Le 01. Atomic Structure.

The fundamental particle of a substance is known to be an Atom. An atom is electro-statically netrual in Nature, That's why it should consisting of same no.of negetive (-ve), charge with same no.of (+ve) charge. since, electrons are tiny & Protons are Heavy the entire mass of an atom is located at one point is known to be "Neucleus". To keep up stability of of Neculues a charge less, Equal mass of proton known to be Neutron placed b/w Protons That's why Neucleg is Made up of Protons and Neutrons. These are known to be Neuclones.

Atomic Number (Z):-

The no.of electrons around the Neucleus | The no.of Protons present in Neucleus is known to be Atomic number (Z). Therefore | 'Z' = atomic number = no.of electrons = no.of Protons |

Ex:- $_{11}Na^{23}$; 11 = Atomic no. = no.of $e^{\ominus}$ / $e^{\oplus}$

* Mass number :- (A)

Sum of no. of protons and neutrons in nucleus is known to be mass number. Therefore, mass number = (A) = no. of neutrons + no. of protons

| ∴ A - Z = No. of neutrons |

* Properties of wave :-

If you've place a stone in quiet pond then "generation of waves" takes place. The properties are given by

1. Wave length (lamida) (λ)
2. Velocity (v)
3. frequency (ν - new)
4. Wave number ($\bar{\nu}$ - new bar)
5. Amplitude { (A) or a }

① Wave length :-

After the generation of waves in the medium. The distance b/w two successive crest or trough is known to be wave length. (lamida λ)

The units are cm / m

$1A^{\circ} = 10^{-8}$ cm.

② Velocity (V) :-

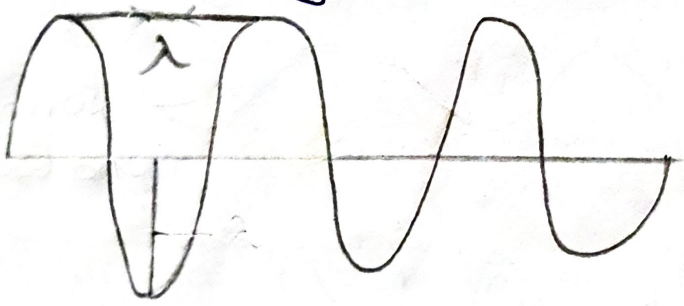
After the generation of waves the distance covered by a wave in unit time is known to be velocity (v)

∴ Velocity (V) = $\frac{\text{displacement}}{\text{time}}$

$v = \frac{d}{t}$ $\left(t = \frac{1}{\text{sec/min..}}\right)$

∴ $\boxed{v = d}$

Velocity = Distance.



③ frequency (ν) :-

After the generation of waves in the medium the no. of waves which is passing from one particular point is known to be frequency.

∴ frequency (ν) = no. of waves

∴ ν = cycles/second or Hertz.

(H) Wave number ($\bar{\nu}$):-

The no of waves placed in 1cm Distance is known to be wave number.

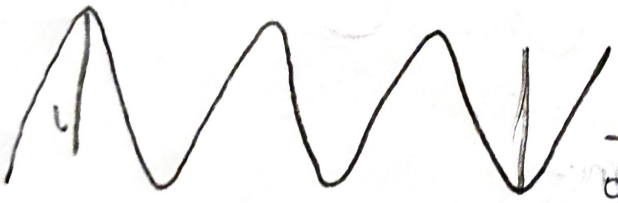
$\therefore$ Wave number $\bar{\nu} = \frac{c}{\lambda}$

$\bar{\nu} \propto \frac{1}{\lambda}$ where c = light velocity.

Amplitude:- (A/a)

The Intesity of waves (sound waves) is Increased by Increasing height of crest is known to be Amplification.

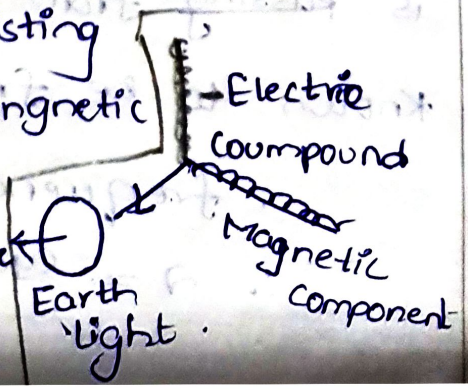
— Normal Sound wave.



→ Increasing height of the sound wave.

