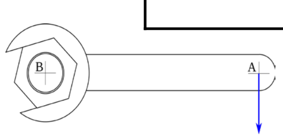
Moment = force X distance

Moment	***Turning effect of a force about a pivot***

Gears	***Increase or decrease the rotational effect of a force***

Lever	***A small force exerted with a long lever applies a large force***

Principle of moments
In a balanced system, the sum of the clockwise moments = the sum of the anti-clockwise moments



Pressure

Pressure = Force ÷ Area

$P = F \div A$

Pressure and depth
Pressure on divers depends on weight of water above

Pressure = height X density X gfs

Upthrust
Resultant force exerted by a fluid

Fluid	***A liquid or gas***
Flows and changes shape to fill a container.	

Hydraulic machine	***Use liquids to transmit pressure***

Atmospheric pressure
Caused by billions of air particles colliding with a surface.

AQA FORCES – (Separates Part 2)

Observing and recording motion

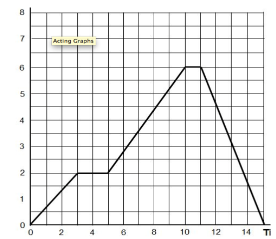
Changing velocity	*Objects in a circular motion, change direction but keep a constant speed, e.g. satellite, car on a bend, plane*

Velocity	*The speed of an object with direction*	Vector

Speed of sound 330m/s.

Describing motion

Distance-time graph	*Shows how far an object moves along a straight line*
Speed of object	*Use the gradient of graph*



Gradient = vertical ÷ horizontal

Accelerating objects	*It takes time for objects to reach top speed*	Draw a tangent to the curve, work out gradient.

Distance travelled	*Area under the graph shape*

Velocity-time graph	*Shows speed of an object*

Accelerating	*Object getting faster*
Decelerating	*Object slowing down*

Acceleration = change in velocity ÷ time taken

Acceleration	*Change in velocity*	Vector

Constant acceleration
(final velocity) ^{2} – (initial velocity) ^{2} = 2 X acceleration X distance $V^2 - u^2 = 2 X a X s$

Falling objects

Falling objects accelerate due to gravity.

Terminal velocity	*Weight of an object is balanced by resistive forces*	Object moves at a constant velocity. Resultant force = 0.

Parachuting	*Size of air resistance depends on area of object and speed*
Larger the area, the larger the air resistance.	
Larger the speed, the larger the air resistance.	

Inertia	*When objects continue in the same state of motion*

Newton's first Law	*Balanced forces*	When the resultant force on an still object = 0, the object is stationary. When the resultant force on a moving object = 0, the object is at a constant speed.
Newton's second Law	*Unbalanced forces*	When the resultant force is greater than 0, the object accelerates. It could speed up, slow down or change direction.
Newton's third Law	*Equal and opposite forces*	When two objects interact the forces exerted are equal and in an opposite direction.

Acceleration is proportional to resultant force.

Acceleration is inversely proportional to mass.

Forces and braking

Frictional forces decelerate a moving object and bring it to rest.

Thinking distance	*Distance travelled whilst the driver reacts*
Braking distance	*Distance travelled whilst the car is stopped by the brakes*
Stopping distance	*Total thinking and braking distances*

Factors affecting stopping distances	*Drivers reaction times*	Drinking alcohol, taking drugs, tired.
	Braking distances	Weather conditions, worn brakes or tyres, road surface, size of braking force.
Braking and kinetic energy	*Work done by braking force, reduces kinetic energy*	Kinetic energy decreases, temperature of brakes increases due to frictional forces.

Force = mass X acceleration

F = m X a

Inertial mass	*How difficult it is to change the velocity of an object*
Inertial mass = force ÷ acceleration	
If the mass is large, to change velocity a big force is needed.	

Momentum

Is a vector

Momentum = mass X velocity

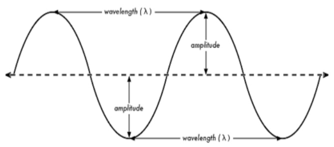
p = m X v

Conservation of momentum
When two objects collide, the momentum they have before the collision = the momentum they have after the collision
Closed system = no external forces acting on it.

Changes in momentum
Force is applied to stop momentum
If momentum changes slowly, the force applied is small so less damage.

