



THE IIT - JEE SECRET

JEE MAINS AND JEE ADVANCED

INORGANIC CHEMISTRY
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PERIODIC CLASSIFICATION

The arrangement of elements in such away that similar elements exists in same place and similar elements are separated, is known as classification of elements.

Periodic table helps us to undergo a systematic study of various elements found in nature without which is impossible for us to study all the elements.

CLASSICAL THEORIES

1. Proust theory - According to this, the atomic weight of an element is equal to N times, the weight of hydrogen, where Capital N is an integer.

According to this, each & every elements is formed by hydrogen atoms, which was totally invalid.

2. Law of dobereiner triad's - According to this the element present at that time of similar property were divided in the group of three. Called triad in which the at mass of middle member is the arithmetic mean of other.

e.g:-	two	At weight	↓	Same Pd.
→	(Li) -	7		
	Na -	23		
	K -	39		

e.g:- two,

\rightarrow	Cl	-	At. weight
	Br	-	35.5
	I	-	80

127

↓ Same Pd

\rightarrow	Ca	-	40
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Stronium → Sr - 88

Barium → Ba - 137

↓ Same Pd

\rightarrow	P	-	31
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Arsenic → As - 75

Antimony → Sb - 120

↓ Same Pd

Demerits:- In some triad's the atom weight of all the three elements are approx. same and they do not follow arithmetic mean rule.

e.g:-

Fe	Co	Ni
56	58.9	58.6

v.i.m.p

3. Newlands law of octaves:-

Sc	Re	Ca	Ma	Pa	Dha	Ni
H	Li	Bc	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Sc	Ti	Mn	Fe

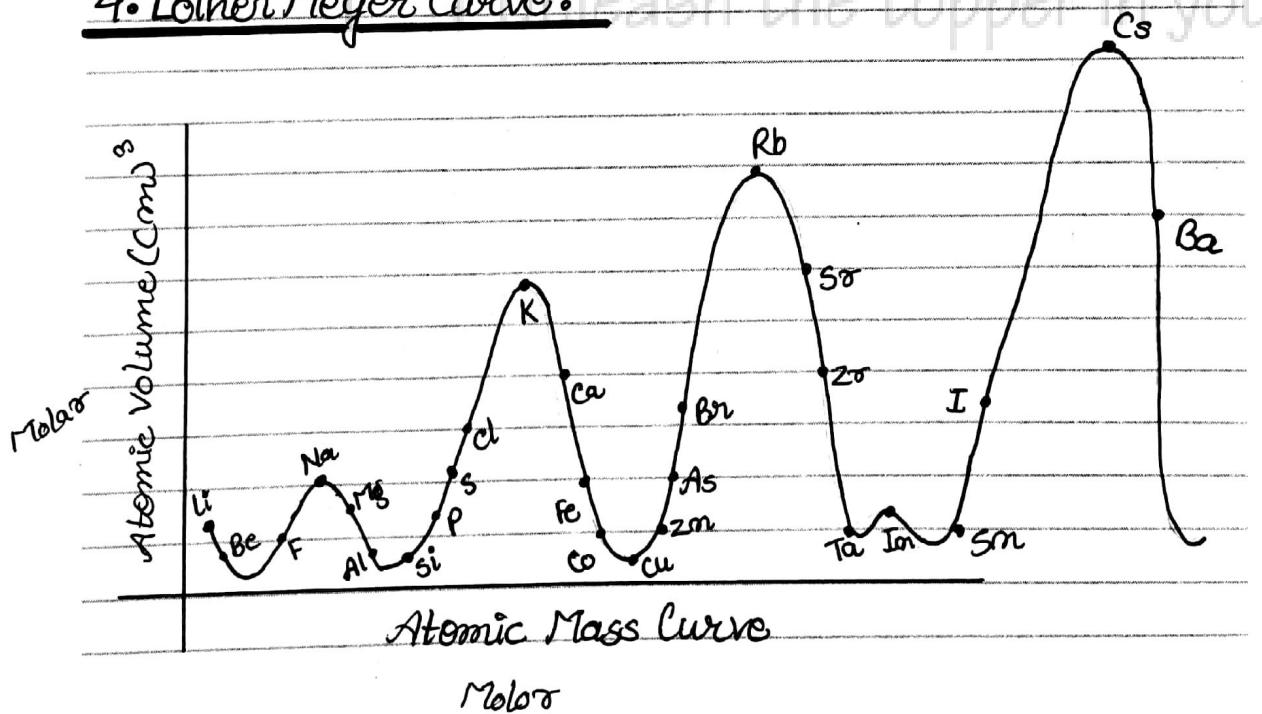
According to this theory when elements are arranged in increasing atomic mass, then the properties of

each elements, repeated with the eight position element like the 8th note of musical scale.

