Name_________________________________

Chemistry Paper 1 Knowledge Booklet

C1 Atomic Structure

- **Define the terms; element, compound and mixture**

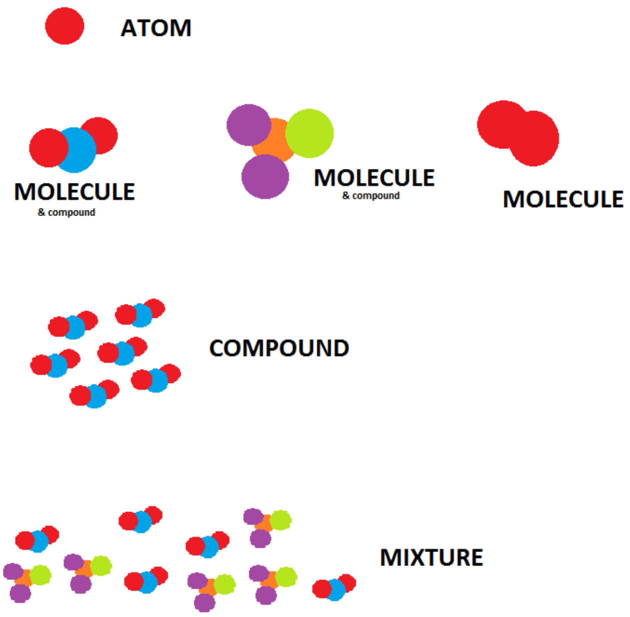
  Element – One type of atom found on the periodic table

  Molecule – When two or more atoms join together

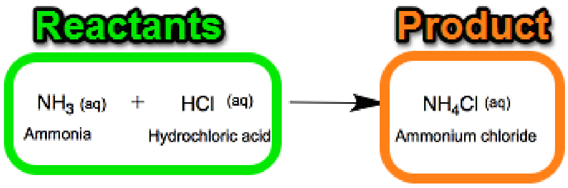
  Compound – Two or more elements joined with a bond

  Mixture – Different atoms or compounds that can be easily separated

  Some things are just molecules (if they are the same element) and some are compounds and molecules (different element bonded together).



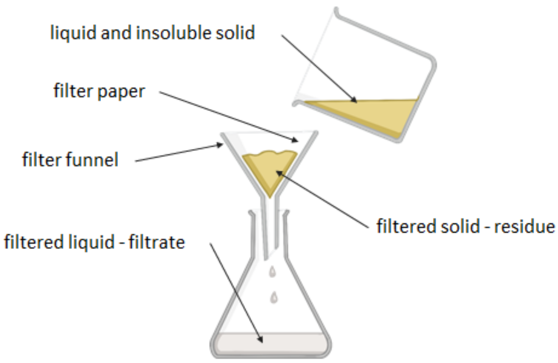
- **Learn the parts of an equation**



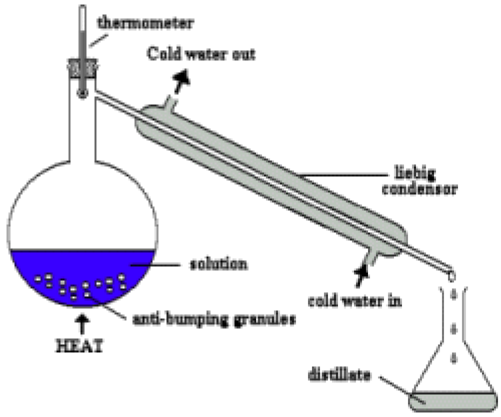
- **Describe what conservation of mass means**

  The number of atoms that react at the beginning of a reaction, are the same as the number at the end of a reaction.

- **Describe how to filter mixtures**



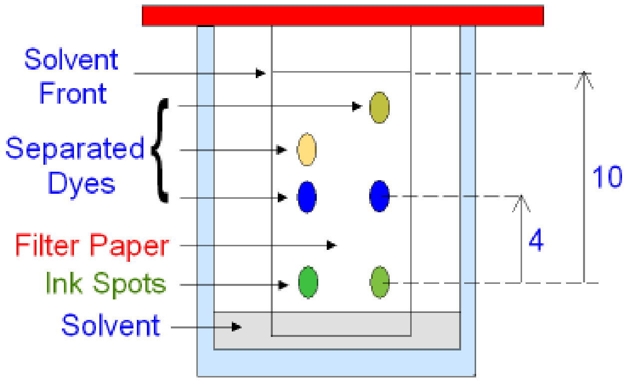
- **Label the equipment used in distillation**



- **Describe how distillation separates liquids**

  Different liquids have different boiling points, for example water boils at 100°C and Ethanol boils at 78°C. The liquids evaporate at different temperatures and then can be condensed. If the mixture of liquids is kept at 79°C, the ethanol evaporates in to the Liebig condenser and the water is left behind because the mixture is not reaching waters boiling point.

- **Label the parts of a chromatogram**



- **Describe how to carry out chromatography**

  Different inks/dyes are placed along a line drawn in pencil (pencil is not soluble so it won't run). A solvent (sometimes water) is used to separate the dyes. The most soluble dyes move up the chromatogram the furthest. The least soluble stays at the bottom.