Electro-magnetic Radiations

Electro-magnetic Radiations are those of Radiations which are consisting of both Electrical and Mangnetic fuld perpindicular to each other and also Be ⊥ to the propogation of wave



Properties of ele-mag radiations:-

1. All Ele.Mag.radiation travels with light velocity ($3 \times 10^8 m/s$)

2. For the propogation of ele.mag.radiations they doesn't require any medium.

Eg:- xrays, Gamma-rays(γ) visible light, UV, IR, Radio waves.

* Electro-magnetic spectrum:-

It is an Arrangement of all known Ele.Mag.radiations with Increasing order of their wave length (λ)

Arrange-ment.

X-rays < γ-rays < UV < VIBGYOR < IR < Radiowave

Increasing order of wave length (λ) in A°

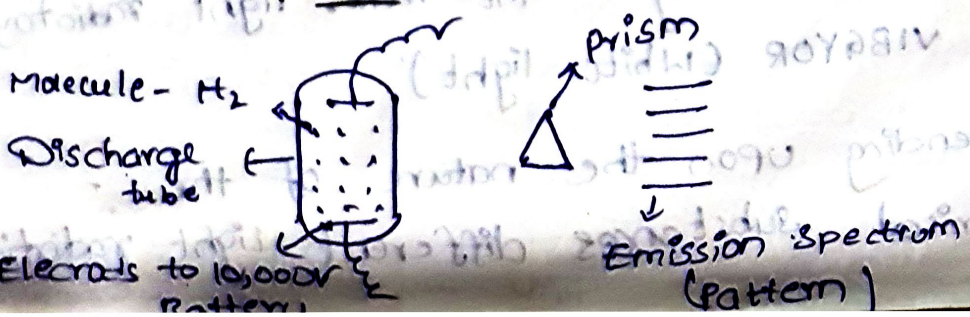
Types of spectrum:-

There are two types of spectrum

1) Emission sprecburm.

2) Absorption Spectrum

① Emission Spectrum:-



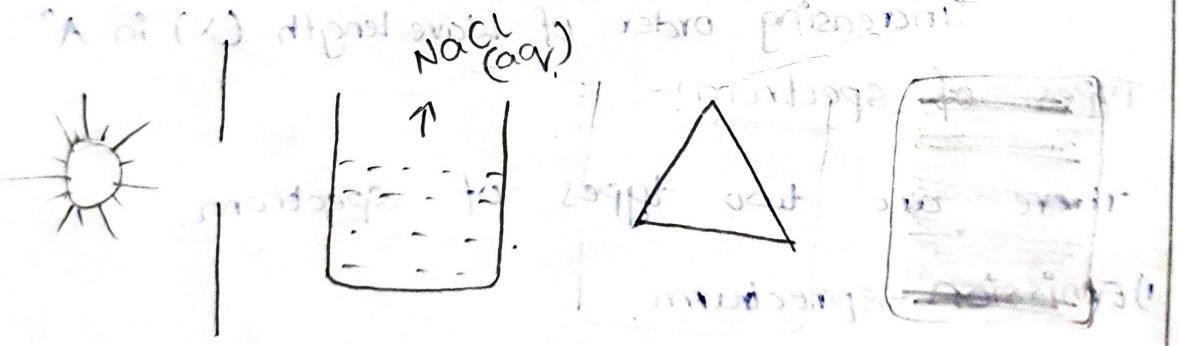
→ In Emission spectrum given sample (Ex:- H_2 gas) has been taken. Due to high electrical Energy (Heat) The Molecules are ~~Dissociate~~ Dissascoiate in to atoms.

→ Due to exicitdation of electrons and relexation when they released energy is captured by Prism Emission spectrum is formed.

→ Due to ~~Exited~~ Excited atoms large amounts of heat Energy is liberated so that to read Emission spectrum "Dull photographic plate" is used

→ Each and Every element has it one own spectrum thats why we can identify Elements with known spetrum.

Absorption Spectrum :-



→ Given sample solution is exposed to sun-light. In sunlight the max. light radiations are VIBGYOR (White light).

→ Depending upon the nature of the chemical substances different light radiations

are absorbed by the given sample.

→ The reamaing light radiations are allowed to pass through a prism and further, A Bright photographic plate

→ The Dull lines corresponding to the sample are characterstick known to be Absorption spectrum.