Demerits:-

1. This Law is valid for lighter elements upto Ca, but for heavier elements, it is invalid.
2. Iron is placed with oxygen family & Mn is placed with Nitrogen family, that means metal Fe & Mn, exist in non-metal group.
3. After the discovery of noble elements, octave rule totally failed.

Lother Meyer Curve:-



At.no.

tmp: *uranium \rightarrow 92

Atomic volume = $\frac{\text{Mass (g/MM)}}{(\text{Molar av volume}) \cdot \text{density}}$

Main points:-

1. Most electron particle metal (alkali metals) are placed at peak of each curve.
2. Alkaline earth metals exist as descending part of curve.
3. Highly electronegative halogens are at ascending part of curve.
4. Transition metals & metalloids are at bottom portion (minimum regions) of the curve.

Demerits:-

1. It is difficult to remember the position of all elements in the Curve.
2. All known elements at that time or did not exist on this curve.

Law (Lothen Meyer Rule) - phy. properties are periodic function of atomic mass.

5. Mendeleeff's periodic table:-

1. Arranged 92 elements in between Hydrogen & Uranium with only 62 known elements on that time including some vacant places for unknown elements.

2. Mendeleeff's law \Rightarrow "The physical & chemical properties

of elements are periodic function of their atomic mass".

3. There are 7 horizontal rows (periods) 4, 8 vertical columns (group) in it.

4. Groups are further divided into sub group A & B.

5. Some places were left vacant for elements which were not discovered at that time.

e.g: eka Aluminium \Rightarrow

eka silicon \Rightarrow Germanium (Ge)

eka Boron \Rightarrow Scandium

6. The atomic weight of some elements were corrected by help of at. weight of adjacent elements

e.g: Li, Be, B

7 9 10.8

Demerits :-

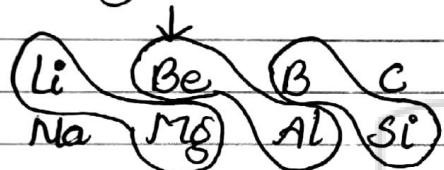
1. Position of Hydrogen :- It is in first alkali metals as well as 7th Halogens group.

2. Anomalous pairs of elements :- Some pairs of elements which do not follow increasing order of at. mass.

CO	Ni	=	Ar	K	=	Te	I	=	Th	Pa
58.9	58.6	=	40	39	=	127.5	127	=	232	231

3. Position of Isotopes :- Isotops were replaced at same position even their at mass were different.

Diagonal Relation



4. No place for Noble Elements.

5. Separation of some similar elements but grouping of some dissimilar elements.

i) e.g.:- Copper, Mercury are placed in different group while they show similar properties but are in diff. groups.

ii) e.g.:- Cu, Ag, Au have different properties but are placed in same group.

Modern Mendeleef's Periodic Table

(Moseley's Suggested)

Moseley's Law :- "The phy. & chem. properties of elements are periodic function of their atomic number (z)". So, if elements are arranged in increasing at. no., elements of similar properties observed after regular intervals (2, 8, 8, 18, 18, 32-----).

ELECTRONIC CONFIGURATION

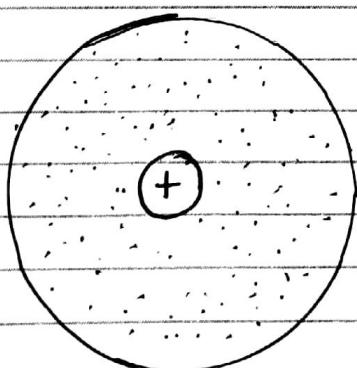
Orbit or Shell :- It's an average distance of electron from the nucleus. This follows 2D motion of electrons given by 'Bohr'. According to e⁻ move in 2-D circular path around the nucleus in which it's energy is constant. These circular orbits are called shell or stationary energy level, represented by n.

e.g:- $n = 1, 2, 3, 4, 5, \dots, \infty$
 K, L, M, N, O, ...

Orbital :- It is 3-D boundary inside which the probability of finding s e⁻ is maximum. It can be of any shape & it follows 3-D Motion of electron.

