

Nephelauxetic effect :-

⇒ Nephelauxetic Series :-

The nephelauxetic series is a list of ligands of the strength of their nephelauxetic effect.

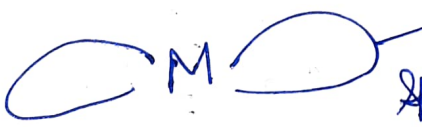
⇒ Nephelauxetic effect :-

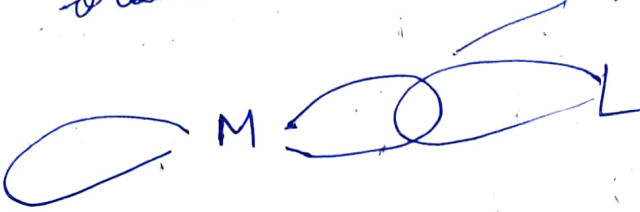
Greek word meaning = cloud expansion.

" The expansion of metal ion d-orbital electron cloud.

In a metal there is a d-orbital electrons. So it means that all the electrons are present only in a d-orbital of metal. which cause repulsion between the electrons (inter e⁻-repulsion).

But when an isolated M-atom make a bond ⇒ with ligands ~~at~~ so due to the M-L bonding the d-orbital of metal ion expands. which cause a less inter electronic repulsion. This effect is known as Nephelauxetic effect.

In Metal ion  In d-orbital the space is very less. So e⁻ repulsion is high.

But when the metal ion d-orbital ~~no~~ overlap the ligand orbital.  Now space is large. the e⁻ can easily move. So, repulsion will get less. This type of effect is called Nephelauxetic effect.

Nephelauxetic effect :-



It is a list of ligands or metal ions ordered on the basis of the ~~the~~ strength of their Nephelauxetic effect.

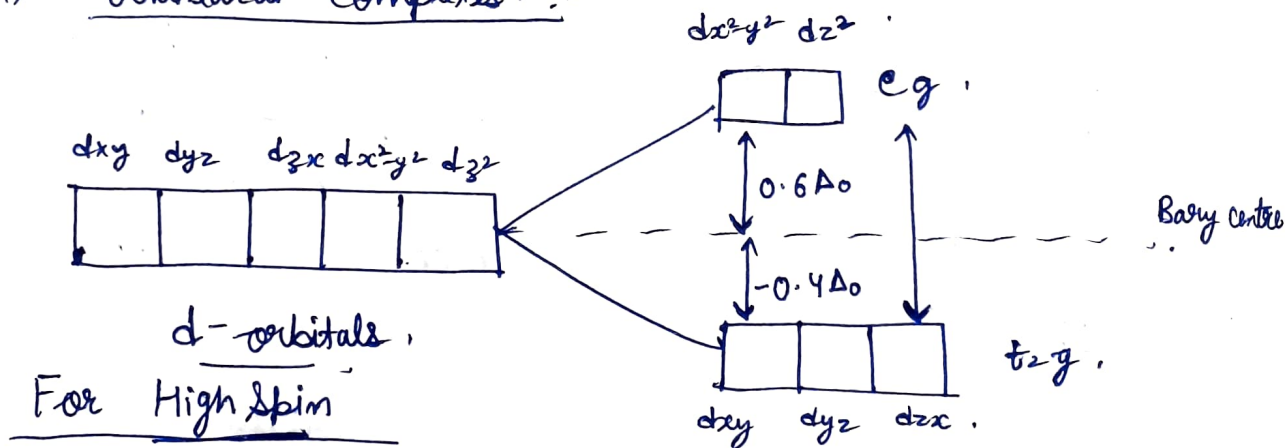
Nephelauxetic parameter is denoted by β .

$$\beta = \frac{B'}{B} \quad \begin{matrix} \text{(For complex)} \\ \text{(Free metal ion)} \end{matrix}$$

$$\beta < 1$$

Crystal field stabilisation energy :-

1) octahedral complexes :-



$$C.F.S.E = [-0.4P + 0.6q] \Delta_o$$

P is the number of electrons present in t_{2g} .
 q is the number of electrons present in e_g .

Low Spin.

$$C.F.S.E = [-0.4P + 0.6q] \Delta_o + mP \rightarrow \text{Pairing energy}$$

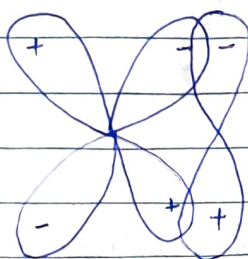
m is the number of Pairs of electrons caused by the ligands.

#

MOT

MOT stands for molecular orbital theory.
 it relates to ligand orbital theory.
 it is the distribution of electrons in atomic orbitals in a molecule.

