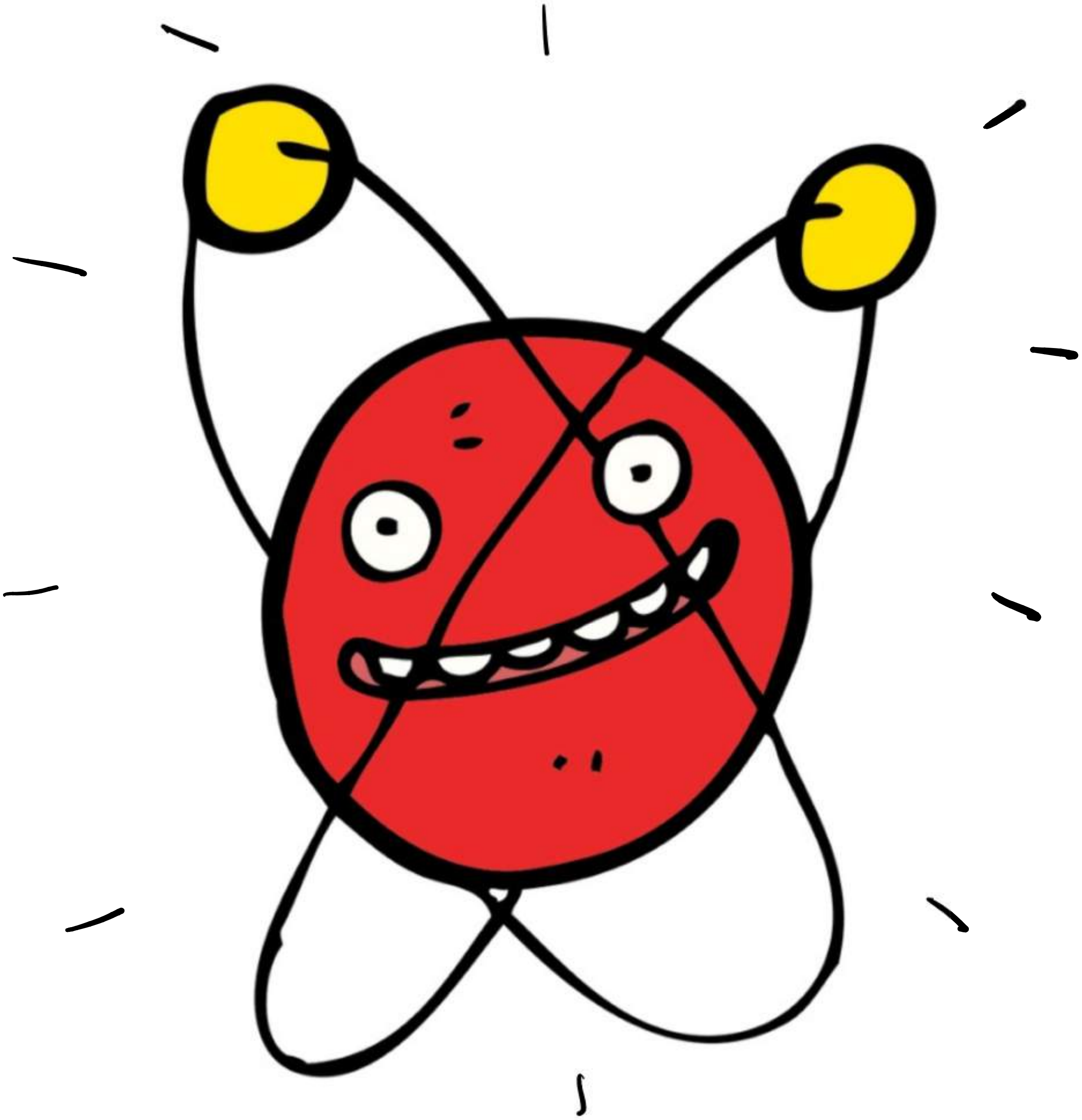
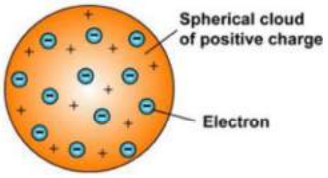
STRUCTURE OF ATOM

HANDWRITTEN NOTES



Thomson's Model (Plum-Pudding Model)



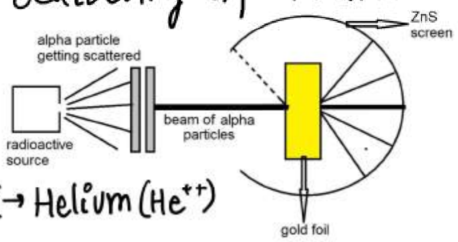
- $e^{\ominus}$ are uniformly distributed in atom
- atom is neutral
- net $\oplus$ve charge on atom ≈ net $\ominus$ve charge on $e^{\ominus}$.
- mass of atom is uniformly distributed.

Drawback – $e^{\ominus}$ are not stationary they are revolving around nucleus.

