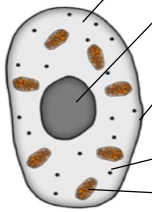
AQA GCSE

Year 9

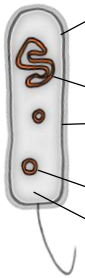
SCIENCE

Knowledge Organiser

AQA Cell Structure



cytoplasm	*site of chemical reactions in the cell*	gel like substance containing enzymes to catalyse the reactions
nucleus	*contains **genetic material***	controls the activities of the cell and codes fro proteins
cell membrane	*semi permeable*	controls the movement of substances in and out of the cell
ribosome	*site of protein synthesis*	mRNA is translated to an amino acid chain
mitochondrion	*site of respiration*	where energy is released for the cell to function



cell membrane	*site of chemical reactions in the cell*	gel like substance containing enzymes to catalyse the reactions
bacterial DNA	*not in nucleus floats in the cytoplasm*	controls the function of the cell
cell wall	***NOT** made of cellulose*	supports and strengthens the cell
plasmid	*small rings of DNA*	contain additional genes
cytoplasm	*semi permeable*	controls the movement of substances in and out of the cell

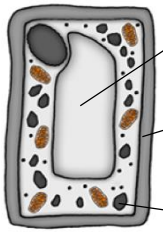
al cells are much smaller than plant and animal cells

animal cell

plant cell

Eukaryotes complex organisms

contains all the parts of animal cells plus extras

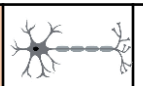


permanent vacuole	*contains cell sap*	keeps cell turgid, contains sugars and salts in solution
cell wall	*made of cellulose*	supports and strengthens the cell
chloroplast	*site of photosynthesis*	contains chlorophyll, absorbs light energy

Prokaryotes simpler organisms

Specialised cells

specialised animal cells

nerve		*carry electrical signals*	long branched connections and insulating sheath
sperm		*fertilise an egg*	streamlined with a long tail acrosome containing enzymes large number of mitochondria
muscle		*contract to allow movement*	contains a large number of mitochondria long

specialised plant cells

root hair		*absorb water and minerals from soil*	hair like projections to increase the surface area
xylem		*carry water and minerals*	TRANSPIRATION - dead cells cell walls toughened by lignin flows in one direction
phloem		*carry glucose*	TRANSLOCATION - living cells cells have end plates with holes flows in both directions

Cell differentiation

how a cell changes and becomes **specialised**
Undifferentiated call are called **STEM** cells

animal cell differentiation

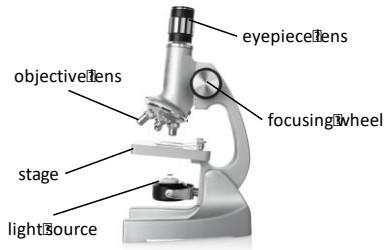
early stages of development only for repair and replacement

plant cell differentiation

all stages of life cycle the stem cells are grouped together in meristems

Microscopy

magnification = size of image / real size of the object



Feature	Light (optical) microscope	Electron microscope
Radiation used	Light rays	Electron beams
Max magnification	~ 1500 times	~ 2 000 000 times
Resolution	200nm	0.2nm
Size of microscope	Small and portable	Very large and not portable
Cost	~£100 for a school one	Several £100,000 to £1 million plus

PREFIXES

Prefix	Multiple	Standard form
centi (cm)	1 cm = 0.01 m	x 10^{-2}
milli (mm)	1 mm = 0.001 m	x 10^{-3}
micro (µm)	1 µm = 0.000 001 m	x 10^{-6}
nano (nm)	1nm = 0.000 000 001 m	x 10^{-9}

AQA Cell Biology 2

largest

smallest

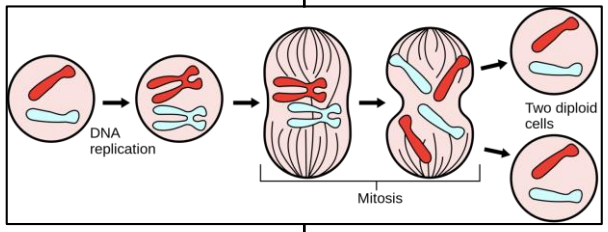
cell	The smallest structural and functional unit of an organism.
nucleus	A structure that contains genetic material and controls the activities of the cell.
chromosome	A thread like structure of coiled DNA found in the nucleus of eukaryotic cells.
DNA	A polymer made up of two strands forming a double helix.
gene	A section of DNA that codes for a specific protein or characteristic.

