SOME BASIC CONCEPT OF CHEMISTRY

1. Some useful Conversion Factors :

1 Å = 10^{-10} m, 1 nm = 10^{-9} m, 1 pm = 10^{-12} m, 1 litre = $10^{-3}m^3$ = 1 dm^3, 1 atm = 760 mm Hg or torr = 101325 Pa or Nm^{-2}, 1 bar = 10^5 Nm^{-2} = 10^5 Pa, 1 calorie = 4.184 J, 1 electron volt (eV) = 1.6022 × 10^{-19} J , (1 J = 10^7 ergs) 1 cal > 1 J > 1 erg > 1 eV)

2. Dalton's atomic theory :

• All matter is made up of tiny, indivisible aprticles called atoms.

• Atoms can be rearranged, combined or separated in chemical reactions.

• Atoms can neither be created nor destroyed. Further more, atoms cannot be divided into smaller particles.

• Atoms of different elements can combined with each other in fixed whole-number ratios in order to form compounds.

• All atoms of a specific element are identical in mass, size and other properties.

3. Laws of chemical combination :

• **Law of conservation of mass :**

This law states that matter can neither be created nor destroyed in other words, the total mass, that is, the sum of the mass of reacting mixture and the products formed remains constant.

• **Law of definite proportions :**

This law states that the proportion of elements by weight in a given compund will always remain exactly the same.

• **Law of Multiple Proportions :**

This law states that if two elements combine to form more than one comopund, the masses of these elements in the reaction are in the ratio of small whole numbers.

• **Gay Lussac's Law of Gaseous Volumes :**

This law states that when gases are produced or combine in a chemical reaction, they do so in a simple ratio by volume given that all the gases are at the same temperature and pressure.

This law can be considered as the law of definite proportions.

• **Avogadro's Law of chemical combination**

It stated that under the same conditons of temperature and pressure, an equal volume of all the gases contains an equal number of molecules.

4. **Gram molar volume (G.M.V.) :**

22.4 L of any gas at STP weigh equal to molecular mass expressed in gram . This mass is called Gram Molecular Mass and this volume is called Gram Molecular volume (G.M.V.)

Note : STP conditions are 1 atm pressure and $0°$ C Temperature. However if the condition taken are 1 bar and $0°$ C , instead of 22.4 L, we have 22.7 L (1 atm = 1.01 bar).

5. **Atomic mass :**

It is the average relative mass of an atom as compared with an atom of carbon – 12 isotope taken as 12.

- The mass of 1 atom = atomic mass (in amu)
- The mass of 1 mole atoms = atomic mass (in g)

eg. mass of one O atom = 16 amu

   mass of 1 mole O atom = 16 g

6. Calculation of average atomic mass. If an element exist in two isotopes having atomic masses 'm_1' and 'm_2' in the percentage abundance x and y present respectively.

average atomic mass = $\dfrac{m_1 \times x\% + m_2 \times y\%}{100}$

7. **Molecular mass :**

Molecular mass of a substance is the average relative mass of its molecules as compared with an atom of C-12 isotope taken as 12.

- The mass of 1 molecule = molecular mass (in amu)
- The mass of 1 mole molecules = molecular mas (in g)

eg.Mass of 1 O_2 molcules = 32 amu

   Mass of 1 mole O_2 molecules = 32 gm

8. For atom $\rightarrow$ 1 g atom = 1 mole

For molecule $\rightarrow$ 1 g molecule = 1 mole

9. 1 amu or 1 u = $\dfrac{1}{12}$ th of the mass of an atom of C-12 = 1.66×10^{-27} kg.

10. 1 mol of $H_2O \neq$ 22400 cc of H_2O (because it is liquid). Instead , 1 mol of H_2O = 18 cc of H_2O (because density of H_2O = 1g / cc)

Calculating number of moles : $n = \dfrac{w}{m} = \dfrac{N}{N_A} = \dfrac{V}{22.4}$

11. Fermi's is a unit of length used for expressing nuclear diameter (1 fermi = 10^{-13} cm = 10^{-15}m) (1 fermi = 1 femto).

12. The number of molecules in one ml of a gas at STP is known as Loschmidt number. Its value = $(6.02 \times 10^{23}) / 22400 = 2.687 \times 10^{19}$ ml^{-1}.

