Summary Sheet Year 9 Atomic Structure

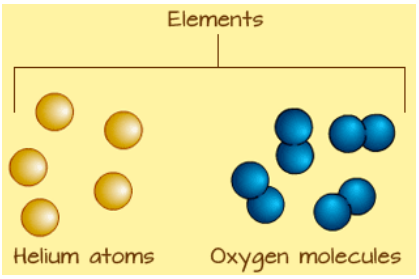
Atom – the smallest part of an element that can exist

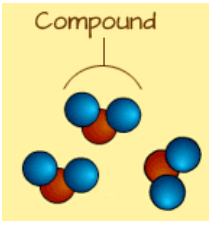
Molecule – a small group of atoms joined together

Element – a pure substance made up from one kind of atom only
e.g. argon, Ar, oxygen, O_2, sodium, Na, chlorine, Cl_2

Compound – a pure substance made from two or more different elements chemically joined together e.g. carbon dioxide, CO_2

Mixture – a substance made from two or more different substances NOT chemically joined together e.g salt water

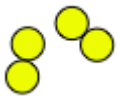




This diagram could show sulfur dioxide molecules (SO_2) or water molecules (H_2O)

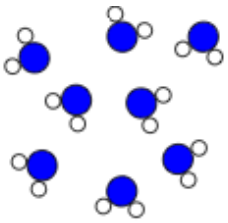
Both of these would also be compounds

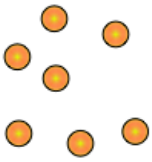
Recognising Particle Diagrams



This is an **element** (one kind of atom only) and a **molecule**

This is a **compound** (2 different kinds of atom) and a **molecule**





This is an **element** (one kind of atom only) and an **atom**

This is a **mixture** of **two different elements**. Both of them are **molecules**

Formulae

The formula of a substance shows us how many of each kind of atom it is made up from.

Examples:

a) **H_2O** is made up from 2 hydrogen atoms (H_2) and 1 oxygen atom (O)

b) **H_2SO_4** is made up from 2 hydrogen atoms (H_2), 1 sulfur (S) and 4 oxygen atoms (O_4)

c) **KNO_3** is made up from 1 potassium atom (K), 1 nitrogen (N) and 3 oxygen atoms (O_3)

Naming compounds

If there is a metal in the compound, the name of the metal goes first.

If the compound contains **only two elements** then one of the element's name has its ending changed to '**ide**'.

e.g. zinc + oxygen = zinc oxi**de**

iron + bromine = iron brom**ide**

If a compound contains **two elements plus oxygen**, then the name ending of one of the elements is changed to '**ate**'.

e.g. sodium + carbon + oxygen = sodium carbon**ate**

potassium + nitrogen + oxygen = potassium nitr**ate**

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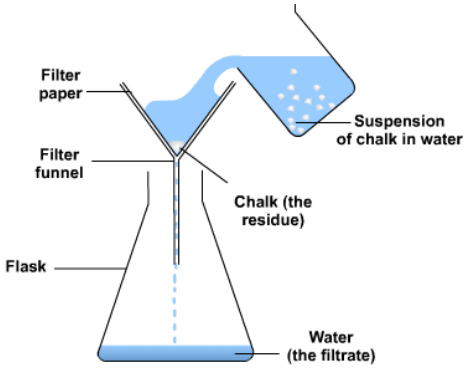
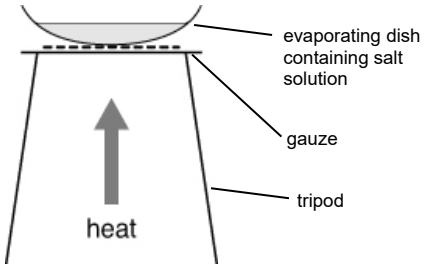
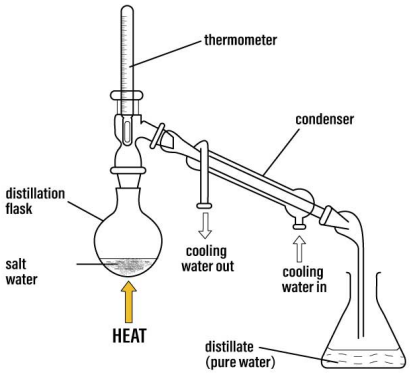
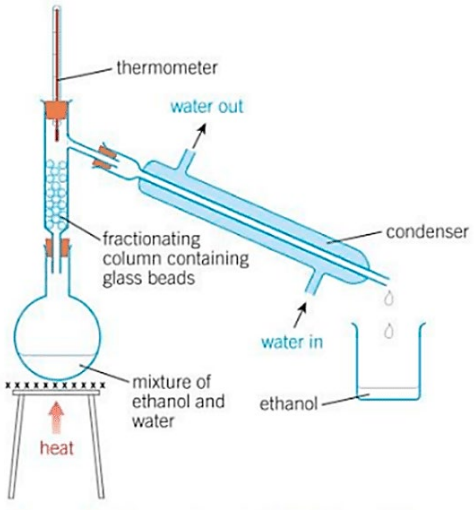
Separating Mixtures