अब जब JJ Thomson साहब fail हुए तो Rutherford chacha story में आते हैं:

Rutherford's Model

α – Scattering experiment:-



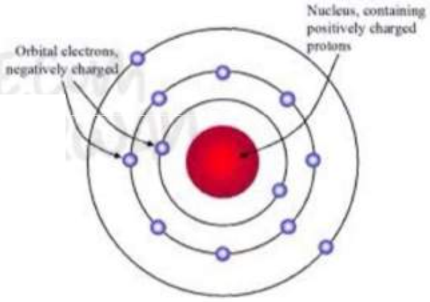
α → Helium (He^{++})

Observation:

- Most of α-particles pass undeflected.
- A few particles deflected at some angle.
- A few (1 out of 2000) deflected at 180°.

Conclusion:

- Most of the part of atom is vacant.
- Atom has some $\oplus$ve charge in it.
- $\oplus$ve charge of atom is concentrated in nucleus.
- $e^{\ominus}$ are revolving around nucleus.
- Protons + Neutrons = Nucleons



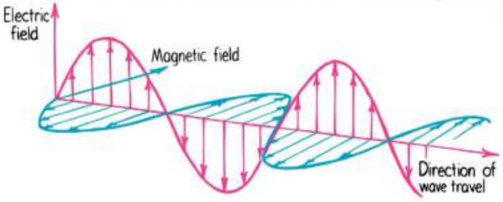
Drawback - He could not explain stability of atom.

अब Rutherford chacha भी fail हो गए, अब story मे आएंगे Bohr दादा but Bohr दादा का model समझने के लिए हमें कुछ conceps समझने होंगे। तो अभी दादाजी का model hold पर रखकर कुछ conceps समझते हैं :-

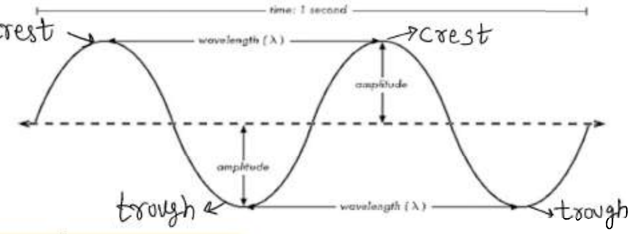
Electromagnetic Radiation

↳ When electrically charged particle moves under acceleration, alternating electrical and magnetic fields are generated and transmitted in form of waves, called electromagnetic waves or electromagnetic radiation (EMR)

(1) Wave Nature of E.M.R



- According to maxwell, a accelerated charge particle produce electric and magnetic field.
- E.F. and M.G are perpendicular to each other and also $\perp$ to direction of propogation.
- E.M.R. donot require any medium and they can travel in vaccum with speed of light ($c = 3 \times 10^8 m/s$)



Crest → topmost
trough → bottommost

(i) **Wavelength (λ)** – Linear distance b/w two consecutive crest or b/w two consequtive trough. It is generally expressed in terms of Angstrom(Å). $[1 Å = 10^{-10} m]$

nu

(ii) **Frequency (ν)** – No. of waves passing through a point in one second. SI unit is hertz (Hz).

s^{-1}

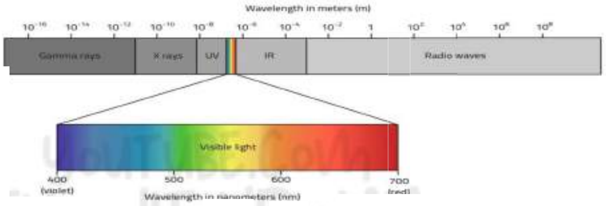
$$\boxed{\nu = \frac{c}{\lambda}}$$ → speed or velocity

(iii) **Velocity (c)** – Linear distance travelled by wave per second.

(iv) **Wave number ($\bar{\nu}$)** – Number of wavelengths per unit length. $\boxed{\bar{\nu} = \frac{1}{\lambda}}$

nu-bar

(v) When the electromagnetic radiations are arranged in order of their increasing wavelengths or decreasing frequencies, the spectrum obtained is called **Electromagnetic spectrum.**



Q: For $\lambda = 5000$ Å, calculate wave number and frequency.

sol:- Given, $\lambda = 5000$ Å
$= 5000 \times 10^{-10}$ m

(इस पूरे chapter मे units का खास ध्यान रखना।
→ इसलिए calculation मे ही साथ मे units लिखते हुए solve करो)

Wave number $(\bar{\nu}) = \frac{1}{\lambda} = \frac{1}{5\times10^{-7} m} = \frac{10^7}{5} \Rightarrow \underline{\underline{2\times10^6 \ m^{-1}}}$

frequency $(\bar{\nu}) = \frac{c}{\lambda} = \frac{3\times10^8 \cancel{m} s^{-1}}{5\times10^{-7} \cancel{m}} \Rightarrow 6\times10^{14} s^{-1}$ or $\underline{\underline{6\times10^{14} Hz}}$

Drawbacks of Wave nature of EMR:-

- It cannot explain black body radiation and photoelectric effect.