Cell division

Cells divide in a series of stages. The genetic material is doubled and then divided into two identical cells.

MITOSIS AND THE CELL CYCLE

Stage 1	***Growth***	Increase the number of sub-cellular structures e.g. ribosomes and mitochondria.
Stage 2	***DNA Synthesis***	DNA replicates to form two copies of each chromosome.
Stage 3	***Mitosis***	One set of chromosomes is pulled to each end of the cell and the nucleus divides. Then the cytoplasm and cell membranes divide to form two cells that are identical to the parent cell.



Mitosis occurs during growth, repair, replacement of cells. Asexual reproduction occurs by mitosis in both plants & simple animals.

STEM CELLS

Undifferentiated cell of an organism

Divides to form more cells of the same type, and can differentiate to form many other cell types.

Human Embryonic stem cells	***Can be cloned and made to differentiate into most cell types***	Therapeutic cloning uses same genes so the body does not reject the tissue. Can be a risk of infection
Adult bone marrow stem cells	***Can form many types of human cells e.g. blood cells***	Tissue is matched to avoid rejection, risk of infection. Only a few types of cells can be formed.
Meristems (plants)	***Can differentiate into any plant cell type throughout the life of the pant.***	Used to produce clones quickly and economically, e.g. rare species, crop plants with pest /disease resisitance

Treatment with stem cells may be able to help conditions such as diabetes and paralysis. Some people object to the use of stem cells on ethical or religious grounds

Transport in cells

Diffusion ***No*** energy required	***Movement of particles in a solution or gas from a higher to a lower concentration***	E.g. O_2 and CO_2 in gas exchange, urea in kidneys. Factors that affect the rate are concentration, temperature and surface area.
Osmosis ***No*** energy required	***Movement of water from a dilute solution to a more concentrated solution***	E.g. Plants absorb water from the soil by osmosis through their root hair cells. Plants use water for several vital processes including photosynthesis and transporting minerals.
Active transport ***ENERGY*** required	***Movement of particles from a dilute solution to a more concentrated solution***	E.g. movement of mineral ions into roots of plants and the movement of glucose into the small intestines.

ADAPTATIONS FOR DIFFUSSION

The greater the difference in concentrations the faster the rate of diffusion.

Small intestines	***Villi – increase surface area, Good blood supply – to maintain concentration gradient, Thin membranes – short diffusion distance.***
Lungs	***Alveoli– increase surface area, Good blood supply – to maintain concentration gradient, Thin membranes – short diffusion distance.***
Gills in fish	***Gill filaments and lamella – increase surface area, Good blood supply – to maintain concentration gradient, Thin membranes – short diffusion distance.***
Roots	***Root hair cells - increase surface area.***
Leaves	***Large surface area, thin leaves for short diffusion path, stomata on the lower surface to let O_2 and CO_2 in and out***

AQA GCSE ORGANISATION Part 1

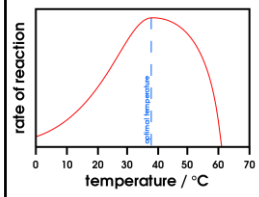
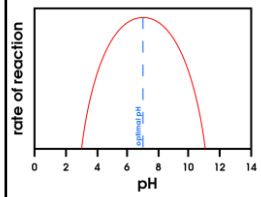
Enzymes in digestion

Enzymes catalyse (increase the rate of) specific reactions in living organisms

The 'lock and key theory' is a simplified model to explain enzyme action

Enzymes catalyse specific reactions in living organisms due to the shape of their active site

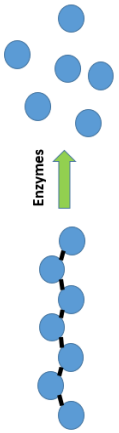
The activity of enzymes is affected by changes in temperature and pH

Enzymes activity has an optimum temperature	*Enzyme activity has an optimum pH*
	

Large changes in temperature or pH can stop the enzyme from working (denature)

Temperature too high	*pH too high or too low*
Enzyme changes shape (denatures) the substrate no longer fits the active site.	

