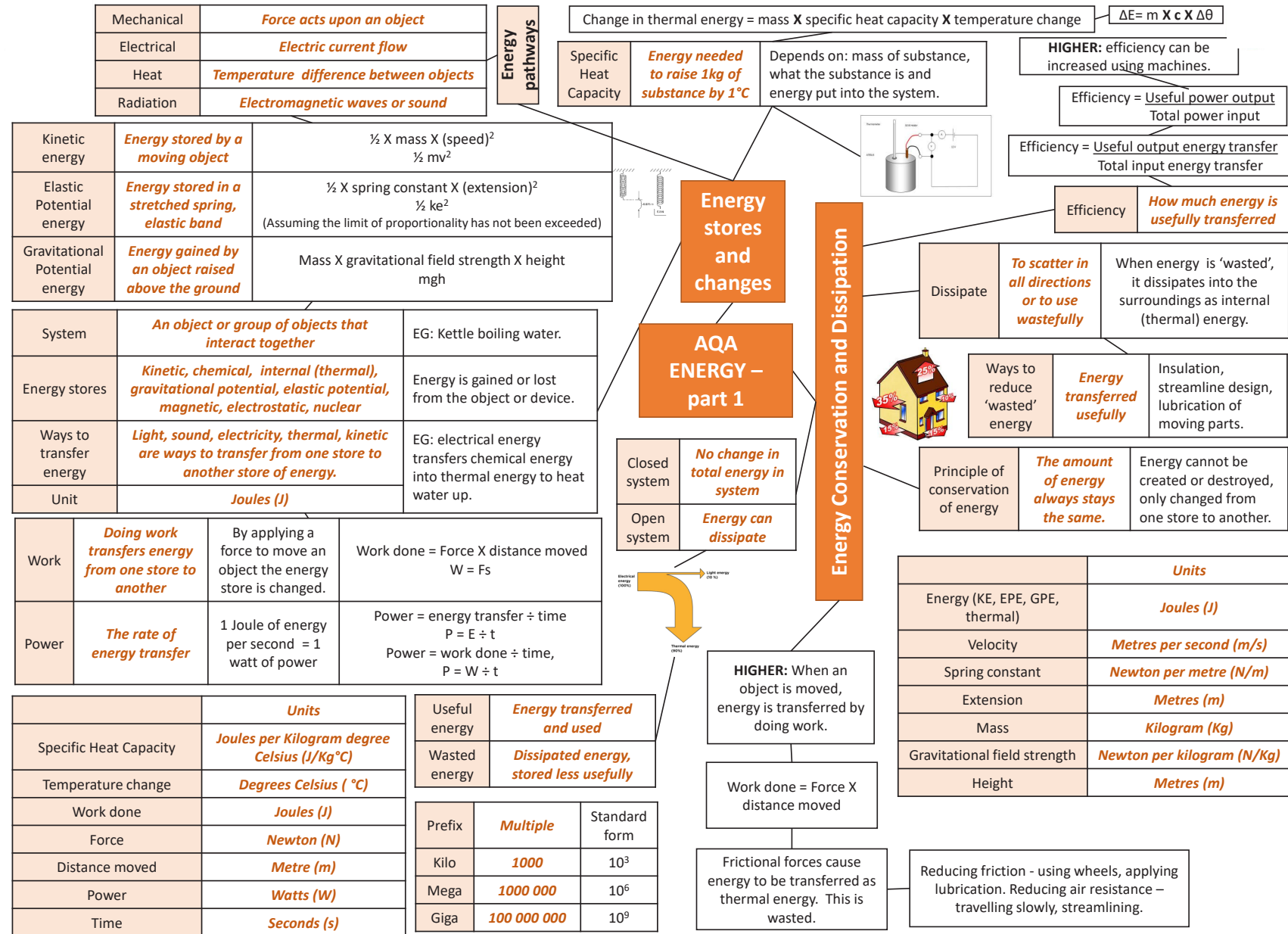
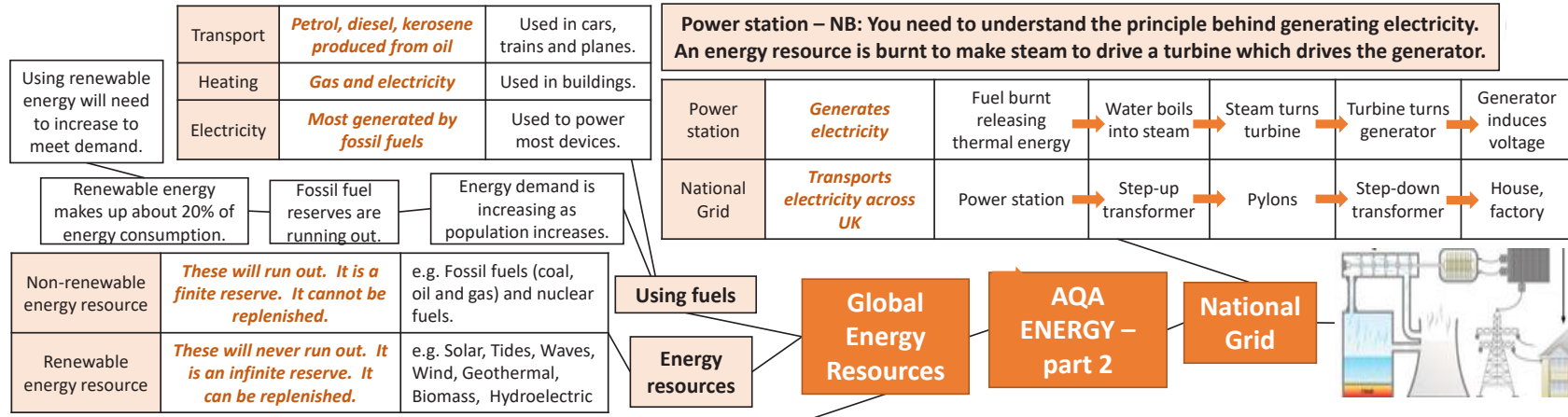