(2) Particle Nature of E.M.R. : Planck's Quantum Theory

↳ The radient energy absorbed are emitted from body not continuously but discontinously in form of Energy packet or quantum.
In case of light, these packets are called **Photons.**

Energy of photon ∝ Frequency

i.e. $E \propto \nu$

or, $\boxed{E = h\nu}$

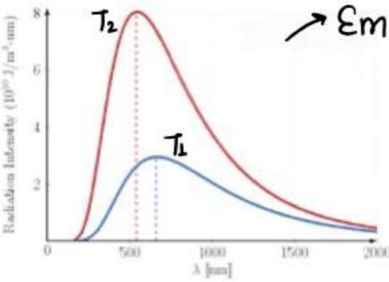
h → plank's constant $= 6.62 \times 10^{-34}$ Js

as we know, $\nu = \frac{c}{\lambda}$, ∴ $\boxed{E = \frac{hc}{\lambda}}$

These are energy of 1 photon
So, for 'n' photons, $\boxed{E = nh\nu = \frac{nhc}{\lambda}}$

K^3B ⇒

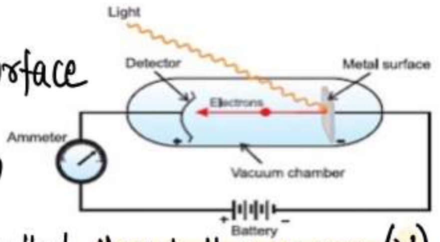
(i) **Black Body Radiation:** The ideal body, that emits and absorbs radiations of all frequencies is called a black body and the radiation emitted by such body is called black body radiation.



↗ Emission of radiation from black body at diff. Temp. T_1 & T_2

At a given temperature, intensity of radiation emitted ↑ with decrease of wavelength, reaches the maximum value at a given wavelength and then starts decreasing with further decrease of wavelength, as shown in graph given below.

(ii) Photo-Electric Effect:



- When photons of sufficient energy hits the metal surface then $e^{\ominus}$ comes out of the metal surface.
- There is no time lag b/w striking of photon and emission of $e^{\ominus}$.
- There is a characteristic minimum frequency required, called threshold frequency (ν_0)
- Min. energy of photon required to remove an $e^{\ominus}$ is called Work function (W_0)

$$\boxed{W_0 = h\nu_0}$$

- Kinetic energy of $e^{\ominus}$ ↑ with increase in frequency of photon.

**

$$\boxed{\begin{aligned} E &= W_0 + K\cdot E \\ \text{or,}\quad h\nu &= h\nu_0 + \tfrac{1}{2} m_e v^2 \end{aligned}}$$

LI: When electromagnetic radiation of wavelength of 310 nm fall on the surface of sodium, the electrons are emmitted with K.E. = 1.5 eV. Calculate the work function of sodium in terms of e.V.

Sol: Given, $\lambda = 310$ n-m, KE = 1.5 ev ; W_0 = ??

We know, $E = W_0 + KE$

$$h\nu = W_0 + KE \Rightarrow W_0 = h\nu - KE$$

$$W_0 = h\left(\frac{c}{\lambda}\right) - KE$$

$$= \frac{124\cancel{00}\ ev\cancel{Å}}{31\cancel{00}\cancel{Å}} - 1.5\ ev \Rightarrow 4 - 1.5\ ev$$

$$\Rightarrow 2.5\ ev$$

(3) Dual Nature of EMR :-

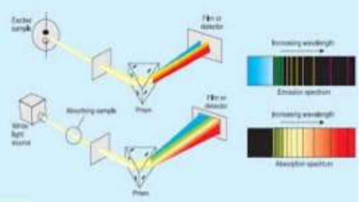
To explain reflection, refraction, diffraction etc., light has been considered as a wave whereas to explain the photoelectric effect, Einstein considered it to be made up of tiny particles called photons.
In other words, light is a kind of radiation exhibits dual behaviour i.e. waves as well as particle behaviour. Such a wave like as well as particle like nature of radiation is known as dual nature of radiation.

K^3B

(1) The splitting of light into series of colour bands is known as dispersion and the series of colour bands is called a spectrum. Two types of spectrum:-

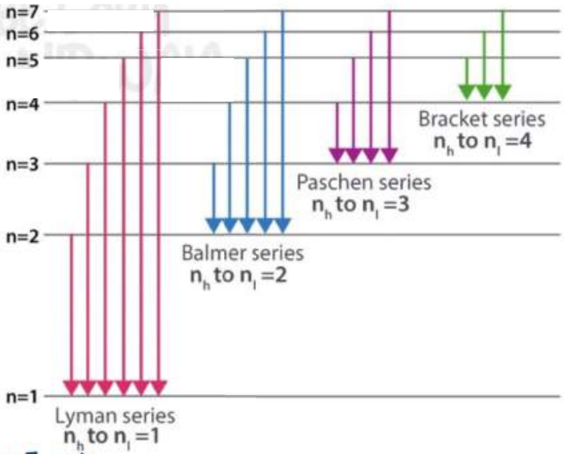
(i) <u>Emission spectra</u>: When the radiations emitted from some source eg: from the sun or by passing electric discharge through a gas at low pressure or by heating some substance to high temperature is passed directly through the prism and then recieved on the photographic plate, the spectrum obtained is called emission spectrum. Depending upon source of radiation, the emission spectra are of two types: Continuous and Line spectra.

(ii) <u>Absorption spectrum</u>: It is like the photographic negative of an emission spectrum. A continuum of radiation is passed through a sample which absorbs radiation of certain wavelength. The missing wavelength which corresponds to the radiation absorbed by the matter, leave dark spaces in the bright continuous spectrum.



(2) Spectral lines of H-atom:-

When hydrogen gas at low pressure is taken in the discharge tube and the light emitted on passing electric discharge is examined with a spectroscope, the spectrum obtained is called the emission spectrum of hydrogen.