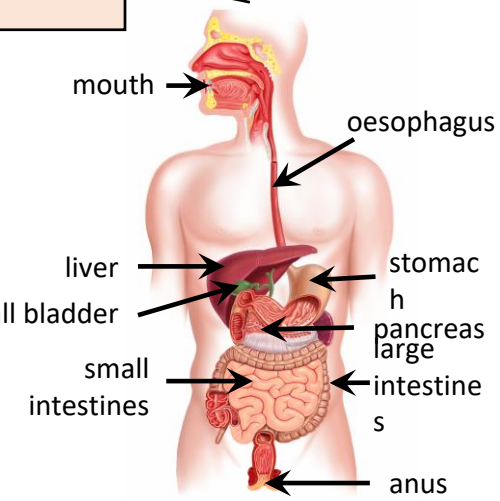
Digestive enzymes speed up the conversion of large insoluble molecules (food) into small soluble molecules that can be absorbed into the bloodstream

Carbohydrases (e.g. amylase)		*Made in salivary glands, pancreas, small intestine*	Break down carbohydrates to simple sugar (e.g. amylase breaks down starch to glucose).
Proteases		*Made in stomach, pancreas*	Break down protein to amino acids.
Lipases		*Made in pancreas (works in small intestine)*	Break down lipids (fats) to glycerol and fatty acids).
Bile (not an enzyme)		*Made in liver, stored in gall bladder.*	Emulsifies lipids to increase surface area to increase the rate of lipid break down by lipase. Changes pH to neutral for lipase to work

The products of digestion are used to build new carbohydrates, lipids and proteins. Some glucose is used for respiration.

The human digestive system

An organ system in which organs work together to digest and absorb food.



Non-communicable diseases

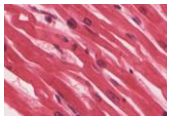
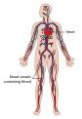
More energy consumed in food and drink than used
obesity
Linked to increased rates of cardiovascular disease and development of diabetes type 2.

Food tests

Sugars (glucose)	*Benedicts' test*	Orange to brick red precipitate.
Starch	*Iodine test*	Turns black.
Biuret	*Biuret reagent*	Mauve or purple solution.

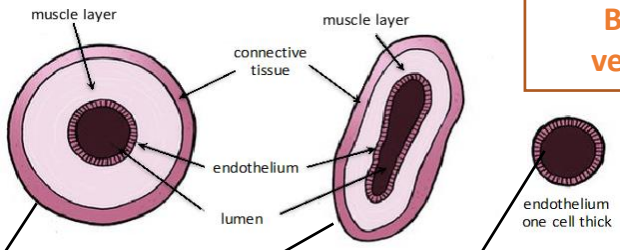
Principles of organisation

Cells, tissues, organs and systems

Cells		*e.g. muscle cells*	The basic building blocks of all living organisms.
Tissues		*e.g. muscle tissue*	A group of cells with a similar structure and function.
Organs		*e.g. the heart*	Aggregations (working together) of tissues performing a specific function.
Organ systems		*e.g. the circulatory system*	Organs working together to form organ systems, which work together to form an organism.