Crumple zones

AQA Waves Foundation



Wave speed	Wave speed = frequency X wavelength	$V = f \times \lambda$
Wave period	Wave period = 1 ÷ frequency	$T = 1 \div f$
Speed	Speed = distance ÷ time	$v = d \div t$

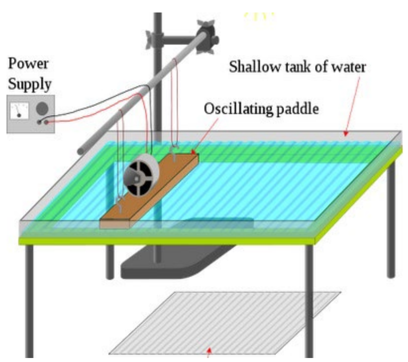
Waves in air, fluids and solids

Properties

Wavelength	*Distance from one point on a wave to the same point of the next wave*
Amplitude	*The maximum disturbance from its rest position*
Frequency	*Number of waves per second*
Period	*Time taken to produce 1 complete wave*

Measuring speed

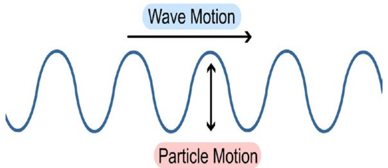
In water, use a ripple tank.

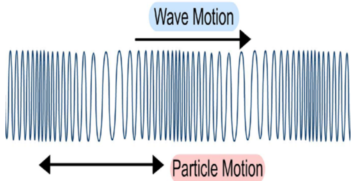


In air, use echoes.

Transverse and Longitudinal waves

Transverse wave	*Vibration causing the wave is at right angles to the direction of energy transfer*	Energy is carried outwards by the wave.	Water and light waves, S waves.
Longitudinal wave	*Vibration causing the wave is parallel to the direction of energy transfer*	Energy is carried along the wave.	Sound waves, P waves.





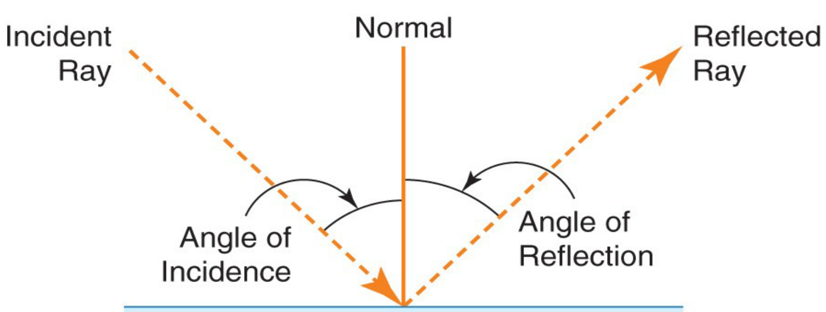
Electromagnetic waves

Electromagnetic wave	*Continuous spectrum of transverse waves*

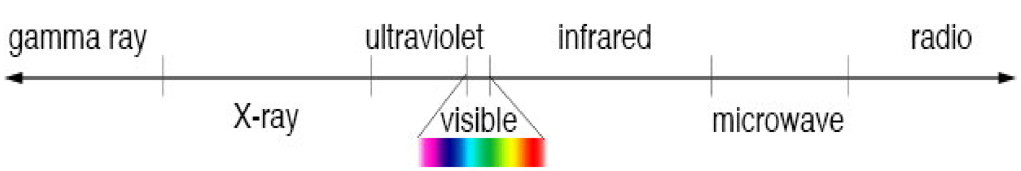
Short wavelengths have high frequency and high energy.

e.g. Gamma

	Units
Distance	*Metres (m)*
Wave speed	*Metres per second (m/s)*
Wavelength	*Metres (m)*
Frequency	*Hertz (Hz)*
Period	*Seconds (s)*



Angle of incidence = angle of reflection
(i) = (r)



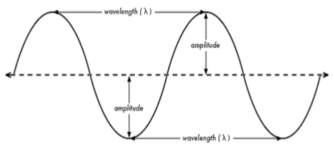
Low frequency, long wavelength.

