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AQA ENERGY – part 2

Global Energy Resources

Using fuels

Transport	***Petrol, diesel, kerosene produced from oil***	Used in cars, trains and planes.
Heating	***Gas and electricity***	Used in buildings.
Electricity	***Most generated by fossil fuels***	Used to power most devices.

Using renewable energy will need to increase to meet demand.

Renewable energy makes up about 20% of energy consumption.

Fossil fuel reserves are running out.

Energy demand is increasing as population increases.

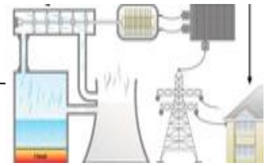
Energy resources

Non-renewable energy resource	***These will run out. It is a finite reserve. It cannot be replenished.***	e.g. Fossil fuels (coal, oil and gas) and nuclear fuels.
Renewable energy resource	***These will never run out. It is an infinite reserve. It can be replenished.***	e.g. Solar, Tides, Waves, Wind, Geothermal, Biomass, Hydroelectric

National Grid

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



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.

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Alkali metals · Halogens · Noble gases · Transition metals

1	2											3	4	5	6	7	0
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	?	?	?						

Metals to the left of this line, non metals to the right

AQA GCSE Atomic structure and periodic table part 2

The Periodic table

Elements arranged in order of atomic number	*Elements with similar properties are in columns called groups*	Elements in the same group have the same number of outer shell electrons and elements in the same period (row) have the same number of electron shells.

Development of the Periodic table

Before discovery of protons, neutrons and electrons	*Elements arranged in order of atomic weight*	Early periodic tables were incomplete, some elements were placed in inappropriate groups if the strict order atomic weights was followed.
Mendeleev	*Left gaps for elements that hadn't been discovered yet*	Elements with properties predicted by Mendeleev were discovered and filled in the gaps. Knowledge of isotopes explained why order based on atomic weights was not always correct.

Metals and non metals

Metals	*To the left of the Periodic table*	Form positive ions. Conductors, high melting and boiling points, ductile, malleable.
Non metals	*To the right of the Periodic table*	Form negative ions. Insulators, low melting and boiling points.

Group 1

Alkali metals	*Very reactive with oxygen, water and chlorine*	Only have one electron in their outer shell. Form +1 ions.
	Reactivity increases down the group	Negative outer electron is further away from the positive nucleus so is more easily lost.

With oxygen	Forms a metal oxide	Metal + oxygen → metal oxide	e.g. $4Na + O_2 \rightarrow 2Na_2O$
With water	Forms a metal hydroxide and hydrogen	Metal + water → metal hydroxide + hydrogen	e.g. $2Na + 2H_2O \rightarrow 2NaOH + H_2$
With chlorine	Forms a metal chloride	Metal + chlorine → metal chloride	e.g. $2Na + Cl_2 \rightarrow 2NaCl$

Group 7

Halogens	*Consist of molecules made of a pair of atoms*	Have seven electrons in their outer shell. Form -1 ions.
	Melting and boiling points increase down the group (gas → liquid → solid)	Increasing atomic mass number.
	Reactivity decreases down the group	Increasing proton number means an electron is more easily gained

With metals	Forms a metal halide	Metal + halogen → metal halide e.g. Sodium + chlorine → sodium chloride	e.g. NaCl metal atom loses outer shell electrons and halogen gains an outer shell electron
With hydrogen	Forms a hydrogen halide	Hydrogen + halogen → hydrogen halide e.g. Hydrogen + bromine → hydrogen bromide	e.g. $Cl_2 + H_2 \rightarrow 2HCl$
With aqueous solution of a halide salt	A more reactive halogen will displace the less reactive halogen from the salt	Chlorine + potassium bromide → potassium chloride + bromine	e.g. $Cl_2 + 2KBr \rightarrow 2KCl + Br_2$

Group 0

Noble gases	*Unreactive, do not form molecules*	This is due to having full outer shells of electrons.
	Boiling points increase down the group	Increasing atomic number.

