VICTORY ZONE CHEMISTRY CLASSES

ADDRESS – 1ST FLOOR PRADEEP PLAZA, IN FRONT OF CHOPRA PALACE , ADARSH NAGAR DURG

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CHAPTER SCHEDULE

STRUCTURE OF ATOM

19 MAY 2025 TO 15 JUNE 2025

S. NO	CLASS DETAIL	TOPICS DETAILS	CHECK LIST
1.	LECTURE NO. 1	HISTORY, FUNDAMENTAL PRATICLES, CATHODE RAYS	✓
2.	LECTURE NO. 2	RUTHERFORD EXPERIMENT	✓
3.	LECTURE NO. 3	REPRESENTATION OF ATOM, ISOTOPES, ISOBARS etc.	✓
4.	LECTURE NO. 4	**QUANTUM PHYSICS THEORY**	✓
5.	LECTURE NO. 5	QUANTUM PHYSICS **30Q**	✓
6.	LECTURE NO. 6	BOHR'S ATOMIC MODEL THEORY Imp.	
7.	LECTURE NO. 7	BOHR'S ATOMIC MODEL & HYDROGEN SPECTRUM 30Q	
8.	LECTURE NO. 8	**BOHR'S ATOMIC MODEL & HYDROGEN SPECTRUM 30Q**	
9.	LECTURE NO. 9	**BOHR'S ATOMIC MODEL & HYDROGEN SPECTRUM 30Q**	
10.	LECTURE NO. 10	DE-BROGLIE, HEISENBERG, SCHRODINGER WAVE EQUATION THEORY	
11.	LECTURE NO. 11	DE-BROGLIE, HEISENBERG, SCHRODINGER WAVE EQUATION 30Q	
12.	LECTURE NO. 12	**ELECTRON FILLING RULES (AFBAU'S, PAULI'S, HUND'S)**	
13.	LECTURE NO. 13	**QUANTUM NUMBER 30Q** Imp.	
14.	LECTURE NO. 14	**SELF ANALYSIS PAPER IN CLASS**	
15.	TEST NO. 3	13/06/2025 **MCQS 30Q MM:120** (YOUR MARKS)	
16.	TEST NO. 4	15/06/2025 **THEORY 16Q MM:30** (YOUR MARKS)	
17.	HOME WORK	NUMBER OF QUESTION DONE BY YOUR SELF	
18.	HOME WORK	NCERT BOOK READING LINE TO LINE	

Chapter - 2 **ATOMIC STRUCTURE :-**

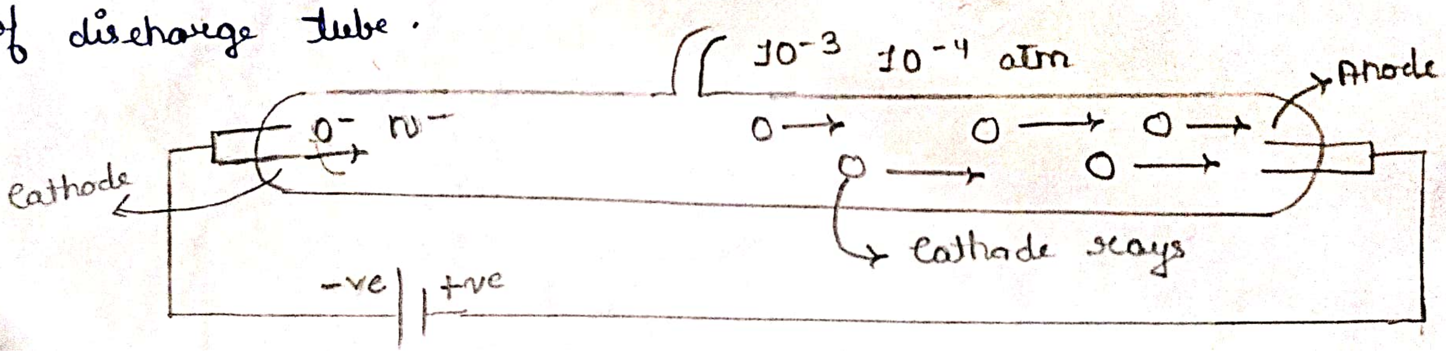
History of Atomic structure
A greek word A Tom is called undivisible.
All other matter are composed of smallest indivisible Particles.

→ Dalton's Atomic Theory :- **
This Theory is based on law of mass conservation, law of definite proportion & law of multiple proportion: i) Each element are composed of extremely small particles called atom.
ii) Atom of a particular element are like different from each other.
iii) Different type of atom have different nature or characteristic like mass, shape, size etc.
iv) Atoms are indistructable "~~Neither~~" Atoms are neither be created nor be destroyed".

*** FUNDAMENTAL PARTICLES :-**
Discovery of Subatomic Particles :-
Electrons, protons, neutrons are the fundamental particles also Called sub-atomic Particles. Electrons & protons were discovered in discharge tube by the behaviour of "like charges repel each other & unlike charge attract each other."

25.*
Discovery of Electron :-
Micheal Ferodey discovered a device called discharge tube by the help of this discharge tube J.J Thomson discovered cathode Rays, charge to Mass ratio of electron & given Thomson's Atomic Model.

CATHODE RAYS :-
Cathode Rays are discovered in discharge tube mechanism of discharge tube.



The result of this experiment are summarise below:-

i) The cathode rays starts from cathode & moves towar-ds the anode.

ii) Cathode rays are go-through straight line but in the presence of magnetic & electric field. North is the direc^n where it bends or +ve. This -ve particles are called cathode rays or electron.

iii) Cathode rays have kinetic Energy because it revolve fan which is present in discharge tube.

iv) Charge to mass ratio of electron. J.J. Thomson was the first scientist who discovered $\frac{E}{m}$ of electron which is equal to 1.75×10^{11} e kg^{-1}

R.A Milican → discovered the charge.
discovered a oil drop experiment method to found a charge in electron.

Quanta means the smallest value eg:- in charge -1.6×10^{-19}C of electron.

i) by this combination $\frac{E}{m}$ and e we discovered the mass of electron.

ii) The mass of electron are not a quanta of mass but it case the quanta of charge $Q = ne$ mass of $e^- = 9.1 \times 10^{-31}$ kg

iii) Discovery Of Proton & Neutron:-

→ Proton are discovered by E. Goldstein or E. Goldstein in discharge tube when hydrogen gas are present in the discharge tube.

→ Neutron was discovered by the James Chadwick in 1930. after 50 years.

$$ {}^{9}_{4}Be + \underset{\alpha \text{ particles.}}{\underset{\downarrow}{{}^{4}_{2}He}} \longrightarrow {}^{12}_{6}C + {}^{1}_{0}n $$

Bombading in Be by He ion -
Important for exam.

Fundamental Particles :-

Name	Sign	Charge	Discover by	Mass	In
electron	e^-	$-1.67\times10^{-19}C$	J-J Thomson	9.1×10^{-31} kg	orbit
Proton	p^+	$+1.67\times10^{-19}C$	Goldstein	1.67×10^{-24} kg	nucleus
neutron	n^0	zero	J. Chadwick,	1.67×10^{-27} kg	nucleus

Atom

$^{16}_{8}O^{-2}_{2}$

Atomic Mass ← A   Charge

Atomic Number ← Z   Number

Z = Atomic no.
= no. of p^+ & e^-

A = Atomic Mass
= no. of p^+ + n^0

A − Z = No. of Neutron.

* Definitions :-

1) Isotopes :- Same no. of Z Atomic no. but different no. of Atomic masses. & "No. of neutrons different"

	^1_1H	^2_1H	^3_1H		$^{12}_6C$	$^{14}_6C$
e	1	1	1	e	6	6
p	1	1	1	p	6	6
n	0	1	2	n	6	8

2) Isobars :- Same Atomic masses but different atomic no.
"A is same by Z different"
no. of p^+ + n^0 → same

	$^{14}_7N$	$^{14}_6C$
e	7	6
p	7	6
n	7	8
n+p	14	14 //

3) Isodiaphares :- have different no. of atomic mass & atomic number.

Same no. of n−p.

	$^{11}_{5}B$	$^{12}_{6}B$
e =	5	6
p	5	6
n	6	7
n-p	1	1

(n-p)

← same.

4) Isotone, Isotonic, Isonumeric :- Same no. of neutron.

	$^{3}_{1}He$	$^{11}_{2}He$
e	1	2
p	1	2
n	2	2

← same.

5) Isosteres :- Same no. of atoms & same no. of electrons.

	CO_2	N_2O
atoms	3	3
electrons	$^{12}_{6}C$ $2\times{}^{16}_{8}O$	$2\times{}^{14}_{7}N + {}^{16}_{8}O$
	6 + 16	14 + 8
	⇒ 22e⁻	22e⁻

6) Isoelectronics :- No. of electrons are same.

	$^{23}_{11}Na^{+}$	$^{20}_{10}Ne$	$^{24}_{12}Mg^{+2}$	$^{18}_{9}F^{-}$	$^{16}_{8}O^{-2}$
e⁻	10e⁻	10e⁻	10e⁻	10e⁻	10e⁻

} all have same no. of e⁻.

* Atomic Str. DPP - 01.

1) $^{16}_{8}O$

e	p	n
8	8	8
8	16	4

$^{20}_{16}O_{new}$

$$\% \text{ increase} = \frac{\text{final} - \text{initial}}{\text{initial}} \times 100\%$$

$$= \frac{20-16}{16} \times 100$$

$$= 25\%$$

Que. 2) Y^{-2}

e	p	n
Z + 2	Z	A - Z
20e⁻	18	

Y^{+3}

⇒ 18 - 3

⇒ 15e⁻ //

Que.3) $^{16}_{8}O$ चूंकि $164 = 100$

$14 = \frac{100}{16}$

$^{12}_{6}C$ $124 = \frac{100}{16} \times 12 = 75$ //

Que.6) $^{27}_{13}Al$

p^+ (a)	e^- (b)	n^0 (c)
13	13	14

c : b : a $\rightarrow$ 14 : 13 : 13 opt - 3.

Que.7) $_{89}Y^{231}$

p^+	e^-	n^0
89	89	$231 - 89 = 142$

2) 89, 142, 89 //

Que.8) Isoelectron is given.

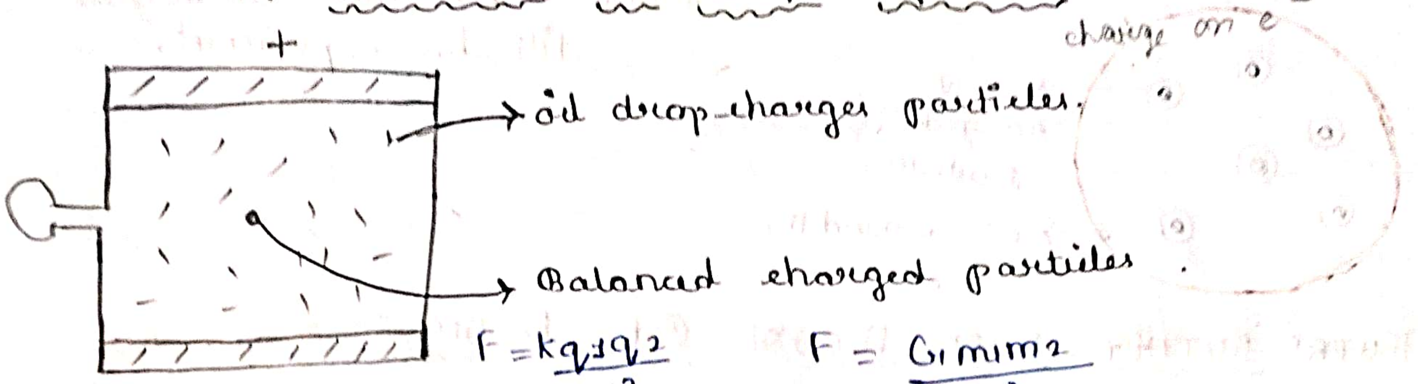
a) Na^+, H_3O^+, NH_4^+ 2b) CO_3^{-2}, NO_3^-, H_2CO_3

b) CO_3^{-2} NO_3^- H_2CO_3

c) P^{-3} HCl C_2H_5 PH_3

d) F^-, Ne Na^+

* Millikan's oil drop experiment :-



$F = \frac{k q_1 q_2}{r^2}$ $F = \frac{G m_1 m_2}{r^2}$

charge on electron Quanta
$Q = ne$ Q = charge $e^- = 1.6 \times 10^{-19}$
n = no. of e^-

*Millikan use oil droplet in the form of milk produced by the atomiser where allowed to enter through a tiny hole in the upper plate of electrical condenser the tiny particles balanced in air because of two opposite forces i) Electrostatic force $F = \frac{k q_1 q_2}{r^2}$
ii) Gravity $= \frac{G m_1 m_2}{r^2}$

Both Force are equal to each other now by this method we defined charge on the oil droplet particles which is equal to Q. $Q = ne$ n = no. of e^-
e = quanta of charge (e^-)
which is equal to $= 1.6 \times 10^{-19}$ C

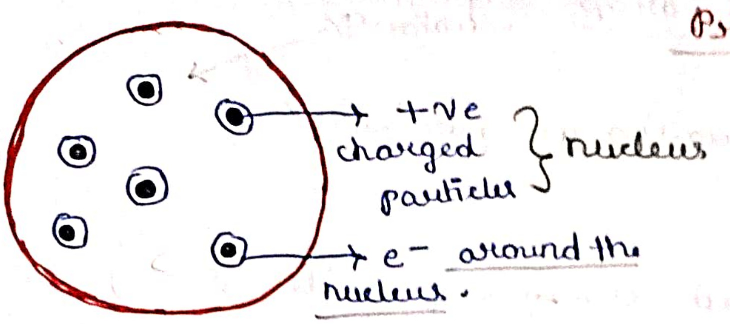
* THOMSON's ATOMIC MODEL :- watermelon Model, Plum-pudding model.

J.J Thomson in 1898 proposed that atom are spherical in shape with $1\text{Å} = 10^{-10}$ m & in which the +ve charge (nucleus) is uniformly distributed & e^- also are embedded into it such a manner as to give the most stable electrostatic arrangement. His experiment concluded neutrality of atom not the stability.

Drawbacks :- He got noble prize in 1906".

1) +velevy charged are nucleus are not +velvey charged we know that nucleus are in centre of the circle.

2) Electrons are not stationery e^- are continuous revolving around nucleus in the fixed orbit.



Proton was not discovered till his experiment.

* ~~RUTAR~~ RUTHER FORD MODEL OF ATOM :-

Rutherford & his student bombarded very thin (10^{-7}m or (0.1 μm)) of gold foil & high speed alpha-particle his experiment is famous for ~~heapb~~ (alpha) α particles scattering experiment.

α-particles are high speed +ve charge Helium particles.

Observation of This Experiment are as below :-

1) Most of the α particles passes through the gold foil undeflected.

2) A small fraction of α particles weas deflected by small angles.

3) A very few α particles (1 in 20,000) bounce back with a deflection of 180°.

* On the basis of above observation Rutherford conclude that. Conclusion's Observation :-

1) most of the space in the atom is empty.

2) A very few +vetively charge particles shows that the repulsive force by +vely charged centre. in very small value.

3) Centre are very strong, very small, compare to the atom & the mass of complete atom are concentric in the centre ⊙

4) Imagine the size of nucleus is just like a cricket so the size of atom could be radius of 5km -

5) The size of atom is nearly 1 Angstrom = 10^{-10} m & the size of nucleus is 1 fermi = 10^{-15} m. so the volume of nucleus are 10^{-15} times smaller than atom.