Simple equation for calculation of wavelength of these lines:-

Imp

$$\boxed{\bar{\nu} = \frac{1}{\lambda} = RZ^2\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)}$$

$(R = 1.097 \times 10^7 m^{-1})$

for eg:- (i) lyman series: 1st line → n=2 to n=1
2nd line → n=3 to n=1
⋮
last line → n=∞ to n=1

i.e. $n_f = 1$ fixed रहेगा
$n_i = 2, 3, 4, \ldots \infty$

(ii) balmer series: 1st line → n=3 to n=2
2nd line → n=4 to n=2
⋮
last line → n=∞ to n=2

$n_f = 2$ (fixed)
$n_i = 3, 4, 5 \ldots \infty$

Similarly for all series...

LI: The diff. b/w the $\bar{\nu}$ of 1st line of Balmer series and the last line of Paschen series for Li^{+2} ion is how much?

Sol^n Balmer: 1st line ($n=3$ to $n=2$)

$$\bar{\nu} = \frac{1}{\lambda} = R(3)^2\left(\frac{1}{(2)^2} - \frac{1}{(3)^2}\right) \Rightarrow R(9)\left(\frac{9-4}{36}\right) \Rightarrow R\left(\frac{5}{4}\right) \quad \text{—(I)}$$

Paschen: last ($n=\infty$ to $n=3$)

$$\bar{\nu} = \frac{1}{\lambda} = R(3)^2\left(\frac{1}{(3)^2} - \overset{0}{\frac{1}{(\infty)^2}}\right) \Rightarrow R \quad \text{—(II)}$$

difference ⇒ (I) − (II)

$$\frac{5R}{4} - R \Rightarrow \frac{R}{4}$$

अब finally हम बात करने जा रहे हैं Bohr दादा के Model के बारे में।

BOHR Model

(Applicable for single electronic species eg:- H, He^+, Li^{+2}, Be^{+3} etc)

Postulates:

(i) Electron revolve around the nucleus in a fixed circular path of definite energy called stationary orbits.

(ii) Electron revolve only in those circular paths for which the value of angular momentum is equal to integral multiple of $\frac{h}{2\pi}$ i.e.

$$** \boxed{m_e v r = n\frac{h}{2\pi}}$$

radius of $e^\ominus$

mass of $e^\ominus$

velocity of $e^\ominus$

orbit no.

(iii) Energy exchange takes place only when electron jumps b/w the orbits.

(iv) The frequency of radiation absorbed or emitted when transition occurs between two stationary states that differ in energy by ΔE is given by

$$\boxed{\nu = \frac{\Delta E}{h} = \frac{E_2 - E_1}{h}}$$

E_1 → Energy of lower state

E_2 → Energy of higher state.

(K^3B) ⇒ Rutherford chacha stability explain नहीं कर पाए थे but Bohr दादा ने कर दी:-

Bohr suggested that an electron revolving in a particular orbit cannot radiate energy. Therefore, emission of radiation is not possible as long as the electron remains in one of its energy levels and hence, there is no cause of instability in his model.

Calculation of Bohr Radius:

According to Bohr's Model, radius of nth orbit is given by:

$$\boxed{r_n = \frac{0.0529 n^2}{Z^2} \text{ nm}}$$

Z → nuclear charge

Bohr radius:- For hydrogen (Z=1), the radius of first stationary state is called as Bohr Radius.

i.e. $r = 0.0529$ n-m is value of Bohr radius.

Energy of an Electron:

$$\boxed{E = -13.6\left(\frac{Z^2}{n^2}\right) \text{ e-V} \quad \text{or} \quad -2.18 \times 10^{-18}\left(\frac{Z^2}{n^2}\right) \text{ J}}$$

K3B ⇒ Why energy of the electron in a hydrogen atom has negative sign for all possible orbits?

ans:- This is because the energy of electron in the atom is lower than the energy of free electron at rest. A free electron at rest is an electron that is infinitely far away from the nucleus i.e. free from influence of nucleus and is assigned the energy value of zero. Mathematically, $n=\infty$ and thus $E_\infty = 0$. In this state hydrogen atom is called ionised H-atom. As the electron gets closer to the nucleus (as n decreases), E_n becomes larger in absolute value and more and more negative. The most negative energy value is given by n=1 which corresponds to the most stable orbit. We call this the ground state.

Calculation of frequency for a transition:-

↳ The frequency (ν) associated with the absorption and emission of the photon can be evaluated by using equation:-

$$\boxed{\quad)^{15}\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right) \text{Hz}}$$

and $$\boxed{\bar{\nu} = \frac{1}{\lambda} = Rz^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)}$$ bove)

K3B • In general, the number of emission lines when an electron jumps from n_2 level to n_1 level are given by the expression:-

$$\boxed{\frac{(n_2-n_1)(n_2-n_1+1)}{2}}$$

- **Ionisation Energy** (I.E.):- Energy required to remove the $e^\ominus$ completely from the atom so as to convert it to a positive ion.