White	Wave lengths reflected
Black	Wave lengths absorbed

High frequency, short wavelength

AQA Waves Higher

Waves in air, fluids and solids



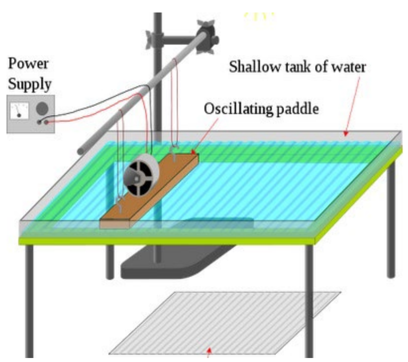
Wave speed	Wave speed = frequency X wavelength	$V = f \times \lambda$
Wave period	Wave period = 1 ÷ frequency	$T = 1 \div f$
Speed	Speed = distance ÷ time	$v = d \div t$

Properties

Wavelength	*Distance from one point on a wave to the same point of the next wave*
Amplitude	*The maximum disturbance from its rest position*
Frequency	*Number of waves per second*
Period	*Time taken to produce 1 complete wave*

Measuring speed

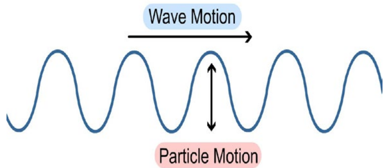
In water, use a ripple tank.

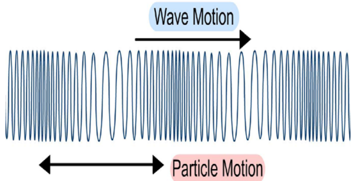


In air, use echoes.

Transverse and Longitudinal waves

Transverse wave	*Vibration causing the wave is at right angles to the direction of energy transfer*	Energy is carried outwards by the wave.	Water and light waves, S waves.
Longitudinal wave	*Vibration causing the wave is parallel to the direction of energy transfer*	Energy is carried along the wave.	Sound waves, P waves.



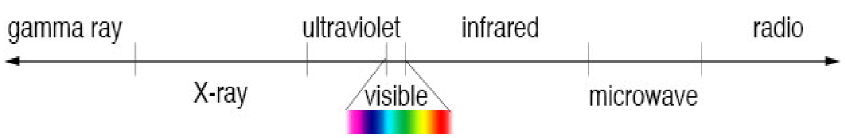


Electromagnetic waves

Electromagnetic wave	*Continuous spectrum of transverse waves*

Short wavelengths have high frequency and high energy.

e.g. Gamma



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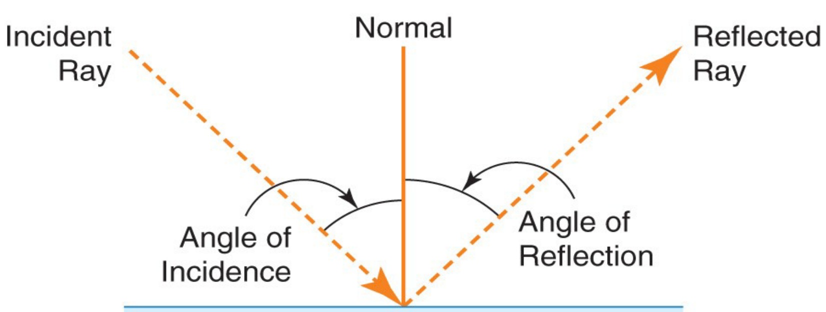


Angle of incidence = angle of reflection
(i) = (r)

Properties

Absorbed light changes into thermal energy store.

EM wave	Danger	Use
Radio	Safe.	Communications, TV, radio.
Microwave	Burning if concentrated.	Mobile phones, cooking, satellites.
Infrared		Heating, remote controls, cooking.
Visible	Damage to eyes.	Illumination, photography, fibre optics.
Ultra violet	Sunburn, cancer.	Security marking, disinfecting water.
X-ray	Cell destruction, mutation, cancer.	Broken bones, airport security.
Gamma		Sterilising, detecting and killing cancer.

Low frequency, long wavelength.