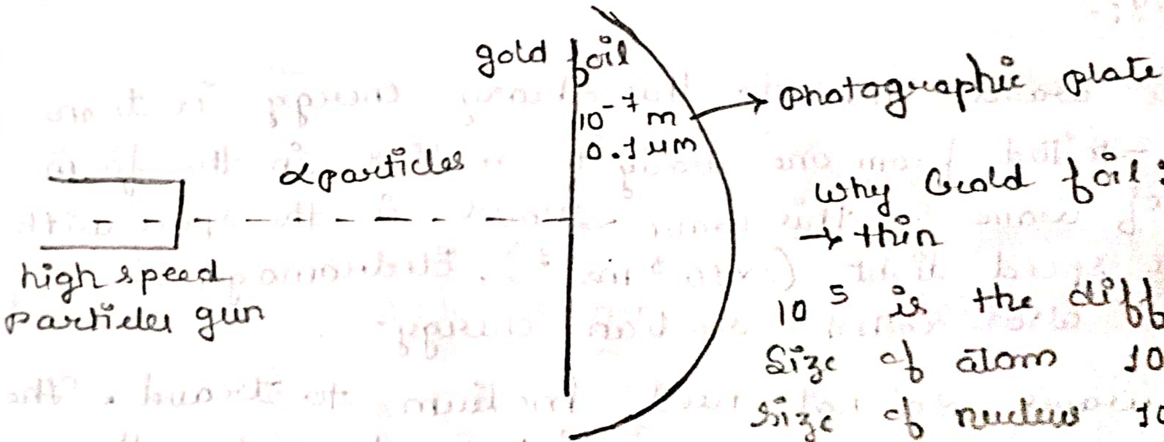
6) Conclu^n: According to this observation & conclusion Rutherford present its atomic model.

i) +vely charge most of the mass of the atom was densely concentrated in the extremely small ~~reason~~ region called nucleus.

ii) The nucleus is surround by electron that move around the nucleus with a high speed circular path called orbits.

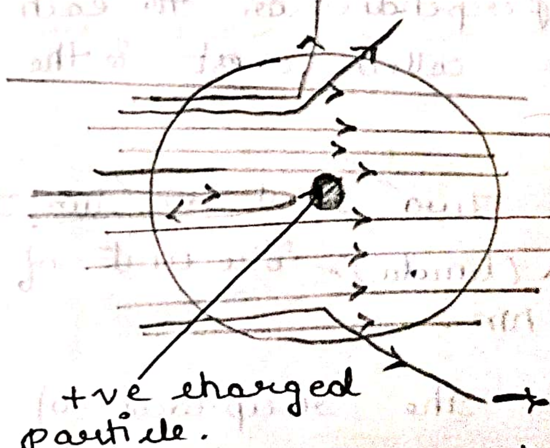
iii) Rutherford atomic model is resembled are solar sy. where nucleus play the role of sun & e^- are just like revolving planets.

iv) Electrons & nucleus are held together by electrostatic force of attraction.



why Gold foil :-
→ thin

10^5 is the difference
Size of atom 10^{-10} m = 1Å
Size of nucleus 10^{-15} m = 1 fermi



Observation :-

→ 99.9 % α particle go straight.

→ 0.1 % α particle don't go straight scattered.

Conclusion :-

→ 99.9 % place is empty.

→ Center are very small very strong & mass of complete atom are in centre.

* Why Rutherford used Gold foil?
→ The nucleus of gold are very heavy appear 2004 so high speed alphaparticles cannot able to destroy nucleus.

** Drawn of Rutherford :-
Acc^n to Maxwell rotating charge particles omitted radiation so the energy of electron loss & e⁻ follow the spiral path & merged into the nucleus. The stability of atom are invalid.

Further Bohr & De broglie are the scientist which describe the rotation of electrons.
Another serious drawback are the stability of electrons & orbit

* WAVE THEORY:-

1. Electromagnetic waves:- Acc^n to this theory energy is trans-mitted from one body to another in the form of wave & this wave travel in the space with the speed light. ($3\times10^8\ ms^{-1}$). Electromagnetic waves are also called radian energy.

EM waves do not need medium to travel. The both E & M waves are perpendicular to each other. The upper most part are called crest & the lower most part are called Trough.

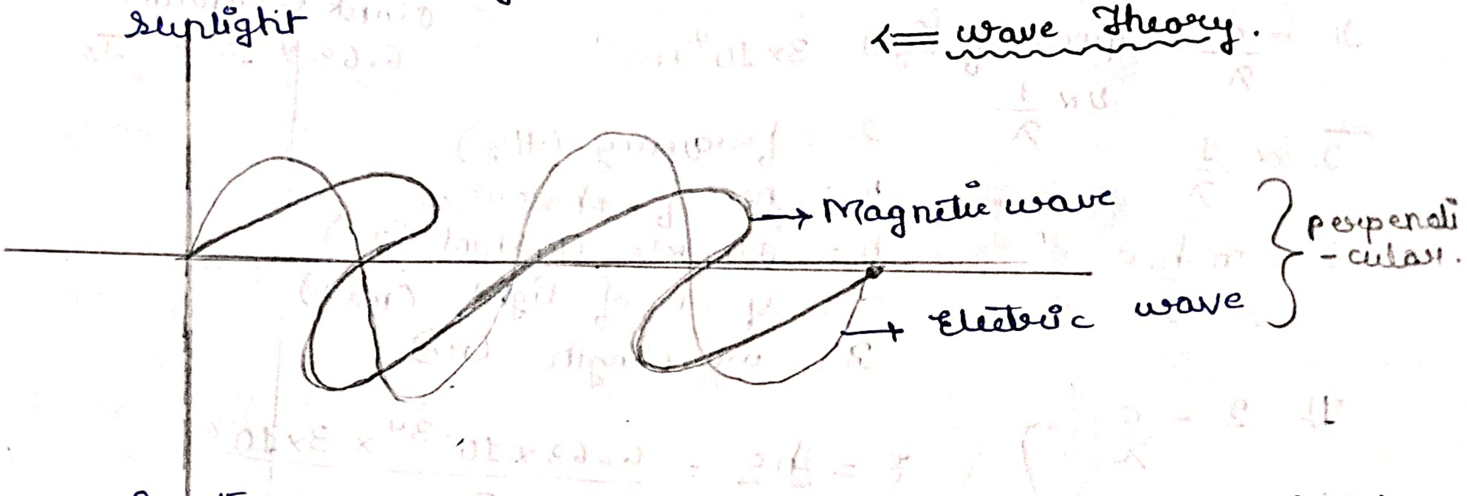
Wavelength :- The distance b/w two crest or two trough it is denoted by λ (lemda). The unit of λ are measured in Å or nm.

Wave number :- (nu bar) it is the reciprocal of wavelength. $\bar{\nu} = \frac{1}{\lambda}$ This is the no. of wave present unit length its unit are m^{-} or cm^{-}

frequency :- It is denoted ν (nu), the frequency of wave is defined as the no. of waves which pass through a point in 1 second. It's unit are cycle per second or $second^{-1}$ or sec^{-1}.

Hz (hertz) :- Time taken by a wave to pass through one point. $T = \frac{1}{\nu}$

velocity (c) :- Velocity of the wave is defined as distance covered by a wave in 1 second.
$\lambda \times \nu$



Spectrum

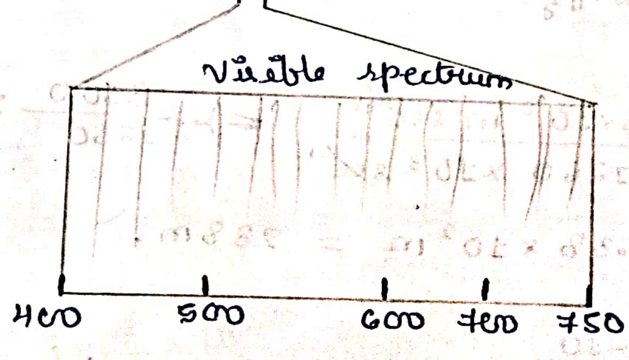
↓ wavelength (λ) (nm)

Cosmic waves	γ waves	X-Rays	UV	IR	Micro-wave	FM	AM	3G, 4G, 5G
						Radio waves		Long radio waves

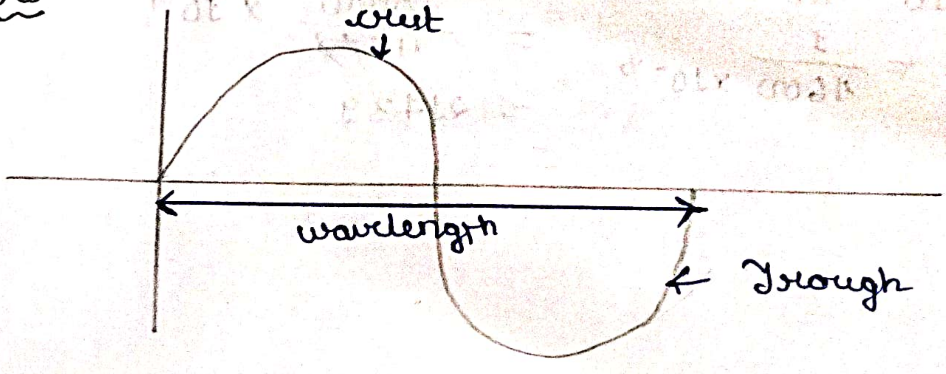
↑ ν
↓ λ

R M I V U X G C ↑ λ ↓ ν

$\lambda \propto \frac{1}{\nu}$



Waves

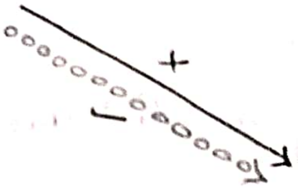


$T = \frac{1}{\nu}$

1 sec = frequency

* Plank Quantum Theory :-

According to Plank light travels in the form of ray with smallest packet of energy called photons. The smallest packet is called quanta. The smallest packet of energy is called quantum.



$E \propto \nu$

$E = h\nu$ → Plank's constant 6.63×10^{-34} Js

$\nu = \frac{c}{\lambda}$ → speed of light $3 \times 10^{8} ms^{-1}$

$\nu \propto \frac{1}{\lambda}$

$\bar{\nu} \propto \frac{1}{\lambda}$

for no. of photons.

$$\boxed{E = n\frac{hc}{\lambda}}$$

ν = frequency (Hz)
n = no. of photons.
h = Plank's constant (Js)
c = speed of light (ms^{-1})
λ = wavelength (m).

$$\boxed{\begin{array}{l} 1) \ \nu = \frac{c}{\lambda} \\ 2) \ \frac{1}{\lambda} = \bar{\nu} \text{ wave bar} \\ 3) \ E = h\nu \end{array}}$$

from this

$E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{\lambda}$

$= \frac{2 \times 10^{-25}}{\lambda}$

DPP-02 pg-21 :-

Que. 1) $\nu = 1260 \times 10^{3}$ Hz.

$\nu = \frac{c}{\lambda}$

$\lambda = \frac{c}{\nu} = \frac{3 \times 10^{8} \ m \ \cancel{sec^{-1}}}{1260 \times 10^{3} \ \cancel{sec^{-1}}} \Rightarrow \frac{3000}{1260} \times 10^{5-3}$

$\Rightarrow 2.38 \times 10^{2} m = 238 m.$

Ans 2) $\bar{\nu}$ in cm^{-}

$\lambda = 4600 \times 10^{-10} m$

$\frac{1}{\lambda} = \bar{\nu} = \frac{1}{4600 \times 10^{-8}} = \frac{1000\cancel{0}}{46\cancel{00}} \times 10^{4}$

$= 21739$

Ans. 3) A = 1.850 kHz . B = 2025 = kHz .

ν_1 ν_2

$\nu \propto \frac{1}{\lambda}$

$\frac{\nu_1}{\nu_2} = \frac{\lambda_2}{\lambda_1} \Rightarrow \frac{\lambda_1}{\lambda_2} = \frac{\nu_2}{\nu_1} = 3:2$ //

DPP-03 Pg-22

Ans 2) $\lambda = 6500$ Å $\nu = \frac{c}{\lambda}$

$\nu = \frac{3\times10^8}{6500\times10^{-10}}$

$= \frac{3000\cancel{0}}{65\cancel{0}\cancel{0}} \times 10^{4+10}$

option-4) $\nu = 4.6 \times 10^{14}\ s^{-1}$ //

1) $\nu = \frac{c}{\lambda}$ ← speed of light

ν frequency, λ → wavelength

2) $\bar{\nu} = \frac{1}{\lambda}$ ↓ wave number.

Energy of photon.

3) $E = h\nu$

$E = \frac{hc}{\lambda}$ $E = \frac{2\times10^{-25}}{\lambda}$

$E = n\frac{hc}{\lambda}$

Ans. 3) 5e volt Energy.

$5ev = 5\times1.6\times10^{-19}$ J

$E = \frac{hc}{\lambda e}\ ev = \frac{2\times10^{-25}}{\lambda\times e}\ ev$

$5\ ev = \frac{1.25\times10^{-6}}{\lambda}\ ev$

$\lambda = \frac{12.5\times10^{-7}}{5}$

$= 2.5\times10^{-7}m$ //

Ans 4) $E = \frac{hc}{e\cdot\lambda}$ $\lambda = 5520$ Å

$E = \frac{1.25\times10^{-6}}{5520\times10^{-10}}$

$\frac{1.25}{5520}\times10^{-6+10}$

$\frac{1250\cancel{0}}{552\cancel{0}} = 2.26\ ev$

option - 1 ✓

Ans 5) $E = \frac{nhc}{\lambda}$

$1J = n \times \frac{2 \times 10^{-25}}{5000 \times 10^{-10}}$

$\frac{5000 \times 10^{-10}}{2 \times 10^{-25}} = n$

$\frac{2500 \times 10^{-10+25}}{2} = n$

$2500 \times 10^{15} = n$

$2.5 \times 10^{18} = n$ //

Ans 6) $E \propto \nu$ directly
$E \propto \frac{1}{\lambda}$ inversely

Ans 7) $E = \frac{hc}{\lambda}$

$4.38 \times 10^{-18} = \frac{2 \times 10^{-25}}{\lambda}$

$\lambda = \frac{2 \times 10^{-25}}{4.38 \times 10^{-18}}$

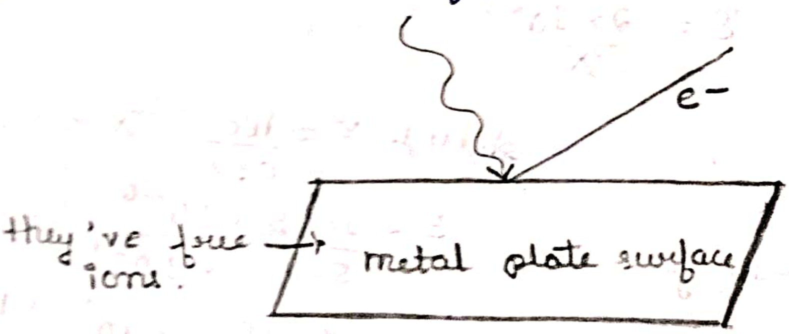
$\lambda = \frac{2 \times 10^{-25+18}}{4.38}$

$\Rightarrow 0.456 \times 10^{-7}$

$\Rightarrow 456 \mathring{A}$ option - 1 ✓

* EINSTEIN PHOTO ELECTRIC EFFECT :- (PEE)

Hertz performed a very interesting experiment in which electron work ~~we~~ ejected when certain metal. eg:- Li, Na, K, Rb, Cs, Fr. were exposed to a beam of light as shown in the figure.



This phenomena is called photoelectric effect and the observation are.