13. Mass of one mole of electrons = Mass of one e$^-$ × Avogadro's No.
$$= (9.11 \times 10^{-31} \text{ kg}) \times (6.02 \times 10^{23})$$
$$= 5.48 \times 10^{-7} \text{ kg}$$

14. Molecular weight (M.W.) = $\dfrac{\text{Mass of one molecule of a substance}}{\text{Mass of one atom of hydrogen}}$

Vapour density (V.D.) = $\dfrac{\text{Mass of a certain volume of gas or vapour}}{\text{Mass of same volume of hydrogen}}$

Molecular weight = 2 × vapour density
M.W. = 2 V.D.

$$\text{V.D.} = \frac{\text{density of gas}}{d_{H_2}}$$

$d_{H_2} = 0.000089$ mg / ml

number of mole (n) = $\dfrac{\text{wt.}}{\text{MW / At wt}}$

$(n) = \dfrac{\text{number of particles}}{N_A}$

$n = \dfrac{\text{volume at STP (inlit)}}{22.4 \text{ litre}}$ or $\dfrac{\text{Volume at STP (inml)}}{22400 \text{ ml}}$

$n = M \times V\text{(lit)}$

Where, n = number of moles
V = volume in litres
M = molarity

15. Molarity (M) = $\dfrac{\text{No. of moles}}{\text{Litres of solution}} = \dfrac{n}{V}$

Molality (m) = $\dfrac{\text{Moles of solute}}{\text{kg of solvent}} = \dfrac{x}{w}$

Mole fraction = $\dfrac{\text{No. of moles of the component}}{\text{Total no. of moles of all the component}} = \dfrac{n_A}{n_A + n_B}$

% composition = $\dfrac{\text{grams of element}}{\text{grams of total elements in the component}} \times 100$

16. Principle of atom conversion (POAC) :

This states that the total number of atoms of reactants must equal the number of atoms of products.

Mass of atom of element in reactant = Mass of atoms of element in product

Number of atoms of element in reactant = number of atoms of element in product

Moles of atoms of element in reactant = moles of atoms of element in product

Limiting reagent :

If any chemical reaction, the limiting reactant (or reagent) is a substance which is fully absorbed when the chemical reaction is complete. This reagent limits the amount of the product generated and the reaction cannot continue without it.

$$\% \text{ composition} = \frac{\text{grams of element}}{\text{total weight of the compound}} \times 100$$

Percentage yield : Reactants often yield quantities of produts that are less than those calculated based on the formulated chemical reaction.

ATOMIC STRUCTURE

- The word "atom" was given by Ostawald.

Discovery & Their Discoveres

Name of Particles	Scienteist	Mass	Charge
Electron	J.J. Thomson	9.1×10^{-31} kg	-1.6×10^{-19} cb
Proton	Goldstein	1.673×10^{-27} kg	$+1.6 \times 10^{-19}$ cb
Neutron	Chadwick	1.675×10^{-27} kg	Zero
Positron	C.D. Anderson	(same as electron)	same as proton
Anti Proton	Sugrie	(same as proton)	Electron
Neutrino	Pauli	Negligible	Zero
Meson	Yukawa	(200 times the electron)	(+, −, zero)
Isotopes	Soddy		
Isobar	Aston		
Cathode Ray	William Crooke's		
Anode Ray	GoldStein		
Neucleus	Rutherford		
Atomic No.	Moseley		
Nomenclature of e^-	Stoney		
Charge of e^-	Millikan		
Specific charge on e^- (e/m)	J.J. Thomson		

- ## Important Definations :

    (i) Atomic number (Z) = no. of protons

    (ii) Mass no. (A) = number of (n + p)

    (iii) Isotopes = Same Z + Different A

    (Iv) Isobar = Same A + Different Z

    (v) Isotones / Isoneutronic / Isotonic = same no. of neutrons

    (vi) Isodiaphers = Same (number of neutrons – number of protons)

    Where n = neutron and p = proton

    (vii) Isosters = Molecules with same no. of atoms and electrons.

    (viii) Isoelectronic = Same no. of e^-s.

