

Topic 2 Atomic structure

Syllabus:

2.1 The nuclear atom

Atoms contain a positively charged dense nucleus composed of protons and neutrons.

Negatively charged electrons occupy the space outside the nucleus.

A brief account of the mass spectrometer in determining the relative atomic mass of an element from its isotopic composition.

2.2 Electron Configuration

Characteristic of emission spectra

Characteristic of line spectra

Energy level, n , can hold a maximum number of electrons, $2n^2$

The main energy level is divided into s , p , d and f sub-level of successively higher energies.

Atomic orbital as a representation of a region in space where there is a high probability of finding an electron.

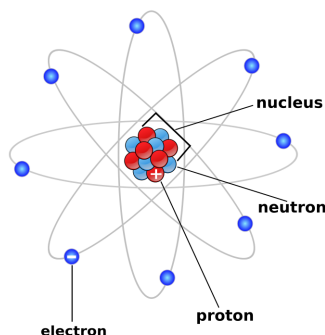
Each orbital has a defined energy state for a given electron configuration and can hold two electrons of opposite spins.

2.1 The nuclear atom

(A) The model of nuclear atom

- Atoms are made up of a nucleus containing **protons** and **neutrons**, with **electrons** moving around the nucleus in shells.
- Nucleus is positively charged.

Atomic Structure

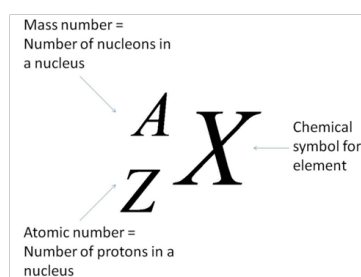


➤ Properties of sub-atomic particles

Particle	Proton (p ⁺)	Neutron (n)	Electron (e ⁻)
Charge	Positive	Neutral	Negative
Position	Nucleus	Nucleus	Outside the nucleus, moving very fast in shells
Relative mass (a.m.u)*	1	1	1/1840

* 1 a.m.u (atomic mass unit) = $\frac{1}{12}$ of the mass of a carbon - 12 atom

(B) Atomic Symbol



- Atomic Number Z = no. of Protons
Since the atoms are neutral, no. of Protons = no. of Electrons
- Mass Number A = no. of Protons + no. of Neutrons

(C) Isotope

- **Isotope:** Atoms of the same element which have different no. of neutrons(different mass no.), same no. of protons.

Isotopes have different physical properties such as m.p, b.p and density because they have different mass number.

Isotopes have the same chemical properties which depend on the number of valence electrons.

- **Relative isotopic mass** is the mass of one atom of that isotope on the Carbon-12 scale. (No Unit)
- For example, Chlorine has two isotope: ³⁵Cl and ³⁷Cl
The relative isotopic mass of ³⁵Cl is 35 and ³⁷Cl is 37.
- The isotopic mass can be determined by **mass spectrometer**.

(D) Relative Atomic Mass

- **Relative atomic mass** of an element is the weighted average of the isotopic masses of its natural isotopes on the Carbon-12 scale.

➤ **Example 1**

Isotope	³⁵ Cl	³⁷ Cl
Relative abundance	75.77	24.23

$$\text{Relative atomic mass of chlorine} = \frac{(35 \times 75.77) + (37 \times 24.23)}{75.77 + 24.23} = 35.48$$

➤ **Example 2**

¹⁰⁷Ag and ¹⁰⁹Ag are two stable isotopes of silver. The relative atomic mass of silver is 107.87.

Show that ¹⁰⁷Ag is more abundant and Find the relative abundance of ¹⁰⁷Ag and ¹⁰⁹Ag.

Let the relative abundance of ¹⁰⁷Ag and ¹⁰⁹Ag be x % and (100 - x) %.

$$\frac{107x + 109(100-x)}{100} = 107.87$$

$$x = 56.5$$

The relative abundance of ¹⁰⁷Ag and ¹⁰⁹Ag be 56.5 % and 43.5 %.

Question 1

Define the term isotopes and give examples of isotope.

Question 2

In the world, there are two isotopes of Cu, ^{63}Cu and ^{64}Cu . The relative atomic mass of Cu is 63.55.
State which isotope has more abundance without calculation.