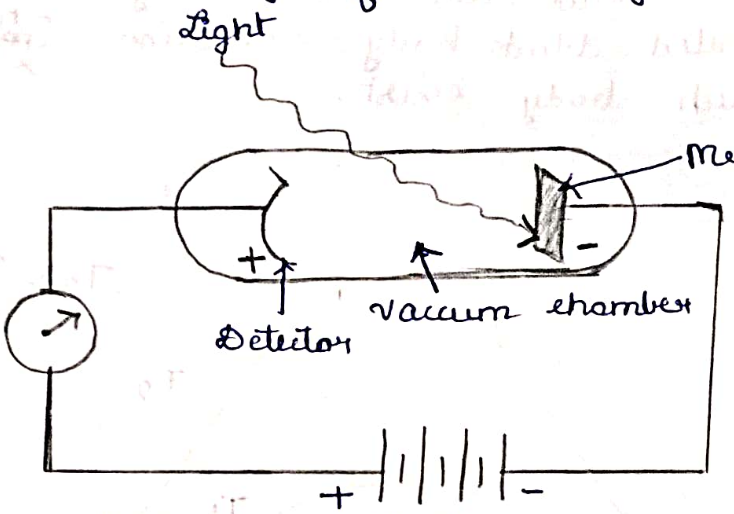
i) There is no time lack b/w the striking of light beam & the ejection of electrons from the metal.

ii) The no. of electrons ejected is proportional to the intensity ~~of~~ or the brighteness of the light.

iii) for each metal their is a minimum characteristics frequency ν_0 also known as threshold frequency.

No emmision or ejection of electron below the the threshold frequency i.e $\nu > \nu_0$. The ejected electron comeout with certain kinetic energy. The kinetic energy of this e^- increases with the in increases of frequency of the light.
$E \propto \nu$

Einstein 1905 was able to explain the PEE using plank's quantum theory of electromagnetic radiation.



Metal → Threshold frequency

Ionization energy.
↓
Energy of photon $= E = h\nu$

Threshold energy $= h\nu_0 = \phi =$ work function.

$E = h\nu$
$\phi = h\nu_0$

$KE = E - \phi$

$$\boxed{\frac{1}{2}mv^2 = h\nu - h\nu_0}$$

* Some imp. definitions:-

i) Threshold frequency – the minimum frequency of light that must be incident on the metal for the emmission of electron to occur.

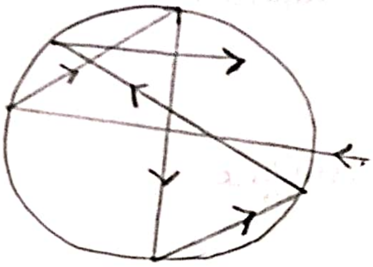
ii) Work Function – The minimum energy required to release one e^- from the surface of the metal.
Incident energy >
$\nu_0 = KE$

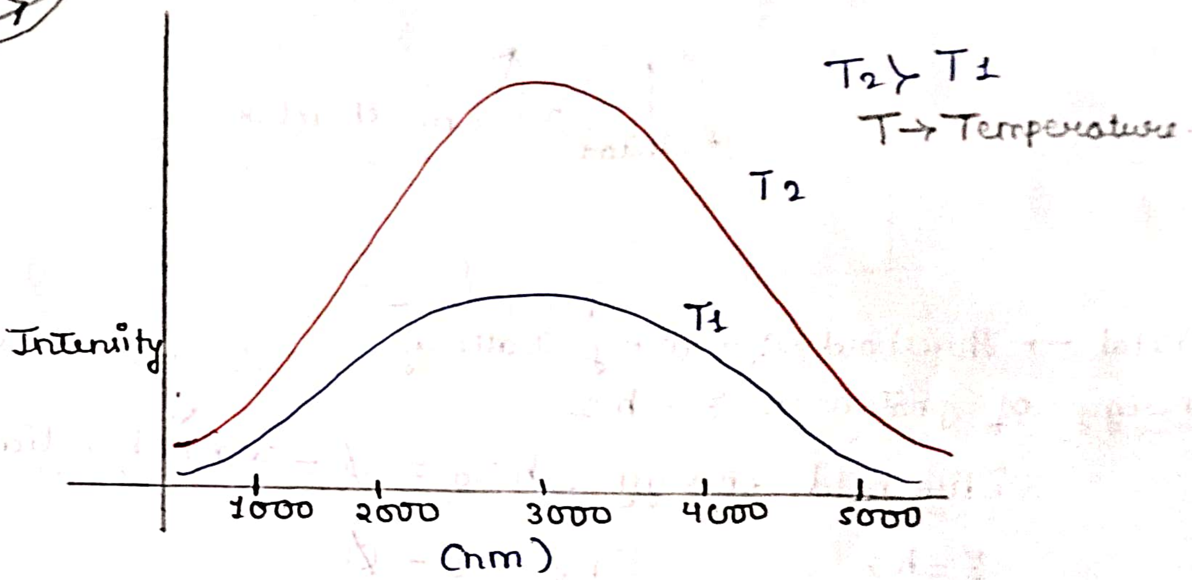
iii) Threshold wavelength – The maximum wavelength of light cause the ejection of e^- from the metal surface.
(inversely $\propto$)

* BLACK BODY RADIATION :-

→ It is the term used to describe the object temperature & the wavelength of the electromagnetic wave radiation it a emits.

* Black Body Radiation :- An ideal body which emit & absorb all frequency of radiation uniformly & the radiation emitted by such a body is called black body radiation impractical no such body exist.





~~Pg-163~~ Que. ~~pg-10~~ ~~the~~ pg-39 NCERT Questions:-

2.3) $\nu = 1368$ kHz

$= 1368 \times 10^3$ Hz.

$\nu = \frac{c}{\lambda} \Rightarrow \lambda = \frac{c}{\nu}$

$\lambda = \frac{3 \times 10^8}{1368 \times 10^3} \Rightarrow \frac{3000 \times 10^{8-6}}{1368} \Rightarrow \frac{3000 \times 10^2}{1368}$

$\Rightarrow 2.19 \times 10^2$ m

$\Rightarrow .219$ m //

2.4) 400nm 750nm

$\nu = \frac{c}{\lambda}$

↳ $\nu = \frac{3 \times 10^8}{750 \times 10^{-9}}$

$\nu = \frac{3 \times 10^8}{400 \times 10^{-19}}$

$\Rightarrow 7.5 \times 10^{14}$ Hz ← Violet

$\nu = \frac{3000 \times 10^{5+9}}{750}$

$\nu = 4 \times 10^{14}$ Hz ← Red

2.5) wavelength = 5800 Å → yellow.

i) $\frac{1}{\lambda} = \bar{\nu} = \frac{1}{5800 \times 10^{-10}}$ ⇒ $\frac{100\cancel{00} \times 10^{6}}{58\cancel{00}}$

$= \frac{10^{10}}{5800}$ ⇒ $1.724 \times 10^{6}\ m^{-1}$

⇒ $1.724 \times 10^{4}\ cm^{-1}$ //

ii) frequency :- $\nu = \frac{c}{\lambda}$

$= \frac{3 \times 10^{8}}{5800 \times 10^{-10}} = \frac{3 \times 10^{8+10}}{5800} = \frac{3 \times 10^{18}}{5800}$

⇒ $\frac{30,0\cancel{00} \times 10^{14}}{58\cancel{00}}$ ⇒ 5.172×10^{14} Hz.

2.6) $n = 6.02 \times 10^{23}$ (mole)

$\nu = 5 \times 10^{14}$ Hz.

$E = nh\nu$

$= 6.02 \times 10^{23}$

$\nu = 5 \times 10^{14}$ Hz.

$E = nh\nu$

$= 6.02 \times 10^{23} \times 6.63 \times 10^{-34} \times 5 \times 10^{14}$

⇒ $199 \times 10^{23+14-34}$

⇒ 199×10^{3} J ⇒ 199 kJ/mole.

2.7) Power $= \frac{W}{T} = \frac{J}{sec}$

$E = \frac{nhc}{\lambda}$

$100 = n \frac{2 \times 10^{-25}}{400 \times 10^{-9}}$

$= \frac{100 \times 400 \times 10^{-9}}{2 \times 10^{-25}} = n$

$= 2 \times 10^{20}$-photons

(2.8) $h\nu = 300nm$

$\frac{1}{2} mv^2 = KE = 1.6 \times 10^{5}$ J/mol

$KE - E = \phi$

$\phi = E - KE$.

$E = \frac{nhc}{\lambda}$

$= \frac{6.02 \times 10^{23} \times 2 \times 10^{-25}}{300 \times 10^{-9}}$

$= \frac{12 \times 10^{23-25+7}}{3}$

$= 4 \times 10^{5}$ Jmole^{-1}

$\phi = 4 \times 10^{5} - 1.6 \times 10^{5}$

$\phi = 2.4 \times 10^{5}$ Jmol^{-1}

2.5) wavelength = 5800 Å → yellow.

i) $\frac{1}{\lambda} = \bar{\nu} = \frac{1}{5800 \times 10^{-10}} \Rightarrow \frac{10000}{5800} \times 10^{6}$

$= \frac{10^{10}}{5800} \Rightarrow 1.724 \times 10^{6}\ m^{-1}$

$\Rightarrow 1.724 \times 10^{4}\ cm^{-1}$

ii) frequency :- $\nu = \frac{c}{\lambda}$

$= \frac{3 \times 10^{8}}{5800 \times 10^{-10}} = \frac{3 \times 10^{8+10}}{5800} = \frac{3 \times 10^{18}}{5800}$

$\Rightarrow \frac{30,0\cancel{00} \times 10^{14}}{58\cancel{00}} \Rightarrow 5.172 \times 10^{14}\ Hz.$

2.6) $n = 6.02 \times 10^{23}$ (mole)

$\nu = 5 \times 10^{14}\ Hz.$

$E = nh\nu$

$= 6.02 \times 10^{23}$

$\nu = 5 \times 10^{14}\ Hz.$

$E = nh\nu$

$= 6.02 \times 10^{23} \times 6.63 \times 10^{-34} \times 5 \times 10^{14}$

$\Rightarrow 199 \times 10^{23+14-34}$

$\Rightarrow 199 \times 10^{3}\ J \Rightarrow 199\ kJ/mole.$

2.7) Power $= \frac{w}{T} = \frac{J}{sec}$

$E = \frac{nhc}{\lambda}$

$100 = n \frac{2 \times 10^{-25}}{400 \times 10^{-9}}$

$= \frac{100 \times 400 \times 10^{-9}}{2 \times 10^{-25}} = n$

$= 2 \times 10^{20}$ - photons

(2.8) $h\nu = 300\,nm$

$\frac{1}{2}mv^{2} = KE = 1.6 \times 10^{5}\ J/mol$

$KE - E = \phi$

$\phi = E - KE.$

$E = \frac{nhc}{\lambda}$

$= \frac{6.02 \times 10^{23} \times 2 \times 10^{-25}}{300 \times 10^{-9}}$

$= \frac{12 \times 10^{23-25+7}}{3}$

$= 4 \times 10^{5}\ J\,mole^{-1}$

$\phi = 4 \times 10^{5} - 1.6 \times 10^{5}$

$\phi = 2.4 \times 10^{5}\ J\,mol^{-1}$

T $\lambda_0 \rightarrow$ maximum wavelength

$2.4 \times 10^5 \, J \, mol^{-1} = \frac{nhc}{\lambda_0}$

$\lambda_0 = \frac{6.02 \times 10^{23} \times 2 \times 10^{-25}}{2.4 \times 10^5}$

2.9) $= \frac{12}{2.4} \times 10^{23-25-5}$

$\Rightarrow 5 \times 10^{-7}$

$\frac{5 \times 10^{-7} \times 100}{100}$

$5 \times 10^{-7} \times 10^{-2} \times 100$

500×10^{-9}

$KE = \cancel{2 \times 10^{-9}}$ 500nm

$\nu_0 = 7 \times 10^{14} \, s^{-1}$

$\nu = 100 \times 10^{15} \, s^{-1}$

$KE = h\nu - h\nu_0$

$= h(\nu - \nu_0) = h(10 \times 10^{14} - 7 \times 10^{14})$

$\Rightarrow 6.63 \times 10^{-34} \times 10^{14} \times 3$

$\Rightarrow 19.8 \times 10^{-20}$ $\quad KE = 2 \times 10^{-19} \, J$.

$\boxed{\text{Exercise pg-69}}$

Que. 1) $1e$ mass $= 9.1 \times 10^{-28} g$

$9.1 \times 10^{-28} g = 1e^-$

$1g = \frac{1}{9.1 \times 10^{-28}} = \frac{1}{9.1} \times 10^{28} = \frac{10}{91} \times 10^{27}$

1 mole e^-

$6.02 \times 10^{23} e^-$

$1e^- = 9.1 \times 10^{-31}$ kg.

1 mole $= 9.1 \times 10^{-31} \times 6.02 \times 10^{23}$

$= 54.4 \times 10^{-8}$

$\Rightarrow 5.4 \times 10^{-7}$ kg

1 mole of charge.

$\Rightarrow 1.6 \times 10^{-19} \times 6.02 \times 10^{23}$

$\Rightarrow 96500$

$\Rightarrow 9.6 \times 10^4 \, C$

1 Farad

Que. 6) i) 3×10^{15} Hz

$E = h\nu$

$= 6.63 \times 10^{-34} \times 3 \times 10^{15}$

$= 19.88 \times 10^{-19}$

$E = 1.988 \times 10^{-18} \, J$

ii) $0.5 \, \mathring{A}$

$E = \frac{hc}{\lambda}$

$= \frac{2 \times 10^{-25}}{0.5 \times 10^{-10}}$

$4 \times 10^{-25+10}$

$\Rightarrow 4 \times 10^{-15} \, J$//

Que. 7) $T = 2 \times 10^{-10}$ sec

$\frac{1}{T} = \nu$

$= \frac{1}{2 \times 10^{-10}} = \frac{1}{2} \times 10^{+10} \Rightarrow \frac{\cancel{10}^{5}}{\cancel{2}} \times 10^{+9} \Rightarrow 5 \times 10^{+9}$

$\nu = 5 \times 10^{+9}$ Hz.

