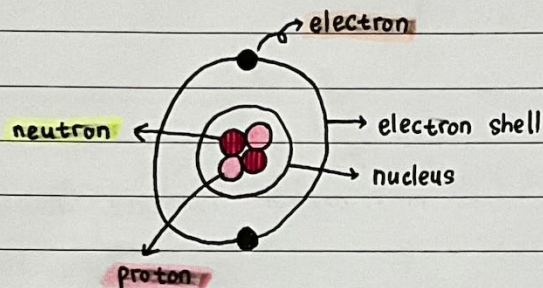


Chapter 3 : Elements, Compounds & Mixtures (Atomic Structure)

Atom

- An atom is the **smallest particle** of a substance.
- It has a nucleus which contains **protons** and **neutrons**.
- **Electrons** move around the nucleus in the **electron shells**.
- The diagram below shows an atom:



- The characteristics of the three subatomic particles:

Subatomic particle	Proton	Electron	Neutron
Relative mass	1	$\frac{1}{1840}$	1
Relative charge	+1	-1	0
Location	Nucleus	Electron shell	Nucleus

- An atom has an **equal number of protons and electrons**. The total number of positively charged protons is neutralised by an equal number of negatively charged electrons. So, an atom is **electrically neutral**.

- In an atom:

→ **Proton number** or **Atomic number**:

- The number of protons in the nucleus of an atom

→ **Nucleon number** or **Mass number**:

- The total number of protons and neutrons in the nucleus of an atom.

→ **Number of protons = Number of electrons**

→ **Number of neutrons = Nucleon number - Proton number**

Electronic configuration in an atom

- In an atom, electrons are arranged in **electron shells (or energy levels)** around the nucleus.

- The **electronic configuration (or electronic structure)** is the arrangement of electrons in an atom.

→ Electrons in the **innermost shell**, closest to the nucleus, have the **lowest energy**.

→ Electrons in the **outermost shell**, furthest away from the nucleus, have the **highest energy**.

- For each energy level, there is a maximum number of electrons that is allowed to occupy.

Electron shell	Max. electrons allowed
1	2
2	8
3	8

- The **valence electrons**

→ The **valence shell** or **outermost shell** is the electron shell which is the furthest from the nucleus.

→ The electrons in the valence shell are called the **valence electrons** or **outermost electrons**.

- **Using valence electrons to determine metals or non-metals**

→ For the first 20 elements, we can use the number of valence electrons to determine if the element is a metal or a non-metal.

No. of valence electrons	Classification of element
1	Metal
2	Metal
3	Metal
4	Non-metal
5	Non-metal
6	Non-metal
7	Non-metal
8	Non-metal

Stable electronic configurations of noble gases

- When an atom has the maximum number of electrons in the valence shell, it is still stable and unreactive.
- All the elements in Group 18 of the Periodic Table have stable electronic configurations. They are called the noble gases.
- They are inert and exist as monochromatic elements.

Isotopes

- Isotopes are elements with the same number of protons but different number of neutrons.
- Due to the difference in the number of neutrons, isotopes have different nucleon numbers.
- Similarities and differences of isotopes :
 - Similarities
 - Same numbers of protons and electrons
 - Similar chemical properties
 - Same proton number
 - Differences
 - Different mass number due to different number of neutrons
 - Different physical properties
 - Different nucleon number

Formation of ions

- All atoms are electrically neutral due to an equal number of protons and electrons. The positive charges and the negative charges neutralise each other.
- When an atom loses or gains electrons, the number of protons is not equal to the number of electrons anymore. Therefore, the atom will no longer be electrically neutral.
- When an atom is not electrically neutral, it is called an ion.
- There are two types of ions:
 - If an atom loses electron(s), it becomes a cation (positive ion).
 - If an atom gains electron(s), it becomes an anion (negative ion).
- Cations and anions are joined together to form ionic bonding.

- From an atom to an ion

→ The atom of most elements do not have a stable electronic configuration because their valence shell is not completely filled, so they do not have the maximum number of valence electrons. As a result, they do not have a stable electronic configuration.

→ In order to achieve the noble gas electronic configuration, they must either lose or gain electrons so that their valence shells have the maximum number of electrons.

→ In the formation of ions:

- Metals lose electrons to form cations

- Non-metals gain electrons to form anions

→ Hence, electrons are responsible for the chemical properties of an atom.

→ When an atom forms an ion, the proton number and nucleon number remain unchanged because protons and neutrons are not involved.

- Valency electrons

→ Valency electron refers to the number of valence electrons (or outermost electrons) of an atom involved when forming a chemical bond through gaining, losing or sharing.

→ Valency electron allows us to deduce the chemical formula of a substance.

- Molar mass (M_r) is a way to measure the mass of a substance through the atomic masses