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Energy resource	How it works	Uses	Positive	Negative
Fossil Fuels (coal, oil and gas)	<i>Burnt to release thermal energy used to turn water into steam to turn turbines</i>	Generating electricity, heating and transport	Provides most of the UK energy. 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	<i>Nuclear fission process</i>	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	<i>Plant matter burnt to release thermal energy</i>	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	<i>Every day tides rise and fall, so generation of electricity can be predicted</i>	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	<i>Up and down motion turns turbines</i>	Generating electricity	Renewable. No waste products.	Can be unreliable depends on wave output as large waves can stop the pistons working.
Hydroelectric	<i>Falling water spins a turbine</i>	Generating electricity	Renewable. No waste products.	Habitats destroyed when dam is built.
Wind	<i>Movement causes turbine to spin which turns a generator</i>	Generating electricity	Renewable. No waste products.	Unreliable – wind varies. Visual and noise pollution. Dangerous to migrating birds.
Solar	<i>Directly heats objects in solar panels or sunlight captured in photovoltaic cells</i>	Generating electricity and some heating	Renewable. No waste products.	Making and installing solar panels expensive. Unreliable due to light intensity.
Geothermal	<i>Hot rocks under the ground heats water to produce steam to turn turbine</i>	Generating electricity and heating	Renewable. Clean. No greenhouse gases produced.	Limited to a small number of countries. Geothermal power stations can cause earthquake tremors.

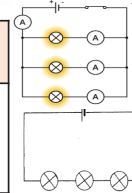
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Electrons carry current. Electrons are free to move in metal.

Cell	Battery	Switch	Lamp	Ammeter	Volt meter	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



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 $Q = I \times t$

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

Controlling current:

Series and parallel circuits

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 resistance value of the smallest individual resistor.

Series: A circuit with one loop

Parallel: A circuit with two or more loops

Total p.d.: If cells are joined in series, add up individual cell values

AQA Electricity

Energy transfers

Work is done when charge flowing.

Power (W) = potential difference X current $R = V \times I$

Power = (current)² X resistance $P = I^2 \times R$

Energy transferred = Power X time $E = P \times t$

Domestic uses and safety

National Grid: Distributes electricity generated in power stations around UK

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

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.	

$R = V \div I$

Resistance = Potential difference ÷ Current

Thermistor	LDR
Resistance varies with temperature	Resistance varies with light intensity
Resistance decreases as temperature increases.	Resistance decreases as light increases.

Ohmic conduct or	At a constant temperature, current is directly proportional to the p.d. across the resistor.
Filament lamp	As current increases, the resistance increases. The temperature increases as current flows.
Diode	Current flows when p.d. flows forward. Very high resistance in reverse.