ATOMIC STRUCTURE

Electromagnetic Radiations

- The electric & magnetic components of wave have same wavelength, frequency speed and amplitude but they vibrate in two mutually perpendicular planes.
- EM waves do not need any medium for propagation and all EM waves travel with same velocity (3×10^8 ms^{-1}).
- Relation between frequency (v), wavelength (l), wave number $(\bar{v})$ and time period (T).
  - $c = v\lambda$
  - $\vec{v} = \dfrac{1}{\lambda} = \dfrac{v}{c}$ $\boxed{1 \text{ cm}^{-1} = 100 \text{ m}^{-1}}$
  - $T = \dfrac{1}{v} = \dfrac{\lambda}{c}$

Electromagnetic Spectrum

The arrangment of various types of electromagnetic radiations in the order of their increasing or decreasing wavelength or frequency is known as electromagnetic spectrum.

Radition	Wavelength (Å)	Frequency (Hz)
Gamma rays	0.01 to 0.1	3×10^{19} to 3×10^{20}
X-rays	0.1 to 150	2×10^{16} to 3×10^{19}
UV radiations	150 to 3800	7.9×10^{14} to 2×10^{16}
Visible rays	3800 to 7600	3.95×10^{14} to 7.9×10^{14}
Microwaves	6×10^6 to 3×10^9	1×10^5 to 1×10^9

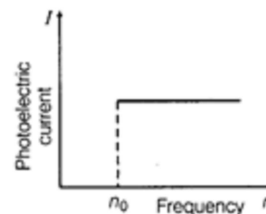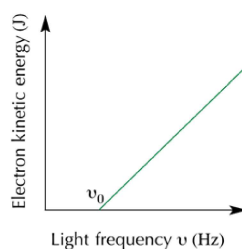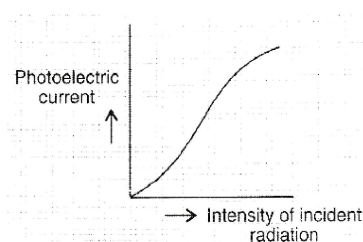## Plancks Quantum theory (Importatant Formulae)

- $E = hv$ (E = Energy of one photon)

  or $E = hv = \dfrac{hc}{\lambda} = hc\bar{v}$
- Total energy transfered = N × Energy of one photon.

  $E_r = N \times hv = N \times \dfrac{hc}{\lambda} = N \times hc\bar{v}$

  Where h = planck constant $= 6.626 \times 10^{-34}$ Js
  $\qquad\qquad\qquad\qquad = 6.626 \times 10^{-27}$ erg s

Photoelectric effect

E_{photon} = Thereshold Energy (work function) + KE

E_{photon} = $h\nu_0$ + KE

Where,

h = planck's constant

ν_0 = threshold frequency

KE = kinetic energy

$$h\nu = h\nu_0 + KE$$

$$h\nu = h\nu_o + \frac{1}{2}m_e v^2$$

or $\quad$ KE = h $(\nu - \nu_0)$

Bohr's Model

Applicable for single e^- species only like H, He^+, Li^{+2}, Be^{+3}, Na^{+10} etc.

Related with particle nature of electron.

Based on Plancks Quantum theory.

Important Formula :

Angular momentum in an orbit is quantized. $\quad$ mvr = n × $\dfrac{h}{2\pi}$

Where,

n = number of corresponding energy of orbit 1, 2, 3, ...

m = mass of the electron

v = velocity of electron

r = readius of orbit

h = planck's constant

Radius of bohr orbit = r = 0.529 n^2/zÅ

n = number of corresponding energy of orbit

z = atomic number

where 0.529 Å = a_0 is called atomic unit of length (Bohr) .

Velcoity of electron in Bohr orbit.

$$v = \frac{2\pi KZe^2}{nh}$$

On solving $\quad$ v = 2.18 × 10^6 $\dfrac{Z}{n}$ m/s

n = number of corresponding energy of orbit

z = atomic number

$$v = 2.18 \times 10^8\ \frac{Z}{\nu}\ cm/s$$

ATOMIC STRUCTURE

n = number of corresponding energy of orbit
z = atomic number
Energy of electron in Bohr orbit

Potential energy (PE) = $-\dfrac{KZe^2}{r}$ i.e.,   At $r = \infty$, PE = 0

k = constant = $\dfrac{1}{4\pi\varepsilon_0}$

z = atomic number

Kinetic energy (KE) = $\dfrac{1}{2}\dfrac{KZe^2}{r}$ i.e.,   At $r = \infty$, KE = 0