  Simply, The energy absorbed by electron in ground state (n=1) so as to jump to infinity (n=∞).

  for eg, for H:- $\text{I.E.} = E_\infty - E_1$

  $$= \left[\frac{-2.18\times10^{-18}(1)^2}{(0)^2}\right] - \left[\frac{-2.18\times10^{-18}(1)^2}{(1)^2}\right] \text{J}$$

  $$\Rightarrow 2.18\times10^{-18} \text{ J}$$

  ↓

  इसी तरह से किसी की भी I.E. निकाल सकते है।

- Velocity of an electron in any Orbit:- $$\boxed{V = \frac{2\pi k z e^2}{nh} \text{ m/sec} = 2.18\times10^6\left(\frac{z}{n}\right) \text{ m/sec}}$$

- Frequency of revolutions / Number of revolutions $= \frac{V}{2\pi r}$

  substituting value of r, $= \frac{2\pi m v Z e^2}{n^2 h^2}$

Sol^n:-

$$\frac{f_1}{f_2} = \frac{v_1/\cancel{2\pi} r_1}{v_2/\cancel{2\pi} r_2}$$

$$= \frac{v_1}{v_2} \times \frac{r_2}{r_1} \quad \text{— (I)}$$

for, $\frac{v_1}{v_2} = \frac{2.18\times10^6 \times Z/n_1}{2.18\times10^6 \times Z/n_2} \Rightarrow \frac{n_2}{n_1}$ & $\frac{r_1}{r_2} = \frac{0.529 \times (n_1)^2/Z}{0.529 \times (n_2)^2/Z} = \frac{(n_1)^2}{(n_2)^2}$

ATQ, $\frac{r_1}{r_2} = \frac{\cancel{4R}}{\cancel{16R}} \Rightarrow \left(\frac{n_1}{n_2}\right)^2 = \frac{1}{4}$

$$\frac{n_1}{n_2} = \frac{1}{2}$$

putting these values in (I) $\Rightarrow \frac{f_1}{f_2} = \frac{v_1}{v_2} \times \frac{r_2}{r_1}$

$$= \left(\frac{n_2}{n_1}\right) \times \left(\frac{n_2}{n_1}\right)^2 \Rightarrow \left(\frac{n_2}{n_1}\right)^3$$

$$\Rightarrow \frac{8}{1} = \boxed{8:1}$$

LP:- Calculate energy ratio for 3rd orbit of Li^{+2} ion & 2nd orbit of Be^{+2} ion

Sol^n:-

$$\frac{E_{Li^{+2}}}{E_{Be^{+3}}} \Rightarrow \frac{-13.6\left(\frac{Z_1^2}{n_1^2}\right)}{-13.6\left(\frac{Z_2^2}{n_2^2}\right)} \Rightarrow \frac{9/9}{16/4} \Rightarrow 1:4$$

LP:- What are the frequency and wavelength of a photon emitted during a transition from n= 5 state to the n=2 state in hydrogen atom?

Sol^n:

$$\Delta E = 2.18\times10^{-18} J\left[\frac{1}{n_i^2} - \frac{1}{n_f^2}\right]$$

$$= 2.18\times10^{-18} J\left(\frac{1}{5^2} - \frac{1}{2^2}\right)$$

$$= -4.58\times10^{-19} J.$$

Taking only magnitude

$$\nu = \frac{\Delta E}{h} \Rightarrow \frac{4.58\times10^{-19} J}{6.626\times10^{-34} Js} \Rightarrow 6.91\times10^{14} Hz$$

$$\lambda = \frac{c}{\nu} \Rightarrow \frac{3.0\times10^8 m/s}{6.91\times10^{14} Hz} \Rightarrow 434 \text{ n-m.}$$

Limitations of Bohr's Atomic Model:-

- Only applicable on single $e^\ominus$ species.
- Does not explain wave nature of $e^\ominus$.
- Could not explain the ability of atoms to form molecules by chemical bonds.

de-Broglie Equation

↳ Every particle has a wave associated with it, the wavelength of which is called de-Broglie wavelength given by:

$$\boxed{\lambda = \frac{h}{mv} = \frac{1}{p}}$$ ($p = mv$ called momentum)

Heisenberg's Uncertainty Principle.

↳ We can't measure exact position and velocity of $e^{\ominus}$ simultaneously.

Mathematically, $\Delta x \times \Delta P_x \geqslant \frac{h}{4\pi}$

or, $\Delta x \times \Delta mV_x \geqslant \frac{h}{4\pi}$

or, $\Delta x \times \Delta V_x \geqslant \frac{h}{4\pi m}$

K^3B ⇒ The effect of Heisenberg Uncertainity principle is significant only for motion of microscopic objects and is negligible for that of macroscopic objects.

LP:- A golf ball has mass of 40g and a speed of 45 m/s. If the speed can be measured within accuray of 2%, calculate the uncertainity in the position.

soln Uncerteinity in velocity, $\Delta V = 45 \times \frac{2}{100} = 0.9\,ms^{-1}$

from heisenberg's principle,

$$\Delta x = \frac{h}{4\pi m \cdot \Delta V} \Rightarrow \frac{6.6 \times 10^{-34}\,kg\,m^2 s^{-1}}{4 \times 3.14 \times 40 \times 10^{-3}\,kg \times 0.9}$$

$$\Rightarrow 1.46 \times 10^{-33}\,m.$$

Reasons for failure of the Bohr Model:-

- It did not consider the dual behaviour of matter.
- It contradicts Heisenberg Uncertainity principle

Quantum Mechanics.