Method	Used to separate	Apparatus used	Examples
Filtering (filtration)	An insoluble solid from a liquid		• separating sand from a mixture of sand and water
Evaporation (or crystallisation)	A soluble solid from a liquid (useful when you only want the solid)		• separating salt from salt solution
Distillation (evaporation followed by condensation)	A solvent from a solution (useful when you want to keep the liquid as well as the solid)		• separating pure water from a salt solution
Fractional distillation	Mixtures with **different boiling points** into fractions, as they condense at different temperatures (useful when you want to keep both the liquids)		• separating two liquids with **different boiling points** e.g. alcohol (78°C) and water (100°C) • separation of crude oil into useful substances

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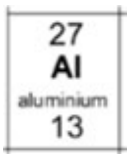
Sub Atomic Particles

	relative mass	relative charge	location
proton	1	+1	In nucleus
neutron	1	0	In nucleus
electron	Very small or 0	-1	In electron shells or energy levels

An aluminium atom has a mass number of 27, and an atomic (proton) number of 13



Aluminium has: **13 protons** (positive)
13 electrons (negative)
27-13 = **14 neutrons**

Number of **positive protons and negative electrons** must be the **same** since **atoms are neutral** (no overall charge)

Mass number means the total number of particles with mass, so protons and neutrons must add up to 27

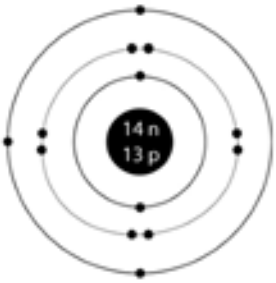
Electron Structure

This shows the way the electrons are arranged in **energy levels or shells** around the nucleus of the atom.

Protons and neutrons are in the nucleus, but the electrons are drawn around the outside using dots or crosses

Aluminium atoms have 13 electrons, $_{13}$**Al**

- 1st shell holds 2 e^-
- Other shells hold up to 8 e^-



The electron structure is also written as **2,8,3**

Aluminium is in **group 3** of the periodic table as it has **3 outer shell electrons**

It is also found in the **third period** (3rd row down) as it has **3 electron shells**

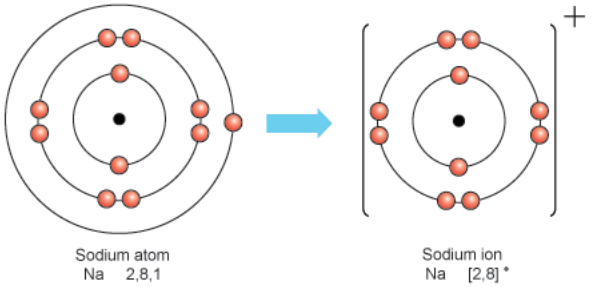
eg. calcium, $_{20}$**Ca** has an electron structure of **2,8,8,2** so calcium is found in **group 2**, and **period 4**

Ion Formation

Atoms gain or lose electrons to obtain a <u>full outer shell of electrons</u>

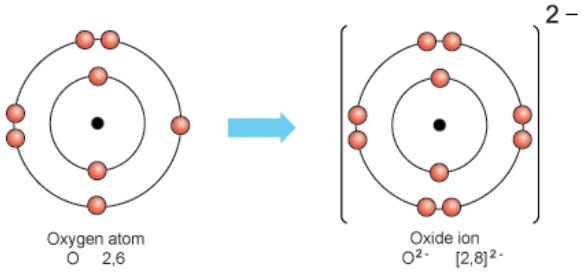
Metal atoms **lose electrons** to form **positive ions**

e.g. sodium in group 1 will lose 1 electron for a full outer shell



Non-metal atoms **gain electrons** to form **negative ions**

e.g. oxygen in group 6 will gain 2 electrons for a full outer shell



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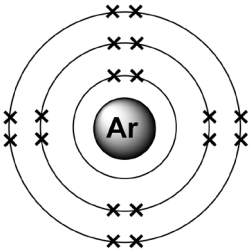
Group 0 – Noble Gases

e.g. helium, neon, argon



Unreactive (inert) gases.
Do not want to gain or lose electrons as they already have a **full outer shell of electrons.**

Often used in light bulbs and food packaging (crisp packets) due to their full outer shell of electrons and unreactive nature.

History of the Periodic Table

Early periodic tables were arranged by atomic weight (mass number).

John **Newlands** made a periodic table by starting a new column every eighth element. Some elements (like copper, Cu) were placed in inappropriate groups based on reactivity when the order of atomic weights (mass number) was followed.

The pattern of reactivity only worked for the first 15 elements or so. Scientists did not accept his ideas.

H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co/Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce/La	Zr	Di/Mo	Ro/Ru
Pd	Ag	Cd	U	Sn	Sb	Te
I	Cs	Ba/V	Ta	W	Nb	Au
Pt/Ir	Tl	Pb	Th	Hg	Bi	Os

Mendeleev overcame problems by **leaving gaps** (?) for elements that hadn't been discovered and **changed the order of some elements** to fit the chemistry better. e.g. Mendeleev swapped the positions of Te and I.

When new elements were discovered that fit into the gaps, Scientists accepted Mendeleev's table.

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
Period 1	H							
Period 2	Li	Be	B	C	N	O	F	
Period 3	Na	Mg	Al	Si	P	S	Cl	
Period 4	K Cu	Ca Zn	? ?	Ti ?	V As	Cr Se	Mn Br	Fe Co Ni
Period 5	Rb Ag	Sr Cd	Y In	Zr Sn	Nb Sb	Mo Te	? I	Ru Rh Pd

The **modern periodic table** is arranged by **proton number (atomic number)**, not mass numbers.
Each proton number is unique.