Total energy (TE) = $-\dfrac{2\pi^2 mK^2 z^2 e^4}{n^2 h^2}$

On solving TE = $-2.18 \times 10^{-18}\,\dfrac{z^2}{n^2}$ J/atom

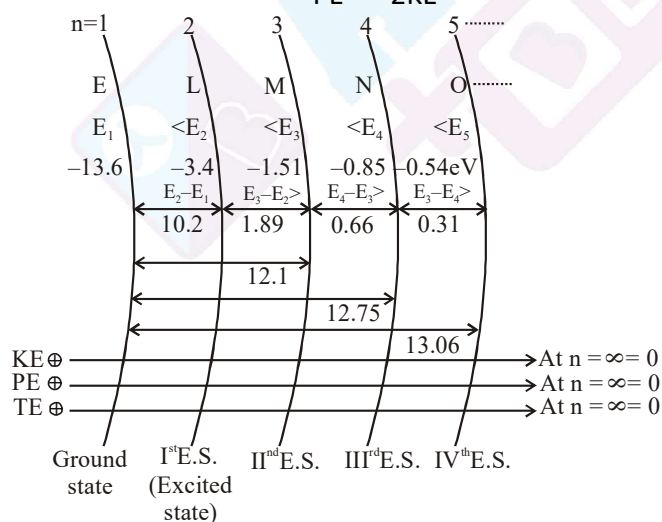$\qquad\qquad = -13.6 \times \dfrac{z^2}{n^2}$ eV/atom

$\qquad\qquad = -313.6 \times \dfrac{z^2}{n^2}$ Kcal/mol

$\qquad\qquad = -1313,6 \times \dfrac{z^2}{n^2}$ KJ/mol

Relation between TE, PE and KE   = PE = 2 × TE
$\qquad\qquad\qquad\qquad\qquad\qquad\quad$ = TE = −KE
$\qquad\qquad\qquad\qquad\qquad\qquad\quad$ = PE = −2KE

Important Shortcuts

Transition energy $\Rightarrow$ The energy change associated with a transition is related to the frequency of the electromagnetic wave.

ATOMIC STRUCTURE

$E = h\nu$

Where, h = planck constant,

n = the freqeuncy of the wave is related to its wavelength.

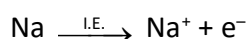T.E. of any H-like species = TE or Hydrogen $\times Z^2$ (For same orbit)

ΔE for H like species = ΔE (For hydrogen) $\times Z^2$ (For same transition)

Energy in n^{th} orbital for H like species = $\dfrac{E_1}{n_1}$ [For same atom]

(I.E.) Ionisation Energy $\Rightarrow$ n = 1 $\rightarrow$ n = ∞

Ionisation energy $\Rightarrow$

The amount of energy required to remove an electron from an isolated gases atom.

$Na \xrightarrow{\text{I.E.}} Na^+ + e^-$

(S.E) Separation Energy   n = 2, 3, 4............. $\longrightarrow$ n = ∞

| Ist S.E |
| 2nd S.E. |

(E.E.) Excitation Energy -   n = 1 $\longrightarrow$ n = 2, 3, 4

| Ist E.E |
| 2nd E.E. |

Spectrum (Important points)

Continous emission spectrum is given by incandescent sources.

Emission line spectrum is given by atoms.

Emission band spectrum is given by molecules.

More lines are observed in emission spectrum than absorption specturm.

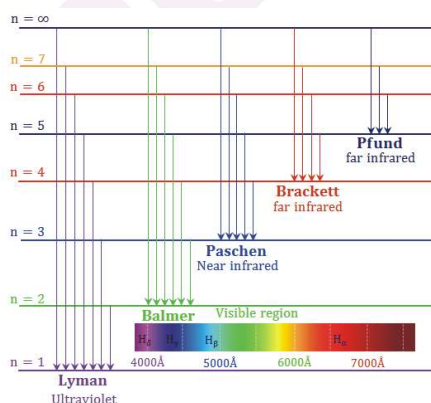**Hydrogen Spectrum (n_2)**   **(n_1)**

Lyman $\longrightarrow$ Any higher orbit $\longrightarrow$ 1 [Found in U.V. region]

Balmer $\longrightarrow$ Any higher orbit $\longrightarrow$ 2 [Found in Visible region]

Paschen $\longrightarrow$ Any higher orbit $\longrightarrow$ 3 [Found in I.R. region]

