STRUCTURE OF ATOM

Constituents of the atom: Atom is not the smallest indivisible particle but is made up of still smaller particles, i.e., electrons, protons and neutrons called fundamental or sub-atomic particles.

Electron

What is electron? An electron is that sub-atomic or fundamental particle which carries one unit negative charge and has mass nearly $1/1840^{th}$ of that of hydrogen atom.

Properties of cathode rays

(i) Cathode rays travel in **straight lines**

(ii) Cathode rays are made up of material **particle**

(iii) Cathode rays carry **negative charge**

(iv) When cathode rays strike a metal foil, the foil becomes hot. This indicates that cathode rays produce **heating effect**.

(v) They causes **ionization** of the gas through which they pass.

(vi) They produce **green fluorescence** on the glass walls of the discharge tube as well as on certain other substances such as zinc sulphide (ZnS).

(vii) They produce **penetrating effect** i.e. they can easily pass through thin foils of metal.

Proton

What is proton? When hydrogen gas is taken in the discharge tube, the anode rays are found to be made up of positively charged particles having one unit positive charge and mass nearly equal to that of hydrogen atom. These were called protons. Thus, proton is that sub-atomic or fundamental particle which carries one unit positive charge and has mass nearly equal to that of hydrogen atom.

Rutherford's Gold Foil Scattering Experiment:

Observations: After the bombardment of α-particles on the thick gold foil, Rutherford observed that:

(i) Most of the fast moving α-particles passed through the gold foil undeflected.

(ii) Some of the α-particles were deflected by small angles and some were deflected through large angles.

(iii) A very few particles (1 in 20,000) bounded back i.e. were deflected by nearly 180°.

Conclusion: On the basis of these observations, Rutherford drew the following conclusions regarding the structure of atom:

(i) Most of the space in an atom is empty as most of the α-particles passed through the foil undeflected.

(ii) A few α-particles were deflected from their path. The deflection must be due to enormous repulsive force showing that the positive charge of the atom is not spread throughout the atom, as Thomson had thought. According to Rutherford, the positive charge of the atom occupies very little space. This very small portion of the atom was called **nucleus.**

(iii) A very small fraction of the α-particles were deflected by 180°, showing that all the positive charge and mass of the gold atom were concentrated in a very small volume within the atom. (Radius of the atom is about 10^{-10} m while that of nucleus is 10^{-15} m).

Bohr's model of atom: An atom consists of a small heavy positively charged nucleus in the centre and the electrons revolve in certain discrete orbits having fixed energies. These orbits are called 1^{st}, 2^{nd}, 3^{rd} etc. or K, L, M etc. energy levels.

Neutron

- **Discovery of neutron:** Chadwick discovered the presence of neutral particles in the nucleus. These were called neutrons. A neutron is that sub-atomic or fundamental particle which is neutral but has mass nearly equal to that of proton.
- **Composition of the nucleus:** Nucleus contains protons and neutrons, collectively called nucleons.
- **Atomic Number (Z):** It is equal to the number of protons present in the nucleus. For a neutral atom, it is also equal to number of electrons present in the extra nuclear part.
- **Mass Number (A):** It is equal to the sum of protons and neutrons.
- Representation of Z and A with the symbol of the element. ${}^{A}_{Z}X$.
- Calculation of number of electrons, protons and neutrons from Atomic number (Z) and Mass number (A) in a neutral atom.

No. of protons = No. of electrons = Atomic number (Z)

No. of neutrons = Mass number (A) – Atomic number (Z)

Comparison of the characteristics of electron, proton and neutron

Particle	Charge on the particle	Mass of the particle	Symbol	Location in the atom
1. Electron	– 1 unit (– 1.602 x 10^{-19} coulomb)	9.11 x 10^{-31} kg $\left(\frac{1}{1840}u\right)$	${}^{0}_{-1}e$	Outside the nucleus (Extra nuclear part)
2. Proton	+ 1 unit (+1.602 x 10^{-19} C)	1.673 x 10^{-27} kg (1u)	${}^{1}_{1}p$	In the nucleus
3. Neutron	No charge	1.675 x 10^{-27} kg (1u)	${}^{1}_{0}n$	In the nucleus