↳ The branch of science that deals with dual behaviour of matter i.e. wave as well as particle nature, is called Quantum mechanics.

Schrodinger Wave Equation:- On the basis of quantum mechanics, Schrodinger proposed a quantum mechanical model of an atom. He gave Schrodinger wave equation to describe the wave motion of the electron in three dimensional space around the nucleus.

$\boxed{\hat{H}\psi = E\psi}$ $\hat{H}$ is called Hamiltonian operator, E and ψ are obtained from solution of schrodinger wave equation.

K³B ⇒ When Schrodinger equation is solved for hydrogen atom, the solution gives the possible energy levels the electron can occupy and the corresponding wave function(s) of ψ of electron associated with each energy level. These quantized energy states and corresponding wavefunctions which are characterized by a set of three quantum numbers - principal quantum number n, azimuthal quantum number l and magnetic quantum number m.

Atomic Orbitals : Wave functions of hydrogen or hydrogen like species with one electron. (Wave function is a mathematical function whose value depends upon the coordinates of the electron in the atom and does not carry any physical meaning.

⊛ An orbital is a region in space around the nucleus where the prob. of finding the electron is maximum.

ORBIT	ORBITAL
∘ It is well defined circular path around the nucleus in which electron revolve. ∘ Max^m no. of $e^\ominus$ that an orbit can have is given by $2n^2$ where n is the no. of orbit.	∘ It shows the 3 dimensional space around the nucleus within which the probability of finding an $e^\ominus$ is maximum. ∘ Max^m no. of electrons that can be occupied by an orbital is always two.

Quantum Numbers

↳ Set of 4 numbers which is used to define an electron completely — n, l, m_l, s

n → principal quantum number
l → Azimuthal quantum number.
m_l → Magnetic quantum number
s → spin quantum number.

K³B ⇒ orbit के अंदर subshell, फिर उसके अंदर orbital.

circular path around nucleus in which $e^\ominus$ revolve. ← Orbit no. (max^m no. of $e^\ominus$ in any orbit is $2n^2$)

↓

Subshell

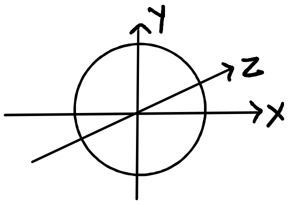
↓

Region or space around nucleus where probability of finding an $e^\ominus$ is maximum. ← Orbital (orbital can have max^m of $2e^\ominus$)

