

- **Electrons** are fundamental subatomic particles carrying one unit negative charge ($1.6022 \times 10^{-19}\text{C}$) and having mass $9.11 \times 10^{-31}\text{ kg}$.
- **Protons** are subatomic particles having one unit positive charge ($1.6022 \times 10^{-19}\text{C}$) and mass $1.67 \times 10^{-27}\text{ kg}$.
- **Neutrons** are subatomic particles having no charge and mass $1.675 \times 10^{-27}\text{ kg}$.
- Electron was discovered by J.J. Thomson during discharge tube experiments.
- J.J. Thomson determined e/m for electrons ($1.76 \times 10^8\text{ C per gram}$). Millikan determined charge of the electron ($1.6022 \times 10^{-19}\text{ C}$).
- E. Goldstein discovered anode rays.
- Neutron was discovered by Chadwick.
- **Atomic number** (Z) = No. of protons = No. of electrons.
- **Mass number** (A) = No. of protons + No. of neutrons.
- **Isotopes** are atoms of same element having same atomic number but different mass numbers *e.g.*, $^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$.
- **Isobars** are atoms of different elements having same mass number *e.g.*, $^{40}_{18}\text{Ar}$ and $^{40}_{20}\text{Ca}$.
- **Isotones** are atoms having same number of neutrons but different mass numbers. *e.g.*, $^{30}_{14}\text{Si}$, $^{31}_{15}\text{P}$ and $^{32}_{16}\text{S}$.
- **Isoelectronic species** are atoms, ions or molecules having same number of electrons. *e.g.*, O^{2-} , F^{-} , Ne , Na^{+} , Mg^{2+} .
- **Isosters** are molecules having same number of atoms and same number of electrons *e.g.*, N_2 and CO ; CO_2 and N_2O .
- The arrangement of different types of electromagnetic radiations in the increasing order of wavelengths (or decreasing frequencies) is known as **electromagnetic spectrum**.
- **Planck's quantum theory** states that radiant energy is not emitted continuously but discontinuously in the form of small packets of energy called **quantum** or **photon** (for light), each having energy $= h\nu$.
- When the radiations emitted from substances are analysed with the help of spectroscope, we get emission spectra.
- When a continuous electromagnetic radiation is allowed to pass through a gas or solution of the substance and the transmitted light is analysed, we obtain a spectrum in which dark lines are observed in otherwise continuous spectrum. This is called **absorption spectrum**.
- Spectrum of H consists of many lines called **Lyman, Balmer, Paschen, Brackett and Pfund**.
- Bohr model gave the concept of well defined circular **orbits** or **energy levels** in which energy remains constant.
- Louis de Broglie suggested that all microscopic material particles in motion have dual character *i.e.*, particle and wave characteristics.

$$\lambda = \frac{h}{mv} \quad \text{or} \quad \frac{h}{p}$$

Dual nature of electrons was experimentally verified by Davisson and Germer (1927) and G. Thomson (1928).

- Heisenberg uncertainty principle states that it is impossible to measure simultaneously both the position and momentum (or velocity) with absolute accuracy for a microscopic particle. Mathematically, it may be expressed as:

$$\Delta x \times \Delta p \geq \frac{h}{4\pi}$$

- Schrodinger gave a mathematical equation to describe behaviour of electron in an atom. Schrodinger wave equation may be expressed as :
 $\hat{H}\psi = E\psi$ ψ gives the amplitude of electron wave and ψ^2 is the probability density.
- Wave mechanics gave the concept of **orbitals**, which are regions around the nucleus where the probability of finding the electrons is maximum.
- A set of four numbers used to specify energy, size, shape and orientation of the electron orbital and spin of the electron are called **quantum numbers**.
- **Principal quantum number** (n) tells about the energy of the electron and size of the shell.