NOTE :-

→ for a particular element there is no need to take up two spectrums Each and Every Specturm is characterstic

Difference b/w Emission and Absorption Spectum

Emission spectum	Absorption Spectum
1. In Emission spectrum, The emitted light radiation are characterstics	1. The Absorption of VIBGYOR By the sample is characterstic.
2. In Emission spetrum bright lines are formed againest Dull photographic plate.	In Absorption spectrum Dull ~~lines~~ bands are formed againest Bright one.
3. Emission spectrum is caused by Exicted atoms is known to be Atomic spectum.	Absorption spectrum is caused by molecules thatswhy it is known to be Molecular Spectrum

* Rutherfords theory: *(No in Exam point of view)

1. Since, the atom is Eletrostatically Neutral in Nature. The atom should consisting of same no. of +ve charge and -ve charge.
2. The entire mass of an atom is located at one point is known to be Neucleus
3. The Electrons Rotates around the Neudus in certain specified paths is known to be orbits which are furthur named as :-

   n = 1, 2, 3, 4 ....

   (or)

   K, L, M, N ....

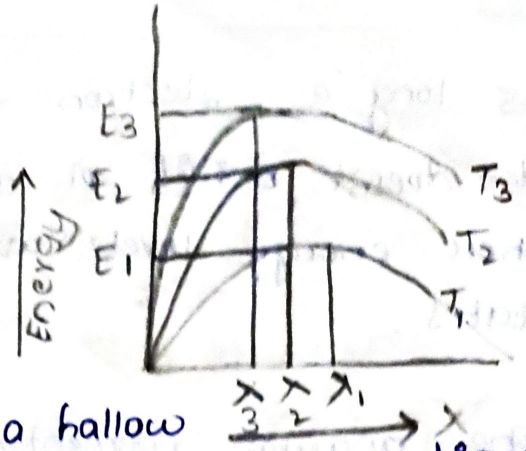
* Drawbacks :-

1. According to "clerk Maxwell", - If any charged body is under circular motion, It should emits energy continuously.
2. Rutherford couldn't explain the formation of "Dis-continuous spectrum". because, If a electron emmits energy continuously one has to get Continuous spectrum

To over-come the Drawbacks of Rutherfords theory Planks - black body radiation theory is useful.

* Plank's Theory:-

→ **Black body:-**



It is a perfect absorber and emmiter of heat energy. In reality in universe their is no ideal black body. but, a hallow metallic sphere inside walls of the continer is painted with black colour & a pin hole made on the surface of the sphere nearly acts as a black body.

✓ (*) **Planks Theory:-** (8 m) n(4m)

1. The energy emmited by black body is not at all continuous: It is in discreate energy packets known to be "quanta".

2. The energy in the form of $1h\nu$, $2h\nu$, $3h\nu$... known to be quantisation.

* Bohrs Theory:

1. Since, an atom is electrostatically Neutral in Nature. It should consisting of same no. of Positive charge (Protons) with same no. of -ve charge (electrons).

2. The entire mass of an atom is located at one point known to be Neucley, and same no. of electrons should revolve around the Neucles in certain specified paths known to be orbits. which are noted as $n=1,2,3...$ and K, L, M...

3. As long as electron revolves around the Nucleus it doesn't emmit or absobes energy. That's why these energy levels are known to be stationary states.

4. The angular momentum of electron is Quantised in terms of $\frac{h}{2\pi}$

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

m = mass of electron

v = velocity of electron

r = radius of the orbit

$n = 1, 2, 3 \ldots$

h = planks constant

5. When energy supplied to electron then electron excited to $n=2$, the come back to ground state :

$$E_2 - E_1 = h\nu$$

Drawbacks :-

* Bohr couldn't explain this theory towards multi-electron system.

* Bohr couldn't explain fine spectra (By using a Quality prism.

* Bohr couldn't explain "stark effect"

→ STARK EFFECT :-

The splitting of spectra when Emission spectrum is under electric field. (Discharge tube is placed in electric field).

* Bohr couldn't Explain zeemann effect

→ Zeemann effect :-

The splitting of spectrum lines in the Magnetic feild. (If Discharge tube placed in external Magnetic feild).

To overcome these drawbacks - "Quantum Numbers" has been proposed

Quantum Numbers :-

There are four Quantum numbers which are given by :-

1. Principle Quantum number (n)
2. Azumutal Quantum number (l)
3. Magnetic Quantum number (m)
4. Spin Quantum number (m_s)

* Principle Quantum number :-

Principle Quantum number is proposed by Bhor, According to Bohr's Theory the electrons should revolves around the neculy in certain specified paths known to be orbits as the ~~no. of~~ atomic number increases the energy of the atom is also increases.