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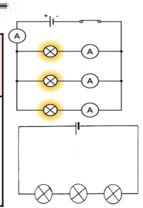
Electrons carry current. Electrons are free to move in metal.

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*



Circuit symbols

AQA Electricity

Current, potential difference and resistance

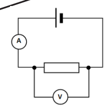
Current and Charge

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*

$R = V \div I$

Resistance = Potential difference ÷ Current

Resistance (Ω)	*A measurement of how much current flow is reduced*

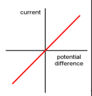
The higher the resistance, the more difficult it is for current to flow.

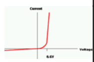
Increasing resistance, reduces current.

Increasing voltage, increases current.

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

Current – Potential difference graphs





Ohmic conductor	*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.*

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.

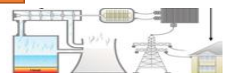
Series	Parallel
A circuit with one loop	*A circuit with two or more loops*

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

Energy transfers

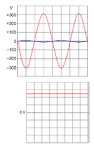
Work is done when charge flowing.

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	$E = P X t$



National Grid — *Distributes electricity generated in power stations around UK*

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.

'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

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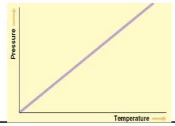
AQA PARTICLE MODEL OF MATTER

Particle model



State	*Particle arrangement*	Properties
Solid	*Packed in a regular structure. Strong forces hold in place so cannot move.*	Difficult to change shape.
Liquid	*Close together, forces keep contact but can move about.*	Can change shape but difficult to compress.
Gas	*Separated by large distances. Weak forces so constantly randomly moving.*	Can expand to fill a space, easy to compress.

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

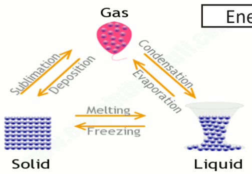
Density = mass ÷ volume.

Density	*Mass of a substance in a given volume*

	Units
Density	*Kilograms per metre cubed (kg/m³)*
Mass	*Kilograms (kg)*
Volume	*Metres cubed (m³)*
Energy needed	*Joules (J)*
Specific latent heat	*Joule per kilogram (J/kg)*
Change in thermal energy	*Joules (J)*
Specific heat capacity	*Joule per kilogram degrees Celsius (J/kg°C)*
Temperature change	*Degrees Celsius (°C)*
Pressure	*Pascals (Pa)*

Change of state

Freezing	Liquid turns to a solid. Internal energy decreases.
Melting	Solid turns to a liquid. Internal energy increases.
Boiling / Evaporating	Liquid turns to a gas. Internal energy increases.
Condensation	Gas turns to a liquid. Internal energy decreases.
Sublimation	Solid turns directly into a gas. Internal energy increases.
Conservation of mass	When substances change state, mass is conserved.
Physical change	No new substance is made, process can be reversed.



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.

ΔE= m **X c X** Δθ

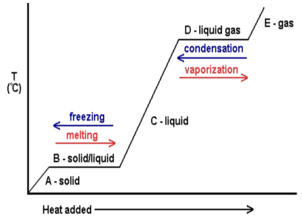
Specific Latent Heat	*Energy needed to change 1kg of a substance's state*
Specific Latent Heat of Fusion	*Energy needed to change 1kg of solid into 1 kg of liquid at the same temperature*
Specific Latent Heat of Vaporisation	*Energy needed to change 1kg of liquid into 1 kg of gas at the same temperature*

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

ΔE= m X L

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.



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AQA ATOMIC STRUCTURE

Atom structure

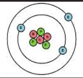
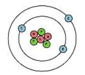
Radius of an atom 1×10^{-10} m

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*

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

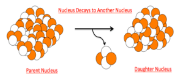
Atoms and Isotopes

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

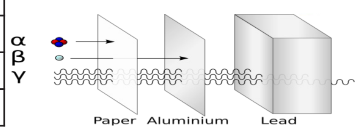
Discovery of the nucleus

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.