Bracket $\longrightarrow$ Any higher orbit $\longrightarrow$ 4 [Found in I.R. region]

P fund $\longrightarrow$ Any higher orbit $\longrightarrow$ 5 [Found in I.R. region]

Rydberg Equation :

$$\overline{v} = \frac{1}{\lambda} = R_H Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \quad \begin{bmatrix} \text{Where C = velocity of} \\ \text{electromagnetic waves} \end{bmatrix}$$

$$v = R_H C Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

$$E = R_H Ch Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

Where R_H = Rydberg constant = 109678 cm^{-1}
= 10967800 m^{-1} $\boxed{\dfrac{1}{R_H} = 912\text{Å}}$

$R_H Ch$ = Energy of Ist orbit of hydrogen
$R_H Ch\, Z^2$ = Energy of Ist orbit of any hydrogen like species.

Important Point :

α line / First line/starting line/Initial line (First line of any series)
Last line/limitting line/ marginal line (Last line of any series)
Total number line in a sample of atoms (For $n_2 \to n_1$)

(T.E.L.) Total Emission lines = $\dfrac{(n_2 - n_1)(n_2 - n_1 + 1)}{2}$

But for $(n \to 1)$, T.E.L. = $\dfrac{n(n-1)}{2}$

Maximum and minimum wavelength :

$$\frac{1}{\lambda} = Rz^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

Series	n_1	For $\lambda_{max.}$ n_2	For $\lambda_{min.}$ n_2	$\lambda_{max.}$	$\lambda_{min.}$
Lyman	1	2	∞	$\lambda = \dfrac{4}{R}$	$\dfrac{1}{R}$
Balmer	2	3	∞	$\dfrac{36}{5R}$	$\dfrac{4}{R}$
Paschen	3	4	∞	$\dfrac{144}{7R}$	$\dfrac{9}{R}$
Brakett	4	5	∞	$\dfrac{400}{9R}$	$\dfrac{16}{R}$
Pfund	5	6	∞	$\dfrac{900}{11R}$	$\dfrac{25}{R}$
Humphery	6	7	∞	$\dfrac{1764}{13R}$	$\dfrac{36}{R}$

Maximum number of spectral lines = N = $\dfrac{(n_2 - n_1)(n_2 - n_1 + 1)}{2}$

Maximum number of spectrfal lines for lyman series, lines for any particular series = $n_2 - n_1$.

ATOMIC STRUCTURE

De-Broglie Equation (Important Formulae)

$$\lambda = \frac{h}{mv} = \frac{h}{P}$$

Where h = Planck's constant $\boxed{\because P = mv}$

P = momentum

m = mass

$$\lambda = \frac{h}{\sqrt{2mKE}}$$

v = velocity

KE = Kinetic Energy

$$\lambda = \frac{h}{\sqrt{2mqv}}$$ (for e^- if solved) than $\lambda = \sqrt{\frac{150}{V}}\,\mathring{A}$

m = mass

q = charge particle having charge

v = charge particle is accelerate by a potential

Important Points :

When an e^- revolves in orbit then no. of waves made by e^- = orbit number (n).

Frequency of matter waves.

$$v = \frac{v}{\lambda} = \frac{vP}{h} = \frac{mv^2}{h} = \frac{2KE}{h}\left[v = \text{frequency}\right]$$

Electron microscope is on the basis of the wave nature of electron. de-Broglie on the basis of Milikan's oil drop experiment (which showed partical nature) and diffraction study (which showed wave nature) suggested the dual nature of electron.

Heisenberg Uncertainity Principle.

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

or $$\Delta x \times \Delta V \geq \frac{h}{4\pi m}$$

$$v = \frac{\Delta x}{\Delta t}$$

$\Delta x = v.\Delta t$

Change in kinetic energy of particle is

$\Delta E = \Delta p.V$

$$\Delta p = \frac{\Delta E}{v}$$

$$\Delta x.\Delta p = v.\Delta t \times \frac{\Delta E}{v}$$

$\Delta x.\Delta p = \Delta E.\Delta t$

Then from uncertainty principle.

$\Delta E.\Delta t = h$

ATOMIC STRUCTURE

$$E = \frac{h}{2}$$

where Δx = Uncertainity in position

Δv = Uncertainity in velocity

ΔP = Uncertainity in momentum

m = Mass of particles

$$\frac{h}{4\pi} = 5.27 \times 10^{-35} \text{ Js} \quad \text{(In SI unit)}$$

Quantum Number

In an atom each shell, subshell, orbital and electron are designated by a set of four quantum numbers respectively.

