

**Atoms, Elements and Compounds**

All substances are made up of **atoms**. **Atoms** are the smallest part of an element that can possibly exist.

Atoms have a radius of around 1 nm ( $1 \times 10^{-10}$  m)

Atoms of each element are represented by a chemical symbol:

**O** for oxygen  
**Ca** for calcium

If the symbol only contains 1 letter, this letter must be capital.

If the symbol contains 2 letters, the first must be capital and the second must be lower case.

An **element** is a substance made up of only **one type of atom**.

**Compounds** contain two more elements chemically combined in fixed proportions:

**CaCl<sub>2</sub>** for calcium chloride

No small number after Ca means there is 1 calcium atom in calcium chloride.

A small 2 after the Cl means there are 2 chlorine atoms in calcium chloride.

**Compounds** are not easily **separated**. They can only be separated by chemical reaction.

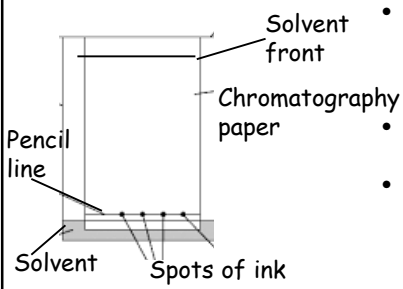
**Compounds** can be named using the following rules:

- The name of the metal goes first
- The name of the non-metal goes second
- Change the non-metal name ending from -ine to -ide

**Word equation:**  
lithium + bromine → lithium bromide

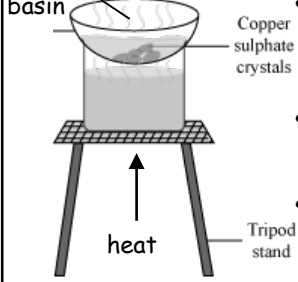
**Symbol equation:**  
 $Li + Br \rightarrow LiBr$

**Chromatography - used to separate a mixture of substances dissolved in a solvent e.g. inks**



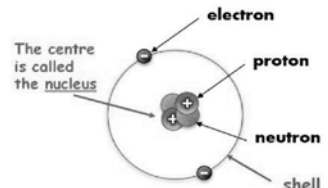
- Distance travelled by the spot depends on the **solubility** of the substance.
- Pencil line must be **above** solvent.
- Must be drawn in pencil as ink will dissolve and run up the paper.

**Crystallisation - used to obtain crystals from a solution**



- Evaporating** water from a solution on a water bath is gentler than heating directly.
- You should stop heating at the point of **crystallisation** - when crystals appear.
- The excess water can then be left on a window sill to evaporate.

**Structure of the atom:**



In an atom the number of **protons** is equal to the number of **electrons**.

particle	mass	charge
electron	0.005	-1
proton	1	+1
neutron	1	0

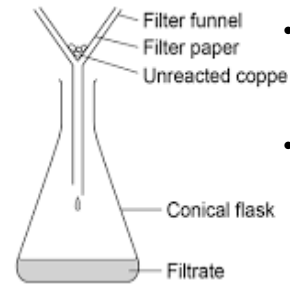
**Atoms have no overall charge**

**12** This is the mass number. It tells you how many **protons + neutrons** in the atom.

**C** This is the chemical symbol.

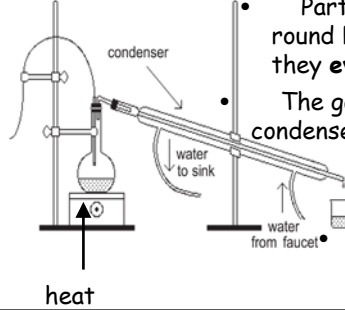
**6** This is the atomic number. It is the number of **protons** in the atom.

**Filtration - used to separate insoluble solids from a liquid or solution.**



- Insoluble solid particles are too big to fit through holes in the filter paper.
- Soluble particles break up when they dissolve so they are small enough to pass through filter paper.

**Distillation - used to separate a mixture of liquids**



- Particles are heated in the round bottomed flask until they **evaporate**.
- The gases travel down the condenser where they **condense**. The pure liquid is then collected.
- The liquid with the **higher boiling point** is left behind.

**Electronic structure**

Electrons are arranged around the nucleus in shells.  
The shell closest to the nucleus (1<sup>st</sup> shell) is filled first and can hold up to 2 electrons.  
The 2nd shell can hold up to 8 electrons.  
The 3rd shell can hold up to 8 electrons.



e.g. Oxygen has 8 electrons in total. Its electron structure is 2,6.

**Ions and isotopes**

Atoms can lose or gain electrons to become charged.  
Charged atoms are called **ions**.  
They have charges because there are a different number of protons to electrons.

E.g. the **Li<sup>+</sup>** ion has **3 protons** and **2 electrons**.

Atoms with the same number of protons but different number of neutrons are called **isotopes**.  
Isotopes are the same element but with different **masses**.

### Periodic Table

The **periodic table** is a list of elements arranged according to their **atomic number**.

Elements in the same *Group* have the same number of outer shell electrons (e.g. group 1 all have 1 electron in their outer shell) and similar **properties** (e.g. the noble gases are all very unreactive gases). The number of **electrons** in an elements out shell determines its **chemical properties**.

### Metals and non-metals

- **Metals** are found on the **left** side of the periodic table and **non-metals** are found on the **right**.
- **Metals** form **positive** ions ( $Li^+$ )
- **Non-metals** form **negative** ions ( $O^{2-}$ )

### History of the atom

**Dalton:** Indivisible spheres.  
**Thomson:** Plum pudding- positive ball with embedded electrons.

**Rutherford:** Nuclear model. Experiment with gold foil shows most of an atom empty (helium nuclei pass through) with a positive nucleus (helium nuclei deflected).

**Bohr:** Planetary model- electrons in fixed orbits around the nucleus.  
**Protons** discovered.  
**Chadwick:** Discovered the neutron.

### General physical properties

Metals	Non-Metals
Lustrous (shiny)	Dull
Good conductor	Poor conductor
High density	Low density
Strong	Brittle
Malleable and ductile	
High melting point	Low melting point

### History of the Periodic Table

Before the discovery of subatomic particles (electrons, neutrons and protons) periodic tables were arranged based on atomic weight.

Mendeleev and Newlands both suggested different periodic tables.

Newlands	Mendeleev
Ordered elements by atomic weight	
Included only the elements known at the time	Left gaps for undiscovered elements
Arranged by atomic weight only	Arranged by atomic weight and adjusted for chemical properties
Every 8 <sup>th</sup> element had similar properties (Newlands' Law Of Octaves)	Elements in groups had similar properties
Criticised for grouping elements with very different properties.	Not believed until the gaps he left for new elements proved to be correct.

Key

relative atomic mass	atomic symbol	name	atomic (proton) number
----------------------	---------------	------	------------------------

Metals

Non- Metals

Elements with atomic numbers 112 - 116 have been reported but not fully authenticated

Each Column is a **group**

- The group number tells you how many electrons are in the elements out shell.

Each row is a **period**

- The period number tells you how many shells an element has

Following the discovery of **protons** our modern periodic table is now arranged by **atomic number**.

The discovery of **isotopes** made it possible to explain why ordering elements by **atomic weight** was not always correct... as Mendeleev thought (look at Ar and K).