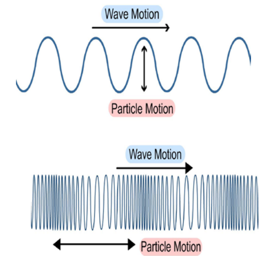
White	Wave lengths reflected
Black	Wave lengths absorbed

High frequency, short wavelength

AQA Waves (Separates only)

Properties

Wave speed (m/s)	Wave speed = frequency X wavelength	$V = f \times \lambda$
Wave period (s)	Wave period = 1 ÷ frequency (Hz)	$T = 1 \div f$
Speed	Speed = distance ÷ time	$v = d \div t$



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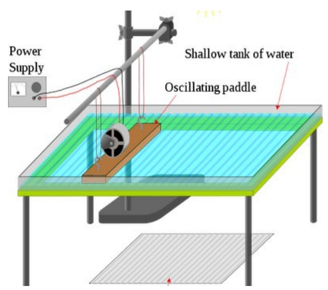
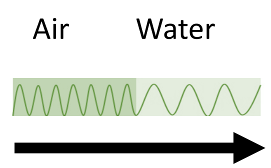
Measuring speed

In water, use a ripple tank.

In air, use echoes.

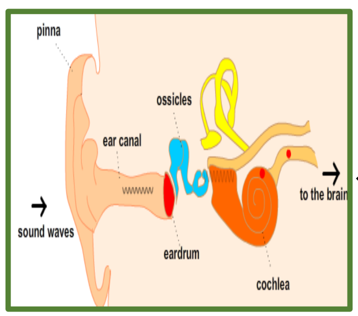


Sound waves travelling through different mediums, the frequency stay constant.



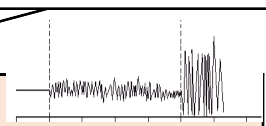
Waves in air, fluids and solids

Angle of incidence = angle of reflection (i) = (r)

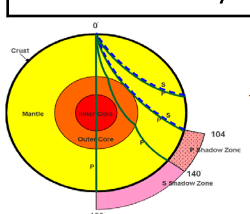


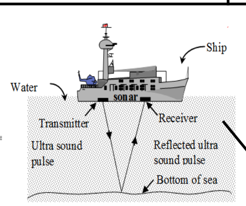
Hearing	***Frequencies between 20 – 20,000 Hz***	Longitudinal waves cause ear drum to vibrate, amplified by three ossicles which creates pressure in the cochlea.

Seismic waves



P wave	S wave	Seismograph
Longitudinal	***Transverse***	***Shows P and S waves arriving at different times.***
Fast	***Slow***	
Travel through solids and liquids	***Travels through solids***	By using the times the waves arrive at the monitoring centres, the epicentre of earthquake can be found. ($v = x \div t$).
Produced by earthquakes.		



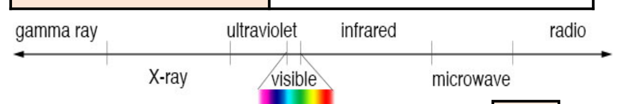


Ultra sound	***Partially reflected off boundary***	Used for medical and foetal scans.
Sonar	***Reflected off objects***	Used to determine depth of objects under the sea.

Electromagnetic waves

Light refracts as it slows down in a denser substance

Electromagnetic wave	***Continuous spectrum of transverse waves***



Short wavelengths have high frequency and high energy.

e.g. Gamma

Properties

Absorbed light changes into thermal energy store.

Black surfaces	***Good emitters, good absorbers***
White surfaces	***Poor emitters, poor absorbers***
Shiny surfaces	***Good reflectors***

EM waves refract

EM wave	Danger	Use
Radio	Safe.	Communications, TV, radio.
Microwave	Burning if concentrated.	Mobile phones, cooking, satellites.
Infrared		Heating, remote controls, cooking.
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X-ray	Cell destruction, mutation, cancer.	Broken bones, airport security.
Gamma		Sterilising, detecting and killing cancer.

Low frequency, long wavelength.

White	Wave lengths reflected
Black	Wave lengths absorbed

High frequency, short wavelength

Black body radiation

Earth and Global warming

Ultraviolet, visible light, infra-red radiation penetrate atmosphere and heat up Earth's surface.

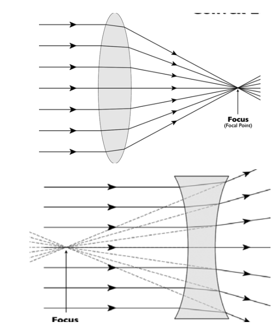
Longer wavelengths are radiated back, trapped by atmosphere.

Energy lost is not at the same rate as energy being absorbed so Earth heats up.

Black body radiation	***All objects absorb or reflect infrared radiation***	Hotter objects emit more infrared radiation.
Constant temperature	***Rate of absorption = rate of radiation***	Intensity and wavelength of energy affects temperature.