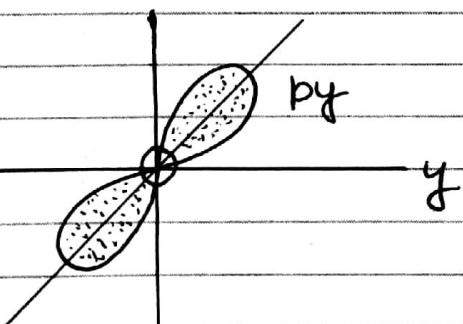
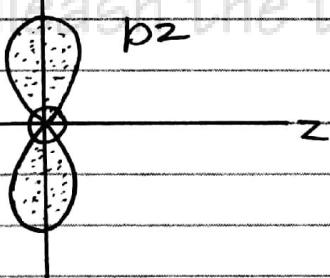
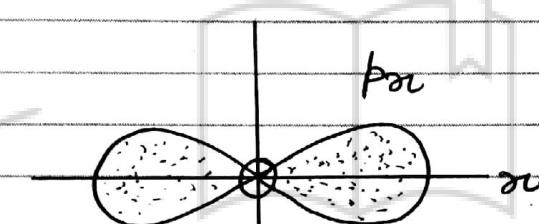
Orbital is developed after wave theory of moving particle, given by De-broglie.

S-orbital :- It is spherical in shape & non-directional.



P-Orbital :- It is of 3 types, that means p-orbital has 3 different types of orientation. It is dumbbell in shape having symbol p_x, p_y, p_z . In absence of external electric & magnetic field, all three p orbitals are of same energy. Thus they are called de-generate orbitals (of same energy).

e.g:-



Penetrating power
 $ns > np > nd > nf$

Collection of degenerate orbitals (has 3 diff) form it's subshells.

e.g:- Collection of p_x, p_y, p_z form p subshell.

Combination of closer energy subshells form shell.

Quantum Numbers

These are the numbers by which we can get complete address of an e^- around the nucleus.

First three Quantum no. given the location of e^- , while spin quantum no. is not related with location.

Types of quantum numbers:-

- i) Principal quantum no.
 - ii) Azimuthal quantum no.
 - iii) Magnetic quantum no.
 - iv) Spin quantum no.
- } Location } Spin

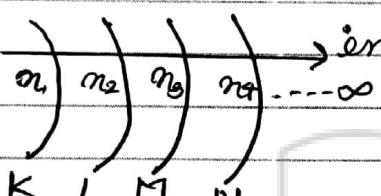
i) Principal Quantum no. $\rightarrow (n)$

It gives an idea of shell, represented by (n) .

e.g:- $n = 1, 2, 3, 4, \dots \infty$
 K, L, M, N, O, P, \dots

2. It indicate the average distance of electron from the nucleus.

3. It gives an average energy of electron from the nucleus.

e.g. \rightarrow  increasing energy order.

$$E_4 > E_3 > E_2 > E_1$$

In a particular shell, (a) total no. of orbitals are n^2 (4^{th} total max. e^- which can exist = $2n^2$).

ii) Azimuthal Quantum no. $\rightarrow (L)$

a) It gives an idea of sub-shell of electron in which it exist, represented by (L).

b) value $\rightarrow L=0 \text{ to } (n-1)$.

e.g. $\rightarrow L=0, 1, 2, 3, 4, 5, \dots, n-1$.
 sub shells $\Rightarrow S P d f g h \dots$

If $n=1$, then $L=0$ (sub-shell)-S

If $n=2$, then $L=0$ (sub-shell)-S $L=1$ (sub-shell)-P

If $n=3$, then $L=0$ (s-subshell) $L=1$ (p-subshell)
 $L=2$ (d-subshell)

Sub-shell
1S
2S
2P
3S
3P
3d

1. Note \rightarrow Types of Sub shell which can exist in n^{th} shell & equal to n .

2. Note \rightarrow The values of l start from 0 & can be max. upto $(n-1)$. It's value never be n or $>n$.

iii) Magnetic Quantum no. (m_l) :- It gives idea of orbitals present in a sub-shell, related with orientation of electron cloud (orbitals) in which electron exist.