AQA GCSE ORGANISATION part 2

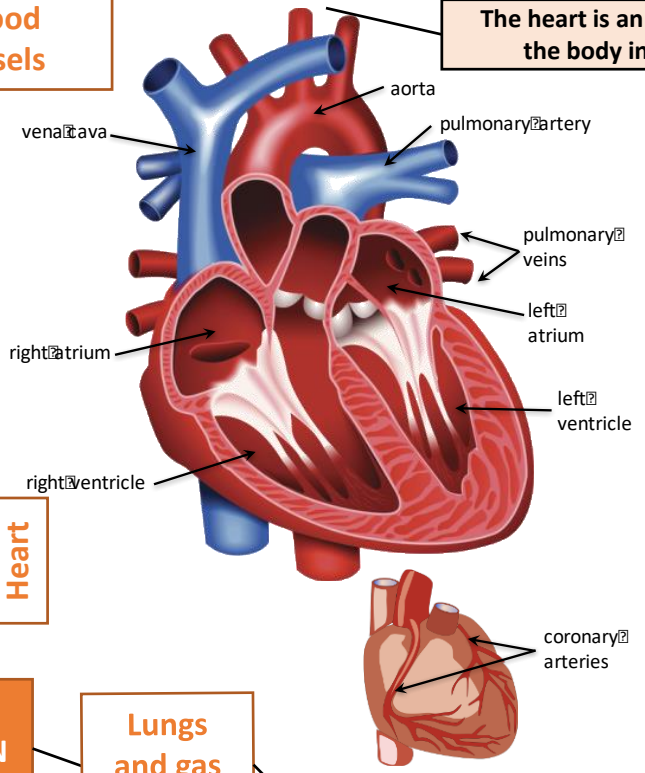
Blood vessels



Artery	Vein	Capillary
Carry blood away from the heart	*Carry blood to the heart*	*Connects arteries and veins*
Thick muscular walls, small lumen, carry blood under high pressure, carry oxygenated blood (except for the pulmonary artery).	Thin walls, large lumen, carry blood under low pressure, have valves to stop flow in the wrong direction, carry deoxygenated blood (except for the pulmonary vein).	One cell thick to allow diffusion, Carry blood under very low pressure.

Heart

The heart is an organ that pumps blood around the body in a double circulatory system



Different structure in the heart have different functions	
Right ventricle	Pumps blood to the lungs where gas exchange takes place.
Left ventricle	Pumps blood around the rest of the body.
Pacemaker (in the right atrium)	Controls the natural resting heart rate. Artificial electrical pacemakers can be fitted to correct irregularities.
Coronary arteries	Carry oxygenated blood to the cardiac muscle.
Heart valves	Prevent blood in the heart from flowing in the wrong direction.

Blood

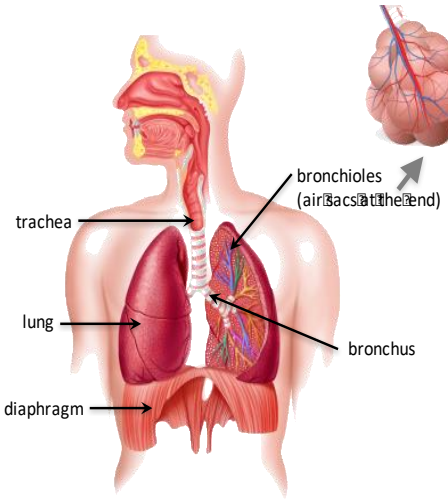
Blood is a tissue consisting of plasma, in which blood cells, white blood cells and platelets are suspended

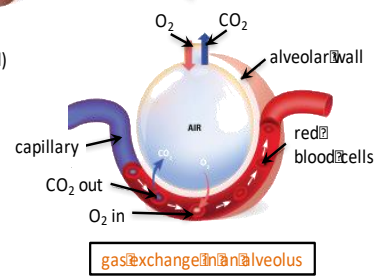
Plasma (55%)	*Pale yellow fluid*	Transports CO_2, hormones and waste.
Red blood cells (45%)	*Carries oxygen*	Large surface area, no nucleus, full of haemoglobin.
White blood cells (<1%)	*Part of the immune system*	Some produce antibodies, others surround and engulf pathogens.
Platelets (<1%)	*Fragments of cells*	Clump together to form blood clots.

Lungs and gas exchange

The heart pumps low oxygen/high carbon dioxide blood to the lungs

Trachea	*Carries air to/from the lungs*	Rings of cartilage protect the airway.
Bronchioles	*Carries air to/from the air sacs (alveoli)*	Splits into multiple pathways to reach all the air sacs.
Alveoli	*Site of gas exchange in the lungs*	Maximises surface area for efficient gas exchange.
Capillaries	*Allows gas exchange between into/out of blood*	Oxygen diffuses into the blood and carbon dioxide diffuses out.





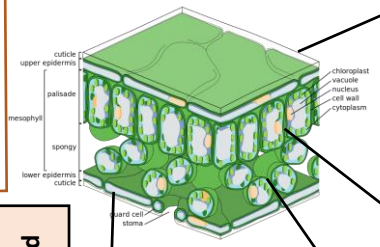
gas exchange in an alveolus

AQA GCSE ORGANISATION part 3

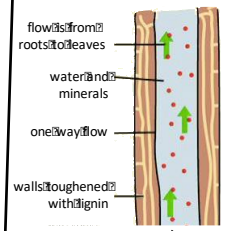
Heart failure can be treated with a transplant or artificial heart