Current - Potential difference graphs

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. = 0V
Earth - Green and Yellow stripes	Only carries current if there is a fault.	p.d. = 0V

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

Mains supply: Frequency 50Hz, 230V

Generator.	Cell or battery.
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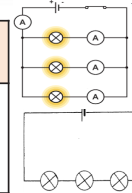
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Total p.d. If cells are joined in series, add up individual cell values	

AQA Electricity

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Resistance = Potential difference ÷ Current

Thermistor	LDR
Resistance varies with temperature	Resistance varies with light intensity
Resistance decreases as temperature increases.	Resistance decreases as light increases.

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.

Current - Potential difference graphs

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

Mains supply: Frequency 50Hz, 230V



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Radius of an atom
 $1 \times 10^{-10}\text{m}$



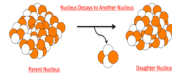
Electrons gained

Electrons lost

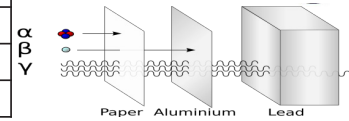
Negative ion

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



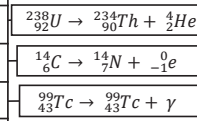
Decay	Range in air	Ionising power	Penetration power
Alpha	Few cm	Very strong	Stopped by paper
Beta	Few m	Medium	Stopped by Aluminium
Gamma	Great distances	Weak	Stopped by thick lead



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

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

Decay	Emitted from nucleus	Changes in mass number and atomic number	
Alpha (α)	Helium nuclei (${}^4_2\text{He}$)	-4	-2
Beta (β)	Electron (${}^0_{-1}\text{e}$)	0	+1
Gamma (γ)	Electromagnetic wave	0	0
Neutron	Neutron	-1	0



Isotope

${}^6_3\text{Li}$

${}^7_3\text{Li}$

Different forms of an element with the same number of protons but different number of neutrons

Atom structure

Atoms and Isotopes

Atoms and Nuclear Radiation

AQA
ATOMIC
STRUCTURE

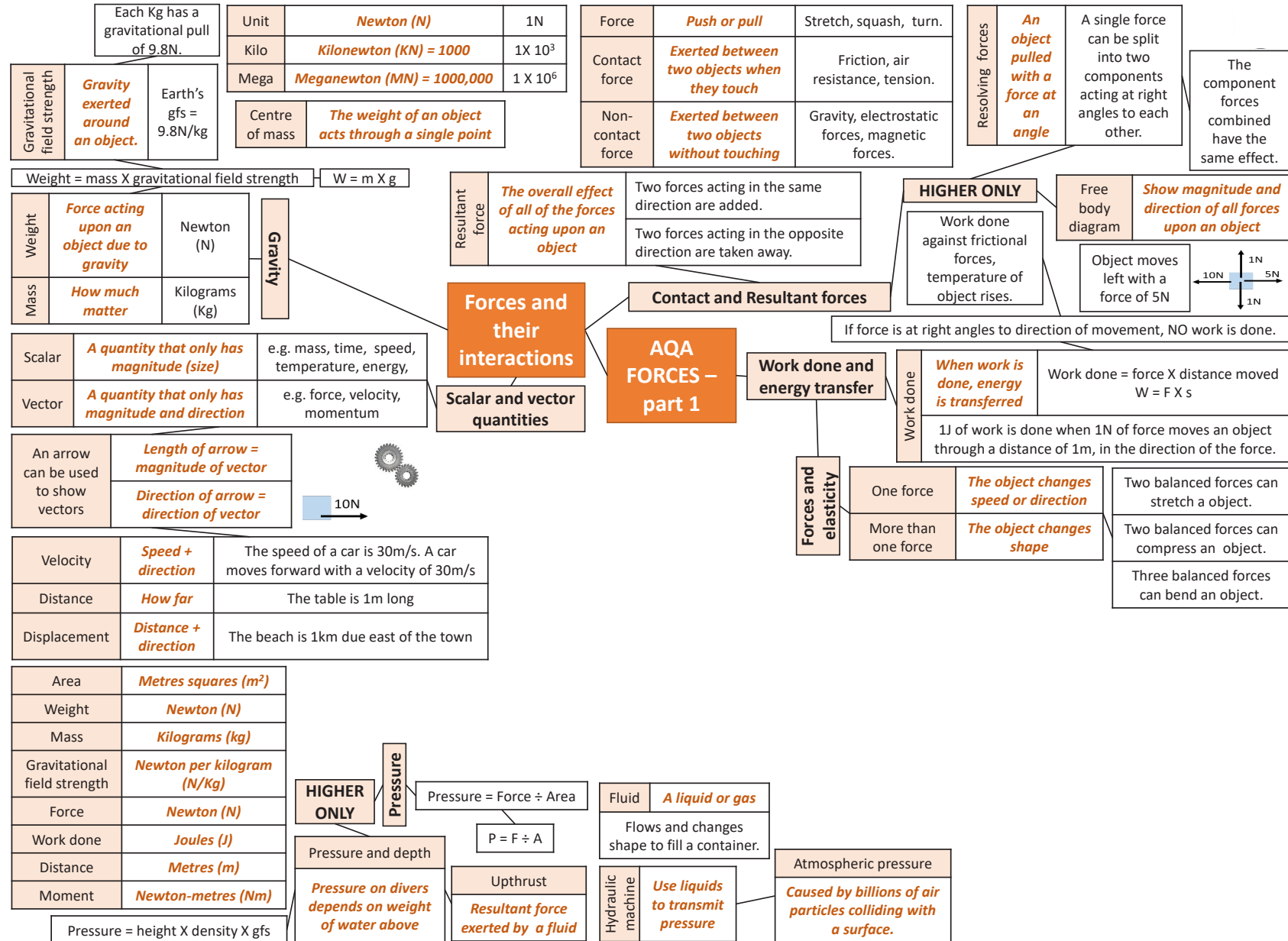
PHYSICS ONLY: Hazards and uses of Radioactive emissions and of background radiation