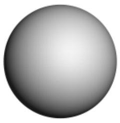
- **Describe how to calculate Rf Values**

  Rf = <u>Distance travelled by the substance</u>
  Distance travelled by the solvent front

  The Rf value of a particular compound is always the same - if the chromatography has been carried out in the same way. This allows industry to use chromatography to identify compounds in mixtures.

- **Describe the history of the development of the current model of the atom**

  We haven't always known very much about the atom and different theories have been developed about the atom over time.

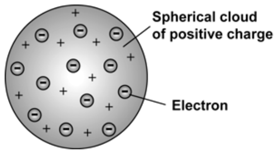


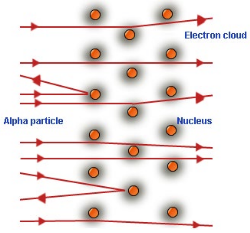
John Dalton – 1880

Atoms are solid spheres that make up everything. Atoms of the same element are the same.

JJ Thompson – 1900 **The Plumb Pudding Model**

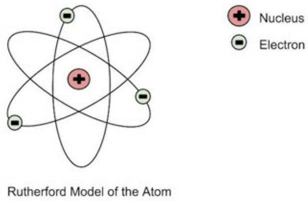
He discovered electrons. He said that there was a sphere of positive charge with lots of floating electrons, like plumbs floating in a pudding.





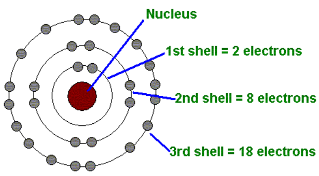
Ernest Rutherford – 1911 **The Nuclear Model**

An experiment was completed where positively charged alpha particles were fired at thin gold foil that was only one atom thick. Some of the alpha particles passed straight through, showing most of the atom was empty space. Some were deflected from the nucleus of the atom, showing that the nucleus of that atom must be dense and positive.

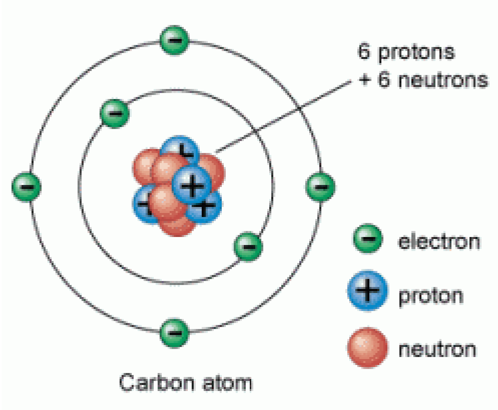


Niels Bohr – 1915

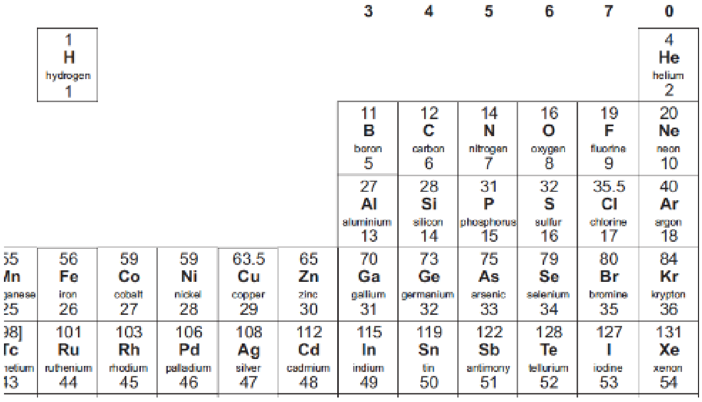
He tweaked Rutherford's model by developing the idea that the electrons orbit the nucleus in shells in a certain configuration.



- **Label the current model of the atom giving, the name, charge and relative mass of the sub-atomic particles**



- ### Describe what the numbers mean on the periodic table

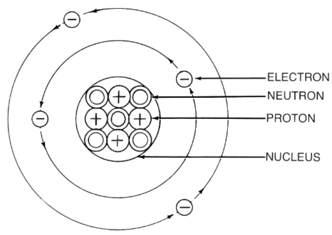


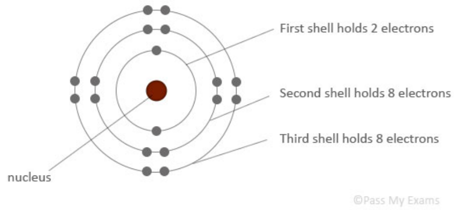
Relative Atomic Mass - The largest number tells you the number of protons + neutrons added together.
Atomic Number – The smallest number tells you the number of protons, which is the same as the number of electrons.

Boron has 5 protons and 5 electrons (the smallest number) and 6 neutrons (11-5).

- ### Describe how to draw an atom

Protons and neutrons are in the nucleus of the atom and the electrons are positioned on the shells of the atom. 2 in the first shell, 8 in the second shell and 8 in the third shell.





- ### Define the terms; atoms, ions and isotopes

Atom – The smallest particle that makes up everything. They are uncharged as they have the same number of electrons and protons.
Ions – Charged atoms that have lost or gained electrons.
Isotopes – An atom with the same number of protons and electrons and a different number of neutrons.