Metal - ligand interaction.



Metal ligand

π -Bonding in octahedral complexes.

orbitals.	Representation
S	a_{1g}
p_x, p_y, p_z	t_{1u}
d_{xy}, d_{yz}, d_{zx}	t_{2g}
$d_{x^2-y^2}, d_{z^2}$	e_g

Where a = non-degenerate
 e = doubly degenerate
 t = triply degenerate

Bonding ^{molecular} orbital

These orbitals have less energy and they are more stable.

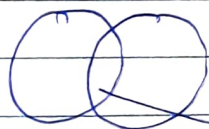
Anti-Bonding ^{molecular} orbital

These orbitals have more energy and they are less stable.

(σ) Sigma Bond formation

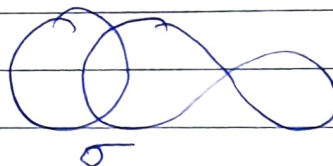
The end to end overlap of atomic orbital in a complex molecule is called sigma bond. it is denoted by σ .

S-S overlapping

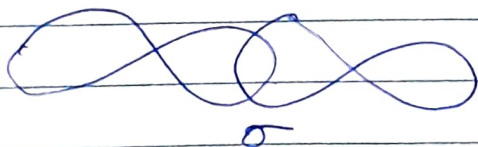


Sigma Bond
(σ)

