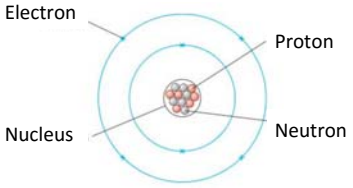
Chemistry 1: Atomic structure and the periodic table

Atoms

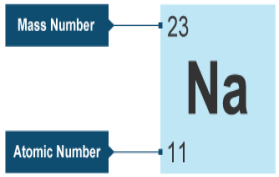
Atoms are tiny, too small to see. They have a radius of 0.1 nanometres (1×10^{-10} m)

Atoms have no charge because they have the same number of **protons** and **electrons.**



Type of sub-atomic particle	Relative charge	Relative mass
proton	+1	1
neutron	0	1
electron	−1	very small (it would take almost 2000 electrons to have the same mass as one proton or neutron)

Electron	Orbit around nucleus in shells
Proton	Found in the nucleus
Neutron	Found in the nucleus



Mass Number :

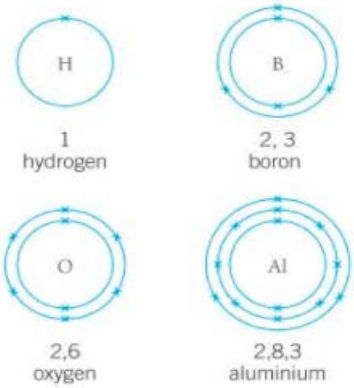
protons + neutrons

Atomic number:

Protons

Electronic Structure

- 1st **shell**– Lowest energy level and can hold 2 **electrons**
- 2nd **shell**– Energy level can hold up to 8 **electrons**
- 3rd **shell** onwards– Can hold up to 8 **electrons**.



Electron structure and the **periodic table**

Elements in the same **group** have the same number of **electrons** on their outer **shell.**

Proton number = **Electron** Number

Number of **neutrons**=

Mass number—**Atomic number**

Ions

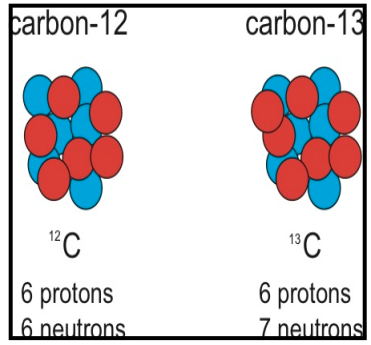
An **ion** is an atom that has lost or gained electrons.

In an i**on** the number of protons is not equal to the number of **electrons** so the atom has an overall charge. This can either be **positive** or **negative.**

Isotopes

An **isotope** is an atom that has the same number of **protons** but a different number of **neutrons**.

They have the same **atomic number** but different **atomic mass** numbers.



Relative atomic mass (A_r)

Relative atomic Mass (Ar) = sum of (**isotope** abundance x **isotope** mass number) / sum of abundance of all the **isotopes**

An average mass of an **element** that has a number of different **isotopes**.

Chemical Equations

Chemical reactions are shown using:

- **Word equations**

Magnesium + Oxygen ⟶ *Magnesium Oxide*

(reactants) *(product)*

- ***Symbol equations***—*Show the **atoms** on both sides*

$2Mg + O_2 \longrightarrow 2MgO$

Balancing equations:

- There must always be the same number of **atoms** on both sides of a **symbol equation**.
- Atoms can't just disappear.
- You **balance** equations by putting numbers **in front** of the number.

$$CH_4 + 4Cl_2 \longrightarrow CCl_4 + 4HCl$$

C = 1	C = 1
H = 4	H = 4
Cl = 8	Cl = 8

History of the atom

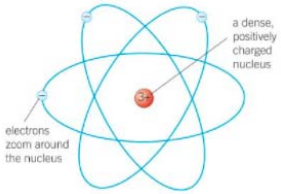
*Ideas about **atoms** have change over time.*

Plum pudding model

An **atom** was a ball of positive charge with **electrons** scattered in the ball.