C2 The Periodic Table

- ### Describe the history of the development of the periodic table

1869 Newland's Octaves – He arranged all the elements known at the time into a table in order of *relative atomic mass*. When he did this, he found that each element was similar to the element eight places further on. For example, starting at Li, Be is the second element, B is the third and Na is the eighth element.

Mendeleev - He realised that the physical and chemical properties of elements were related to their atomic mass in a 'periodic' way, and arranged them so that groups of elements with similar properties fell into vertical columns in his table.

- ### Explain why the work of Mendeleev was so important

Mendeleev:

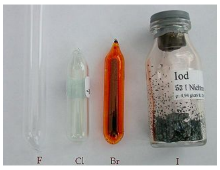
- He left gaps in the periodic table, which predicted elements that had not been discovered yet
- He grouped elements that had similar properties
- He put elements in order of atomic number

- ## Identify key groups in the periodic table

Group 1 – The alkali metals
They are soft metals that are easily cut. React with water, oxygen and acids.

Lithium + Oxygen > Lithium Oxide
Potassium + Water > Potassium + Water Hydroxide

They get **more** reactive down the group so Francium is the most reactive and makes large explosions.

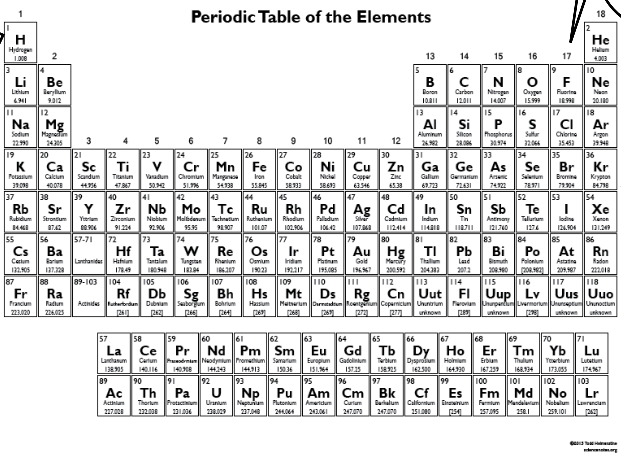


Group 7 – The Halogens
These are coloured gases, liquids and then solids.

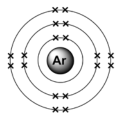
They get **less** reactive down the group so Fluorine is the most reactive and can displace less reactive halogens.

Potassium + Fluorine > Potassium + Chlorine Chloride Fluoride

The fluorine is more reactive so displaces chlorine and 'steals' the potassium.



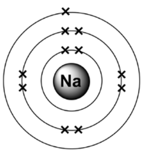
Group 0/8 – The Noble Gases
These are unreactive gases as they have a **full outer shell** – eight electrons.



They are used in environments where you don't want a reaction or explosion. Some light bulbs have argon in them to stop them exploding or popping.

- ## Describe what group number and period tell you

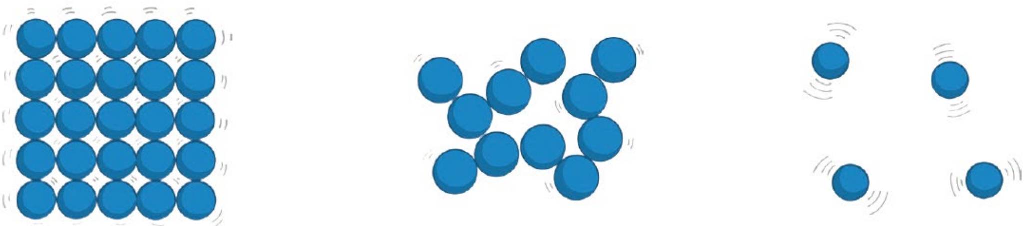
The group number above an element tells you how many electrons are in the other shell of an atom. The period tells you how many shells the atom has.



This atom of sodium is in group 1, as it has one outer electron. This is in period three as it has three shells.

C3 Structure and Bonding

- ## Describe the properties of the three states of matter

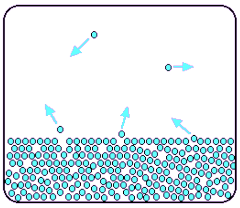


Solid Liquid Gas

Solids have the least internal kinetic energy and vibrate on the spot. Gases have the most internal energy and have a lot of kinetic energy. The particles tend to have a range of speeds.

	volume	shape	ease of flow	ease of compression
solid	definite	definite	doesn't flow	not easily
liquid	definite	takes shape of container	flows easily	not easily
gas	no definite volume	takes shape of container	flows easily	easy

- **Describe how a substance evaporates**

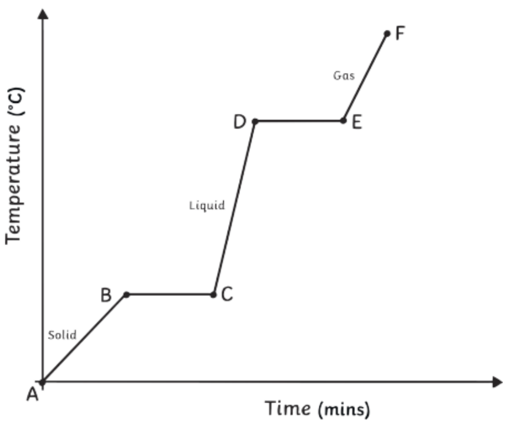


Particles are heated and gain kinetic energy. Particles at the surface of the liquid gain enough energy to overcome the forces of attraction to the surface. This is when the particle moves away from the surface and become a gas.

