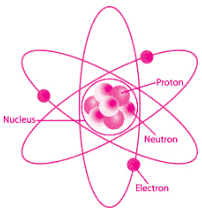
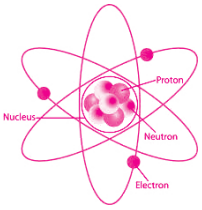


2. STRUCTURE OF ATOM

1 OMQ + 2 VSAQ + 1SAQ + LAQ [1 M + 2M + 2M + 4M + 8M = 17 M]



CONCEPTS & DEFINITIONS

1. The five prominent Atomic models :

i) **Dalton's Atomic model** (1808)

ii) **Thomson's Watermelon model** (1898)

iii) **Rutherford's Planetary model** (1910)

iv) **Bohr's Atomic model** (1913)

v) **Quantum Mechanical model** (1926).

2. Orbital: Orbital is the 3D space, around the nucleus in an atom, where the probability of finding an electron is maximum (95%).

- The shape of **s-orbital** is **spherical**.
- The shape of **p-orbital** is **dumb-bell** with 2 lobes. The p-subshell contains 3 sub-orbitals. They are p_x, p_y, p_z orbitals.
- The shape of **d-orbital** is **double dumb-bell** with 4 lobes except d_{z^2}. The d -subshell contains 5 sub-orbitals. They are d_{xy}, d_{yz}, d_{zx}, d_{z^2}, $d_{x^2-y^2}$.

3. Three important principles which govern the configuration of electrons:

- **Pauli's exclusion principle:** No two electrons in an atom can have the same set of all four quantum numbers.
- **Auf-bau principle:** 'In the ground state of the atoms, the orbitals are filled with electrons, in their increasing order of energies'(low to high).

  Rule 1: The orbital with lower $(n+l)$ value, contains lower energy.

  Rule 2: If the orbitals have the same $(n+l)$ value, then the orbital with lower 'n' value contains lower energy.
- **Hund's rule :** 'In degenerate orbitals, pairing of electrons starts, only after the filling up of available orbitals with one electron each'.

4. Rutherford's Planetary Model of Atom : Electrons revolve around the nucleus, just like the planets revolve around the sun. This model **could not** explain the **stability of atom**.

5. **Bohr's atomic model** proposed the circular paths of moving electrons as Orbits.

Bohr's Model successfully explained the **Spectrum of Hydrogen**.

Transition of electrons from any higher orbit to

1) n=1 produces spectral lines in the **UV** region. This series is named **Lyman series**
2) n=2 produces spectral lines in the **visible (vibgyor)** region.This is named **Balmer series**
3) n=3,4,5 produces spectral lines in the **IR** region.These are named **Paschen , Brackett and Pfund** series respectively.

6.1 Zeeman effect: The splitting of spectral lines in the presence of strong magnetic field.

6.2 Stark effect : The splitting of spectral lines in the presence of external electric field.

7. **Black body:** An ideal body, which emits and absorbs all frequencies of electromagnetic radiation

8. **Quantum :** The smallest quantity of energy that can be emitted or absorbed in the form of electromagnetic radiation. Quantum is just an energy packet and it has no mass.

9. Light is a form of **E**lectro**M**agnetic **R**adiation **(**EMR**).**

Light possesses wave nature **(Maxwell's Electro magnetic theory)**

Light possesses particle nature **(Planck's Quantum theory)**

Microscopic particles possess both wave nature & particle nature **(de Broglie's Hypothesis)**

10. **Planck's Quantum theory** explains the black body radiation.It supports the **Particle nature** of electro magnetic radiation.

11. **de Broglie's Hypothesis:** Micro particles like electrons exhibit **dual behaviour**. They have both **particle and wave nature**.

- de Broglie equation $\lambda = \frac{h}{mv} = \frac{h}{p}$.

Here, λ=wave length of the particle, h=Planck's constant,

m= mass , v = velocity of the particle, p= moment of the particle.

12. **Heisenberg's uncertainty principle :** It is impossible to determine simultaneously the exact position and exact momentum of the moving electron around the nucleus.

13. Quantum numbers :

S. No.	Quantum number (Scientist)	Significance	notation	Values	Remarks
1.	**Principal Quantum no.** (Bohr)	Size & energy of the orbit	n	1,2,3,4.... K,L,M,N....	no.of electrons in n^{th} orbit $=2n^2$
2.	**Azimuthal Quantum no.** (Somerfeld)	Shape of the orbital	l	0,1,2,...(n-1) (n values)	Angular momentum $mvr=\sqrt{l(l+1)}.\frac{h}{2\pi}$
3.	**Magnetic Quantum no.** (Lande)	Orientation of the orbital	m	$-l....0...l$ $(2l+1)$ values	Explains the Zeeman & Stark effect
4.	**Spin Quantum no.** (Uhlenbeck & Goud smith)	Spin of the electron	s	$+\frac{1}{2},-\frac{1}{2}$	↑ for clock wise spin ↓ for anti clock wise

Imp. Formulae for IPE Problems

1. $c = \nu\lambda$; wave length $\lambda = \frac{c}{\nu}$;

frequency $\nu = \frac{c}{\lambda}$; $c = 3.0\times10^{8}\ ms^{-1}$

2. Energy $E = h\nu = h\times\frac{c}{\lambda}$

$h = 6.626\times10^{-34}$ Js $= 6.626\times10^{-27}$ ergs

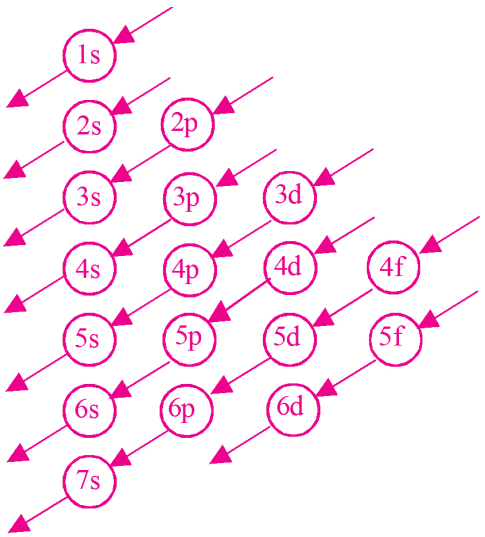
3. Wave number $\bar{\nu} = \frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$;

$R_H = 1,09,677\ cm^{-1}$

4. $\lambda = \frac{h}{p} = \frac{h}{mv}$; **5.** $\Delta x.\Delta p \simeq \frac{h}{4\pi}$

6. Mass of electron m = 9.11×10^{-28} g;
Charge of electron e = 4.8×10^{-10} esu;
$= 1.6\times10^{-19}$ C;

MOELLER DIAGRAM



Increasing order of energies of various orbitals:
1s<2s<2p<3s<3p<4s<3d<4p<5s<4d<5p<6s<4f.....

☛ For **Chem Beats** of this chapter Refer Page **No. 199 to 201**