$\nu = \frac{c}{\lambda}$

$\nu = \frac{3 \times 10^{8}}{5 \times 10^{9}} = \frac{\cancel{30}^{6}}{\cancel{5}} \times 10^{\cancel{8}\,7-9} = 6 \times 10^{-2}$ m $= \lambda$

$\frac{1}{\lambda} = \bar{\nu} = \frac{1}{6 \times 10^{-2}} = \frac{100}{6} = 16.66$ m^{-1}

Que. 8) $E = n\frac{hc}{\lambda}$

$\frac{E \times \lambda}{hc} = n$

$\frac{1 \times \cancel{4000}^{2} \times 10^{-12}}{\cancel{2} \times 10^{-25}}$

$2 \times 10^{-12+28}$

$n = 2 \times 10^{16}$

Que. 9) $\phi = 2.13$ ev

$\lambda = 4 \times 10^{-7}$ m

$E = \frac{hc}{e\lambda} = \frac{1.25 \times 10^{-6}}{4 \times 10^{-7}}$

$E = \frac{12.5}{4}$

$E = 3.15$ ev

$KE = E - \phi$

$= 3.15 - 2.13$

$= 1.02$ ev

$\Rightarrow 1 \times 1.6 \times 10^{-19}$ J

$\frac{1}{2}mv^2 = 1.6 \times 10^{-19}$ J

$v = \sqrt{\frac{1.6 \times 10^{-19} \times 2}{9.1 \times 10^{-31}}}$

$\Rightarrow \frac{4}{3}\sqrt{10^{-28+31} \times 2}$

$\Rightarrow$

$\frac{4}{7} \times 10^{6}$

$\Rightarrow \frac{40}{7} \times 10^{5}$

$\Rightarrow 5.7 \times 10^{5}$ ms^{-1} //

Ans. 10) Ionization energy kJ/mol

$\downarrow$

work function

$\lambda_0 = 242\ nm$

$E = \frac{hc}{\lambda}$

$E = \frac{2 \times 10^{-25} \times 6.02 \times 10^{23}}{242 \times 10^{-9}}$

$E = \frac{12}{242} \times 10^{-25+23+9}$

$= \frac{12}{242} \times 10^{7}$

$\Rightarrow \frac{12 \times 1000}{242} \times 10^{4}$

$\Rightarrow 43 \times 10^{4}$

$\Rightarrow 4.3 \times 10^{5}$

430 kJ/mol approx

Ans. 11) 25 watt $= P = \frac{J}{sec}$

$\lambda = 0.57\ \mu m$

$E = n\frac{hc}{\lambda}$

$\frac{25 \times 0.57 \times 10^{-6}}{2 \times 10^{-25}} = n$

$\frac{25 \times 0.57}{2} \times 10^{+25-6} = n$

7.12×10^{19} photons sec^{-1}

Ans 12) $KE = 0$

$KE = E - \phi$

$0 = E - \phi$

$\phi = E$

$\lambda = 6800\ Å$

$= 6800 \times 10^{-10}$

$E = \frac{hc}{\lambda}$

$= \frac{2 \times 10^{-25}}{6800 \times 10^{-10}}$

$\Rightarrow \frac{2}{6800} \times 10^{-25+10}$

$\Rightarrow \frac{20,000}{6800} \times 10^{-19}$

$\phi \Rightarrow 2.9 \times 10^{-19}\ J$

$\Rightarrow E = h\nu$

$\frac{2.9 \times 10^{-19}}{6.6 \times 10^{-34}} = \nu$

$\frac{3}{6.6} \times 10^{-19+34} = \nu$

$\frac{1}{2.2} \times 10^{15} = \nu$

$\frac{10}{2.2} \times 10^{15} = \nu$

$4.41 \times 10^{14}\ Hz = \nu$

* BOHR'S ATOMIC MODEL (1913)

→ Accr to Bohr, he used plank constant concept of quantinization of energy.

Concept of Quantum Physics. Bohr model for the of hydrogen atom is based of on following postulates :-

i) The electron in the hydrogen atom can move around the nucleus in a circular path are called Orbits. The orbit have particular radius, velocity & Energy of Electron.

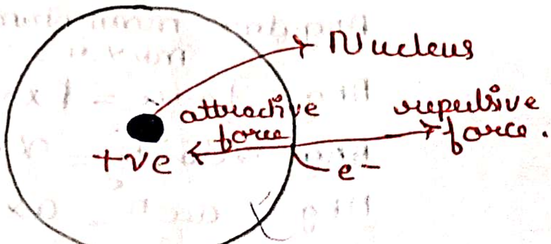
The Orbits are denoted by 'n' n is a +ve integer 1, 2, 3 it's called K, L, M, N.

ii) The Energy of electron in the orbit does not change with the time. Electron will move from a lower energy level to higher energy level.

iii) The Angular momentum of an electron is Quantanized

$$\boxed{mvr = \frac{nh}{2\pi}}$$ where, n = no. of orbit.
v = velocity
m = mass of electron

from Rutherford,



Attractive force = Electrostatics

$$F_e = \frac{Kq_1q_2}{r^2}$$

Repulsive force = centrifugal force (outsider F).

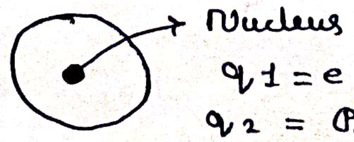
$$F_c = \frac{mv^2}{r}$$

Both force are equal & opp. to each other.

$$F_e = F_c$$

$$\frac{Kq_1q_2}{r^{\cancel{2}}} = \frac{mv^2}{\cancel{r}}$$

$$\frac{Kq_1q_2}{r} = mv^2 \quad \text{——— (1)}$$



$q_1 = e$
q_2 = Proton or Nucleus.

No. of proton = Z

charge on proton = e

$q_1 = e$ ← electron
$q_2 = Ze$ ← Nucleus.

no. of orbits = n = n

Plank's constant = h = h

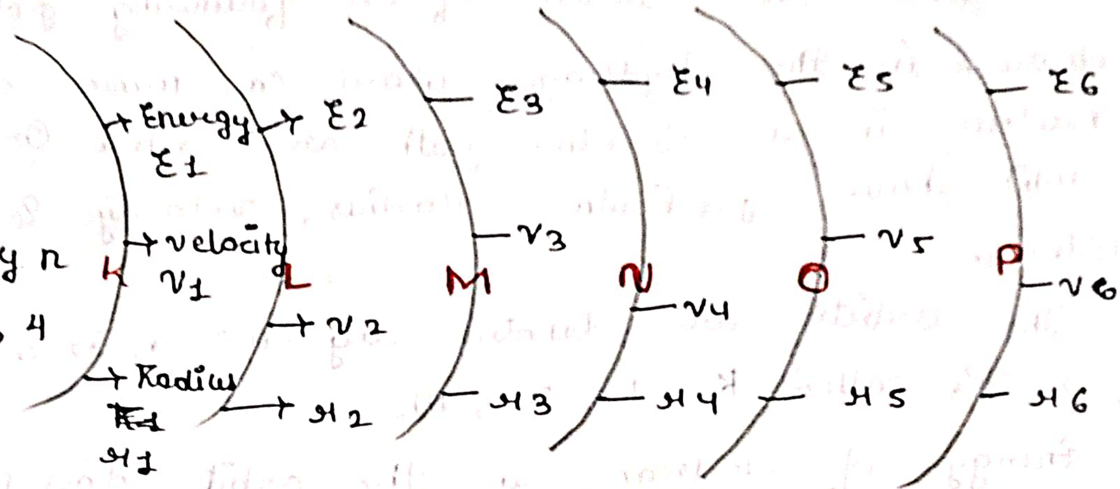
no. of proton = z = z

two number = 2 = two no. = 2

Denoted by n

n = 1, 2, 3, 4

= K L M N



$mvr = \frac{1 \times h}{2\pi}$ $mvr = \frac{2 \times h}{2\pi}$ $mvr = \frac{3h}{2\pi}$ $mvr = \frac{4\pi h}{2\pi}$

$mvr = \frac{5h}{2\pi}$ $mvr = \frac{6h}{2\pi}$

* Angular momentum $= mvr = \frac{nh}{2\pi}$ — ② Why? No Reason.

* BOHR'S ATOMIC MODEL was only applicable for mono-atomic species. (single e^-)

^1_1H $^4_2He^+$ $^6_3Li^{+2}$ $^8_4Be^{+3}$

Rough
$p = mv$
Angular momentum
$mv \times r$.
Ang. force $= F \times r = \bar{S}$
Ang. velocity $= v \times r$
Ang. acc^n $= a \times r$.

Now,
from eq^n ① By Rutherford.

$$\frac{kq_1q_2}{r^2} = \frac{mv^2}{r}$$

$q_1 = e$

$q_2 = ze$

$$\frac{k \times e \times ze}{r} = mv^2$$

$$r = \frac{kze^2}{mv^2}$$

from eq^n ② given Bohr.

$$mvr = \frac{nh}{2\pi}$$

Put the value of r in eq^n ②

$$\cancel{m} \times v \times \frac{kze^2}{\cancel{m}v^{\cancel{2}}} = \frac{nh}{2\pi}$$

$$v_n = \frac{2\pi kze^2}{nh}$$

$$v_n = \frac{2\pi k z e^2}{nh}$$

for example: $z = 2$

$\pi = \frac{22}{7}$

$K = 9 \times 10^9 = \frac{1}{4\pi\varepsilon_0}$ $e = 1.6 \times 10^{-19}\,C$

$h = 6.63 \times 10^{-34}\,Js.$

$$v_n = 2.188 \times 10^6 \times \frac{z}{n}\ m\,sec^{-}$$

${}^{1}_{1}H \rightarrow$ 2nd orbit velocity.

$$v_2 = 2.188 \times 10^6 \times \frac{1}{2}$$

$1 \rightarrow z$, $2 \rightarrow$ no. of orbit.

${}^{4}_{2}He^{+} \rightarrow$ 3rd orbit velocity

$$v_3 = 2.188 \times 10^6 \times \frac{2}{3}$$

From equation (1).

$$\frac{kze^2}{r} = mv^2$$

Put the value of v in eqn (1).

$$\frac{kze^2}{r} = m\left(\frac{2\pi k z e^2}{nh}\right)^2$$

$$\frac{\cancel{k}\cancel{z}\cancel{e^2}}{r} = \frac{m\,4\pi^2 k^{\cancel{2}} z^{\cancel{2}} e^{\cancel{4}\,2}}{n^2h^2}$$

$$\boxed{r_n = \frac{n^2h^2}{4m\pi^2 kze^2}}$$

$$r_n = 0.529 \times \frac{n^2}{z}\ \mathring{A}$$

Ratta hai

$\Rightarrow {}^{4}_{2}He^{+} \rightarrow$ 3rd orbit radius

$$r_3 = 0.529 \times \frac{3^2}{2}\ \mathring{A}$$

$\Rightarrow {}^{9}_{4}Be^{+3} \rightarrow$ 6th orbit radius

$$r_6 = 0.529 \times \frac{6^2}{4}\ \mathring{A}$$

* ratio & proportion :-

$$v_n \propto z \propto \frac{1}{n}$$

$$\frac{v_1}{v_2} = \frac{z_1}{z_2} = \frac{n_2}{n_1}$$

$$r_n \propto n^2 \propto \frac{1}{z}$$

$$\boxed{\frac{r_1}{r_2} = \frac{n_1^2}{n_2^2} \times \frac{z_2}{z_1}}$$

* Energy :-

$$KE = \frac{1}{2}mv^2$$

$$\frac{1}{2} \times m \times \left(\frac{2\pi k z e^2}{nh}\right)^2$$

$$\frac{1}{\cancel{2}} \times m \times \frac{\cancel{4}^{\,2}\pi^2 k^2 z^2 e^4}{n^2h^2}$$

$$KE = \frac{2\pi^2 k^2 z^2 e^4}{n^2h^2}$$

$$KE = 1312 \times \frac{z^2}{n^2}\ kJ\,mol^{-}$$

$$\boxed{= 13.6 \times \frac{z^2}{n^2}\ ev\,atom^{-}}$$

$-2 \times KE = PE$.

$$PE = \frac{-2 \times 2\pi k^2 z^2 e^4 m}{n^2 h^2}$$

$$PE = \frac{-4\pi k^2 z^2 e^4 m}{n^2 h^2}$$

1) $r_n = \frac{n^2 h^2}{4\pi k z e^2 m}$

2) $E_n = \frac{-2\pi^2 k^2 z^2 e^4 m}{n^2 h^2}$

3) $v_n = \frac{2\pi k z e^2}{nh}$

$TE = PE + KE$

$= -4 + 2$ (VICTORY ZONE)

$= -2$ (VICTORY ZONE)

$$E_n = \frac{-2 \times \pi^2 k^2 z^2 e^4 m}{n^2 h^2}$$

$\Rightarrow -13.6 \times \frac{z^2}{n^2}$ eV atom^{-1}

$\Rightarrow -1312 \times \frac{z^2}{n^2}$ kJ mol^{-1}

${}^4_2He^+ \rightarrow$ 3rd orbit energy

$$E_3 = -13.6 \times \frac{2^2}{3^2}$$

for example :-

${}^4_2He^+ \rightarrow$ 4th orbit
${}^9_4Be \rightarrow$ 2nd orbit
} ratio

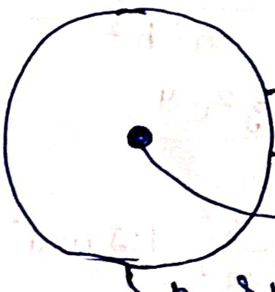
$$\frac{E_{4He}}{E_{2Be}} = \frac{2^2}{4^2} \times \frac{2^2}{4^2} = \frac{1}{16}$$

$\Rightarrow E_n \propto z^2 \propto \frac{1}{n^2}$

$$\frac{E_1}{E_2} = \frac{z_1^2}{z_2^2} \times \frac{n_2^2}{n_1^2}$$

* BOHR'S ATOMIC THEORY :-

1)



→ Atoms are spherical in shape 2

→ e → planets (orbits) 3

→ nucleus (sun) 4

→ Stationary Plantey system.

n = principal Quantum Number.

4) Orbits → K , L , M , N

n = 1 2 3 4

1) Radius (r_n) $= \frac{n^2h^2}{4\pi k z e^2 m}$ $= 0.529 \times \frac{n^2}{z}$ Å

$= 5.29 \times n^2/z$ nm

2) Velocity (V_n) $= \frac{2\pi k z e^2}{nh}$ $= 2.188 \times 10^8 \times \frac{z}{n}$ m/sec

3) Energy (E_n) $= \frac{-2\pi^2 k^2 z^2 e^4 m}{n^2h^2}$ $= -13.6 \times \frac{z^2}{n^2}$ ev/atom

$= -1312 \times \frac{z^2}{n^2}$ kJ/mol

Note :- 1) Acc^n to Rutherford.

size of Atom $=$ Å $= 10^{-10}$

size of Nucleus $=$ fermi $= 10^{-15}$

→ Bohr = Atom size

→ Rutherford = Nucleus size

suppose,

$r_r = r_0 (A)^{1/3}$

A = Atomic mass

r = Rutherford.

$\frac{10^{-10}}{10^{-15}} = 10^{-10+15}$

$= 10^5$ times

${}^1_1H$ Nucleus → 0.529 fermi

${}^{27}_{13}Al$ size

$r_{Al} = r_H (A)^{1/3}$

$r_{Al} = r_H (3^3)^{1/3}$

$r_{Al} = r_H \times 3$ → 3 times greater in Al than Hydrogen

2) Bohr model :- no. of electron $= 1e^-$

Mono-electronic species

${}^{14}_{7}N$ 7e × applicable.

${}^{27}_{13}Al$ 13 e not applicable

${}^{14}_{7}N^{+6}$ 1e applicable

${}^{27}_{13}Al^{+12}$ is applicable

4) frequency $(f_n) = \frac{1}{T}$

$= \frac{4\pi k z^2 e^4 m}{n^3h^3}$.

3) Time period :- $\frac{D}{v} = \frac{2\pi r_n}{V_n}$

(T_n)

$\Rightarrow \frac{\cancel{2\pi} \times n^2 \times h^2 \times nh}{2\cancel{\pi}k z e^2 m \times 2\pi k z e^2}$

$T \Rightarrow \frac{n^3h^3}{4\pi k z^2 e^4 m}$

5) Energy :-

$$TE = -KE = \frac{PE}{2}$$

suppose.
$TE = -13.6$ ev
$KE = 13.6$ ev
$PE = -27.2$ ev.

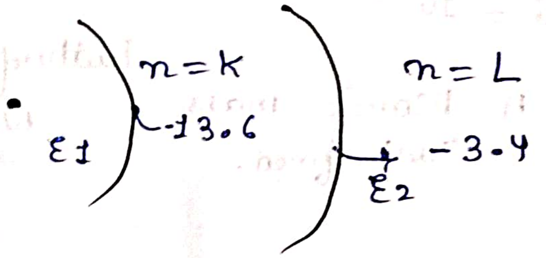
4) Excited word :- +1

Ground state $n = 1$

suppose, 1st excited energy $= 1 + 1 = \underline{2 = n}$

* Difference b/w energy of Two Orbits? :-

$$\Delta E = E_2 - E_1$$



$\Delta E = E_2 - E_1$
$\Delta E = -3.4 + 13.6$
$\Delta E = 10.2$ ev.