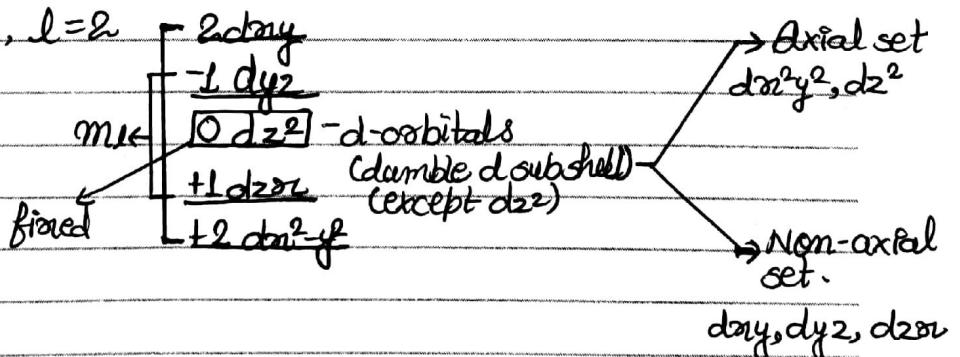
$$m_l = -l \text{ to } +l$$

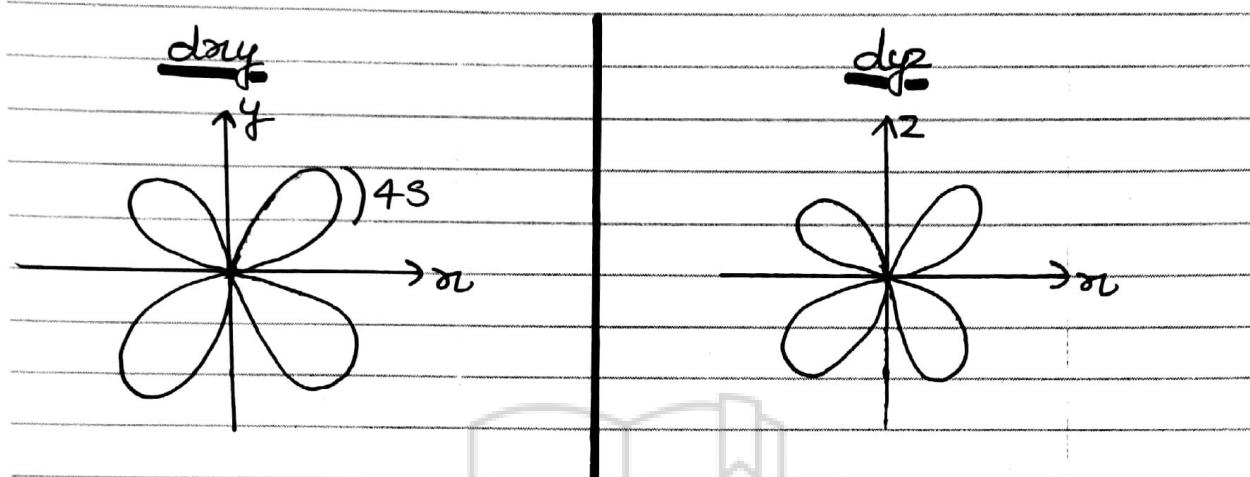
$\Rightarrow l=0$ (S-sub shell), $m_l=0$ (S-orbital)

$\Rightarrow l=1$ (P-Sub shell), $m_l=-1, 0, +1$

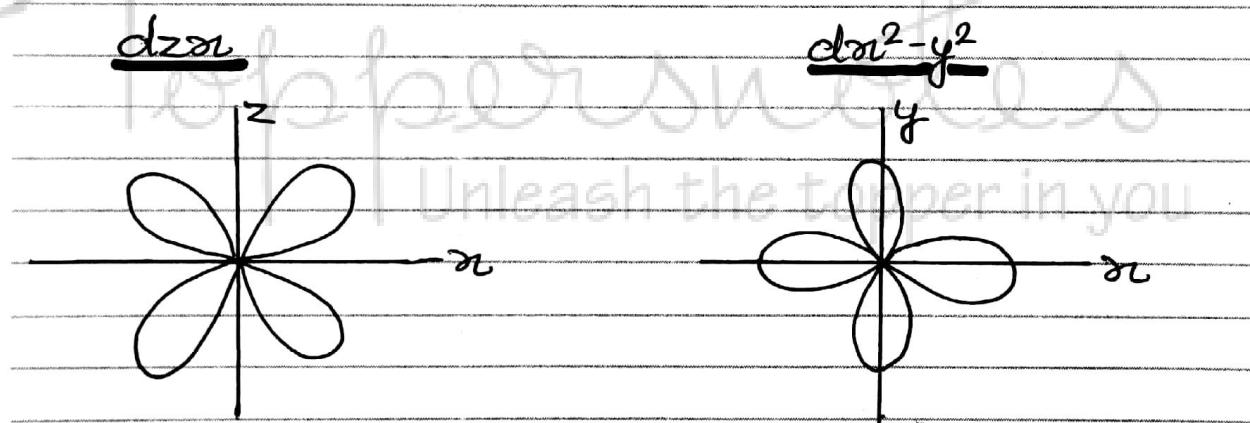
0 p_z → enter changeable
 ↓ fixed +1 by ↴
 but l set at a time.