S-P overlapping



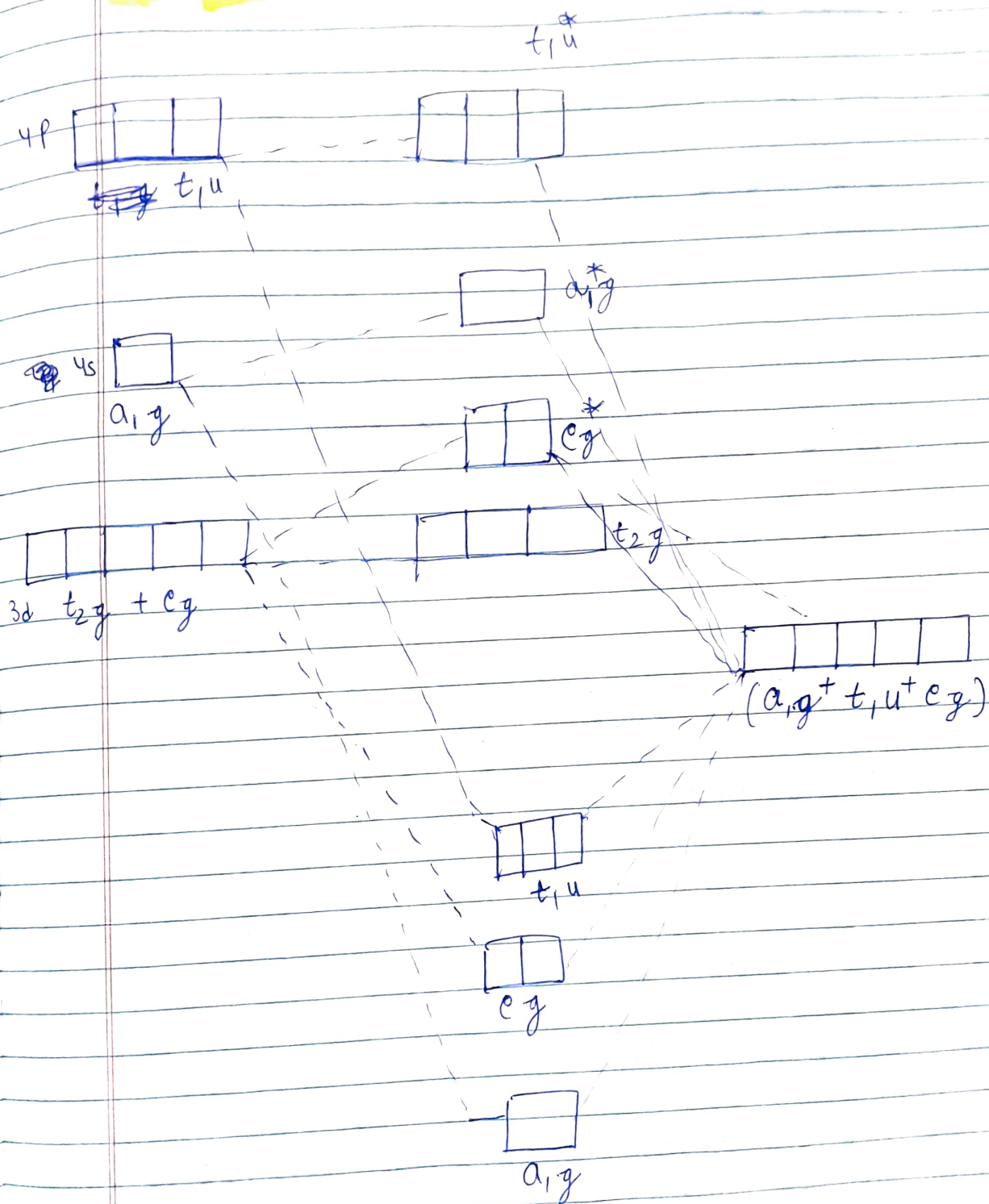
P-P overlapping



(π) Pi Bond formation

The side by side overlapping of atomic orbitals in a complex compound is called π bond. it is denoted by π .

⇒ The generation of π and σ molecular orbitals in octahedral complexes.



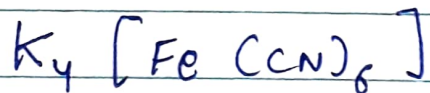
Bonding orbitals = $t_{1u}, e_g, a_{1g}, t_{2g}$.

Anti Bonding orbitals = $t_{1u}^*, e_g^*, a_{1g}^*, t_{2g}^*$.

Ques 2> = What is Coordination Compound.

=> A Coordination complex is the product of Lewis Acid - base reaction in which, neutral molecules or anions (called ligands) bond to a central metal atom (or ion) by Coordinate Covalent bonds.

Example



Potassium hexacyano ferrate (II).

Ques 3> = Give the limitations of CFT.

=> 1> The assumption of the interaction b/w Metal-ligand is purely electrostatic and can not said to realistic.

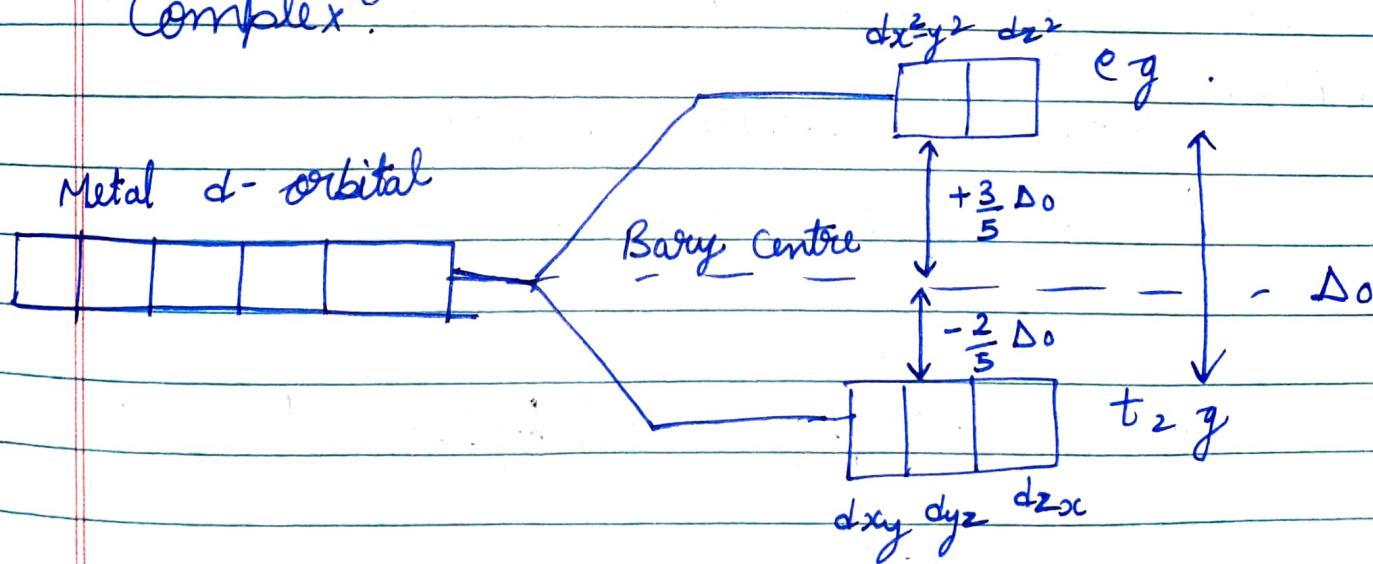
2> They theory study d-orbitals of a central metal atom but the s and p orbits are not considered for the study.

- 3) This theory could not explain the behaviour of some complexes about why some orbitals show large splitting and some show less splitting.
- 4) It cannot explain why H_2O is stronger ligand than OH^- .
- 5) The theory rules out the possibility of having p bonding. This is a serious drawback because p bonding is found in many complexes.
- 6) The theory gives no significance to the orbitals of the ligands.