Disease	Cause	Effect	Treatment
Coronary heart disease (CHD)	A build up for fatty substances in the coronary arteries (atherosclerosis)	Oxygen-ated blood cannot get to the cardiac muscle.	Stents: inserted into the blocked artery to open it up. Statins: lower harmful cholesterol.
Faulty heart valves	Valves don't open or close properly	Blood can leak or flow in the wrong direction	Biological valve transplant or a mechanical valve can be inserted

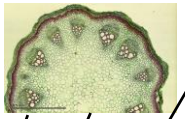
Plant organ systems



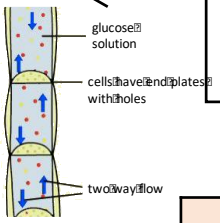
The roots, stem and leaves form a plant organ system for transport of substances around the plant

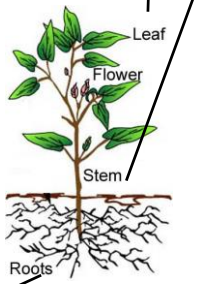


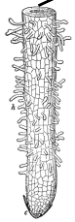
xylem

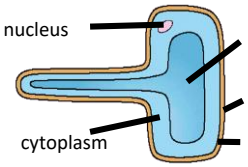


phloem









Plant tissues

Epidermal tissues	Waxy cuticle (top layer of the leaf)	Reduces water loss from the leaf
	Guard cells and stomata	Guard cells open and close the stomata to control water loss and allow for gas exchange (oxygen and carbon dioxide).
Palisade mesophyll	Palisade cells	Cells near the top surface of the leaf that are packed with chloroplasts that contain chlorophyll. Both adaptations maximize photosynthesis.
Spongy mesophyll	Air spaces in the leaf between cells	Increased surface area for gas exchange so that carbon dioxide can diffuse into photosynthesising cells.
xylem	Hollow tubes strengthened by lignin adapted for the transportation of water in the transpiration stream	Allows transport of water and mineral ions from the roots to the stem and the leaves.
phloem	Cell sap moves from one phloem cell to the next through pores in the end walls	Transports dissolved sugars from the leaves to the rest of the plant for immediate use or storage (translocation).
Meristem tissue	New cells (roots and shoot tips) are made here including root hair cells	Root hair cells have an increased surface area for the uptake of water by osmosis, and mineral ions by active transport.

Cancer

Non-communicable diseases

The result of changes in DNA that lead to uncontrolled growth and division

Benign tumour	Contained in one area of the body (usually by a membrane) – not cancer.
Malignant tumour	Invade tissues and spread to different parts of the body to form secondary tumours.

Some cancers have genetic risk factors

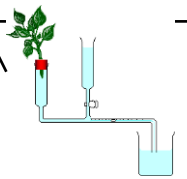
Carcinogens and ionising radiation increase the risk of cancer by changing/ damaging DNA

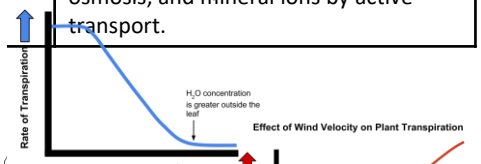
Risk factors for heart/lung disease and certain types of cancer include drinking alcohol, diet, obesity and smoking

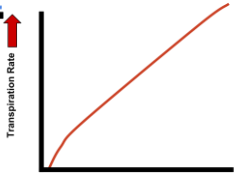
These risks factors can also affect the brain, liver and the health of unborn babies

Transpiration

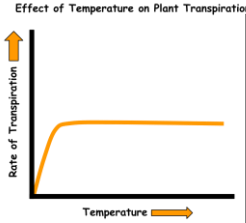
A potometer is used to measure the amount of water lost over time (rate of transpiration)







Transpiration	The rate at which water is lost from the leaves of a plant. The transpiration stream is the column of water moving through the roots, stem and leaves	Temperature, humidity, air movement and light intensity affect the rate of transpiration.

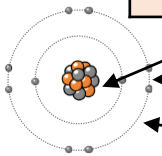


The shape of the graph for light intensity is the same for temperature (energy)

AQA GCSE Atomic structure and periodic table part 1

Atoms, elements and compounds

Atom	*The smallest part of an element that can exist*	Have a radius of around 0.1 nanometres and have no charge (0).
Element	*Contains only one type of atom*	Around 100 different elements each one is represented by a symbol e.g. O, Na, Br.
Compound	*Two or more elements chemically combined*	Compounds can only be separated into elements by chemical reactions.