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*

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*

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

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

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

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

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AQA FORCES – part 1

Forces and their interactions

Each Kg has a gravitational pull of 9.8N.		
Gravitational field strength	*Gravity exerted around an object.*	Earth's gfs = 9.8N/kg

Weight = mass X gravitational field strength → W = m X g

Gravity

Weight	*Force acting upon an object due to gravity*	Newton (N)
Mass	*How much matter*	Kilograms (Kg)

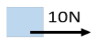
Unit	*Newton (N)*	1N
Kilo	*Kilonewton (KN) = 1000*	1X 10^3
Mega	*Meganewton (MN) = 1000,000*	1 X 10^6

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

Area	*Metres squares (m^2)*
Weight	*Newton (N)*
Mass	*Kilograms (kg)*
Gravitational field strength	*Newton per kilogram (N/Kg)*
Force	*Newton (N)*
Work done	*Joules (J)*
Distance	*Metres (m)*
Moment	*Newton-metres (Nm)*

Contact and Resultant forces

Force	*Push or pull*	Stretch, squash, turn.
Contact force	*Exerted between two objects when they touch*	Friction, air resistance, tension.
Non-contact force	*Exerted between two objects without touching*	Gravity, electrostatic forces, magnetic 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.

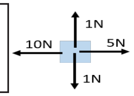
HIGHER ONLY

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



Work done and energy transfer

Work done against frictional forces, temperature of object rises.

If force is at right angles to direction of movement, NO work is done.

Work done	*When work is done, energy is transferred*	Work done = force X distance moved W = F X s
	1J of work is done when 1N of force moves an object through a distance of 1m, in the direction of the force.	

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.

Pressure (HIGHER ONLY)

Pressure = Force ÷ Area

P = F ÷ 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.

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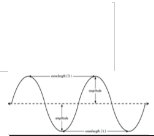
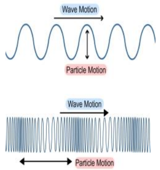


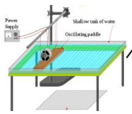
Wave speed	Wave speed = frequency X wavelength	$V = f X \lambda$
Wave period	Wave period = 1 ÷ frequency	$T = 1 \div f$
Speed	Speed = distance ÷ time	$v = d \div t$

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*



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.

Transverse and Longitudinal waves



Properties

Measuring speed
- In water, use a ripple tank.
- In air, use echoes.

Waves in air, fluids and solids

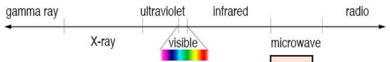
AQA Waves

Electromagnetic waves

e.g. Gamma

Short wavelengths have high frequency and high energy.

Electromagnetic wave	*Continuous spectrum of transverse waves*



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

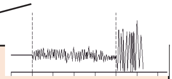
HIGHER: Properties

Absorbed light changes into thermal energy store.

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

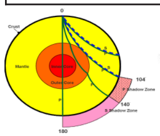
EM waves refract

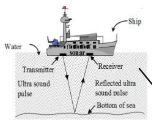
Seismic waves



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 ÷ t).
Produced by earthquakes.		

EM wave		Use
Radio		Communications, TV, radio.
Microwave		Mobile phones, cooking, satellites.
Infrared		Heating, remote controls, cooking.
Visible		Illumination, photography, fibre optics.
Ultra violet		Security marking, disinfecting water.
X-ray		Broken bones, airport security.
Gamma		Sterilising, detecting and killing cancer.



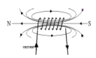


Ultra sound	*Partially reflected off boundary*	Used for medical and foetal scans.
Sonar	*Reflected off objects*	Used to determine depth of objects under the sea.

PHYSICS F TRILOGY KNOWLEDGE ORGANISER

AQA MAGNETISM AND ELECTROMAGNETISM

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.

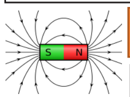
Magnetic fields from the permanent magnet and current in the foil interact. This is called the motor effect.

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.

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.