As long as electrons revolves around the nucleus in a circular orbits one single Parameter (radius [r]) is sufficent to explain the properties of electron.

$n=1 \longrightarrow K$

$n=2 \longrightarrow L$

$n=3 \longrightarrow M$

$n=4 \longrightarrow N$

* Azumutal Quantum number :- (l)

According to Sommerfield the electron in an atom revolves around 'elipseoid' ~~manner/sm/way~~. That's why the distance blw Neucleus & electron, The angles made by the distance towards major-axis (AB). is also changes, so that According to this Quantum number we have two parameters :-

Distance, Angle

According to this Quantum number $\frac{AB}{CD} = \frac{n}{k}$

where AB = major Axis
CD = Minor Axis
n = principle quantum number.

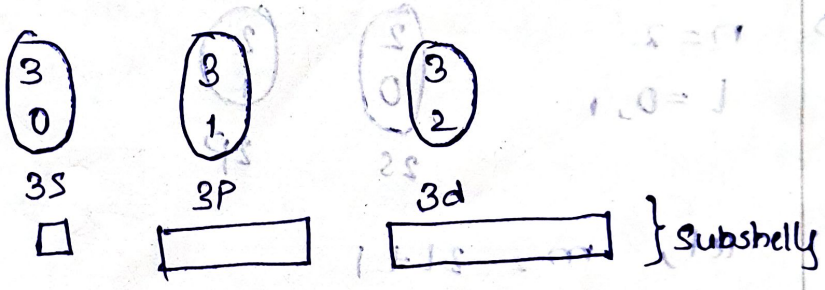
To Explain practile event 'k' is replaced by 'l' which is Azumulal Quantum number

$l = 0, 1, 2 \ldots, (n-1)$

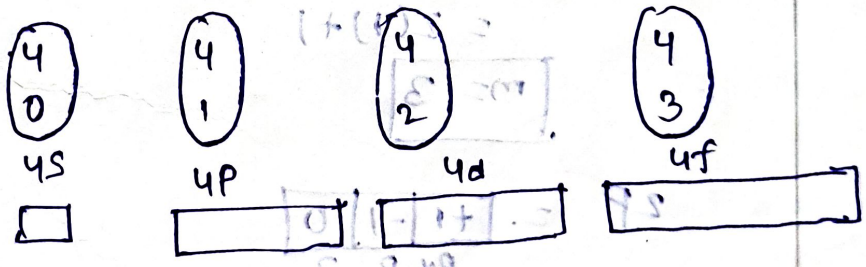
→ $n = 1$, $l = 0$ is (subshell) □ → 1S

→ $n = 2$
$l = 0, 1$

→ $n = 3$
$l = 0, 1, 2$

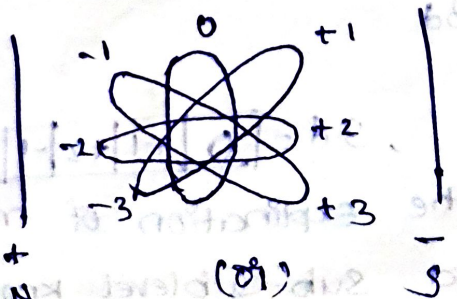


→ $n = 4$
$l = 0, 1, 2, 3$



To Explain zeeman and Stark effects magnetic Quantum number has been Proposed.

(3) Magnetic Quantum number :-



According to magnetic quantum number (m) if an electric wire is placed in External strong feild to over-come attraction of External feild the internal tiny electric feild Arranged | seelects (2l+1) orientions. Therefore, magnetic quantum number = (2L+1) orientations.

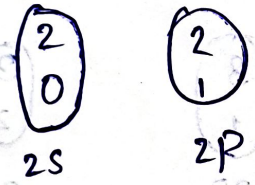
→ n=1, l=0, m=0

1S

□

(only one orentation)

→ n=2, l=0, 1



2S 2P

ref, m = 2L+1

= 2(1)+1

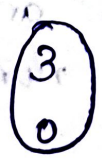
m = 3

2P = | +1 | -1 | 0 |

Px Py Pz

→ n=3, l=0, 1, 2

l=0, 3s



l=1, 3p = | -1 | 0 | 1 |

l=2 

- 3d

m = 2(2)+1, 3d = | 0 | +1 | +2 | -1 | -2 |

m = 5 .(*) The explination of magnetic Quantum number toward sub-sublevel known to be orbital

* Spin Quantum number: (m_s)

Like earth revolving around the sun electro is also revolves around the neucleus towards clockwise direction is known to be '$+\frac{1}{2}$'. Similarly, there is a chance to rotate itself in anti-clockwise Direction lead to $\frac{-1}{2}$ are known to be spin quantum numbers.