$\frac{E z^2}{n^2} \left(\frac{1}{n^2} - \frac{1}{n_2^2} \right)$

page = 145) Que. 52 to 53 :-

A Radius $\propto \underline{n^2}$ (sopto)

B Angular Momentum $= mvr = \frac{nh}{2\pi} \propto \underline{n^1}$

c K.E. $\propto \frac{2\pi^2 k^2 z^2 m e^4}{n^2 h^2} = \underline{n^{-2}}$

D P.E. $\propto n^{-2}$

Que. 1) DPP = 05) In which of the following - - ?

Ans) $r \propto \frac{n^2}{z}$

H - 1 $\qquad {}_2^2He^{+2} = 2$

H - 1

${}_4^1Be^{+3} = 4$ ✓ option - 3 ✓

Que. 2) ${}_2^4He$ ✗ $\qquad He^{+2}$ ✓

${}_3Li^{+2}$ ✓ $\qquad He^{+2}$ ✓

option - 4) 1 & 3 both.

Qu·3) option - 3) ✓

Qu·4) $n = 2$

$n = 4$

$Z = Li^{+2} = 3$

$r \propto n^2 \propto \frac{1}{Z}$.

$\frac{r_2}{r_4} = \frac{(n_2)^2}{(n_4)^2} = \frac{(2)^2}{(4)^2}$

$= \frac{\cancel{4}}{\cancel{16}} \frac{1}{4}$ option 3) 1 : 3 ✓

Qu·5) $n = 4$ & $n = 3$

$He^{+} = Z = 2$ Be^{+3}

$r \propto n^2 \propto \frac{1}{Z}$

$\frac{r_4 He}{r_3 Be} = \frac{(n_4)^2}{(n_3)^2} \times \frac{Z_{Be}}{Z_{He}}$.

option - 1) $\frac{(4)^2}{(3)^2} \times \frac{4}{2} = \frac{\cancel{64}\ 32}{\cancel{18}\ 9}$

=> 32 : 9.

Qu·6) $\frac{r_1}{r_2} = \frac{(n_1)^2}{(n_2)^2} \times \frac{Z_2}{Z_1}$

$\sqrt{\frac{1}{9}} = \sqrt{\frac{n_1^2}{n_2^2}} \times \frac{\cancel{Z}}{\cancel{Z}}\ 1$

$K \leftarrow 1$

$M \leftarrow 3$

K & M option - 3 ✓

Qu·7) angular momentum of P shell

$n = 6$

$mvr = \frac{nh}{2\pi} = \frac{{}^{3}\cancel{6}h}{\cancel{2}\pi}$

$mvr \Rightarrow \frac{3h}{\pi}$ option - 1 ✓

Qu·8) $Z = 1$

$v_1 : v_2 : v_3$

$v \propto \frac{1}{n}$

$v_1 \propto \frac{1}{1}$, $v_2 \propto \frac{1}{2}$

$v_3 \propto \frac{1}{3}$

1 : 1/2 : 1/3

Qu·9) $r \propto n^2$

$\frac{r_1}{r_2} = \frac{(n_1)^2}{(n_2)^2}$

$\sqrt{\frac{4}{1}} = \sqrt{\frac{n_1^2}{n_2^2}}$

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

$K \leftarrow 1$

L & K option - 2

Qu·10) 3rd orbit

$mvr = Z \frac{nh}{2\pi}$

$mvr = \frac{3h}{2\pi}$

=> option - 1 ✓

DPP - 05) Pg - 26.

Qu·1) 3rd excited state

$n = 3 + 1 = 4$

$Z = Li^{+2} \rightarrow 3$

$r = 0.529 \times \frac{n^2}{Z}$ Å

$r = 0.529 \times \frac{4^2}{3}$ Å

$= 2.828$ Å //

Que 2) 2nd excited orbit

$n = 2+1 = 3$

$Z = 1$

$$\frac{r_H}{r_{Li^{+2}}} = \frac{n_1^2}{n_2^2} \times \frac{Z_2}{Z_1}$$

$$= \left(\frac{3}{2}\right)^2 \times \frac{3}{1} = \frac{27}{4}$$

option - 2) 27 : 4 //

Que 3) $TE = -0.54$ eV

$PE = ?$

$$TE = \frac{PE}{2}$$

$PE = 2 \times TE$

$= 2 \times -0.54$ eV

$PE = -1.08$ eV

Que 4) $T = \frac{D}{v} = \frac{2\pi r}{v}$

$n = 3$

$Z = 3$

$$T = \frac{2 \times \pi \times 0.529 \times \frac{n^2}{Z} \mathring{A}}{2.188 \times 10^6 \times \frac{Z}{n}}$$

$$= \frac{2 \times \pi \times 0.529 \times 10^{-10} \times \cancel{(3)}^2}{2.18 \times 10^6 \times \cancel{3}}$$

$T = 1.52 \times 10^{-16}$ sec.

Que 5)

E_1 E_4

$n_1 = 1$ $n_4 = 4$

$Z = 1$

$$E_1 = -13.6 \times \frac{\cancel{Z^2}}{\cancel{n^2}}$$

$E_1 = -13.6$

$$E_4 = -13.6 \times \frac{1^2}{4^2} = -0.85 \text{ eV} //$$

$\Delta E = E_4 - E_1$

$\Delta E = -0.85 + 13.6$

$\Delta E = 12.75$ eV.

Que 6) Ionization Energy

$IE = \Delta E = E_\infty - E_1$

$H \rightarrow H^+$ option - 3 ✓

$$E \propto \frac{Z^2}{n^2} = E \propto \frac{1}{\infty^2}$$

$\Delta E = 0 - E_1$

$H \rightarrow +13.6$

$Z = Li^{+2} = 3$ $n =$ ground $= 1$

$$E_{Li^{+2}} = -13.6 \times \frac{Z^2}{n^2} = -13.6 \times 9$$

$\Delta E = 0 - (-122.4)$

$= +122.4$ eV //

Que 7) Seperation energy

↓

2nd

$n = 2+1 = 3$

∞

$\Delta E = E_\infty - E_3$

$$\Delta E = 0 - \left(-13.6 \times \frac{Z^2}{n^2}\right)$$

$$\Delta E = +13.6 \times \frac{1}{9} = 1.511 \text{ eV.}$$

Que 8) $\Delta =$ final - initial.

$\Delta E = E_4 - E_1$

$Z = 2$ $$\Delta E = -\frac{13.6 \times 2^2}{4^2} + \frac{13.6 \times}{1^2}$$

$$= 13.6 \times 2^2 \left(\frac{1}{1} - \frac{1}{(4)^2}\right)$$

$$\Delta E = 13.6 \times 2^2 \left(\frac{16-1}{4^2}\right)$$

$$= 13.6 \times \frac{1}{4} \times 15$$

$\Delta E = 51$ eV //

* Spectrum :-

Emission | Absorption.

When Light Emitted from a source (sun) & passed through a prism light get seperated into different discrete wavelength this is called dispersion of the light when we use a photographic plate of different wavelength is called the Absorption Spectrum.

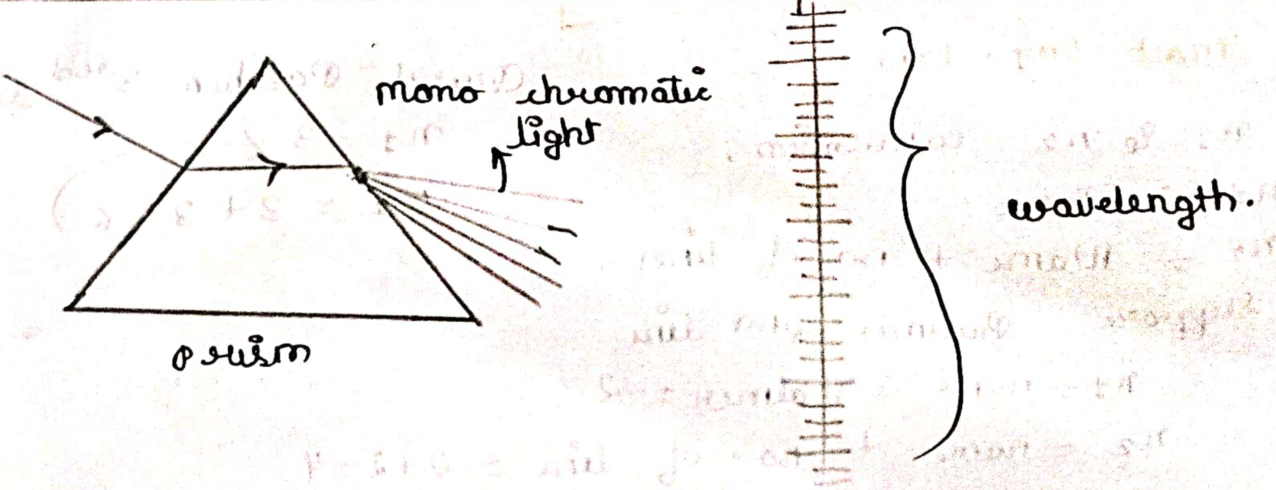
When Light is far from a source its intensity decreases This is called Absorption Spectrum. $\frac{1}{r^2}$

Emission Spectrum :-

When light emitted from an object (burnt object) & pass through a prism then seperated to a different wavelength which is recorded in photographic plate this is called Emission spectrum.

*** The Difference b/w Absorption & Emission spectrum are :-**

Category	Atomic Absorption spectroscopy.	Atomic emission spectroscopy.
Definition	Find concentration of metals by Absorption.	Find concentration of the analyte by emission.
Principle	Absorption of Light by e^-	Emission of Light by e^-
Transitions	Ground to excited state	Excited to ground state
EMR	Absorbed	Emitted
Solid sampler	Cannot by analyzed	Can be analyzed
Spectrum.	~~Coloured~~ Dark Spectrum.	~~Dark~~ coloured lines



Source	Hallow cathode lamp	Heat or light
Dependence.	Ground state atoms	Excited state atom.

25.

* BOHR's 5th POSTULATE :-

Any e^- move from ground level to excited level with absorbed energy in the form of :-

a) Heat

b) Radiation ($h\nu$)

c) ~~Volt~~ Field, Electric field.

But e^- come back to orbit they emitted energy only in the form of radiation ($h\nu$) & its energy are equal to

$$\Delta E = E_2 - E_1$$

$$\Delta E = \frac{hc}{\lambda} = \frac{2\pi^2 k^2 z^2 e^4 m}{h^2} \cancel{\frac{z^2}{n^2}} \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\bar{\nu} = \frac{1}{\lambda} = \frac{2\pi^2 k^2 z^2 e^4 m}{h^3 c} \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

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

R = Rydberg's constant $\quad R = 1.01 \times 10^7 \, m^{-1}$

$$\frac{1}{R} = 912 \, Å$$

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

NOTE Most Important

n_1 & n_2 calculation.

n_1 = Name

n_2 = Name + no. of lines.

Que) suppose Balmer 2nd line

n_1 = name = Balmer = 2

n_2 = name + no. of line = 2+2=4

Que. 24. Paschen 3rd line

$n_1 = 3$

$n_2 = 3 + 3 = 6$

$n_1 = 4$
$n_2 = 4 + 2 = 6$
6 to 4th orbit

* FORMULA SHEET :-

1) $E = h\nu$ $\quad \nu = \frac{c}{\lambda}$

2) $E = \frac{hc}{\lambda}$

3) $\frac{1}{\lambda} = \bar{\nu}$

4) $r = \frac{n^2 h^2}{4\pi k z e^2 m}$

5) $v = \frac{2\pi K z e^2}{nh}$

6) $TE = \frac{-2\pi^2 k^2 z^2 e^4 m}{n^2 h^2}$

7) $TE = -KE = \frac{PE}{2}$

8) $\frac{1}{\lambda} = \bar{\nu} = R z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

9) $\Delta E = 13.6 \times z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

10) $\frac{1}{2} mv^2 = h\nu - h\nu_0$

11) $mvr = \frac{nh}{2\pi}$

12) If direct frequency is asked for NEET

$\nu = \underline{\underline{3.3}} \times 10^{15} \times z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

no need to find λ.

ϕ work funcⁿ = Ionization energy.

Bohr = $mvr = \frac{nh}{2\pi}$

from de-broglie

$\lambda = \frac{h}{p}$

$\lambda = \frac{h}{mv}$ —(1)

$n\lambda = 2\pi r$

$n \times \lambda = 2\pi r$

$n \times \frac{h}{mv} = 2\pi r$

$\frac{nh}{2\pi} = mvr$

$\lambda = \frac{h}{p}$

$2\pi r = n\lambda$

$2\pi r = n\frac{h}{p}$

$mvr = \frac{nh}{2\pi}$

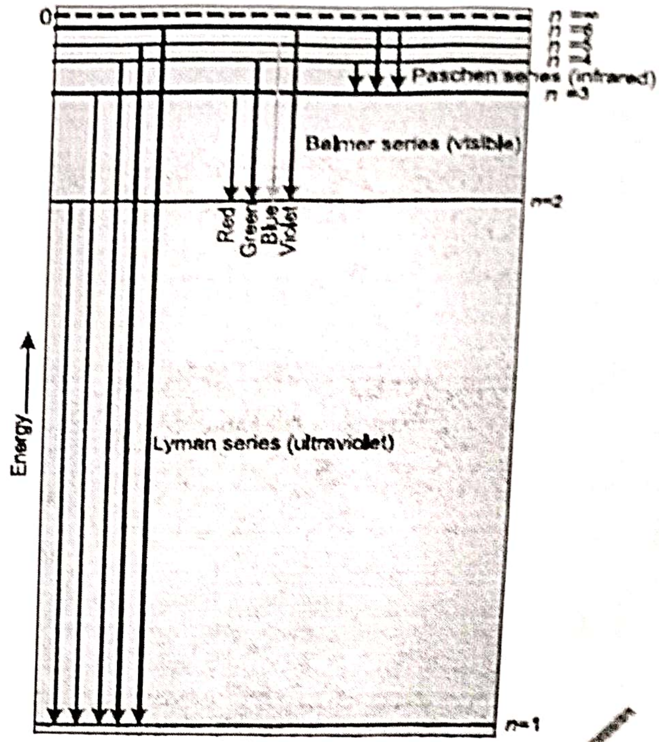
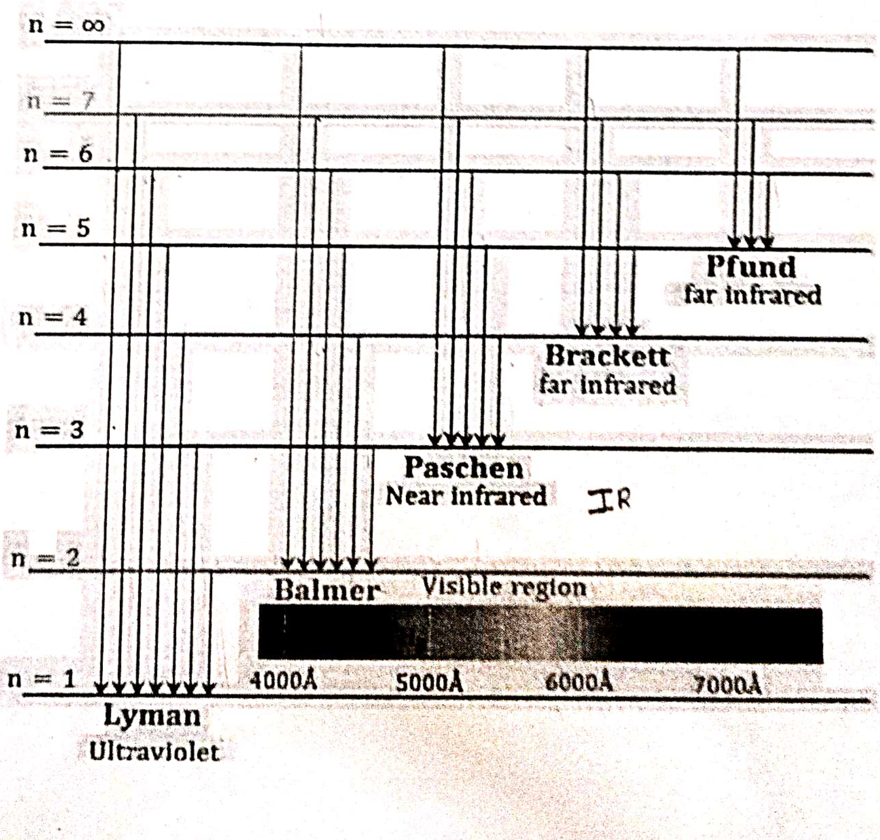


Fig. 2.11 Transitions of the electron in the hydrogen atom (The diagram shows the Lyman, Balmer and Paschen series of transitions)



DPP - 06 pg - 28

Que 1) $5 \to 1$

Total no. of line $= \frac{(n_2 - n_1)(n_2 - n_1) + 1}{2}$

$= (5-1)(5-1)+1/2$

$= \frac{4 \times 5}{2}$

$= \frac{20}{2}$ 10 option 4)

Que 2) $n_1 = 2$

$4 - 2 = 5$

option - 2.