Lenses

Convex	Real or virtual images.
Concave	Only virtual images.



Magnification = image size ÷ object size

2F	Image same size, upside down, real.
2F - F	Image larger, upside down, real.
< F	Image bigger, right way, virtual.

Specular	Flat surface reflection.
Diffuse	Rough surface reflection.

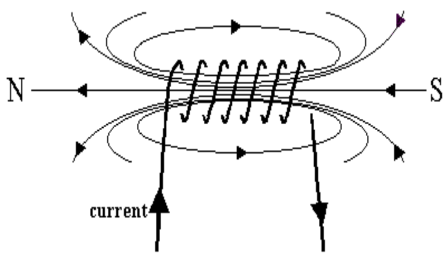
AQA MAGNETISM AND ELECTROMAGNETISM - Foundation

Motor effect

Relay	*A device using a small current to control a larger current in another circuit*	Solenoid is wound around an iron core. Small current magnetises the solenoid. This attracts to electrical contacts, making a complete circuit. Current flows from battery to starter motor.

Electromagnet	*Lots of turns of wire increase the magnetising effect when current flows*
	Turn current off, magnetism lost.

Increase strength of magnetic field	*Use larger current*
	Use more turns of wire
	Put turns of wire closer together
	Use iron core in middle



Solenoid	*A long coil of wire*	Magnetic field from each loop adds to the next.

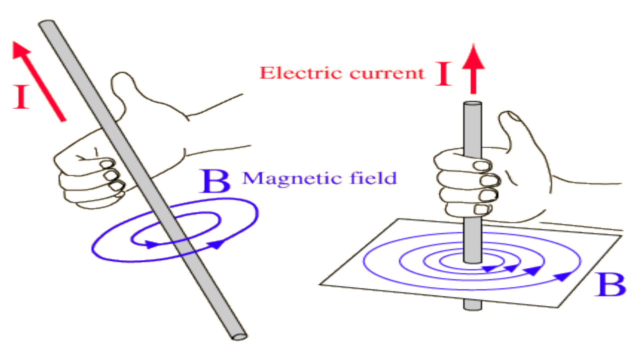
Magnetic field around a wire

Electric current flowing in a wire produces a magnetic field around it.

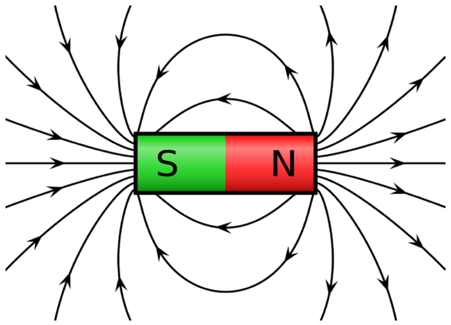
- Reverse current, magnetic field direction reverses.
- Further away from the wire, magnetic field is weaker.
- Current large enough, iron filings show circular magnetic field.
- If current is small, magnetic field is very weak.

Right hand rule

Thumb	Direction of current.
Fingers	Direction of magnetic field.



Permanent and Induced Magnetism



Magnets

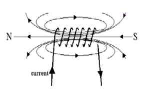
Magnetic	*Materials attracted by magnets*	Uses non-contact force to attract magnetic materials.
North seeking pole	*End of magnet pointing north*	Compass needle is a bar magnet and points north.
South seeking pole	*End of magnet pointing south*	Like poles (N – N) repel, unlike poles (N – S) attract.
Magnetic field	*Region of force around magnet*	Strong field, force big. Weak field, force small. Field is strongest at the poles.
Permanent	*A magnet that produces its own magnetic field*	Will repel or attract other magnets and magnetic materials.
Induced	*A temporary magnet*	Becomes magnet when placed in a magnetic field.

AQA MAGNETISM AND ELECTROMAGNETISM - Higher

Motor effect

Relay	*A device using a small current to control a larger current in another circuit*	Solenoid is wound around an iron core. Small current magnetises the solenoid. This attracts to electrical contacts, making a complete circuit. Current flows from battery to starter motor.

Electromagnet	*Lots of turns of wire increase the magnetising effect when current flows*	Turn current off, magnetism lost.