1. Principal Quantum Number (By Bohr)

Indicates Size and energy of the orbit, distance of e^- from nucleus

Values in = 1,2,3,4,5..............

$$\text{Angular momentum} = n \times \frac{h}{2\pi}$$

Total number of e^-s in an orbit = $2n^2$

Total number of orbitals in an orbit = n^2

Total number of subshell in an orbit = n

2. Azimuthal / Secondary/Subsidiary/Angular Momentum

$\Rightarrow$ Given by = Sommerfeld

$\Rightarrow$ Indicates = Subshells/sub orbit/sub level

$\Rightarrow$ Value $\Rightarrow$ 0,1..........(n–1)

$\Rightarrow$ Indicates shape of orbital/Subshell

Values of n	Values of l [Shape]	Initial from word
e.g. If n = 4	1 = 0 (s) [Spherical]	Sharp
	1 [p [Dumb bell]	Principal
	2 [d] [Double dumb bell]	Diffused
	3 [f] [Complex]	Fundamental

Total number of e^-s in a sub-orbit = $2(2\ell + 1)$

Total number of orbitals in a sub - orbit = $(2\ell + 1)$

$$\text{Orbital angular momentum} = \sqrt{\ell(\ell+1)}\frac{h}{2\pi} = \hbar\sqrt{\ell(\ell+1)\text{h}}$$

h = Plank's cosntant

For H & H-like species all the subshell of a shell have same energy

i.e.,   2s = 2p

3s = 3p = 3d

3. Magnetic Quantum number (m)

Given by linde

Indicates orientation of orbitals ie., direction of e^- density

value of m = $-\ell$.............0.............$+\ell$

Maximum no of e's in an orbital = 2 (with opposite spin)

m for p sub shell =
$$\begin{array}{ccc} p_x & p_y & p_z \\ -1 & 0 & +1 \end{array}$$

m for d sub shell =
$$\begin{array}{ccccc} dxy & dyz & dzx & dx^2\text{-}y^2 & dz^2 \\ -2 & -1 & 0 & +1 & +2 \end{array}$$

4. Spin Quantum no. (m_x or s)

Given by Uhlenbeck & Goldsmit

Value of s = $\pm\dfrac{1}{2}$

Total values of spin in an atom = $\pm\dfrac{1}{2}$ × number of unpaired e^-

Since Angular momentum = $\sqrt{s(s+1)}\,\dfrac{h}{2\pi}$

Rules for filling of Orbits :

1. Aufbau principle : The electron are filled up in increasing order of the energy in subshells.

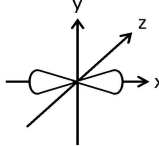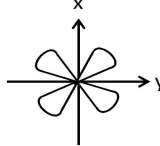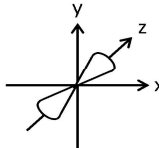$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^{14} 6d^{10}$
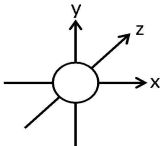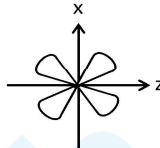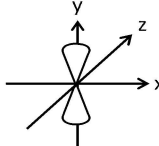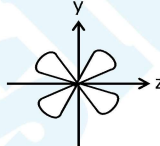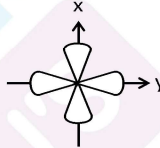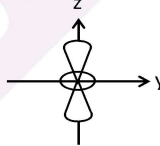
2. (n + ℓ) rule : The subshell with lowest (n + ℓ) values is filled up first, but when two or more subshell have same (n + ℓ) value then the subshell with lowest values of n is filled up first.

3. Pauli exclusion principle : Pauli stated that no two electrons in an atom can have same values of all four quantum numbers.

4. Hund's rule of maximum multiplicity : Electrons are distributed among the orbitals of subshell in such a way as to give maximum number of unpaired electrons with parallel spin.

5. Shapes of orbitals :

s	p	d
Spherical	dumbbell shaped (Two lobes symmetrical)	Clover leaf shape or double dumbbell
1s atomic orbital	p_x	d_{xy}
	p_z	d_{zx}
	p_y	d_{yz}
		$d_{x^2} - d_{y^2}$
		d_{z^2}

Nodes are the spaces where the probability of finding the electron is 0.