- **Describe how a substance condenses**

Gas particles are cooled and lose kinetic energy. This causes them to become a liquid.

- **Identify and define specific latent heat**

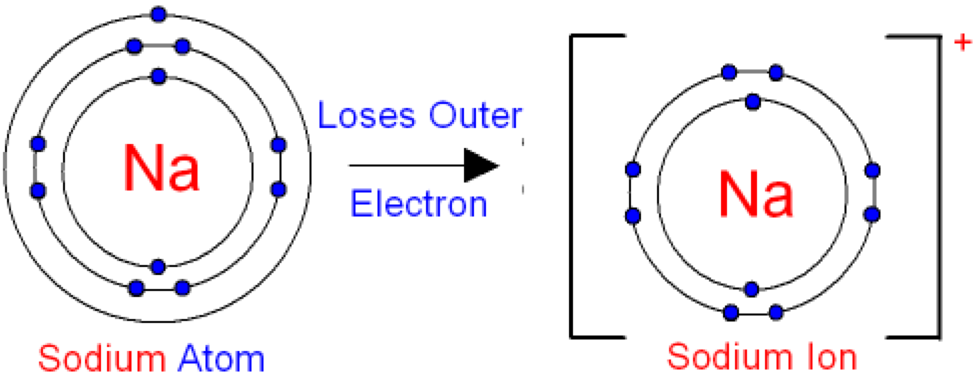


Specific latent heat of vaporisation – The energy needed to boil 1kg of substance in to a gas. Show by D-E on the graph.
Specific latent heat of fusion – The energy needed to melt 1kg of substance. Shown by B-C on the graph.

The temperature doesn't change when s substance is changing states as the energy is being used to change the state of the substance, rather than increase the temperature.

- **Draw atoms becoming ions**

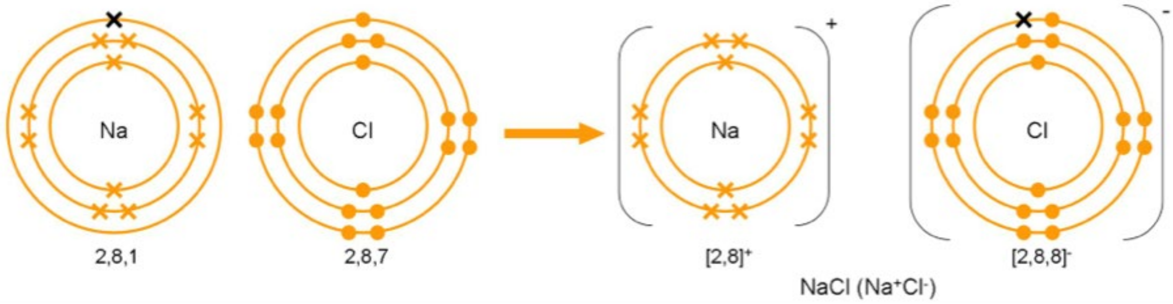
The atom will lose or gain outer electrons to get a full outer shell.
If it loses electrons the ion gets a positive charge.
If it gains electrons the ion gets a negative charge.
(loses weight, happy +. Gains weight, sad -)



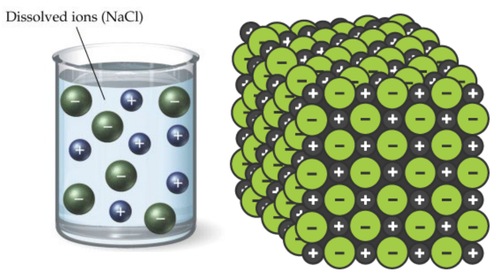
- **Describe the three different types of bonding**
  Bonding is how atoms join together. When atoms bond together the properties of them change. For example, Oxygen molecules are a gas, when oxygen is bonded to hydrogen we get liquid water.

  Between two non-metal atoms – Covalent Bonding – shared pair of electron
  Between a metal and a non-metal atom – Ionic bonding – transfer of electrons
  Between two metal atoms – metallic bonding – Delocalised electrons

- **Draw ionic bonds – transfer of electrons**



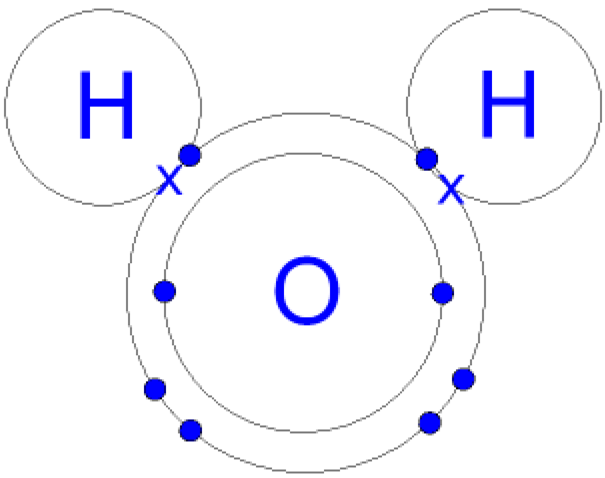
- **Describe the properties in ionic substance**