So, that the entire ~~discussion~~ dissocssio leads to a Perfect Identification of electron around the neucleus believed to be an address for electron.

Ex:- Write Four Quantum no. for '1' electron in Hydrogen atom.

Atomic number of Hydrogen = 1

$= 1s^1$

n	l	m	m_s
1	0	0	$+\frac{1}{2}$ ↑
or			
1	0	0	$-\frac{1}{2}$ ↓

Write 4 Quantum numbers for Helium atom

Helium Atomic number = 2

Electron configuration = $1s^2$

n	l	m	m_s
1	0	0	$+\frac{1}{2}, -\frac{1}{2}$ ↑↓

* Write '4' Quantum numbers for Helium ion.

Helium ion is nothing but Hydrogen atom

n	l	m	m_s
1	0	0	$+\frac{1}{2}$ | $-\frac{1}{2}$

* Write 4 Quantum numbers for Na^+ ion.

$Na = 11$

configuration = $1s^2 2s^2 2p^6 3s^1$

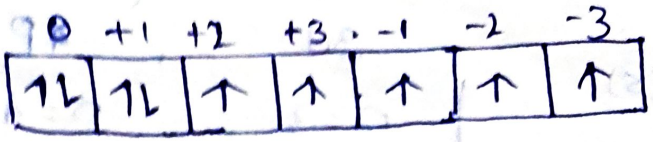
$Na^+ = 1s^2 2s^2 2p^6$

sub levels
$L = 0 = s$
$L = 1 = p$
$L = 2 = d$
$L = 3 - f$

n	l	m	m_s	
1	0	0	$+\frac{1}{2}$	} Indicates 1s.
1	0	0	$-\frac{1}{2}$	
2	0	0	$+\frac{1}{2}$	} 2s.
2	0	0	$-\frac{1}{2}$	
2	1	-1	$+\frac{1}{2}$	} Indicates 2p.
2	1	-1	$-\frac{1}{2}$	
2	1	0	$+\frac{1}{2}$	
2	1	0	$-\frac{1}{2}$	
2	1	+1	$+\frac{1}{2}$	
2	1	+1	$-\frac{1}{2}$	

Write 4 Quantum numbers for $_{7}f^{9}$.

$_{7}f^{9}$ =



n	l	m	m_s
7	3	0	$+\frac{1}{2}$
7	3	0	$-\frac{1}{2}$
7	3	+1	$+\frac{1}{2}$
7	3	+1	$-\frac{1}{2}$
7	3	+2	$+\frac{1}{2}$
7	3	+3	$+\frac{1}{2}$
7	3	-1	$+\frac{1}{2}$
7	3	-2	$+\frac{1}{2}$
7	3	-3	$+\frac{1}{2}$

* Atomic laws :- (Aufbau principle, Hund, Pauli principle)

① Aufbau Principle :-

"During the occupation of electrons in different orbitals, electron prefers to occupy lowest energy orbital.

When two orbitals are supposed to be same value of $(n+l)$, then electron prefers to occupy lowest numbered principle quantum no. (n) orbital. Otherwise which orbital has got lowest number, electron prefers to occupy the same.

① Eg:- 3d, 4P

	3d	4P
l = 0 (s)	n = 3	n = 4
l = 1 (P)	l = 2	l = 1
l = 2 (d)	n+l = 5	n+l = 5
l = 3 (f)		

∴ 3d < 4P. electron first enters into 3d after into 4P.

② Eg:- 3P; 4S

n+l = 3+1 , 4S

n+l = 4 = 3P. n+l = 4+0

∴ n+l = 4

3P < 4S . electron first enters into 3p after 4S.