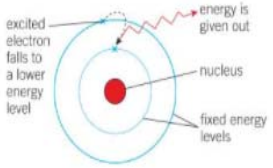
Rutherford's nuclear model

Electrons orbiting the **nucleus** which contains very dense positively charged **protons.**



Bohr's model

Electrons orbit the **nucleus** at set distances in fixed energy levels **(shells).**



The Periodic table

The arrangement of the periodic table has changed.

Early 1800s

- Arranged my **relative atomic mass**.
- Scientists had not yet discovered proton, neutrons or electrons.
- There were gaps for missing elements that had not been found yet.

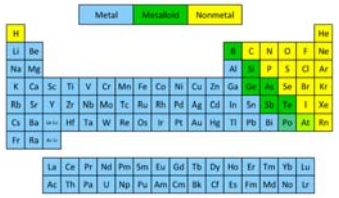
Dimitri Mendeleev

- Ordered mainly by **atomic mass**.
- Elements with similar properties in the same **group**.
- Gaps left for **elements** that hadn't been found yet.

You will need to know the first 20 **element** names and their **symbols**

Modern Day

- In order of increasing **atomic mass**.
- Repeating patterns in the properties of the **elements**.
- **Metals** are on the left and **non– metals** are on the right.



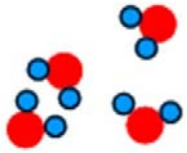
Properties of **metals** - **Ductile** - **Malleable**

- High **melting** and **boiling** point
- **Conduct** heat - **Conduct** electricity

Properties of **non- metals** - Brittle

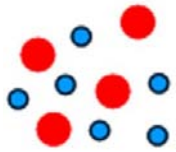
- **Insulators** of heat and electricity
- Not always **solids** - lower **density**

Compounds



- Have a fixed composition
- Can be separated by a **chemical reaction**
- Chemical **bonds** between **atoms**

Mixtures



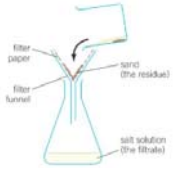
- No fixed composition
- Can be separated by physical means
- No chemical **bonds** between **atoms**

Separating Mixtures

Filtration

*Separates **insoluble solids** from **liquids.***

- Put filter paper in a funnel and pour the **solution** through it. The liquid passes through and the solid is caught in the filter paper.



Evaporation

*Used to separate a **soluble** salt from a **solution.***

- Heat the **solution** until the **solvent evaporates**.

Crystallisation

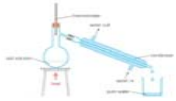
*Used to separate a **soluble** salt from a **solution.***

- Heat the **solution** and then leave

Distillation

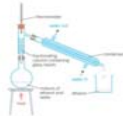
*Used to separate **liquid** from a **solution.***

Heat **solution** and the part with the lowest **boiling** point **evaporates** and is **condensed** back into a **liquid.**



Fractional Distillation

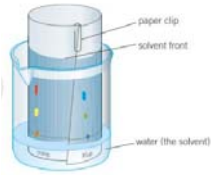
*Used to separate a mixture of **liquids** from a **solution.***



Paper chromatography

Can be used to separate different dyes in an ink.

- **Compounds** are **dissolved** by using filter paper and a **solvent**, in which the **compounds** are placed.



Group 1– Alkali metals

- *One **electron** on outer shell*
- *Very **reactive***

Reactivity** increases down the **group.

Li
Na
K
Rb
Cs
Fr

Group 7– Halogens

- Seven **electrons** on outer shell
- Less **reactive** down the group
- Higher **melting** and **boiling** points down the group

F
Cl
Br
I
At

Group 0– Noble gases

- Eight **electrons** on outer shell
- **Unreactive** as they have a full outer shell and are stable
- Colourless gases

He
Ne
Ar
Kr
Xe
Rn