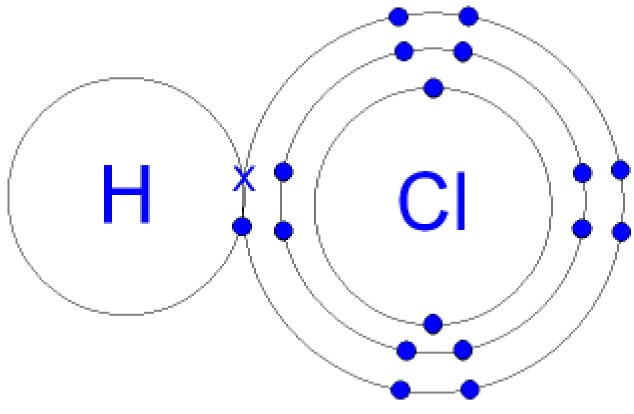


When in a solid, ionic substances form giant ionic lattices. These are positive and negative ions in a regular structure. These have high melting and boiling points and solids do not conduct electricity.

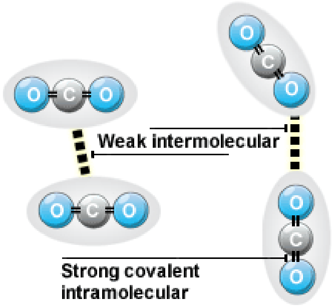
When molten or in solution, the ions are free to move so the liquids can conduct electricity.

- **Draw covalent bonds** – shared pair of electrons
  Covalent bonds are shown when atoms share pairs of electrons to get a full outer shell. This happens between non-metal atoms.





- **Describe the properties of simple covalent structures**

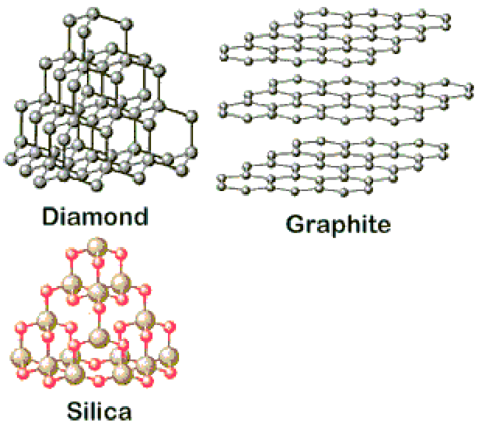


Some molecules that are covalently bonded form simple covalent structures. These have a low melting and boiling points, they are therefore often gases like O_2, CO_2, Cl_2.

This is because they have weak intermolecular forces (between the molecules) that need only a small amount of energy to break them so they have low melting and boiling points.

- **Describe the properties of giant covalent structures**

Some molecules that are covalently bonded form giant covalent structures. These have a high melting and boiling point as they have strong forces holding the atoms together; these need lots of energy to break them.



Diamond is carbon bonding together in a giant structure. Diamond has four bonds to each carbon, does not conduct electricity and has high melting and boiling points.

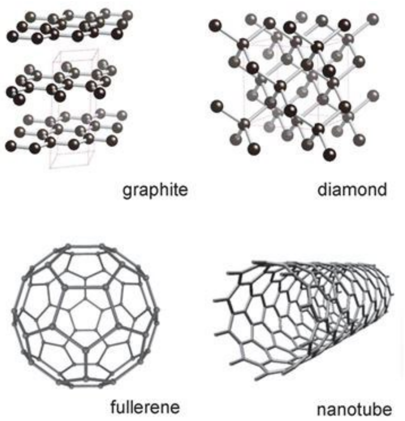
Silicon Dioxide is silicon and two oxygen atoms bonded together. The common name is sand. It does not conduct electricity and does not conduct electricity.

Graphite is carbon bonded together in layers. Each carbon has three bonds to form the layers that are strongly held together. The forces between the layers are weak meaning they can be rubbed off on paper. Graphite is the only non-metal to conduct electricity as it has free/delocalised electrons.

- **Compare the properties of different giant covalent structures**

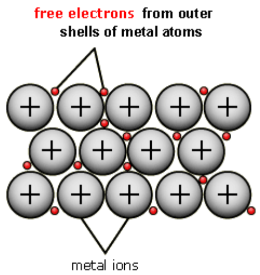
All giant covalent structures have a high melting and boiling point.
Diamond and silicon dioxide is strong whereas graphite is slippery.
Graphite is the only giant covalent structure to conduct electricity as it has free/delocalised electrons.