Que 3) $6 \to 3 \to 3$

$5 \to 3 \to 2$

$4 \to 3 \to 1$

6 lines

Que 4) U.V = 5 lines
↳ 6th = n

I R

$6 \to 3 \to$ 3 line

$6 \to 4 \to$ 2 line

$6 \to 5 \to$ 1 line

6 lines

DPP - 07 pg - 29

Que 1) Last line of Balmer.

$n_1 = 2$

$n_2 = \infty$

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

$\frac{1}{\lambda} = R (1)^2 \left(\frac{1}{2^2} - \frac{1}{\infty^2}\right)$

$\frac{1}{\lambda} = R \times 1 \left(\frac{1}{4}\right) \left(\frac{1}{\infty} = 0\right)$

$\frac{1}{\lambda} = \frac{R}{4}$

$\lambda = \frac{4}{R} = 912 \text{Å} = \frac{1}{R}$.

$\lambda = 4 \times 912 \text{Å}$

$\lambda = 3648 \text{Å}$ 3)

Que 2) $\nu = \frac{c}{\lambda}$

Lyman $n_1 = 1$

$n_2 = 1 + 2 = 3$

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

$\frac{1}{\lambda} = R (1)^2 \left(\frac{1}{(1)^2} - \frac{1}{3^2}\right)$

$\frac{1}{\lambda} = R \left(\frac{1}{1} - \frac{1}{9}\right)$

$\frac{1}{\lambda} = R \times \frac{8}{9}$

$\frac{1}{\lambda} = \frac{R \times 8}{9}$

$\lambda = \frac{9}{8R}$.

$\frac{1}{R} = 912 \text{Å}$

$R = 1.01 \times 10^{7}$

$\nu = \frac{c}{\lambda}$

$\nu = \frac{\cancel{3} \times 10^8 \times \cancel{8}R}{\cancel{8}R\ \cancel{3}\ \cancel{3}}$ 2.9

$\nu = 10^8 \times 2.9 \times 10^7$

3) $\nu = 2.9 \times 10^{15} s^{-1}$

option = c

Ans 3) $n_1 = 4$

$n_2 = 4+3 = 7$.

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

$$\frac{1}{\lambda} = R \times (1)^2\left(\frac{1}{16} - \frac{1}{49}\right)$$

$$\frac{1}{\lambda} = R \times \left(\frac{49-16}{49\times16}\right)$$

$$\frac{1}{\lambda} = R \times \left(\frac{33}{784}\right)$$

$$\frac{1}{\lambda} = \frac{R\times33}{784}$$

$$\frac{1}{\lambda} = 912\,\mathring{A}$$

$$\frac{1}{\lambda} = \frac{784}{33\times \cancel{912\,\mathring{A}}\,R}$$

$$\lambda = \frac{33\times1}{784}\times 912\,\mathring{A}$$

$$\lambda = 21666.6\,\mathring{A}$$

Ans 5) $n_1 = 2$

$n_2 = 3+2 = 5$.

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

$$\frac{1}{\lambda} = RZ^2\left(\frac{1}{(2)^2} - \frac{1}{5^2}\right)$$

$$\frac{1}{\lambda} = RZ^2\left(\frac{25-4}{100}\right)$$

$$\frac{1}{\lambda} = RZ^2\left(\frac{21}{100}\right)$$

$$\lambda = \frac{100}{21\,R\times(1)^2}$$

$$\lambda = \frac{100}{21R}$$ // option - 2 ✓

Ans 4) frequency $\alpha \frac{1}{\lambda}$

$\Rightarrow$ maximum frequency $= \infty$

Lyman $= 1$

Balmer $= 2$.

$$\Rightarrow \frac{1}{\lambda_1} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\Rightarrow \frac{1}{\lambda_1} = R\times\cancel{Z^2}\left(\frac{1}{(1)^2} - \frac{1}{\cancel{\infty^2}}\right)$$

$$\frac{1}{\lambda_2} = R\times\cancel{Z^2}\left(\frac{1}{2^2} - \frac{1}{\cancel{\infty^2}}\right)$$

$$\frac{\lambda_2}{\lambda_1} = \frac{4}{1} \;\alpha\; \frac{\nu_1}{\nu_2}$$

$\Rightarrow 4:1$ // inversely.

NCERT - 49pg. Que. 2.10)

$n_1 < n_2$

$n_1 = 2$

$n_2 = 5$

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

$$= \frac{100}{21R} = \frac{100\times912\,\mathring{A}}{21}$$

$$\Rightarrow 4342\,\mathring{A}$$

$$\nu = \frac{c}{\lambda}$$

$$= \frac{3\times10^8}{4342\times10^{-10}}$$

$$= 6.909\times10^{14}$$

$$= 7\times10^{14}\ Hz.$$

1st method

2nd method.

$$\nu = 3.3 \times 10^{15} \times Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\nu = 3.3 \times 10^{15} \left(\frac{1}{(2)^2} - \frac{1}{(5)^2}\right)$$

$$\frac{3.3 \times 21 \times 10^{15}}{100} \Rightarrow \frac{69.3}{100} \times 10^{15} \Rightarrow 6.93 \times 10^{14}\ Hz.$$ approx.

Ans 2.11) $Z = He^+ = 2$

$n = 1$

$$r_n = 0.529 \times \frac{n^2}{Z}$$

$$= 0.529 \times \frac{(1)^2}{2}\ \mathring{A}$$

$1\mathring{A} = 0.1 nm$

$$\Rightarrow 0.2645\ \mathring{A}$$

$$\Rightarrow \cancel{2.645 \times 10^{-19}}$$

$$\cancel{\Rightarrow 2.645\ nm.}$$

$$\Rightarrow 0.026\ nm.$$

Energy =

$$-13.6 \times \frac{Z^2}{n^2}\ evolt$$

$$\Rightarrow -13.6 \times \frac{(2)^2}{(1)^2}$$

$$\Rightarrow -54.4\ ev$$

$$\Rightarrow 54.4 \times 1.6 \times 10^{-19}\ J$$

$$\Rightarrow -8.704 \times 10^{-18}\ J //$$

Ans 2.13) $n_1 = 2$

$n_2 = 4$

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

$$\frac{1}{\lambda} = R_H \cdot (1)^2 \left(\frac{1}{2^2} - \frac{1}{4^2}\right)$$

$$\frac{1}{\lambda} = R_H \times 1 \times \frac{16-4}{64}$$

$$\lambda = \frac{64}{12R}$$

$$\lambda = \frac{16}{3R}$$

$$\lambda = \frac{16 \times 912}{3}$$

$$\lambda = 4864\ \mathring{A}$$

Ans 2.14) $\Delta E = E_\infty - E_1$

$$\Delta E = -E_1 = -(-13.6) \times \frac{Z^2}{n^2}$$

$$\Delta E = 13.6 \times \frac{(1)^2}{(1)^2}$$

$$\Rightarrow 13.6\ ev.$$

$$\Delta E = E_\infty - E_5$$

$$= -(-13.6) \times \frac{(1)^2}{(5)^2}$$

$$\Rightarrow \frac{13.6}{25}.$$

$$\Rightarrow \frac{E_5}{E_1} = \frac{\cancel{13.6}}{25 \times \cancel{13.6}} = \frac{1}{25}$$

$$\Rightarrow 0.04 //$$

... → ground (1).

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

$$\Rightarrow \frac{(6-1)(6-\cancel{1}+\cancel{1})}{2}$$

$$\Rightarrow \frac{5\times 6}{2} \Rightarrow \frac{\cancel{30}}{\cancel{2}}\ 15 //.$$

2nd method

(5 + 4 + 3 + 2 + 1) lines

⇒ 15 lines.

2.16) $E_1 = -2.18 \times 10^{-18} J$

$$E_5 = -2.18 \times 10^{-18} \times \frac{z^2}{n^2}$$

$$\frac{E_1}{E_5} = 5^2$$

$$E_5 = \frac{\cancel{5^2}}{\cancel{E_1}} = \frac{E_1}{5^2} = \frac{-2.18\times 10^{-19}}{25}.$$

$E_5 = -8.72 \times 10^{-20} J.$

radius $= 0.529 \times \frac{n^2}{z}$ Å

$\Rightarrow 0.529 \times 5^2$

$\Rightarrow 25 \times 0.529$ Å

$\Rightarrow 13.225$ Å

$\Rightarrow 1.32$ nm //

2.17) Rewrite ques.

↓ ↓ longest wavelength by Balmer series

$R = 1.09 \times 10^7 m^{-1}$

$\frac{1}{R} = 912$ Å.

$n_1 = 2$

$n_2 = 3.$

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

$$= \frac{5 \times 1.1 \times 10^7}{36}$$

$\Rightarrow 1.5 \times 10^6\ m^{-1}$ // ← wave number.

2.18) Energy → wave length

$E = -2.18 \times 10^{-11}$ erg.

$= -2.18 \times 10^{-18}$ J

∴ 1J = 10^7 erg.

$E = -2.18 \times 10^{-18} \times \frac{z^2}{n^2}$

Energy E = 5 → 1

$E_5 - E_1.$

$$\Delta E = 2.18 \times 10^{-18} \times z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\Delta E = 2.18 \times 10^{-18} \times (1)^2 \left(\frac{1}{(1)^2} - \frac{1}{(5)^2}\right)$$

$$\Rightarrow 2.18 \times 10^{-18} \times \frac{24}{25} \ J \Rightarrow 2.09 \times 10^{-18} \ J$$

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

$$\frac{1}{\lambda} = \frac{R \times 24}{25} \Rightarrow \lambda = \frac{25}{24 R}$$

$$\Rightarrow \frac{25}{24} \times 912 \ \mathring{A} \Rightarrow 951 \ \mathring{A} \Rightarrow 95 nm.$$

Home work.

Book-1 → pg-59 → 47-80, 128, 129, 140, 156, 157 → 164

NCERT Que. 19, 2.33, 2.55, 2.56.

Book 2 → Que. 41-66

* LIMITATIONS OF BOHR'S ATOMIC MODEL :-

MERIT

→ Bohr model of Hydrogen atom was nuclear model over Rutherford. ↳ improvement.

→ stable atom, spectrum of H, like species etc.

DE-MERIT

→ It failed to explain the spectrum of other atom except Hydrogen atom.

→ It failed to explain the splitting of spectrum line in the presence of Magnetic field (Zeeman effect) & Electric field (Stark effect).

→ It could not explain the ability to form molecules. By chemical bonding.

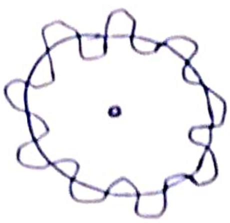
→ He do not explain the mathematical derivation of angular movement. & do not explain its salient feature.

$$mvr = \frac{nh}{2\pi}$$

* WAVE ~~ECO-NOMICAL~~ MACHANICAL MODEL :-

→ de-Broglie dual behaviour of matter light shows dual behaviour :- i) Particle ii) Wave.

→ Acc to him the wavelength of e^- is inversely proportional to its momentum. $\lambda \propto \frac{1}{p}$



de-Broglie wave equation.

$$\lambda \propto \frac{1}{p}$$

$$\lambda = \frac{h}{p}$$

$p \rightarrow$ linear momentum

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

Ques. mass of the Ball = 200g
velocity = 100 ms^{-1}

de-broglie $\lambda = \frac{h}{m \times v}$

$$= \frac{6.63 \times 10^{-34}}{0.2 \times 100} = \frac{6.63 \times 10^{-34}}{20}$$

$$\Rightarrow \frac{6.63 \times 10^{-35}}{2} \Rightarrow 3.3 \times 10^{-35} m //$$

→ $KE = \frac{1}{2} mv^2 \times \frac{m}{m}$

$$= \frac{1}{2} \frac{m^2 v^2}{m}$$

$\Rightarrow \therefore mv = p$

→ $KE = \frac{1}{2} \frac{p^2}{m}$

$$\boxed{p = \sqrt{2KE \cdot m}}$$

$$\boxed{\lambda = \frac{h}{\sqrt{2KE \cdot m}}}$$

$\therefore KE = q \cdot Volt.$

$$\boxed{\lambda = \frac{h}{\sqrt{2 \times q \times V \times m}}}$$

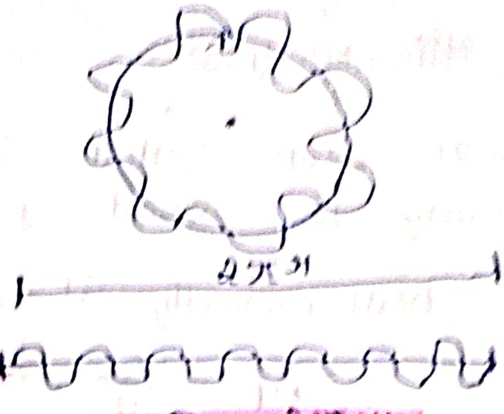
↑ when KE is given to a e^- we can find its wavelength.

$E = mc^2$ — (1) ← Einstein Equation.

$E = h\nu$ — (2) ← Planck's quantum theory.

$h\nu = mc^2$

$h\frac{\cancel{c}}{\lambda} = mc^{\cancel{2}}$



$\boxed{\lambda = \frac{h}{mv}}$ or $\lambda = \frac{h}{mc}$ ← only photons

← ~~for any charge.~~

~~proved de-broglie~~ eqn.

$n\lambda = 2\pi r_n$

$n \times \frac{h}{mv} = 2\pi r$

$n\lambda = 2\pi r_0$ ↳ radius of Orbit

↓ no. of Orbits

$\boxed{\frac{nh}{2\pi} = mvr.}$

Bohr hai from de-broglie eq.