Ques 6) = Explain the splitting of d-orbitals under octahedral crystal field.

=> The difference of energy b/w the two sets of d-orbitals (in octahedral complexes) is called Crystal field splitting energy [CFSE] or Δ_o .

=> Splitting of d-orbital in octahedral complex.

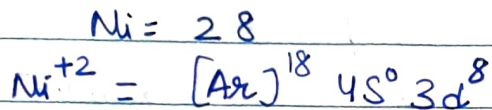


Crystal field splitting energy of octahedral

$$\Delta_o = \left(\frac{3}{5} \psi - \frac{2}{5} \eta \right) \Delta_o$$

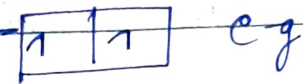
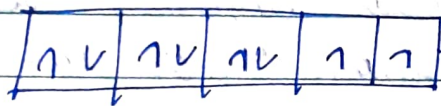
Ques 4) Calculate the CFSE value of $[\text{Ni}(\text{NH}_3)_6]$

$\Rightarrow$



$$x + 6(0) = +2$$

$$x = +2$$



$+0.6$

Δ_o

-0.4



$\text{NH}_3 = \text{Strong ligand.}$

$$\Delta_o = (0.6p - 0.4q) \Delta_o$$

$$= 0.6(2) - 0.4(6) \Delta_o$$

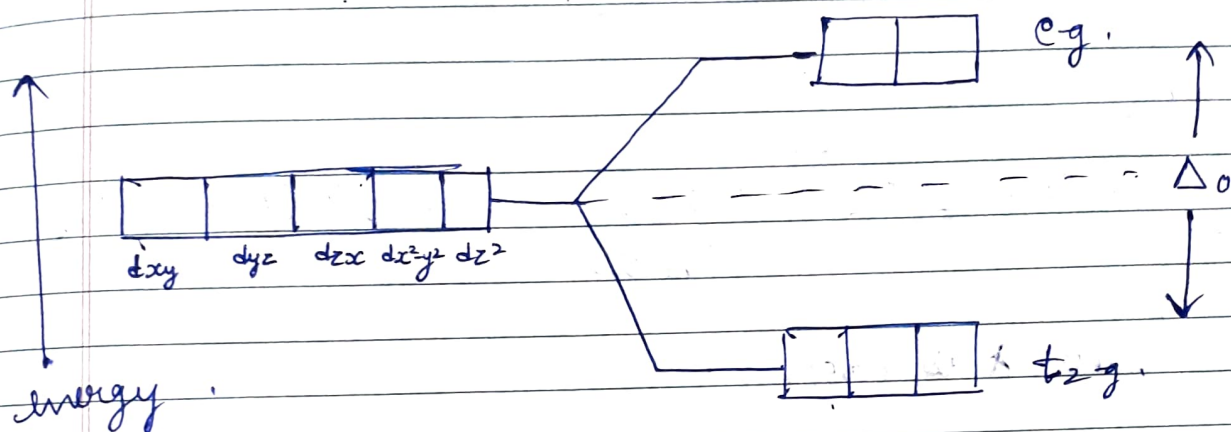
$$= (1.2 - 2.4) \Delta_o$$

$$\text{C.F.S.E} = -1.2 \Delta_o$$

Ques = What is meant by CFT?

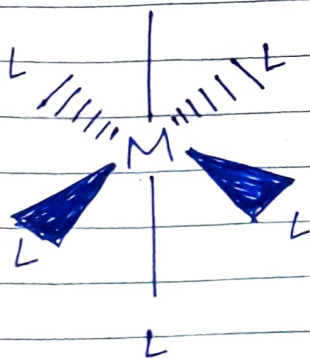
⇒ The CFT stands for Crystal field theory. It describes the breaking of orbital degeneracy in transition metal complexes due to the presence of ligands.

Crystal field splitting in octahedral complex.

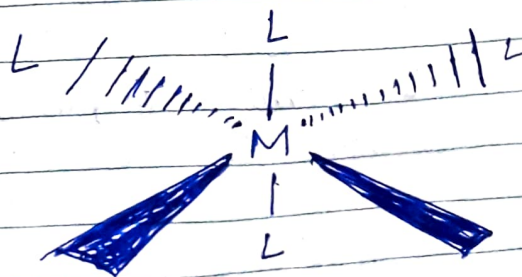


Ques = Explain Jahn-Teller distortion.

⇒ The Jahn-Teller effect is a geometric distortion of a non-linear molecular system that reduces its symmetry and energy. This distortion is typically observed among octahedral complexes where the two axial bonds can be shorter or longer than those of the equatorial bonds.



Elongated



Compressed.