lobe → $e^{\ominus}$ density

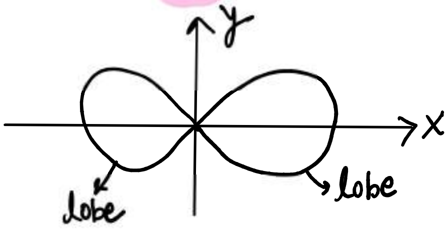
Shape of Orbitals :-

- s-orbital – spherical shape

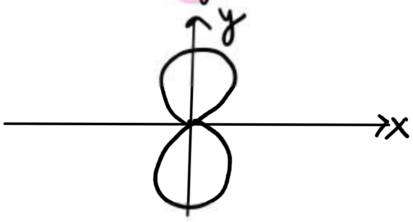


- P-orbital – dumb-bell shape

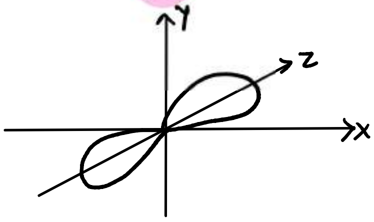
P_x



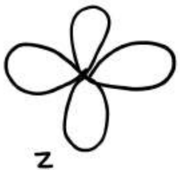
P_y

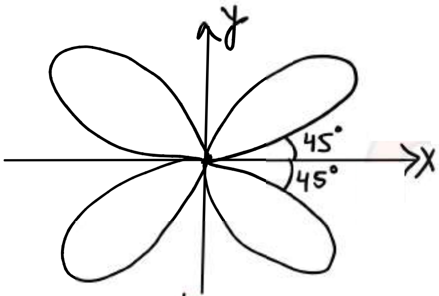


P_z

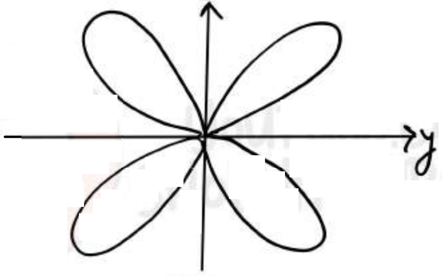


- d-orbitals: double-dumb-bell

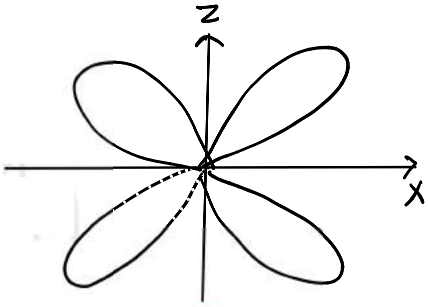




d_{xy}

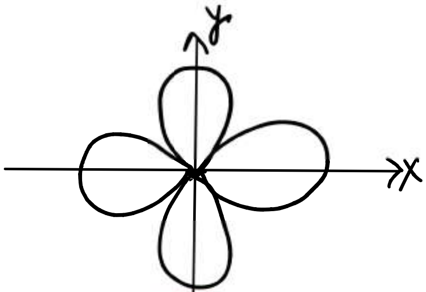


d_{yz}

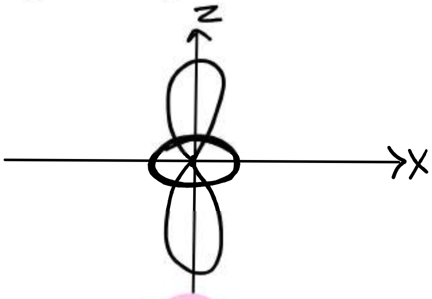


d_{xz}

$e^{\ominus}$ density is along the plane



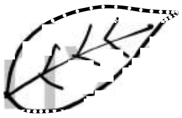
$d_{x^2-y^2}$



d_{z^2}

$e^{\ominus}$ density is along axis.

- f-orbital – complex or leaf type.



Quantum Numbers:-

(a) Principal Quantum Number (n):-

- It describes shell or orbit.

n =	1	2	3	4	----
shell =	K	L	M	N	---

- no. of subshell = n
- no. of orbitals = n^2
- no. of $e^{\ominus}$ = $2n^2$

(b) Azimuthal Quantum Number (l):-

- It describes subshell.
- Values of 'l' = 0 to $n-1$
- gives info about shape of orbital.
  (अगर s,p,d,f पता चल गया तो shape भी बता देंगे)
- Orbital Angular momentum

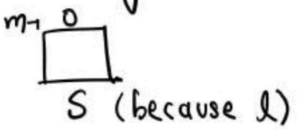
$$\boxed{(L) = \frac{h}{2\pi}\sqrt{l(l+1)}}$$

$l=0 \rightarrow s$
$l=1 \rightarrow p$
$l=2 \rightarrow d$
$l=3 \rightarrow f$
$l=4 \rightarrow g$.

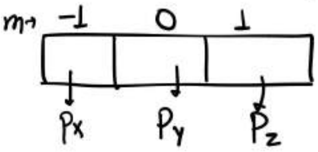
(c) Magnetic Quantum Number:- (m_l)

- It describes shape and orientation of shell.
- Values of m: $-l \leq m \leq +l$ including zero.

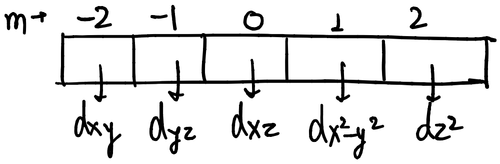
$l=0 \longrightarrow m=0$
↳ (s)



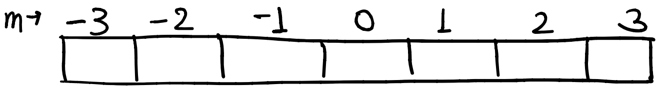
$l=1 \longrightarrow m=-1,0,1$
↳ (p)



$l=2 \longrightarrow m=-2,-1,0,1,2$
↳ (d)



$l=3 \rightarrow m=-3,-2,-1,0,1,2,3$
↳ (f)



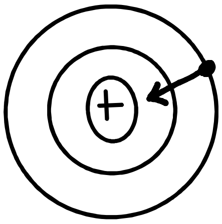
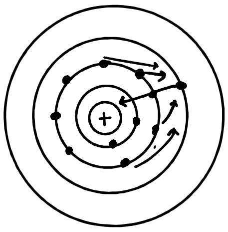
(d) Spin Quantum Number:- (s)

- describes the spin of an $e^{\ominus}$. (clockwise or anticlockwise)

$\boxed{\uparrow\downarrow}$ ✓ $\boxed{\uparrow\uparrow}$ ✗ $\boxed{\downarrow\downarrow}$ ✗

- Spin angular momentum = $\frac{h}{2\pi}\sqrt{s(s+1)}$

Energy of orbitals :-

Monoelectronic Species	Multi electronic Species
- There is only nuclear attractive force	- It is nuclear attractive force as well as interelectronic forces.
	
- Energy of all orbitals in same shell is same - Energy only depends on principal Quantum number.	- Energy of different orbitals is different in same shell due to interelectronic repulsion. - Energy depends upon 'n' as well as 'l'.
$1s < 2s <= 2p < 3s = 3p = 3d$	$1s < 2s < 2p < 3s < 3p < 4s < 3d$

Zeff (Effective Nuclear Charge) :-

↳ Due to shielding of outer shell $e^{\ominus}$ from nucleus by inner shell $e^{\ominus}$, net $\oplus$ve charge experienced by outer shell $e^{\ominus}$ from nucleus.