Discovery of 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.
Rutherford (1911)	Used above evidence to suggest alpha particles deflected due to electrostatic interaction between the very small charged nucleus, nucleus was massive. Proposed mass and positive charge contained in nucleus while electrons found outside the nucleus which cancel the positive charge exactly.
Bohr (1913)	Suggested modern model of atom – electrons in circular orbits around nucleus, electrons can change orbits by emitting or absorbing electromagnetic radiation. His research led to the idea of some particles within the nucleus having positive charge; these were named protons.
Chadwick (1932)	Discovered neutrons in nucleus – enabling other scientists to account for mass of atom.

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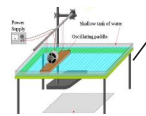


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Wave speed	Wave speed = frequency X wavelength	$V = f \times \lambda$
Wave period	Wave period = $1 \div$ frequency	$T = 1 \div f$
Speed	Speed = distance \div time	$v = d \div t$

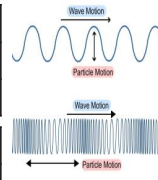
Wavelength	<i>Distance from one point on a wave to the same point of the next wave</i>
Amplitude	<i>The maximum disturbance from its rest position</i>
Frequency	<i>Number of waves per second</i>
Period	<i>Time taken to produce 1 complete wave</i>



In water, use a ripple tank.
In air, use echoes.

Measuring speed

Properties



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

Transverse and Longitudinal waves

Waves in air, fluids and solids

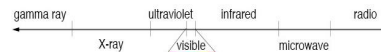
AQA Waves

e.g. Gamma

Electromagnetic waves

Short wavelengths have high frequency and high energy.

Electromagnetic wave	<i>Continuous spectrum of transverse waves</i>
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Absorbed light changes into thermal energy store.

HIGHER: Properties

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

Seismic waves

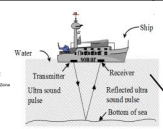
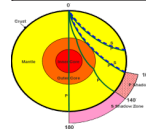
P wave	S wave	Seismograph
<i>Longitudinal</i>	<i>Transverse</i>	<i>Shows P and S waves arriving at different times.</i>
<i>Fast</i>	<i>Slow</i>	
<i>Travel through solids and liquids</i>	<i>Travels through solids</i>	By using the times the waves arrive at the monitoring centres, the epicentre of earthquake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

Black surfaces	<i>Good emitters, good absorbers</i>
White surfaces	<i>Poor emitters, poor absorbers</i>
Shiny surfaces	<i>Good reflectors</i>



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.
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.



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

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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.

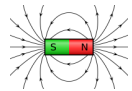
Reverse current, magnetic field direction reverses.

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.

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



Permanent and Induced Magnetism

Magnets

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

Motor effect

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AQA MAGNETISM AND ELECTROMAGNETISM

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.