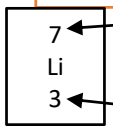
Central nucleus	Contains protons and neutrons
Electron shells	Contains electrons

Name of Particle	Relative Charge	Relative Mass
Proton	+1	1
Neutron	0	1
Electron	-1	Very small

Electronic structures

Electronic shell	Max number of electrons
1	2
2	8
3	8
4	2

Relative electrical charges of subatomic particles

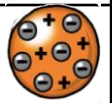
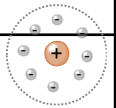


Mass number	*The sum of the protons and neutrons in the nucleus*	
Atomic number	*The number of protons in the atom*	Number of electrons = number of protons

Mixtures	*Two or more elements or compounds not chemically combined together*	Can be separated by physical processes.

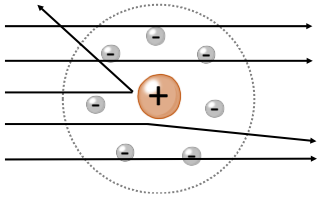
Method	Description	Example
Filtration	*Separating an insoluble solid from a liquid*	To get sand from a mixture of sand, salt and water.
Crystallisation	*To separate a solid from a solution*	To obtain pure crystals of sodium chloride from salt water.
Simple distillation	*To separate a solvent from a solution*	To get pure water from salt water.
Fractional distillation	*Separating a mixture of liquids each with different boiling points*	To separate the different compounds in crude oil.
Chromatography	*Separating substances that move at different rates through a medium*	To separate out the dyes in food colouring.

The development of the model of the atom

Pre 1900		*Tiny solid spheres that could not be divided*	Before the discovery of the electron, John Dalton said the solid sphere made up the different elements.
1897 'plum pudding'		*A ball of positive charge with negative electrons embedded in it*	JJ Thompson 's experiments showed that showed that an atom must contain small negative charges (discovery of electrons).
1909 nuclear model		*Positively charge nucleus at the centre surrounded negative electrons*	Ernest Rutherford's alpha particle scattering experiment showed that the mass was concentrated at the centre of the atom.
1913 Bohr model		*Electrons orbit the nucleus at [illegible] distances*	Niels Bohr proposed that electrons orbited in fixed shells; this was supported by experimental observations.
James Chadwick		*Provided the evidence to show the existence of neutrons within the nucleus*	

Rutherford's scattering experiment

A beam of alpha particles are directed at a very thin gold foil



Most of the alpha particles passed right through.
A few (+) alpha particles were deflected by the positive nucleus.
A tiny number of particles reflected back from the nucleus.

Chemical equations

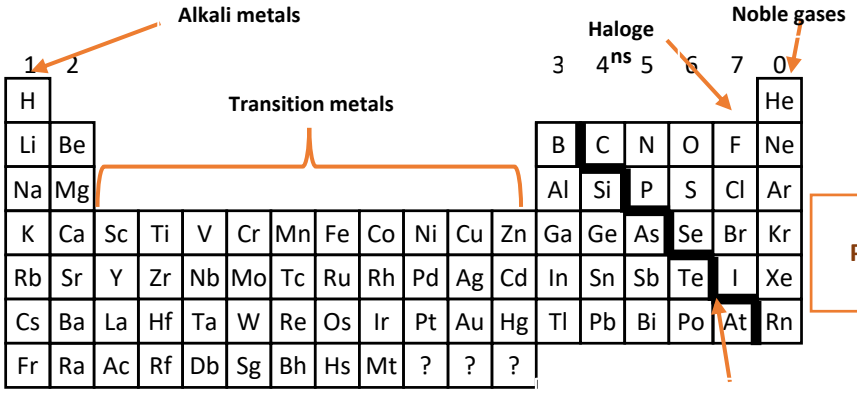
Chemical equations	*Show chemical reactions - need reactant(s) and product(s) energy always involves and energy change*	Law of conservation of mass states the total mass of products = the total mass of reactants.

Word equations	*Uses words to show reaction* **reactants → products** magnesium + oxygen → magnesium oxide	Does not show what is happening to the atoms or the number of atoms.
Symbol equations	*Uses symbols to show reaction* **reactants → products** $2Mg + O_2 \rightarrow 2MgO$	Shows the number of atoms and molecules in the reaction, ~~these need to be balanced~~.