Eg:- 6S, 4f.

n+l	n+l
= 6+0	= 4+3
= 6	= 7

6S < 4f,

* Hund's Principle:-

"During the occupation of electrons in same of energy orbitals the pairing of electro Takes pbce after the half ocupation of the orbital

Ex:- (i) P^4 = ↑↓ | ↑ | ↑ | ✓ , ↑↓ | ↑↓ | | X

(ii) d^6 = ↑↓ | ↑ | ↑ | ↑ | ↑ | ✓ , ↑↓ | ↑↓ | ↑↓ | | | X

* Pauli Exclusive principle :-

"No two electrons in a orbital of a particular atom can have the four set of quantum numbers."

Eg:- He = 2

electron configuration = $1s^2$

n	l	m	m_s
1	0	0	$+\frac{1}{2}$
1	0	0	$-\frac{1}{2}$

* Wave character of electron :- "Debroglie" scientist

According to Einstein Energy mass relation

$E = mc^2 \longrightarrow ①$.

According to planks equation $E = h\nu \longrightarrow ②$

from ① and ②

$mc^2 = h\nu \quad (\because \nu = \frac{c}{\lambda})$

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

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

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

∴ electron e⊖ never (wave) travels, with light velocity

∴ c is replaced by 'v' to get

$$\boxed{\lambda = \frac{h}{mv}}$$ is "Debroglie wave Equation"

This Equation Explains dual nature of matter

i.e, (i) Particle character

(ii) Wave character

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

'λ' stants for wave nature in R.H.S 'm' refers to particle nature.

* **Heisenberg uncertainity principle**

"The simultanious and exact determination of position and momentum of a sub-atomic Particle (electron) is impossible." Therefore According to Heisenberg principle.

P = momentum

= (mass) x velocity

$P = mv$

$$\boxed{\therefore \Delta P = m.\Delta v}$$ (Hence, mass is constant).

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

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

where, Δx = There is no Error in finding displacem

i.e, $\Delta x = 0$

$$0.\Delta v \geq \frac{h}{4\pi}$$

$$\therefore \Delta V = \frac{1}{0} \cdot \frac{h}{4\pi} = \infty \text{ (Infinity.}$$

(Wrong case)

Similarly,

If $\Delta v = 0$

[There is no error in finding velocities]

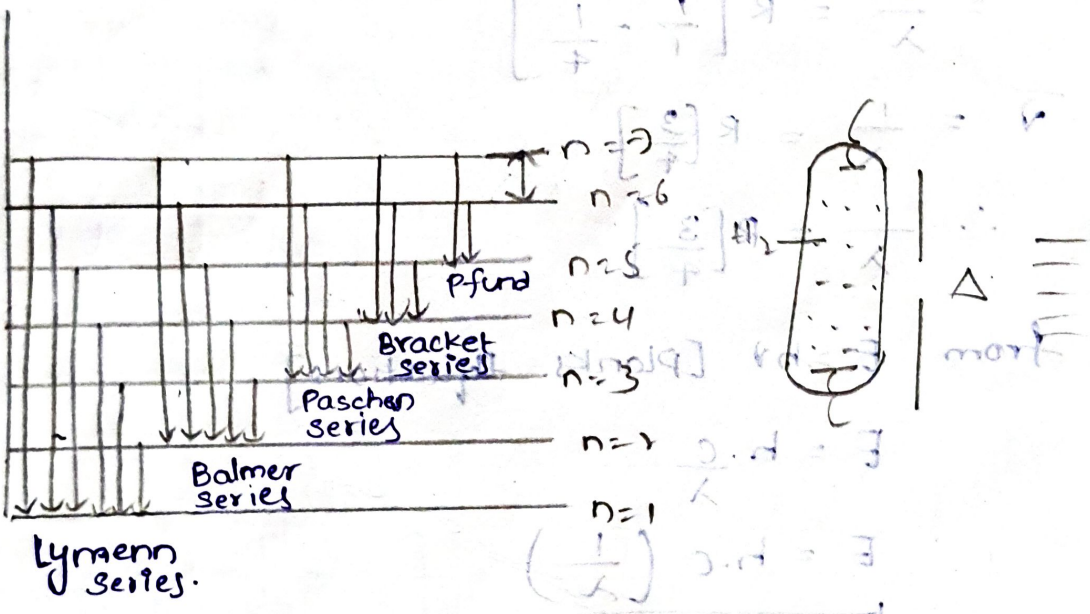
$$\Delta x \cdot 0 \geq \frac{h}{4\pi}$$

$$\therefore \Delta x = \frac{1}{0} \cdot \frac{h}{4\pi}$$

$$\Rightarrow \Delta x = \text{infinite} = \infty$$

(Wrong case.)