$Z_{eff} \downarrow$ $l \uparrow$

Shielding Power $s > p > d > f$

For same subshell Energy ↓ as atomic no. ($Z_{eff} \uparrow$)

eg: $E_{2s}(H) > E_{2s}(Li) > E_{2s}(Na) > E_{2s}(K)$

here $n \rightarrow$ const

$E \propto -Z^2$

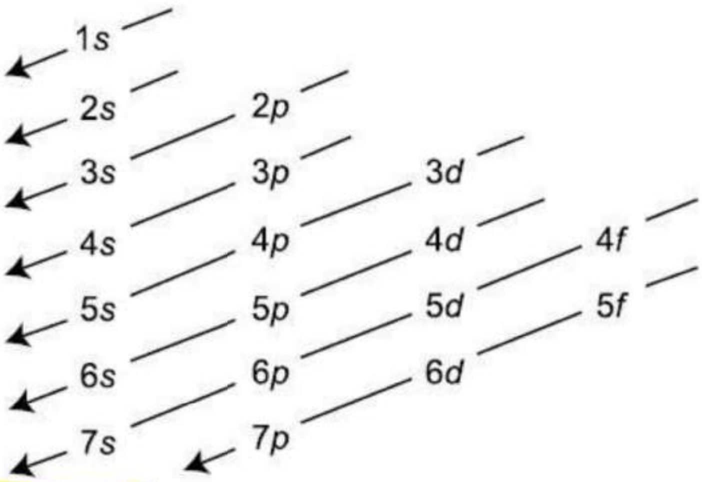
$\therefore Z \uparrow \; E \downarrow$

means building up

Autbau Principal

- Acc to Autbau principal, $e^{\ominus}$ are filled in orbitals in increasing order of energy.
- 1st $e^{\ominus}$ are filled in lower energy orbitals and then $e^{\ominus}$ are filled in higher energy orbitals.

Energy :- $1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5p < 6s < 4f < 5d < 6p < 7s$



Pauli Exclusion Principle

↳ It states that no two $e^{\ominus}$ can have same quantum number. (or) Two $e^{\ominus}$ can be filled in orbitals but they must have opp. spin.

Magnetic moment or Paramagnetism:-

$\mu = \sqrt{4s(s+2)}$ s = total spin = $n/2$

$\mu = \sqrt{n(n+2)}$ $n \rightarrow$ no. of unpaired $e^{\ominus}$

SI Unit → B.M. (Bohr Magneton)

K^3B Paramagnetic substance → having unpaired $e^{\ominus}$
Diamagnetic substance → no unpaired $e^{\ominus}$ $[n=0]$

Hund's Max^m Multiplicity Rule

↳ Pairing of $e^{\ominus}$ in orbitals of same subshell does not take place until each orbital of that subshell is singly occupied or half filled.

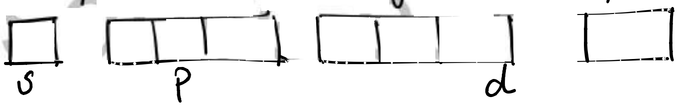
Electronic Configuration of Atoms

↳ Distribution of electrons into orbitals of an atom is called its electronic configuration. Two ways to assign electronic configuration of different atoms:-

(i) $s^a p^b d^c$ --- notation : In it, the letter symbol shows subshell and the superscript such as a, b, c, --- etc, shows the number of electrons present in the subshell.

(ii) Orbital diagram: In this, box is used to represent each orbital of the subshell and an arrow [with positive (↑) or negative (↓) spins] represents the electron.

eg:-



LP:- Write E.C. of :-

(i) ${}_{12}Mg$ = $1s^2\ 2s^2\ 2p^6\ 3s^2$

(ii) ${}_{18}Ar$ = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

(iii) ${}_{10}Ne$ = $1s^2\ 2s^2\ 2p^6$

(iv) ${}_{20}Ca$ = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

(v)* ${}_{24}Cr$ = $[Ar]_{18}\ 4s^2\ 3d^4$ X → $[Ar]_{18}\ 4s^1\ 3d^5$ (d मे अगर 4 या 9 हो तो Jump करके 5 और 10 बनेगा।)

(vi) ${}_{28}Ni$ = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^8$ or $[Ar]_{18}\ 4s^2\ 3d^8$

*(vii) ${}_{29}Cu$ = $[Ar]_{18}\ 4s^2 3d^9$ X → $[Ar]_{18}\ 4s^1\ 3d^{10}$

K³B ⇒ For Ions → lower energy मे से पहले बाहर निकलेगा → for cation
for anion → last वाले मे भरो।

eg ${}_{26}Fe = [Ar]_{18}\ 4s^2\ 3d^6$

$$\begin{tikzcd} & {}_{26}Fe = [Ar]_{18}\ 4s^2\ 3d^6 \arrow[dl] \arrow[dr] & \\ Fe^{+2} & & Fe^{+3} \end{tikzcd}$$

Fe^{+2}: $[Ar]_{18}\ 3d^6\ 4s^0$

Fe^{+3}: $[Ar]_{18}\ 3d^5\ 4s^0$

eg: ${}_8O = 1s^2\ 2s^2\ 2p^4$

↳ ${}_8O^{-2} = 1s^2 2s^2\ 2p^6$

Node and Nodal Planes

↳ The region where the probability of finding an electron is minimum or nearly zero. is called as node.

Radial Node : Spherical region where probability of finding $e^\ominus$ is zero.
formula: $(n-l-1)$

Angular Node : Plane where probability of finding $e^\ominus$ is zero.
formula: (l)

eg 1s → Radial node = $n-l-1 = 1-0-1 \Rightarrow 0$
1s → Angular node = $l \Rightarrow 0$

3s → Radial = $n-l-1 = 3-0-1 \Rightarrow 2$
3s → Angular = $l \Rightarrow 0$