- **Define the term; allotropes of carbon**



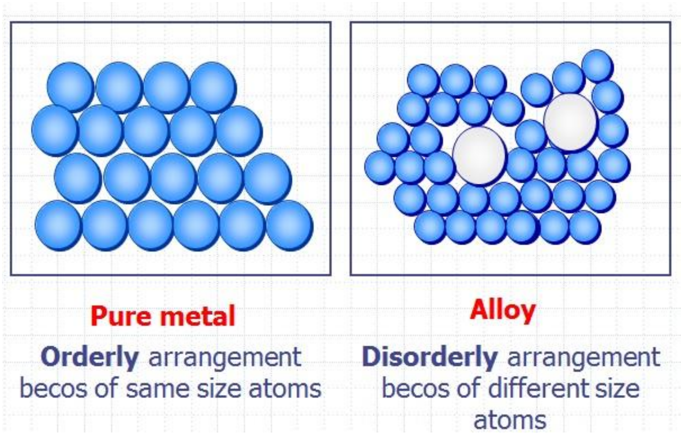
Allotropes of carbon are carbon molecules bonded in to different forms. They often have unique properties because they have a high surface area.

- **Describe the properties of metals**



Metallic bonding is between two metal ions. The structure is held together by the fact that metal ions lose some of their outer electrons, these are free/delocalised electrons. The metal ions are positive (as electrons are delocalised. These free electrons mean that metals conduct electricity and heat.

- **Define alloys**



Alloys – A mixture of metals with atoms of different sizes.

Pure metals have atoms that are arranged in layers, these can slide over each other. This makes them soft and malleable (easily shaped).
Alloys have a mix of different sized atoms so the atoms are not in layers, so there is not sliding making the structure stronger.

C4 Quantitative Chemistry

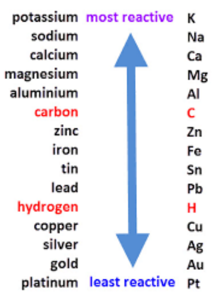
- **Calculate Relative Formula Mass**
  The largest number on an element on the periodic table tells you the relative atomic mass of an element. The relative formula mass is the atoms in a molecule added up. E.g.
  $CaCO_3$
  Mass of Calcium = 40, Carbon = 12, Oxygen = 16
  So the relative formula mass = 40+12+16+16+16=100

- **Define the term; concentration**
  Concentration is the amount of solute (solid) in a given volume of solvent (liquid).

- **Calculate concentration**
  $1dm=1000cm^3$
  Concentration= $\frac{\text{Amount of solute(g)}}{\text{Volume of solution } (dm^3)}$

C5 Chemical Change

- **Recall the order of the reactivity series**



Potassium is the most reactive metal and platinum is the least reactive metal. Being reactive means that element is more likely to bond with oxygen and other and need separating from these to get the pure substance we can use in industry.

Anything above carbon is extracted by electrolysis.

Anything between hydrogen and carbon is reduced using carbon.

Anything below hydrogen is found pure as it is unreactive.

- **Define the term ore**
  Rock that contains metal. This metal can be extracted and used in industry and manufacturing.

- **Define Oxidation and Reduction**
  Oxidation is when an element reacts with oxygen.
  Iron + Oxygen > Iron Oxide

  Reduction is when oxygen is removed from an element.
  Lead Oxide + Carbon > Lead + Carbon dioxide

  The Oxygen is removed from the lead so this is reduced.
  Carbon reacts and bonds with oxygen so this is oxidised.

- **Describe how different metals react with water and acid**

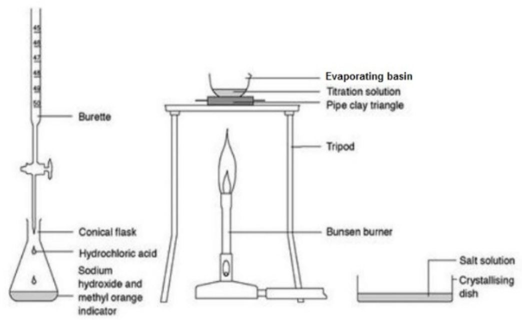
Order of reactivity	Reaction with water	Reaction with dilute acid
potassium	fizz, giving off hydrogen gas, leaving an alkaline solution of metal hydroxide	explode
sodium		
lithium		
calcium		fizz, giving off hydrogen gas and forming a salt
magnesium	very slow reaction	
aluminium		
zinc		
iron		
tin	slight reaction with steam	react slowly with warm acid
lead		
copper	no reaction, even with steam	no reaction
silver		
gold		

- **Describe how to extract each metal from it's ore**
  Anything above carbon is extracted by electrolysis.
  Anything between hydrogen and carbon is reduced using carbon.
  Anything below hydrogen is found pure as it is unreactive.

- **Give the general word equation for metal and acid reactions**

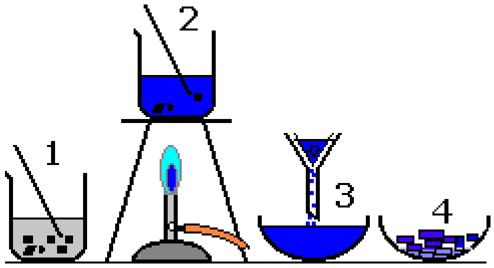
  Metal + Acid > Salt + Hydrogen
  Sodium + Hydrochloric acid > Sodium Chloride + Hydrogen
  Calcium + Nitric acid > calcium nitrate + Hydrogen

- **Describe a method to make a soluble salt from a soluble base and an acid**
  When an acid and an alkali are reacted together they make a salt and water (in a neutralisation reaction). So We can add any acid and alkali together, make sure it is neutral and then evaporate off water to leave a salt.