1) $\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2KE \cdot m}} = \frac{h}{\sqrt{2q \cdot V \cdot m}}$ — (1)

2) $2\pi r_n = n\lambda$ — (2)

Pg - 30) DPP-08

Que-1) For an e^-

$\lambda = \frac{h}{\sqrt{2 \times q \cdot m \times V}}$ → h: 6.63×10^{-34}, m: 9.1×10^{-31}, q: 1.6×10^{-19}

$\left.\frac{h}{\sqrt{2 \times q \times m}}\right\} = 12.3$

$\lambda = \frac{12.3}{\sqrt{V}}$ Å

Que-2) $\lambda \propto \frac{1}{\sqrt{K.E.}}$

$\lambda_1 = \frac{\cancel{h}}{\sqrt{2KE_1 \times \cancel{m}}}$

$\lambda_2 = \frac{\cancel{h}}{\sqrt{2KE_2 \times m}}$

$\frac{\lambda_1}{\lambda_2} = \frac{\sqrt{KE_2}}{\sqrt{KE_1}} = \sqrt{\frac{4K\cancel{E}}{\cancel{KE}}}$

$\lambda_2 = \lambda_1/2$

option-3 half times.

Que-3) $\lambda = \frac{h}{mv}$ option-2

$v = \frac{h}{m\lambda}$

$\because \lambda = \frac{c}{\nu}$

$v = \frac{h\nu}{mc}$ //

Que-4) $\lambda \propto \frac{1}{\sqrt{m}}$

* **Hisenbergy** :-

→ It States that it is impossible to determine simultaneously the exact position & exact momentum of an electron.

Mathematically it can be given as :-

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

Δx → position uncertainity.

Δp → momentum uncertainity

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

mass is not in LHS as m cannot change.

$$\boxed{\Delta v \cdot \Delta x \geq \frac{h}{4\pi m}}$$

* Significance of Uncertainity Principle :-

→ it rules out the existence of definite path of trajectory of electron & other similar particles.

Note :- The Effect of Hisenberg's uncertainity principal is significant only for microscopic object. & neglegable for higher Mass.

Que. → Is it possible that e^- are present in Nucleus ?

given → Nucleus size → 10^{-15} m

$\Delta x = 10^{-15}$ m

Range of Nucleus,

mass $= 9.1 \times 10^{-31}$

$$\Delta v \geq \frac{h}{4\pi m \Delta x}$$

$$\Delta v \geq \frac{\cancel{2}\ 6.63 \times 10^{-34}}{\cancel{4} \times 3.14 \times 9.1 \times 10^{-31} \times 10^{-15}}$$

$0.5 \times 10^{-34+31+15}$

0.5×10^{11}

5×10^{10}

$\Delta v \geq 5 \times 10^{10}$

As it is impossible because the range of velocity uncertain is more than the speed of light ($3 \times 10^8 ms^{-1}$)

DPP-02 pg-31.

Que-1) $\Delta p = 0$ $\quad \Delta x$.

$$\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$$ option = 2

$$\Delta x \geq \frac{h}{4\pi \cdot \Delta p} \qquad \frac{1}{0} = \infty$$

$\Delta p \to 0$

Que-2) Δx = same the

$\Delta x = e^-$

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

$$\frac{\Delta x_1}{\Delta x_2} = \frac{\Delta P_1}{\Delta P_2} \qquad \Delta P_{1e} = \Delta P_2 \text{ the}.$$

option = 32×10^5

Que-3) $\Delta p = 1 \times 10^{-9}$ kg cm s^{-1}

$\Delta x = ?$

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

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

$$\Delta x \geq \frac{6.63 \times 10^{-34}}{4 \times 3.14 \times 1 \times 10^{-9}}$$

$0.5 \times 10^{-34} \times 10^{+9}$

0.5×10^{-25} m

$0.5 \times 10^{-25} \times 100$ cm

0.5×10^{-23} cm //

$\Delta x \geq 0.5 \times 10^{-23}$ cm //

Ans 4) $\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$ $\qquad \Delta p^2 \geq \frac{mh}{4\pi}$ //

$\Delta x \cdot \Delta m \Delta v \geq \frac{h}{4\pi}$ $\qquad$ option - 4)

$\Delta x = \Delta v$

$$\frac{m}{m} \times \Delta v \cdot m \Delta v \geq \frac{h}{4\pi}$$

$$\frac{\Delta v^2 m^2}{m} \geq \frac{h}{4\pi}$$

NCERT pg - 70

Que 2.20) $v = 2.05 \times 10^{7}\ ms^{-1}$

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

$$\lambda = \frac{6.63 \times 10^{-34}}{9.1 \times 10^{-31} \times 2.05 \times 10^{7}}$$

$$\lambda = 3.5 \times 10^{-11} m$$

$= 35\ \mathring{A}$

$= 354\ nm$

Ans 2.21) $m = 9.1 \times 10^{-31}\ kg.$

$KE = 3 \times 10^{-25}\ J$

$$\lambda = \frac{h}{\sqrt{2 \times K.E \times m}}$$

$$\lambda = \frac{6.63 \times 10^{-34}}{\sqrt{2 \times 3 \times 10^{-25} \times 9.1 \times 10^{-31}}}$$

$$\lambda = 9 \times 10^{-7}$$

$$\lambda = 900\ nm$$

2.32) $mvr = \frac{nh}{2\pi}$ Bohr's

$2\pi r = \frac{nh}{mv}$ $\Rightarrow 2\pi r = n \times \lambda$

$2\pi r = n\lambda.$

De Broglie $\lambda = \frac{h}{mv}$

2.59) $\lambda = \frac{h}{mv}$

$\Rightarrow v = 2.19 \times 10^{6}$

2.57) $\lambda = \frac{h}{mv}$

$$\lambda = \frac{6.63 \times 10^{-34}}{9.1 \times 10^{-31} \times 1.6 \times 10^{6}}$$

2.60) $\lambda = \frac{h}{mv}$

2.61) $0.002 nm = \Delta x$

$2 \times 10^{-12} = \Delta x.$

$\Delta p = 2.63 \times 10^{-23} kgms^{-1}$

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

$\Delta p = 1.05 \times 10^{-24}$ $kgms^{-1}$

2.58) $\lambda = 800 pm$

$v = ?$

$m =$ mass of neutron $= 0$

It cannot defined as a actual magnitude of the ... is smaller then the uncertainity.

* **Schrodinger Wave Equation :-**

Schrodinger wave function → Orbital wave funⁿ

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

second derivative of x

ψ^2 = Varible of probability density.

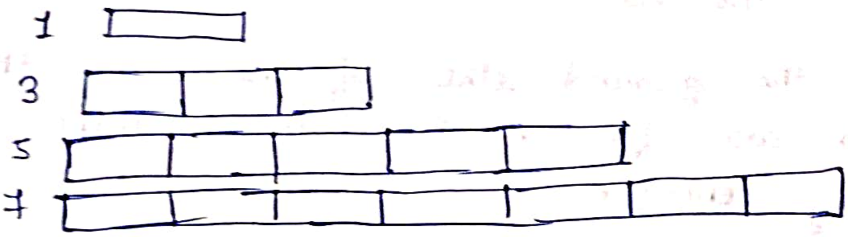
ψ = Orbital wave function.

* significance importance of ψ^2

ψ^2 is the probility density of that the e^- at the point.

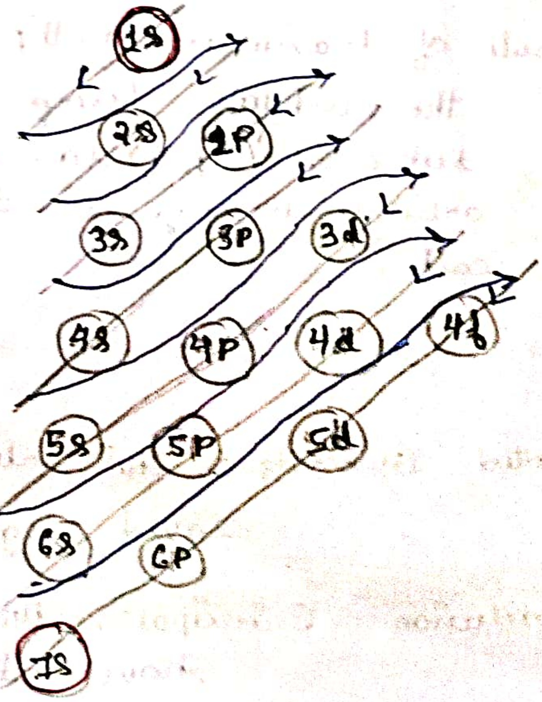
* ψ → the orbital wave funⁿ for an e^- in an atom has no physical meaning.

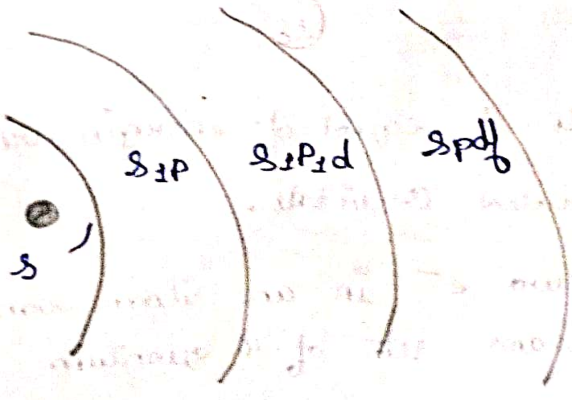
→ **HOME OF ELETRON :-**



→ **AUFBAU's RULE :-**

→ $1s^2, 2s^2, 2p^6\ 3s^2, 3p^6$
$4s^2, 3d^{10}\ 4p^6\ 5s^2, 4d^{10}$
$5p^6\ 6s^2, 4f^{14}\ 5d^{10}\ 6p^6\ 7s^2$





* Electronic Configuration :-

$2n^2$

1 H - $1s^1$

2 He - $1s^2$

3 Li - $1s^2\, 2s^1$

4 Be - $1s^2\, 2s^2$

5 B - $1s^2\, 2s^2\, 2p^1$

6 C - $1s^2, 2s^2, 2p^2$

7 N - $1s^2, 2s^2, 2p^3$

8 O - $1s^2, 2s^2, 2p^4$

9 F - $1s^2, 2s^2, 2p^5$

10 Ne - $1s^2, 2s^2\, 2p^6$

11 Na - $1s^2, 2s^2\, 2p^6\, 3s^1$

12 Mg - $1s^2\, 2s^2\, 2p^6\, 3s^2$

13 Al - $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^1$

14 Si - $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^2$

15 P - $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^3$

16 S - $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^4$

17 Cl - $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^5$

18 Ar - $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^6$

19 K - $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^6\, 4s^1$

20 Ca - $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^6\, 4s^2$

21 Sc - $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^6$
$4s^2\, 3d^1$

22 Ti - $1s^2\, 2s^2\, 2p^6\, 3s^2$
- ~~4s~~ $3p^6\, 4s^2\, 3d^2$

23 V - $1s^2\, 2s^2\, 2p^6\, 3s^2$
$3p^6\, 4s^2\, 3d^3$

*24 Cr - $1s^2\, 2s^2\, 2p^6\, 3s^2$
$3p^6\, 4s^1\, 3d^5$

25 Mn - $1s^2\, 2s^2\, 2p^6\, 3s^2$
$3p^6\, 4s^2\, 3d^5$

26 Fe - $1s^2\, 2s^2\, 2p^6\, 3s^2$
$3p^6\, 4s^2\, 3d^6$

27 Co - $1s^2\, 2s^2$

*28 Cu - $1s^2\, 2s^2\, 2p^6\, 3s^2$ $3d^{10}$
$3p^6\, 4s^1\, 3d^{10}$

30 Zn - in Book

***Afbau Rule** :- "In the ground state of the atoms the orbitals are fit in the order of their increasing energies."

*** Hund's Rule of Maximum Multiplicity** :- "Pairing of the e^- in the orbitals, belong to same sub-shell / same sub orbit (s,p,d,f) does not take place until each orbital belongs to that sub-shell has got 1 e^- each."

$Se^- = \boxed{\uparrow\uparrow}\boxed{\uparrow\uparrow}\boxed{\uparrow\;\;}$

*** Degenerated Orbitals** :- The orbitals of equal of energies are called degenerated Orbitals.

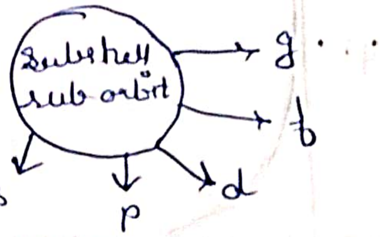
*** Pauli's Exclusion Principal** :- No two e^- in an atom can have the same set of 4 quantum nos.

" Only two e^- may exist in the same orbital & this e^- must have opposite spin.

1s < 2s   2s < 2P

3d > 4s

[| |] 2P



Pauli's law :-

Hund → subshell [↑↑ | ↓ | ↑]

Pauli → Orbitals [↑↓]

*) [↑↑ | ↑↑ | ↑]   H ✓
P X

→ [↑↓ | ↑ |]   H ✗
P ✓

→ [↑↓ | ↑↓ | ↑]   P ✓ H ✓.

* Shape of Orbitals :-

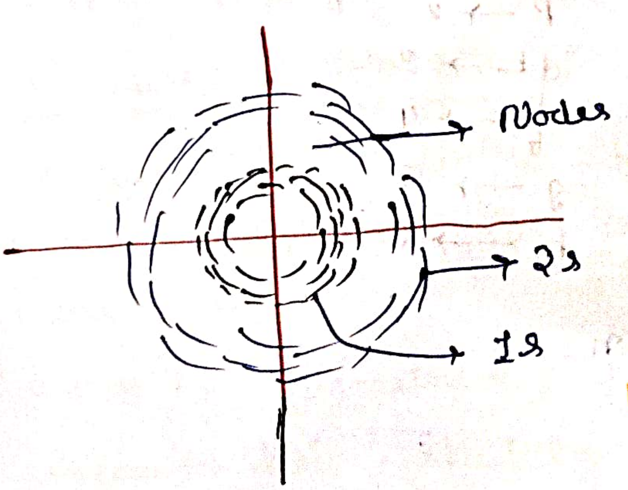
s [ ] → spherical

p [P_x | P_y | P_z] → Dumbell

d [d_{xy} | d_{yz} | d_{zx} | $d_{x^2y^2}$ | d_{z^2}] → Double Dumbell.

f [| | | | | |] → Very complex.

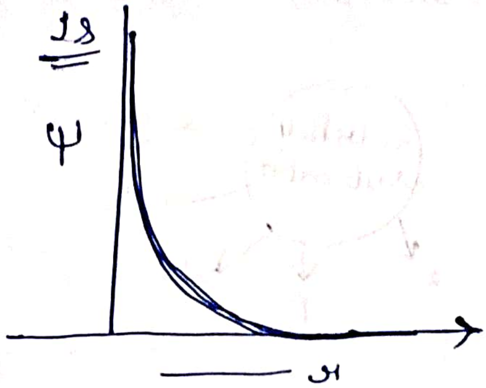
no. of nodes
$n - 1$
$2s = 2 = n$
$2 - 1 = 1$ node

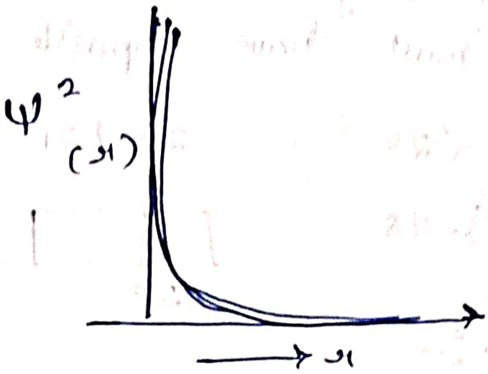


$$\Delta x \cdot \Delta v \geq \frac{nh}{4\pi m}$$

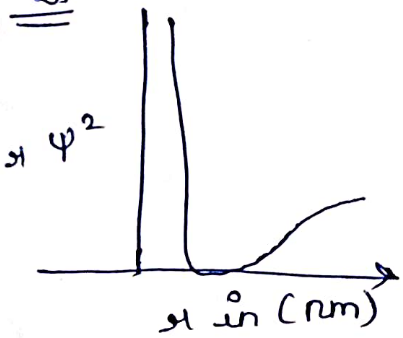
X-Ray Diffraction Method.