* HYDROGEN SPECTRUM EXPLAIN BY BOHRS THEORY!-



Large amounts of hydrogen gas has been taken in discharge tube with the help of electrody the gas is strongly heated. Due to exited atoms Emission spectrum is formed. Since, all the atoms are not at all is in a position to absorbe some extenct of heat Enery. That's why we are getting 5 Series in Emission (Hydrogen spectrum) which are given by.

1. Lymenn, 2. Balmer, 3. Paschan, 4. Bracket, 5. Pfund.

Lyman Balmer Paschen Brackett pfund

* Lymenn:- series

Any excited electron is relaxed towards n_1 directly then lymenn series formed.

According to Rydberg equation.

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$n_1 = 1$, $n_2 = 2, 3, 4 \ldots$

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{1} - \frac{1}{(2)^2}\right]$$

$$= \frac{1}{\lambda} = R\left[\frac{1}{1} - \frac{1}{4}\right]$$

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{3}{4}\right]$$

$$\therefore \frac{1}{\lambda} = R\left[\frac{3}{4}\right]$$

from $E = h\nu$ [Planks Equation]

$$E = h \cdot \frac{c}{\lambda}$$

$$E = h \cdot c \left(\frac{1}{\lambda}\right)$$

$$\boxed{E = hc\left[\frac{3}{4}\right]R}$$

We can conclude the Energy Region in Entire Spectrum.

* Balmar series:-

Any exidation of electron relaxes to directly $n_2 = 3, 4 \ldots$ directly towards $n_1 = 2$

According to Rydberg Equation

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$n_1 = 2, \quad n_2 = 3, 4 \ldots$

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{4} - \frac{1}{9}\right]$$

$$\frac{1}{\lambda} = R\left[\frac{9-4}{36}\right]$$

$$\boxed{\frac{1}{\lambda} = R\left[\frac{5}{36}\right]}$$

* **Paschan series :-**

Relaxation of any exicted electron towards $n_1 = 3$ is known to be paschan series

According to Rydberg Equation.

$n_1 = 3, \quad n_2 = 4, 5 \ldots$

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{3^2} - \frac{1}{4^2}\right]$$

$$\frac{1}{\lambda} = R\left[\frac{1}{9} - \frac{1}{16}\right]$$

$$= R\left[\frac{16-9}{16\times 9}\right]$$

$$= R\left[\frac{7}{144}\right]$$

$$\boxed{\therefore \bar{\nu} = \frac{1}{\lambda} = R\left[\frac{7}{144}\right]}$$

* **Bracket series :-**

Relaxitation of any exicted electron towards $n_1 = 4$ is known to be Bracket series.

$n_1 = 4, \quad n_2 = 5, 6 \ldots$

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{4^2} - \frac{1}{5^2}\right]$$

$$= R\left[\frac{1}{16} - \frac{1}{25}\right]$$

$$= R\left[\frac{25-16}{\ldots}\right]$$

$$\frac{1}{\lambda} = R\left[\frac{9}{400}\right]$$

$$\therefore \bar{\nu} = \frac{1}{\lambda} = R\left[\frac{9}{400}\right]$$

Pfund Series:-

Any Excited electron is relaxes to $n_1 = 5$ is known to be pfund series.

$n_1 = 5$, $n_2 = 6, 7$

$$\bar{\nu} = \frac{1}{\lambda} = R\left[\frac{1}{(5)^2} - \frac{1}{(7)^2}\right] = R\left[\frac{1}{(5)^2} - \frac{1}{(6)^2}\right]$$

$$= R\left[\frac{1}{25} - \frac{1}{49}\right] = R\left[\frac{1}{25} - \frac{1}{36}\right]$$

$$= R\left[\frac{}{25}\right] = R\left[\frac{36-25}{25 \cdot 36}\right]$$

$$\therefore \bar{\nu} = \frac{1}{\lambda} = R\left[\frac{11}{25 \times 36}\right]$$

* Stability of atom:-

Besides stability of atom with respect to completely filled configurations. moreover, half-filled two more stable like completely filled configurations

In the case of half filled configuration Due to decreasing repulsions it has got stability

25) (*) Explain the stability of chromium & copper:-

→ Ca = (chromium)

= 24

Electronic configuration = $4s^2\ 3d^4$

= [↑][↑][↑][↑][↑]

To Explain stability = $4s^1 3d^5$

= ↑ | ↑ | ↑ | ↑ | ↑ | ↑

→ Copper (Cu) = 29

Electronic configuration = $4s^2 3d^9$

= ↑↓ | ↑↓ | ↑↓ | ↑↓ | ↑↓ | ↑

To Explain stability = $4s^1 3d^{10}$

= ↑ | ↑↓ | ↑↓ | ↑↓ | ↑↓ | ↑↓

Thermal energy from the Earth Crust taken to get stability. That's why, They are in "Abundant form."