$\Rightarrow d$ -sub shell, $l=2$

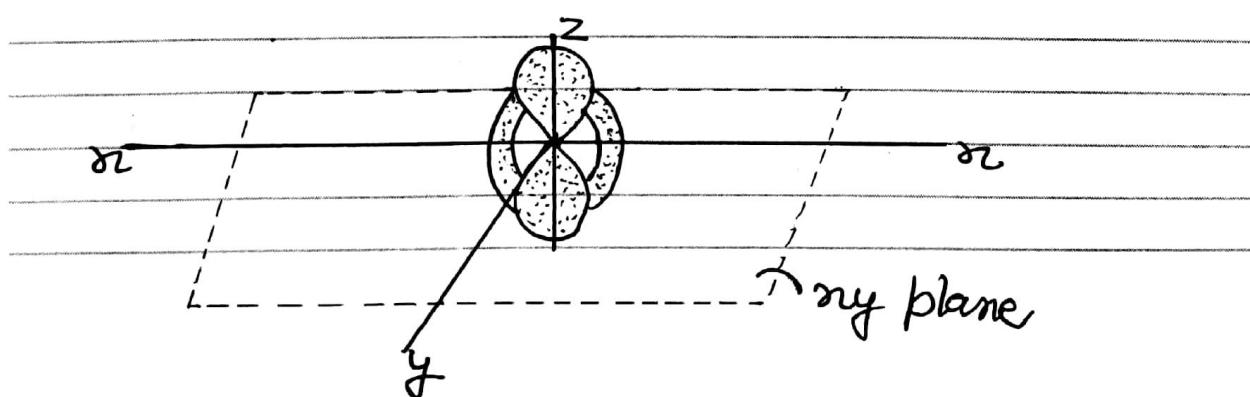




on xy plane in which lobes are at 4s from x & y axis.

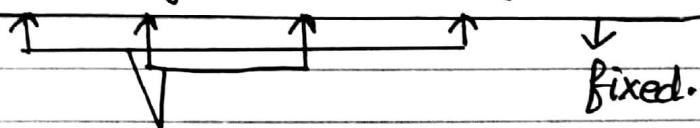


$$\boxed{\frac{dz^2}{2}}$$



2 lobes along z-axis & 1 ring on the xy plane of electron cloud.

e.g:- $d_{xy}, d_{yz}, d_{zx}, d_{x^2-y^2}, d_{z^2}$



Interchangeable

F subshell

$$l=3$$

degenerate orbits

$$m_l = -3, -2, -1, 0, +1, +2, +3$$

F subshell has 7 degenerate orbitals.

Note 1. \Rightarrow Total no. of orbital which can exist in a particular subshell (l) are equal to $(2l+1)$.

Note 2. \Rightarrow As max. two electrons can exist in one orbital in opposite spin, thus-

Maximum electron which can exist in a particular subshell $= 2(2l+1)$.

e.g:- S-subshell $l=0$ $m_l=0$ (1s) $\overset{\text{orbital}}{\text{max. e}^-} = 2 | 2(2l+1) = 2$
in s-subshell.

P-subshell $l=1$ $m_l = \begin{matrix} -1 \\ 0 \\ +1 \end{matrix}$ $\overset{\text{max. e}^- \text{ in}}{\underset{\text{P-subshell}}{=}} 6 | 2(2l+1) = 6$
 $\overset{\text{max. no. of}}{\underset{\text{orbital}}{=}} 2l+1$
 $= 2 \times 1 + 1 = 3$

d subshell $l=2$ no. of orbitals = $2l+1 = 2 \times 2 + 1 = 5$
 max. no. of e^- = $2 \times 2l+1 = 2 \times 5 = 10$

$$\begin{aligned} F \text{ subshell } l &= 3 \quad m_l = 2l+1 \\ &= 6+1 \\ &= 7 \end{aligned}$$

$$\text{max. no. of } e^- = 2 \times 7 = 14$$

$\frac{l}{0}$	types of orbitals	total no. of orbitals
	m_l	
	$0 \} = 1$	
l	$\begin{array}{c} -1 \\ 0 \\ +1 \end{array} \} = 3$	
$m=4$	$\begin{array}{c} -2 \\ -1 \\ 0 \\ +1 \\ +2 \end{array} \} = 5$	$1+3+5+7 = 16$ (4^2)
3	$\begin{array}{c} -3 \\ -2 \\ -1 \\ 0 \\ +1 \\ +2 \\ +3 \end{array} \} = 7$	

Max. no. of orbitals possible in a n th shell = n^2
 i.e. max. e^- which can exist in a shell = $2n^2$