- **Define the term insoluble**
  Insoluble means a substance does not dissolve in water.

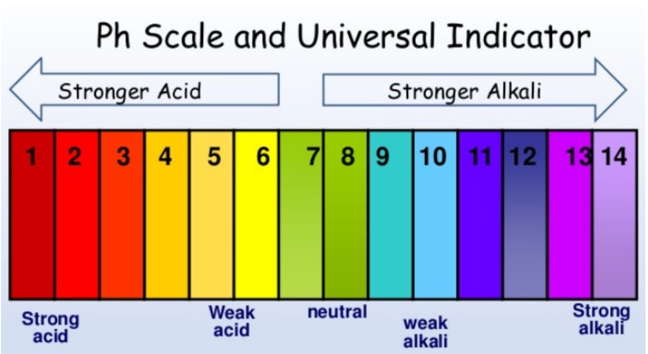
- **RP Describe a method to make a soluble salt from an insoluble liquid**
  Copper Oxide + Sulphuric acid > Copper sulphate + Water
  The c**opper oxide** is insoluble, to make this react we have to heat and stir it in to the **sulphuric acid** in excess. We know we cannot get anymore to react and dissolve when it starts to drop to the bottom of the beaker as it is not dissolve. We filter the solution to remove any unreacted copper oxide. Evaporate using a Bunsen Burner (or leave in a warm place) to evaporate the water and leave behind **copper sulphate** crystals.



- **Write equations with acid and alkalis and acid and carbonates**
  Alkali + Acid > Salt + Water
  Sodium Hydroxide + Hydrochloric acid > Sodium Chloride + Water
  Calcium Hydroxide + Nitric acid > Calcium Nitrate + Water

  Metal carbonate + Acid > Salt + Water + Carbon Dioxide
  Copper carbonate + Hydrochloric acid > Copper Chloride + Water + Carbon Dioxide

- **Identify parts of the pH scale**

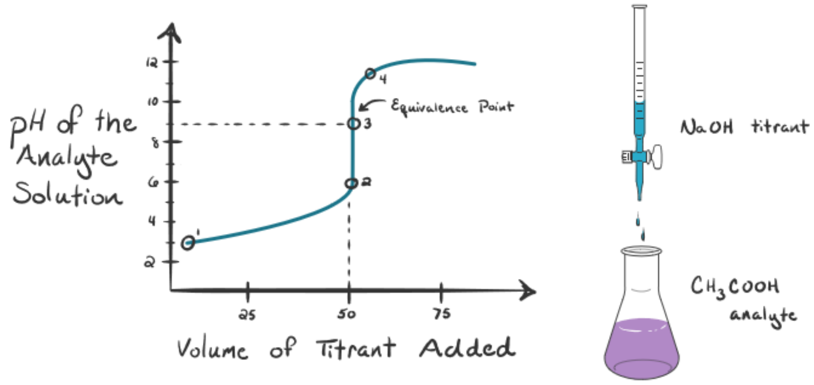


- **Describe different ways to measure pH**
  There is more than one indicator to use to identify the strength of acids and alkalis.

  Universal indicator or universal indicator paper – see colours above
  Phenolphthalein – clear in an acid, pink in an alkali.
  Methyl Orange - Red in an acid, orange in an alkali.

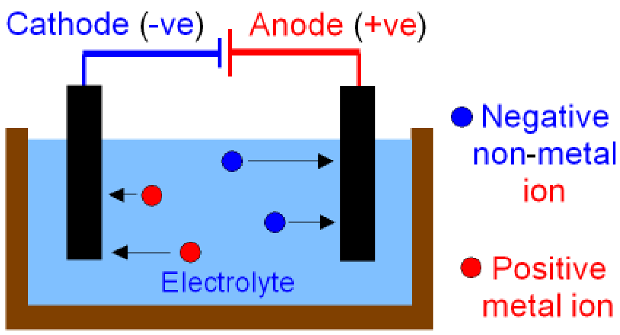
- **Write a word an ionic equation for neutralisation**
  All acids contain H^+ ions. All alkalis contain OH^- ions
  General equations for neutralisation = Alkali + Acid > Salt + Water
  Ionic equation for neutralisation = H^+ + OH^- > H_2O

- **Describe how to obtain a pH curve**



C6 Electrolysis

- **RP Describe what happens during electrolysis of molten (melted) electrolytes.**

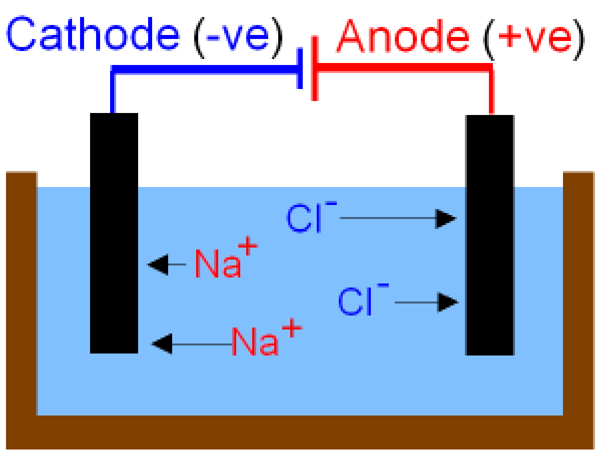


There are two electrodes involved in electrolysis. You need to remember the names of each electrode.