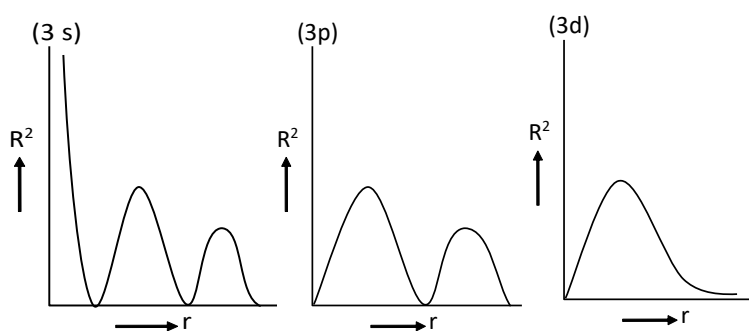To find the number of nodes in an orbital is given as follows :

Number of angular nodes = ℓ

Number of radial nodes = $n - 1 - \ell$

Total number of nodes = $n - 1$

6. Probability distribution : Probability distribution is the function that gives the probabilities of occurence of different possible outcomes for an experiment

ATOMIC STRUCTURE
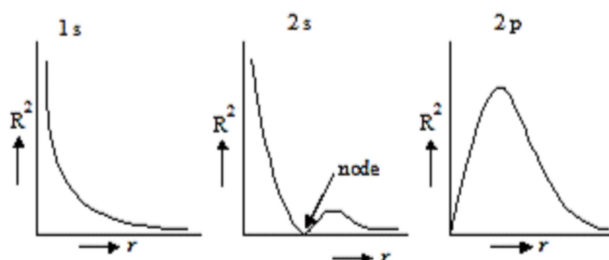
Schrodinger wave equation

$$\frac{\partial^2 \Psi}{\partial x^2} + \frac{\partial^2 \Psi}{\partial y^2} + \frac{\partial^2 \Psi}{\partial z^2} + \frac{8\pi^2 m}{h^2}(E - V)\Psi = 0$$

K.E.   P.E.   Total energy

A particle differential shows how a function depends on one variable when several are changing.

Exchange energy :

Exchange energy is the energy released when two or more electron with the same spin-exchange their position in the degenerate orbitals of a subshell.

Number of electron exchange possible = $\frac{n_A(n_A - 1)}{2} + \frac{n_B(n_B - 1)}{2}$

7. Exceptional electronic configuration :

Element	Symbol	Atomic number	Electronic configuration
Copper	Cu	29	[Ar] $4s^1 3d^{10}$
Chromium	Cr	24	[Ar] $4s^1 3d^5$
Niobium	Nb	41	[Kr] $5s^1 4d^4$
Molybdenum	Mo	42	[Kr] $5s^1 4d^5$
Ruthenium	Ru	44	[Kr] $5s^1 4d^7$
Rhodium	Rh	45	[Kr] $5s^1 4d^8$
Palladium	Pd	46	[Kr] $4d^{10}$
Silver	Ag	47	[Kr] $5s^1 4d^{10}$
Platinum	Pt	78	[Xe] $6s^1 4f^{14} 5d^9$
Gold	Au	79	[Xe] $6s^1 4f^{14} 5d^{10}$
Lanthanum	La	57	[Xe] $6s^2 5d^1$
Cerium	Ce	58	[Xe] $6s^2 4f^1 5d^1$
Gadolinium	Gd	64	[Xe] $6s^2 4f^7 5d^1$
Actinium	Ac	89	[Rn] $7s^2 6d^1$
Thorium	Th	90	[Rn] $7s^2 6d^2$
Protactinium	Pa	91	[Rn] $7s^2 5f^2 6d^1$
Uranium	U	92	[Rn] $7s^2 5f^3 6d^1$
Neptunium	Np	93	[Rn] $7s^2 5f^4 6d^1$
Curium	Cm	96	[Rn] $7s^2 5f^7 6d^1$
Lawrencium	Lr	103	[Rn] $7s^2 5f^{14} 7p^1$

The exactly half-filled & fully filled orbiatls have greater stability than other configuration. The reason for their stability are symmetry & exchange energy. The electron present in the different orbital of the same sub-shell can exchange their positions.