* Orbitals, Types of Orbitals:-

The maximum probability of finding Electron around the Neucles towards 99% is known to be orbital.

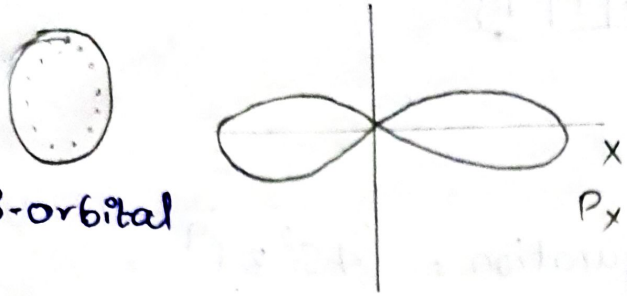
There are four orbitals. s-orbital, p-orbital d-orbital, f-orbital (small letters)

Empty space,

The probability of finding electron around the nucleus is appears to be as follows.

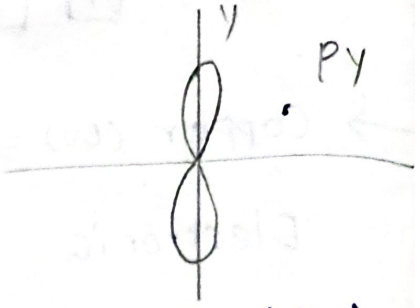
In the case of s-orbital it is appeares to be spherical in nature. whereas, p-orbital 'Dumble'. d-orbital appears to be "double dum'

f - orbital is complex in structure.

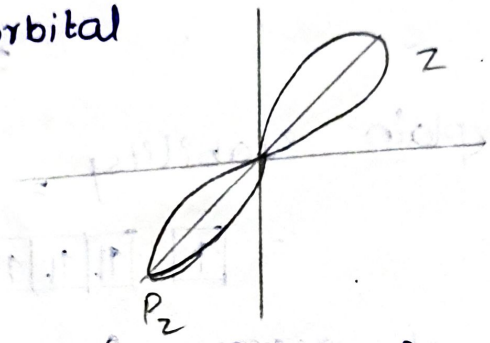


S-orbital

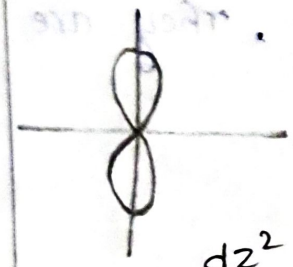
P-orbital



P-orbital

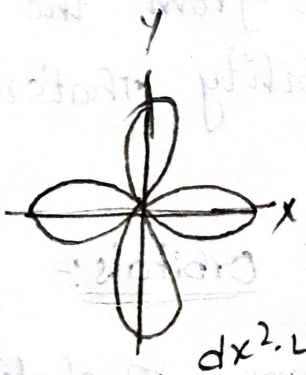


P-orbital.



dz^2

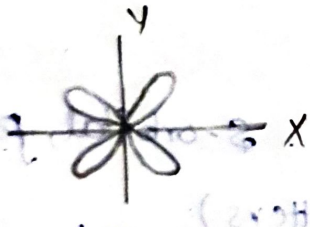
d-orbital



$dx^2.y^2$

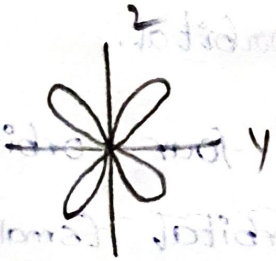
d-orbital.

→ Along the axis



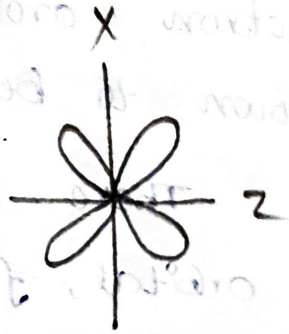
d xy

d-orbital



d_{yz}

d-orbital



d_{zx}

d-orbital

Between the axis