PANIC – Positive Anode, Negative Is Cathode

The negative ion is attracted to the positive Anode. When it touches the anode it gains electrons and turns back in to an atom.

The positive ion is attracted to the negative Cathode. When it touches the cathode it loses electrons and turns back in to an atom.

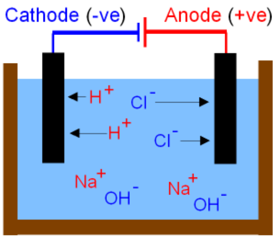


In an example:

The negative Chlor*ide* ion is attracted to the positive Anode. When it touches the anode it gains electrons and turns back into a Chlor*ine* atom, this comes off as a gas (you would see bubbles).

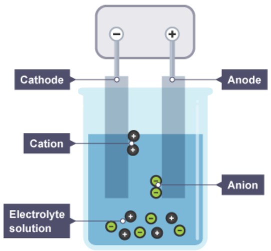
The positive Sodium ion is attracted to the negative Cathode. When it touches the cathode it loses electrons and turns back into a Sodium atom, this is a solid metal (you would see shiny metal on the electrode).

- **RP Describe what happens during electrolysis of aqueous (in solution) electrolytes.**
  If there is more than one ion of each charge, the least reactive is expelled and the most reactive stays in the solution.

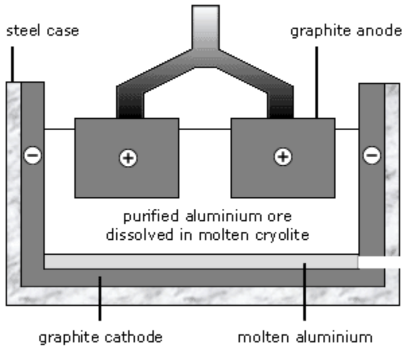


Both H+ and Na+ are attracted to the cathode. Hydrogen is less reaction that Sodium so Hydrogen is expelled as a gas. Sodium stays on the solution.

- **Label the equipment for electrolysis**

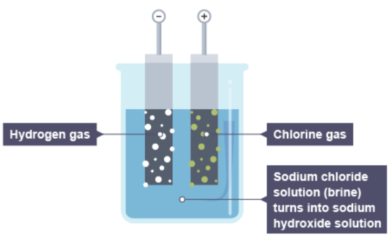


- **Label the equipment involved in the extraction of aluminium**



The equipment used to electrolysis aluminium looks slightly different but it is still the same as above. A negative electrode and a positive electrode.

- **Describe how aluminium is extracted**
  Bauxite ore (rock) is crushed, cryolite is added to reduce the melting point so it takes less energy to melt it. The molten bauxite is dissolved in cryolite to reduce its melting point. Positive aluminium ions are attracted to the cathode, lose electron and become aluminium metal. The metal is at the bottom so is tapped off as a liquid.
- **Describe what happens during the electrolysis of brine**



The electrolysis of brine is an important industrial process as you get three useful products. Brine is very concentrated salt water.

The negative chlorine ions are attracted the anode and form chlorine gas.

The positive hydrogen ions are attracted to the cathode and form hydrogen gas.

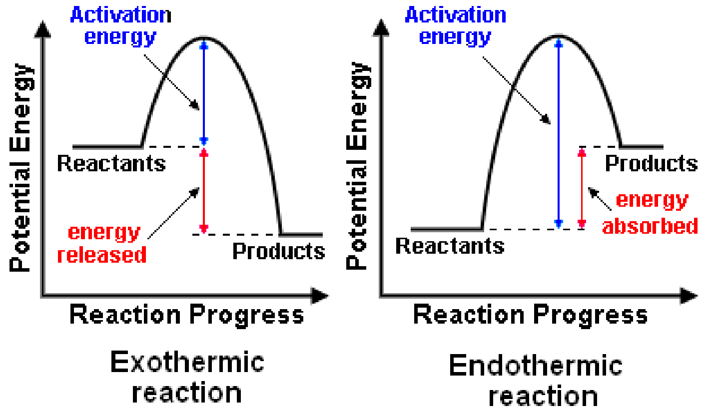
The ions that are the most reactive stay in the solution forming sodium hydroxide which stays in solution.

C7 Energy Changes

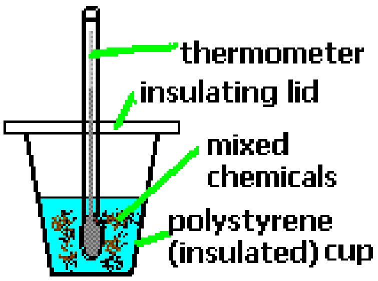
- **Define the term activation energy**
  The minimum amount of energy needed for a reaction to take place.

- **Define endothermic and exothermic reactions**
  Endothermic reactions need energy input to complete a reaction. These show a drop in temperature. Exothermic reactions have excess energy, this is given out to the environment, so the reaction feels hot.

- **Give reaction profiles for endothermic and exothermic reactions**



- **RP Describe how to measure temperature change**



Different reactions are completed in an insulated container. Thermometers are used to measure the temperature change.