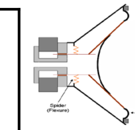
Solenoid	*A long coil of wire*	Magnetic field from each loop adds to the next.

Increase strength of magnetic field	*Use larger current*
	Use more turns of wire
	Put turns of wire closer together
	Use iron core in middle

Right hand rule

Thumb	Direction of current.
Fingers	Direction of magnetic field.

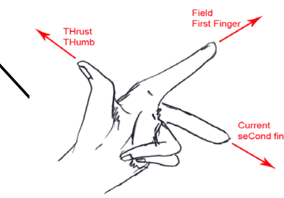
Split-ring commutator	*Split ring touching two carbon brush contacts*	
Loud speakers	*Converts variations in electrical current into sound waves .*	Varying current flows through a coil that is in a magnetic field. A force on the wire moves backwards and forwards as current varies. Coil connected to a diaphragm. Diaphragm movements produce sound waves.
Generators	*Coil of wire rotating inside a magnetic field. The end of the coil is connected to slip rings.*	Produces altering current.
Microphones	*Converts pressure variations in sound waves into variations in current in electrical circuits.*	
Electric motor	*Coil of wire rotates about an axle*	Current flows through the wire causing a downward movement on one side and an upward movement on the other side.



Fleming's left-hand rule

To predict the direction a straight conductor moves in a magnetic field.

Thumb	Direction of movement.
First finger	Direction of magnetic field.
Second finger	Direction of current.



If current and magnetic field are parallel to each other , no force on wire.

Magnetic fields from the permanent magnet and current in the foil interact. This is called the motor effect.

Reverse the current , foil moves upwards.

Aluminium foil placed between two poles of a strong magnet, will move downwards when current flows through the foil.

Size of force acting on foil depends on magnetic flux density between poles, size of current, length of foil between poles.

F = B X I X l

Force = magnetic flux density X current X length

Magnetic flux	*Lines drawn to show magnetic field*	Lots of lines = stronger magnets.
Magnetic flux density	*Number of lines of magnetic flux in a given area*	Measures the strength of magnetic force.

Magnetic field around a wire

Electric current flowing in a wire produces a magnetic field around it.

If current is small, magnetic field is very weak.

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Further away from the wire, magnetic field is weaker.

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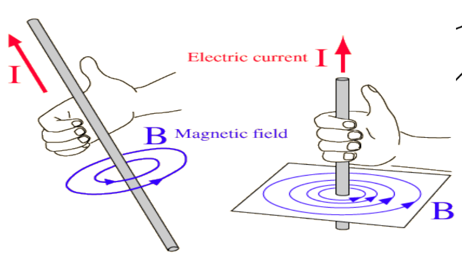
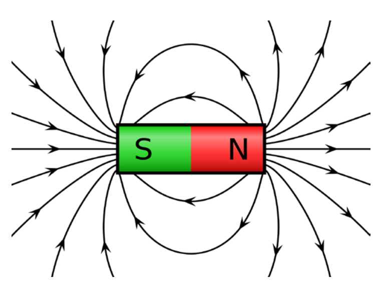




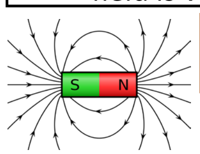
Permanent and Induced Magnetism

Magnetic	*Materials attracted by magnets*	Uses non-contact force to attract magnetic materials.
North seeking pole	*End of magnet pointing north*	Compass needle is a bar magnet and points north.
South seeking pole	*End of magnet pointing south*	Like poles (N – N) repel, unlike poles (N – S) attract.
Magnetic field	*Region of force around magnet*	Strong field, force big. Weak field, force small. Field is strongest at the poles.
Permanent	*A magnet that produces its own magnetic field*	Will repel or attract other magnets and magnetic materials.
Induced	*A temporary magnet*	Becomes magnet when placed in a magnetic field.

AQA MAGNETISM AND ELECTROMAGNETISM (Separates only)

Permanent and Induced Magnetism

Magnets



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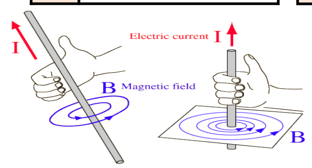
Magnetic field around a wire

Electric current flowing in a wire produces a magnetic field around it.

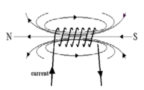
- If current is small, magnetic field is very weak.
- Current large enough, iron filings show circular magnetic field.
- Further away from the wire, magnetic field is weaker.
- Reverse current, magnetic field direction reverses.



