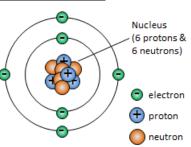
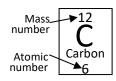
Atoms, Elements and Compounds

Atomic Structure



	Charge	Mass
Proton	1+	1
Neutron	0	1
Electron	1-	almost 0



Radius of an atom = 0.1nm (1 x 10^{-10} m)

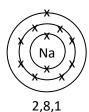
Radius of nucleus = $1 \times 10^{-14} \text{m} (1/10,000 \text{ of an atom})$

The atomic number is the number of protons.

The number of **electrons** = number of protons.

The number of **neutrons** = mass number – atomic number.

Electron Configuration



Atoms can have a **maximum** of **2** electrons in the first shell, 8 in the second and 8 in the third.

You must fill each shell before moving onto the next one.

Isotopes

Different forms of the same element.

Have the same number of protons but different number of neutrons.

Have the same atomic number but different mass numbers

Relative atomic mass =

sum of (isotope abundance x isotope mass number)

sum of abundances of all isotopes

Compounds

Elements are held together by chemical bonds.

Bonds are made by taking, giving or sharing electrons.

Properties usually different from the original elements. Difficult to separate the original elements.

Separation Techniques

Chromatography – separates out different colours in ink. An Rf value can be calculated to compare inks.

Filtration – Separates a solid from a liquid.

Crystallisation – Separates out a solid that has dissolved in a liquid. The liquid evaporates leaving behind the solid.

Distillation – Separates out liquids that have different boiling points.

Balancing Equations

The same number of atoms of each element are needed on each side of an equation:

$$H_2 + O_2 \rightarrow H_2O$$

2 hydrogens on each side ✓

2 oxygens on left, one on right *

$$H_2 + O_2 \rightarrow 2H_2O$$

2 hydrogens on left, four on right

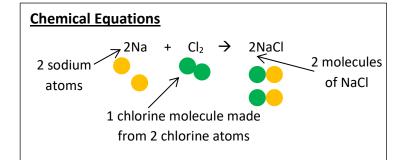
2 oxygens on each side ✓ Multiply by the big number

4 hydrogens on each side ✓ $2H_2 + O_2 \rightarrow 2H_2O$ 2 oxygens on each side <

Element – a group of the same type of atoms (ie. have the same atomic mass)

Compound – two or more different elements chemically joined.

Mixture – different types of molecules that are not chemically joined.



History of the Atom and Periodic Table

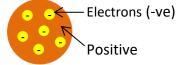
History of the Atom

John Dalton

Atoms are solid spheres. Different spheres are made from different elements.

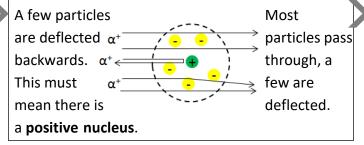
JJ Thomson

Measured charge and mass, showing atoms must contain electrons (-ve charges). Developed the plum pudding model.



Ernest Rutherford

He carried out alpha particle scattering experiments. If the plum pudding model was correct then the positive alpha particles should pass through or deflect slightly.



Niels Bohr

Realised that if the electrons were in a cloud around a nucleus the atom would collapse. Suggested that the electrons orbit the nucleus in fixed shells. **Experiments** supported this.

Further experiments have shown the nucleus is made up of protons and neutrons. James **Chadwick** carried out experiments to prove the existence of neutrons.

Development of the Periodic Table

Scientists used to not know about atomic structure, protons, neutrons and electrons. They arranged the atoms in order of atomic mass. There were lots of elements that had not been discovered so many elements were placed in the wrong group.

Dmitri Mendeleev improved the design of the periodic table:

- **Left gaps** for undiscovered elements. When they were discovered they fitted the pattern
- Changed the order of some elements so that they matched the properties of the rest of the group (eg. Te and I are not in order of atomic mass but they fit the properties of the rest of their group.

Group 1 Elements

React with water to form an alkaline solution: Lithium + water -> lithium hydroxide + hydrogen React vigorously when heated with **chlorine gas**: Sodium + chlorine \rightarrow sodium chloride React with oxygen to form oxides: Lithium forms lithium oxide (Li₂O), sodium forms sodium oxide and sodium peroxide (Na₂O₂) and potassium forms potassium peroxide and potassium superoxide (KO₃). More reactive down the group – the outer electron is further from the nucleus so more easily lost. Lower melting and boiling points down the group.

Group 7 Elements

Less reactive down the group – the outer shell is further from the nucleus so harder to gain an electron. Higher melting and boiling points down the group. Exist as pairs of atoms – eg. Cl₂

A more reactive halogen will **displace** a less reactive halogen: $Cl_2 + KBr \rightarrow 2KCl + Br_2$

Cl = dense green gas

Br = red-brown volatile liquid

I = dark grev solid

Group 0 Elements

Full outer shells so are unreactive (inert).

Boiling point increases down the group - atoms have more electrons so stronger intermolecular forces form between molecules. Are colourless and non-flammable.

Transition Metals

Are typical metals (strong, dense, shiny, good conductors).

Have more than one ion (eg. CU⁺ and CU²⁺) and form coloured compounds.