Relative atomic mass

Isotopes	*Atoms of the same element with the same number of protons and different numbers of neutrons*	^{35}Cl (75%) and ^{37}Cl (25%) Relative abundance = (% isotope 1 x mass isotope 1) + (% isotope 2 x mass isotope 2) ÷ 100 **e.g. (25 x 37) + (75x 35) ÷ 100 = 35.5**

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. $2Na + Cl_2 \rightarrow 2NaCl$

Compared to group 1	• *Less reactive* • *Harder* • *Denser* • *Higher melting points*	• *Cu^{2+} is blue* • *Ni^{2+} is pale green, used in the manufacture of margarine* • *Fe^{2+} is green, used in the Haber process* • *Fe^{3+} is reddish-brown* • *Mn^{2+} is pale pink*
Typical properties	• *Many have different ion possibilities with different charges* • *Used as catalysts* • *Form coloured compounds*	

Transition metals (Chemistry only)

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.

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. $Cl_2 + 2KBr \rightarrow 2KCl + Br_2$

AQA BONDING, STRUCTURE AND THE PROPERTIES OF MATTER 1

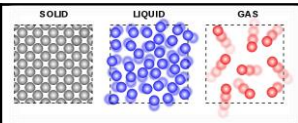
Chemical bonds

Ionic	*Particles are oppositely charged ions*	Occurs in compounds formed from metals combined with non metals.
Covalent	*Particles are atoms that share pairs of electrons*	Occurs in most non metallic elements and in compounds of non metals.
Metallic	*Particles are atoms which share delocalised electrons*	Occurs in metallic elements and alloys.

The three states of matter

Solid, liquid, gas

Melting and freezing happen at melting point, boiling and condensing happen at boiling point.



The amount of energy needed for a state change depends on the strength of forces between particles in the substance.

(HT only)
Limitations of simple model:
- There are no forces in the model
- All particles are shown as spheres
- Spheres are solid

s	solid
l	liquid
g	gas

Properties of ionic compounds

High melting and boiling points	Large amounts of energy needed to break the bonds.
Do not conduct electricity when solid	Ions are held in a fixed position in the lattice and cannot move.
Do conduct electricity when molten or dissolved	Lattice breaks apart and the ions are free to move.

Metals as conductors

Good conductors of electricity	Delocalised electrons carry electrical charge through the metal.
Good conductors of thermal energy	Energy is transferred by the delocalised electrons.

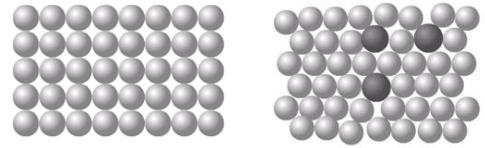
High melting and boiling points	This is due to the strong metallic bonds.
Pure metals can be bent and shaped	Atoms are arranged in layers that can slide over each other.

Properties of metals and alloys

Alloys

Mixture of two or more elements at least one of which is a metal

Harder than pure metals because atoms of different sizes disrupt the layers so they cannot slide over each other.

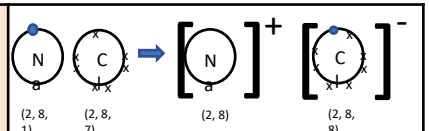
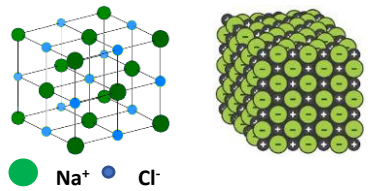


Ionic bonding

Electrons are transferred so that all atoms have a noble gas configuration (full outer shells).

Metal atoms lose electrons and become positively charged ions	Group 1 metals form +1 ions Group 2 metals form +2 ions
Non metals atoms gain electrons to become negatively charged ions	Group 6 non metals form -2 ions Group 7 non metals form -1 ions

Ionic compounds

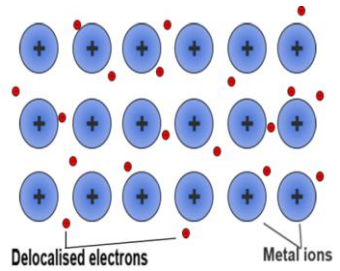
Dot and cross diagram	
Giant structure	

Structure

- *Held together by strong electrostatic forces of attraction between oppositely charged ions*
- *Forces act in all directions in the lattice*

Metallic bonding

Giant structure of atoms arranged in a regular pattern



Electrons in the outer shell of metal atoms are delocalised and free to move through the whole structure. This sharing of electrons leads to strong metallic bonds.