Right hand rule

Thumb	Direction of current.
Fingers	Direction of magnetic field.

Solenoid



Solenoid	***A long coil of wire***	Magnetic field from each loop adds to the next.

Electromagnet

Electromagnet	***Lots of turns of wire increase the magnetising effect when current flows***
	Turn current off, magnetism lost.

Increase strength of magnetic field
- ***Use larger current***
- ***Use more turns of wire***
- ***Put turns of wire closer together***
- ***Use iron core in middle***

Relay

Relay	***A device using a small current to control a larger current in another circuit***	Solenoid is wound around an iron core. Small current magnetises the solenoid. This attracts to electrical contacts, making a complete circuit. Current flows from battery to starter motor.

Motor effect

Magnetic fields from the permanent magnet and current in the foil interact. This is called the motor effect.

- Reverse the current , foil moves upwards.
- Aluminium foil placed between two poles of a strong magnet, will move downwards when current flows through the foil.
- Size of force acting on foil depends on magnetic flux density between poles, size of current, length of foil between poles.

$F = B \times I \times l$

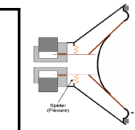
Force = magnetic flux density X current X length

If current and magnetic field are parallel to each other , no force on wire.

Magnetic flux	***Lines drawn to show magnetic field***	Lots of lines = stronger magnets.
Magnetic flux density	***Number of lines of magnetic flux in a given area***	Measures the strength of magnetic force.

Electric motor

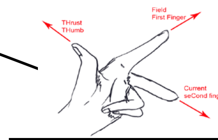
Electric motor	***Coil of wire rotates about an axle***	Current flows through the wire causing a downward movement on one side and an upward movement on the other side.
Generators	***Coil of wire rotating inside a magnetic field. The end of the coil is connected to slip rings.***	Produces altering current.
Split-ring commutator	***Split ring touching two carbon brush contacts***	
Loud speakers	***Converts variations in electrical current into sound waves .***	Varying current flows through a coil that is in a magnetic field. A force on the wire moves backwards and forwards as current varies. Coil connected to a diaphragm. Diaphragm movements produce sound waves.
Microphones	***Converts pressure variations in sound waves into variations in current in electrical circuits.***	



Fleming's left-hand rule

To predict the direction a straight conductor moves in a magnetic field.

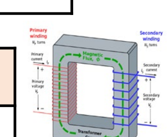
Thumb	Direction of movement.
First finger	Direction of magnetic field.
Second finger	Direction of current.



Induced potential, transformers and National Grid

Induced potential	***When a conducting wire moves through a magnetic field, p.d. is produced***	
Generator effect	***Generates electricity by inducing current or p.d.***	
Uses of the generator effect	***Dynamo, Microphones***	
Transformer	***Two coils of wire onto an iron core***	Alternating current supplied to primary coil, making magnetic field change. Iron core becomes magnetised, carries changing magnetic field to secondary coil. This induces p.d.

Step-up transformers	Step-down transformers
Increase voltage, decrease current	***Decrease voltage, increase current***
Increases efficiency by reducing amount of heat lost from wires.	Makes safer value of voltage for houses and factories.



Power lost = Potential difference X Current

Power supplied to primary coil = power supplied to secondary coil

$V_p \times I_p = V_s \times I_s$

Voltage across the coil X number of coils (primary) = Voltage across the coil X number of coils (secondary)

$V_p \div V_s = n_p \div n_s$

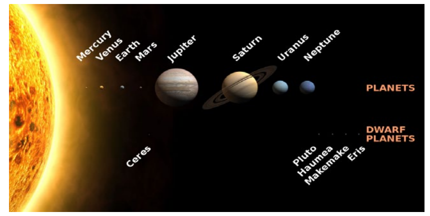
Force	***Newton (N)***
Magnetic flux density	***Tesla (T)***
Current	***Amperes (A)***
Length	***Metres (m)***
Power	***Watts (W)***
p.d.	***Voltage (V)***

AQA SPACE (Separates only)

Solar system

Milky Way our galaxy.

