

Atomic Structure

Big idea: Atoms mark up everything

Key Vocabulary

Atoms	Tiny particles that make up all substances
Atomic model	A model to represent the structure of the atom. This model has been revised over time as new evidence has become available.
Atomic number	The number of protons in each atom of an element.
Chemical formula	This tells us the number of atoms of each element in a compound.
Conservation of mass	The total mass of the products formed in a reaction is equal to the total mass of the reactants.
electron	A negatively charged particle with a charge of -1 that orbits the nucleus of an atom.
element	A substance made of only one type of atom.
energy level	The distance that an electron is orbiting from the nucleus.
ion	A charged atom. The atom has either lost or gained one or more electrons.
isotope	Atoms of the same element with different numbers of neutrons.
Mass number	The number of protons plus the number of neutrons in the nucleus of an atom.
neutron	Particles with no charge that are found in the nucleus of the atom. They have the same mass as a proton.
nuclear model	The model of the atom suggested by Rutherford when they discovered the nucleus. This model has a central positive nucleus with electrons orbiting around the outside.
nucleus	The centre of the atom, containing protons and neutrons.
outer shell	The outermost energy level of an atom.
proton	Particles with a charge of +1 that are found in the nucleus of the atom. They have the same mass as a neutron.

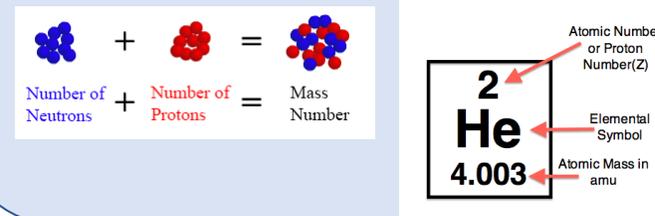
Atoms and Sub-Atomic Particles

Contained in the nucleus are the protons and neutrons. Moving around the nucleus are the electrons which are negatively charged. Overall they have the same number of protons as electrons.

Ions: Have a different number of protons and electrons.

Atomic number = no. of protons

Mass number = no. of protons + no. of neutrons



Particle	Relative Mass	Charge
proton	1	+1
neutron	1	0
electron	Very small	-1

Isotopes and Relative Atomic Mass

Isotope are elements with the same number of protons but **different number of neutrons**.

Isotopes – **same atomic number, different mass number**

ISOTOPES - CALCULATIONS

There are two common isotopes of chlorine. Calculate the average relative atomic mass of chlorine atoms

	Protons	Neutrons	%
$^{35}_{17}\text{Cl}$	17	18	75
$^{37}_{17}\text{Cl}$	17	20	25

Out of every 100 atoms 75 are ^{35}Cl and 25 are ^{37}Cl

$$\text{Average} = \frac{(75 \times 35) + (25 \times 37)}{100} = 35.5$$

Elements and Compounds

Elements

Elements are made of atoms with the same atomic number. Atoms can be represented with symbols.
N = nitrogen O = oxygen
Elements can be groups of atoms called **molecules**. Oxygen gas O_2 is a element.

Compounds

A compound is when two or more elements are **chemically joined** (bonded together). They are difficult to separate. Examples are:
Carbon dioxide (CO_2), Water (H_2O), Sodium chloride (NaCl)

History of the Atom

Scientist	Year	Discovery
John Dalton	Start of 1800's	Atoms as 'indivisible; solid spheres'
JJ Thomson 'Plum pudding'	1897	Plum pudding model – the atom is a ball of charge with electrons scattered
Ernest Rutherford 'Nuclear Model'	1909	Alpha scattering/gold foil experiment – mass concentrated at the centre; the nucleus is charged. Most of the mass is in the nucleus. Most atoms are empty space .
Niels Bohr 'Electron orbits'	around 1911	Electrons are in shells orbiting the nucleus
James Chadwick The neutron	around 1940	Discovered that there are neutrons in the nucleus

Chemical Equations

A word equation

magnesium + oxygen → magnesium oxide
(reactant) (products)

A symbol equation

$2\text{Mg} + 2\text{O}_2 \rightarrow 2\text{MgO}$

Balancing Chemical Equations

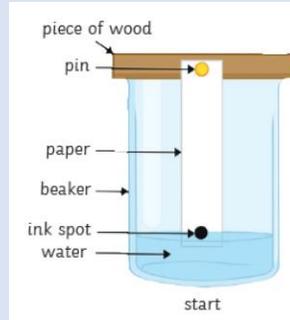
Equations need to be **balanced** to have the same number of atoms on each side.

Mixtures, Chromatography and Separations

Mixtures – in a mixture, there are **no chemical bonds**, so the elements are easy to separate.

Examples of mixtures are air, salt water and milk.

Chromatography – to separate out mixtures



Evaporation – to separate a soluble salt or dissolved solid from a solution. A quick way of separating out the salt.



Filtration – to separate solids from liquids



Crystallisation – to separate a **soluble salt** or **dissolved solid** from a solution; a slower method of separating out a salt.



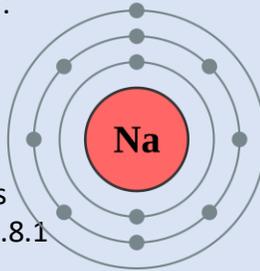
Electron Structure:

Electrons are found in shells that orbit the nucleus.

1st shell = 2

2nd shell = 8

3rd shell = 8

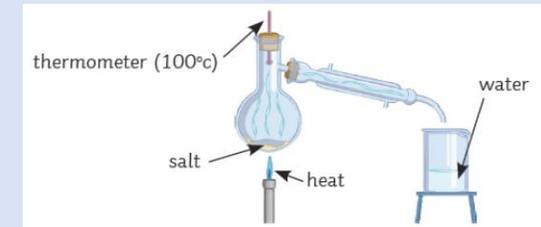


Sodium – 11 electrons

Electron structure = 2.8.1

Distillation

1. **Simple distillation** – separating a liquid from a solution



2. **Fractional distillation** – separating out a mixture of liquids. Fractional distillation can be used to separate out crude oil into fractions.