AQA ENERGY – part 1

Energy stores and changes

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

Energy pathways

Kinetic energy	*Energy stored by a moving object*	½ X mass X (speed)^2 ½ mv^2
Elastic Potential energy	*Energy stored in a stretched spring, elastic band*	½ X spring constant X (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.

Work	*Doing work transfers energy from one store to another*	By applying a force to move an object the energy store is changed.	Work done = Force X distance moved W = Fs
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,

	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)*

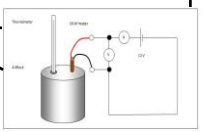
Useful energy	*Energy transferred and used*
Wasted energy	*Dissipated energy, stored less usefully*

Prefix	*Multiple*	Standard form
Kilo	*1000*	10^3
Mega	*1000 000*	10^6
Giga	*100 000 000*	10^9

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.



HIGHER: efficiency can be increased using machines.

Efficiency = Useful power output / Total power input

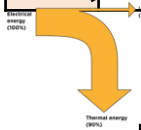
Efficiency = Useful output energy transfer / Total input energy transfer

Energy Conservation and Dissipation

Efficiency	*How much energy is usefully transferred*	
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.

Closed system	*No change in total energy in system*
Open system	*Energy can dissipate*



HIGHER: When an object is moved, energy is transferred by doing work.

Work done = Force X distance moved

Frictional forces cause energy to be transferred as thermal energy. This is wasted.

Reducing friction - using wheels, applying lubrication. Reducing air resistance – travelling slowly, streamlining.

	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)*

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 fuels*	Used to power

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

Using renewable energy will need to increase to meet demand.

Renewable energy makes up about 20% of energy consumption.

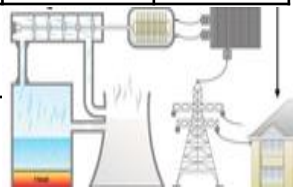
Fossil fuel reserves are running out.

Energy demand is increasing as population increases.

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*	Generating electricity	Renewable. Clean. No	Limited to a small number of countries. Geothermal power stations

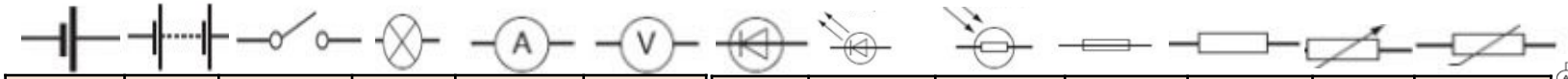
AQA Electricity

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

Cell	Battery	Switch	Lamp	Ammeter	Volt meter
Store of chemical energy	*Two or more cells in series*	*Breaks circuit, turning current off*	*Lights when current flows*	*Measures current*	*Measures potential difference*

Diode	LED	LDR	Fuse	Resistor	Variable resistor	Thermistor
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*

Circuit symbols



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*	Coulomb (C)

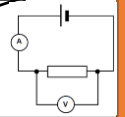
Charge = Current X time

Q = I X t

Current, potential difference and resistance

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.

R = V ÷ 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

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.*

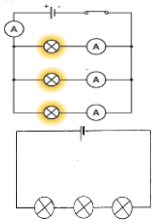
Current – Potential difference graphs

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

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 transfer

Work is done when charge flowing.

Power (W) = potential difference X current

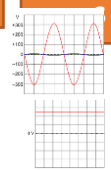
Power = (current)^2 X resistance

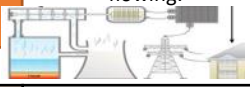
Energy transferred = Power X time

R = V X I

P = I^2 X R

E = P X 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.

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*
Generat	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	Only carries current if there is a fault.	p.d. = 0V

Like charges	*Repel*
Unlike charges	*Attract*

Static electricity

PHYSICS only

Static electricity

Electrical charge is stationary

When two insulating material are rubbed together, electrons move from one material to the other.

Shocks

Walking on carpet causes friction. Electrons move to the person and charge builds up. When the person touches a metal object, the electrons conduct away, making a spark.

Electric fields

Charged objects create electric fields around them. Strongest closest to the object. The field direction is the direction of force on a positive charge. Add more charge increases field strength.