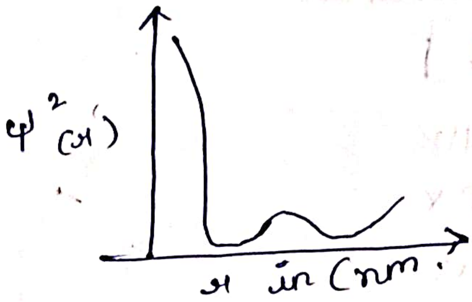
1s

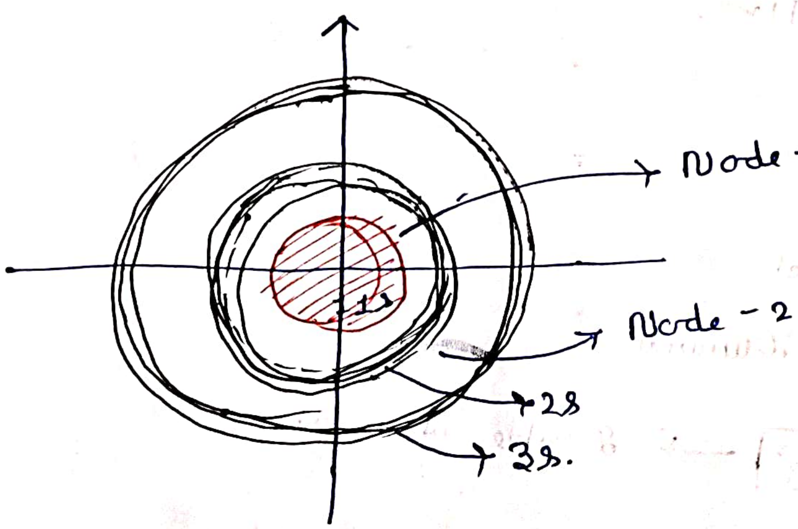


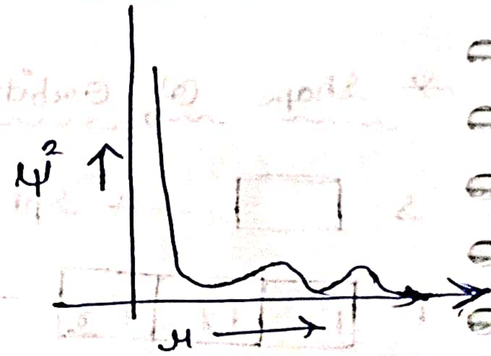


2s





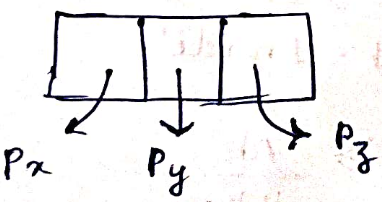




P-Subshell :-

starts from.

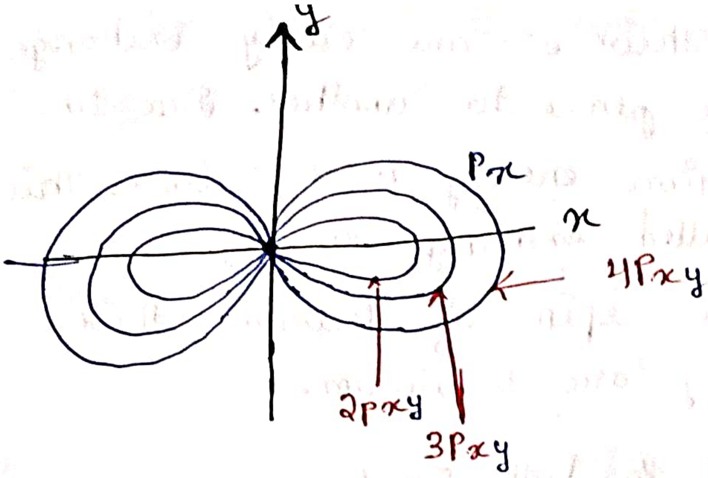
$\boxed{2p}$

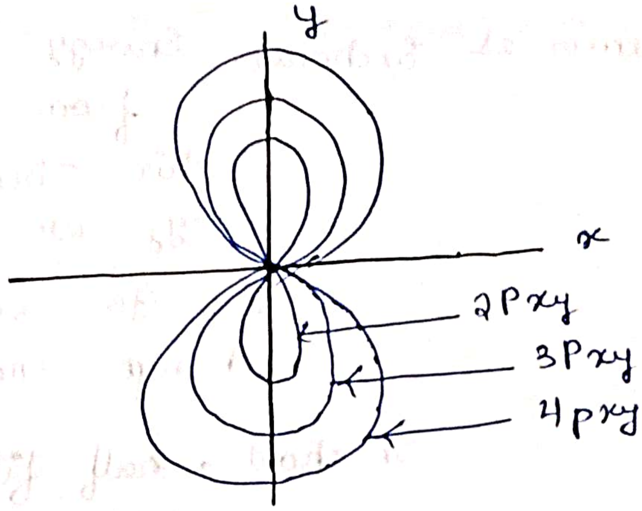


s → 1
p → 2
d → 3
f → 4
g → 5
h → 6

P → Shape → Dumbell shape.

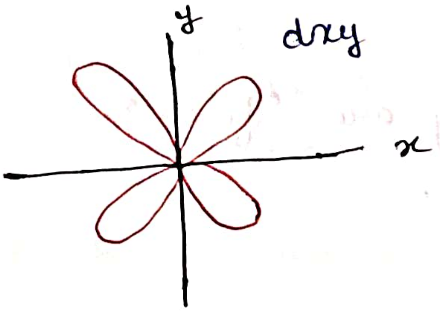
n=6

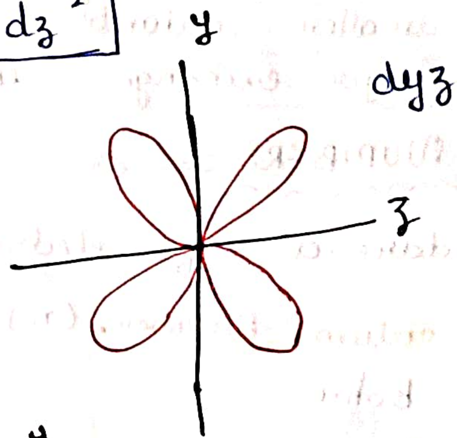


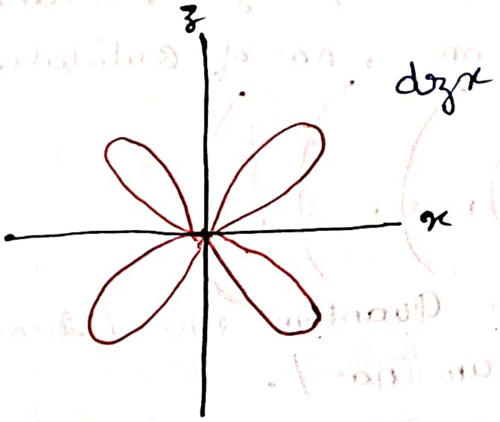


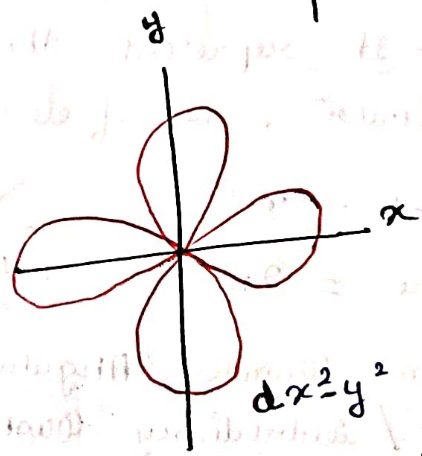
d-subshell → Double Dumbell.

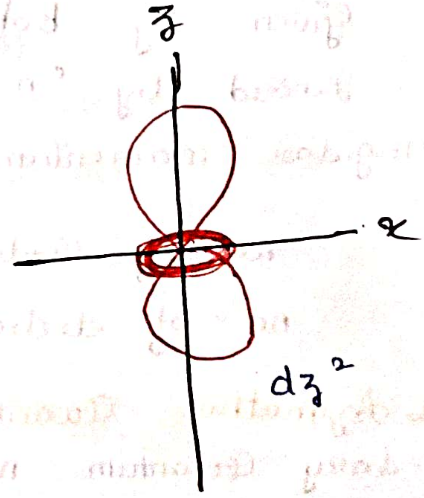
dxy	dyz	dzx	dx^2y^2	dz^2











f - Very complex - Not possible to represent.

* QUANTUM NUMBERS :-

* Causes of stability of half filled & full filled Orbitals.

→ The complete filled & half filled are relatively more stable.
↳ subshell

reason 1) Symmetrical distribution of electron.

reason 2) Their shielding of one another is relatively small that's why their e⁻ are more closely to the nucleus.

Reason 2) Exchange Energy :- Their e^- are easily exchange from one place to another. Due to this transition energy must release. This energy are called exchange energy.

* Due to same spin of electron their exchange energy are maximum.

In short, half filled & full filled are more stable due to :-

i) Relatively small shielding
ii) smaller coulombic repulsion
iii) Larger exchange energy.

} very imp. (PYQ)

* QUANTUM NUMBERS :-

→ Addresses of electron. They are 'four'.

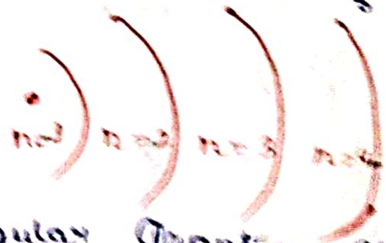
1) Principal Quantum Number. (n) :-

Given by Bohr

Denoted by 'n'. It represent the name, size, radius, Angular momentum (mvr), no. of electrons, no. of orbitals.

no. of Orbitals = n^2

no. of electrons = $2n^2$



2) Azimuthal Quantum Number / Angular Quantum No. / Secon-dary Quantum no. / Subsidiary Quantum no. /.

Denoted by 'l'. It represents the subshell related.

It is related shape of orbitals, Orbital Angular momentum

maximum value of l is always < n. < n

$l < n$ $(n-1)$

It is given by Sommerfeld

n + l Rule :-

Acc^n to Aufbau if any value of (n+l) have more energy.

	l
s	$\rightarrow 0$
p	$\rightarrow 1$
d	$\rightarrow 2$
f	$\rightarrow 3$

Acc^n to Aufba.

		n		l	
2p	$\longrightarrow$	2	+	1	= 3
4s	$\longrightarrow$	4	+	0	= 4
3d	$\longrightarrow$	3	+	2	= 5.

$\rightarrow l < n$

$\rightarrow 2p < 4s < 3d \leftarrow$ increasing energy level.

no. of electrons in any subshell also given by

$2(2l+1)$

$s = l = 0$

$2(2 \times 0 + 1)$

$\Rightarrow 2 \times 1 = 2$.

$p = l = 1$

$2(2 \times 1 + 1)$

2×3

$\Rightarrow 6$

*** Orbital Angular Momentum.**

$\sqrt{l(l+1)} \; \frac{h}{2\pi}$

$\hbar = \frac{h}{2\pi}$ = hash

$\sqrt{l(l+1)} \; \hbar$

*** Shape Of Orbitals :-**

s $\rightarrow$ spherical

p $\longrightarrow$ Dumbell

d $\longrightarrow$ Double Dumbell

f $\longrightarrow$ complex.

$2l + 1 = m$

3) Magnetic Quantum Numbers :-

→ Denoted by m given by Linde.

→ It represents the "orientation of electron" cloud (orbital)

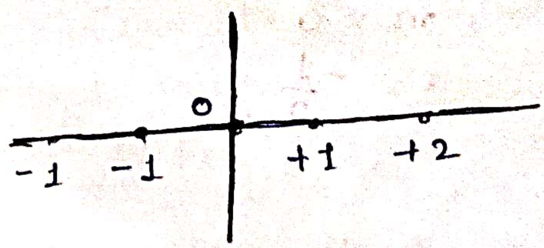
→ The value of m are all the integeral value $-l$ to $+l$,

→ including zero.

s $\rightarrow$ 0

p $\longrightarrow$ 1

p_x	p_y	p_z
-1	0	+1



d $\longrightarrow$ 2

d_{xy}	d_{yz}	d_{zx}	$d_{x^2-y^2}$	d_{z^2}
-2	-1	0	+1	+2

4. Spin Quantum Numbers :-

→ It represents the direction of electron spin around its own axis for clock wise / ↑ it is denoted by $+\frac{1}{2}$

→ for anticlockwise spin / ↓ it is denoted by $-\frac{1}{2}$.

* Spin Angular Momentum of an Electron :-

$$\sqrt{s(s+1)}\,\frac{h}{2\pi} \quad \text{or} \quad \sqrt{s(s+1)}\,\hbar$$

→ each orbital can accomodate two electron with oppo. spin.

* No. of Nodes :- 25-A

1. No. of Angular node (l)
2. No. of radial node (n − l − 1)
3. No. of total nodes (n − 1)

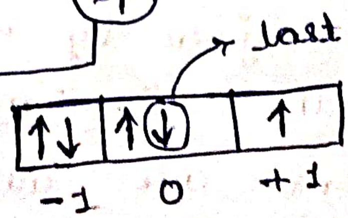
No. of radial nodes are also spherical node or no. of nodal surface in an orbital.

No. of angular nodes / Nodal plane in an Orbital

Ques. $_{17}Cl$ → last e^- all 4 Orbits.

$1s^2 \; 2s^2 \; 2p^6 \; 3s^2 \; 3p^5$

$3p^5$



$n = 3$

$l = 1$

$m = 0$

$s = -\frac{1}{2}$

canal rays ?

Unit-3 Classification Of Elements And Their Periodic Properties

The arrangement of all the known elements acc^n to their properties in such a way that the elements are similar properties are grouped together in the form of periodic table. ~~is called~~ It is tabular form.

* Development Of Periodic Table :-

1) Prout :- Acc^n to him all the elements are made up of Hydrogen.

$$\boxed{\text{Atomic weight of Atom} = n \times \text{atomic weight of Hydrogen.}}$$

Acc^n to him different elements are found in the form of cluster, Group of any things. (Properties are different).
↳ (झुंड)
eg :- Cl → 35.5

2) Dobereiner :- He made a group of 3 having similar (1817) properties called 'TRAID', (3 elements)
Acc^n to him the Atomic weight of the middle elements is the average (nearly equal) atomic weight of 1st & 3rd element.

^{7}Li , Na , ^{39}K

$\frac{7+39}{2}$

$\Rightarrow 23\ Na$

^{17}Cl , Br , ^{53}I

$\Rightarrow \frac{35+127}{2}$

$\Rightarrow \frac{162}{2}$ 81%

79 Br

^{40}Ca , Sr , ^{137}Ba

$\Rightarrow \frac{40 + 137}{2}$

$\Rightarrow$ 88.5%

87 Sr

3) Newland :- "New lands Octaves Rule"
(1865) He arranged the element in their increasing order of their Atomic mass & observe that properties of every 8th element was similar to the first element just like music, vowel notations. (1-20 elements)

Octaves → Group of 8.

Noble gas was not involved.

सा	रे	गा	म	प	ध	नी
सा	Li	Be	B	C	N O	F
	Na	Mg	Al	Si	P S	Cl.