Planet	***A large body orbiting the Sun***
Moon	***A natural satellite orbiting a planet***
Dwarf planet	***A body large enough to have its own gravity which caused a spherical shape***
Solar system	***Any object orbiting the Sun due to gravity***
Galaxy	***Collection of billions of stars***
Universe	***Collection of galaxies***



Other objects.

Comets, asteroids, satellites.

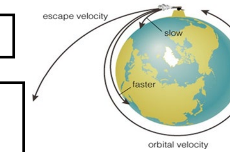
Effect of gravity.

- Gravity causes moons to orbit planets, planets to orbit the Sun, stars to orbit galaxy centres.
- Force of gravity changes the moon's direction not its speed.
- Gravity pulls objects towards the ground.

Orbital motions

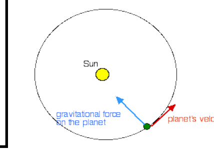
Speed of Orbit.

- Too fast = disappears into Space.
- Correct speed = steady orbit around Earth.
- Too slow = falls to Earth.



HIGHER: Circular orbits.

To calculate speed of Orbit: distance object moves in 1 orbit, Distance = 2∏r, then average speed = distance ÷ time.



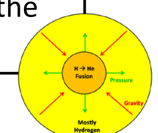
- Planets close to the Sun, gravity pull is strong. Planets move quickly.
- Planets further away from the Sun, gravity pull is weaker. So speed of planet is slower.

HIGHER:

- Velocity = a vector.
- A planet's velocity changes but speed remains constant.
- Due to the Sun's gravity, planets accelerate towards the Sun and so changes direction.

The life cycle of a star.

Nebula	***A cloud of cold hydrogen gas and dust***	Cloud collapses due to gravity, particles move very fast colliding with each other, kinetic energy transfers into internal energy and the temperature increases.
Protostar	***The large ball of gas contracts to form a star***	High temperature causes Hydrogen nuclei to collide and nuclear fusion begins. A star is 'born'.
Main sequence	***Stable period of star***	Gravity tries to collapse the star but enormous pressure of fusion energy expands and balances the inward force.



Stars the same size as our Sun.

Red giant	***A large star that fuses Helium into heavier elements***	Hydrogen runs out, star becomes unstable, pressure inside drops causing star to collapse. Atoms now closer together results in atoms fusing and temperature increases. This increase in temperature causes the core to swell.
White dwarf	***Star collapses***	Nuclear fuel runs out, fusion stops, dense very hot core.
Black dwarf	***Cold dark star***	White dwarf cools down.

Stars larger than our Sun.

Red super giant	***Star swells greatly***	Nuclear fuel begins to run out and star swells (more matter = bigger size).
Supernova	***Gigantic explosion due to run away fusion reactions***	Rapid collapse, heats to very high temperatures causing run away nuclear reactions, star explodes, flinging remnants out into space. Large gravitational forces collapse the core into a tiny space. Remains of supernova form heavier elements (Iron and above)
Neutron star	***Very dense star***	Made out of neutrons.

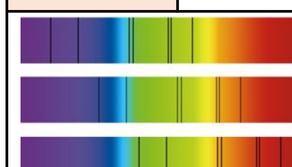
OR if collapse is into a really tiny space.

Black hole	***No light escapes***	Gravitational forces so strong everything is pulled in.

Red shift

Understanding models.

Red-shift	***The observed increase in wavelength of light from most distance galaxies. Light moves towards the red end of the spectrum.***
Hubble (1929)	***He studied light from distant galaxies; found as frequency decreases, wavelength increases.***



- Light from star in our galaxy.
- Light from star in nearby galaxy.
- Light from star in distant galaxy.

- When ambulances go past the sound changes from a high pitch to a low pitch.
- Frequency of sound wave decreases, wavelength increases.

- Galaxies are moving away from us in all directions.
- Light from distant galaxies is red-shifted, so galaxy is moving away from us.
- Galaxies further away have bigger red-shift so are moving faster away.

The Big Bang	***Universe began 13.8 billion years ago***
All matter and space expanded violently from a single point.	Red—shift provides evidence for expansion.

Aristotle (ancient Greek)	***Earth at the centre, other heavenly bodies move around the Earth.***
Copernicus (1473 - 1543)	***Sun at the centre, other heavenly bodies move around the Sun.***
Galileo (1610)	***Made a telescope, looked at Jupiter, found four moons rotating around planet.***

Planets and moons moved at different speeds to stars = reason for different positions.