

CRYSTAL FIELD THEORY

developed by Hans Bethe
& John Hasbrouck Van Vleck

CFT describes the breaking of orbital degeneracy in transition metal complex due to the presence of ligands.

→ It describes qualitatively the strength of Metal-Ligand bond.

Based on strength of $M \rightarrow L$, the energy of the system is altered.

Leads to change in Magnetic properties & color.

In simple words, this theory explains the effect of the electrical field of neighboring ions on the energies of the valence orbitals of an ion in a crystal.

Acc. to CFT, the attraction b/w the central metal & ligand in a complex is purely electrostatic.

Important features of CFT:

1. Central metal cation is surrounded by ligands which contains one or more lone pairs of electrons.
2. The ionic ligands (e.g. F^- , Cl^- , CN^- etc) are considered as negative pt. charges or point charges.

Neutral ligands (H_2O , NH_3 etc) are considered as point dipoles or simple dipoles and the negative end of ligand dipole is oriented towards the metal cation.

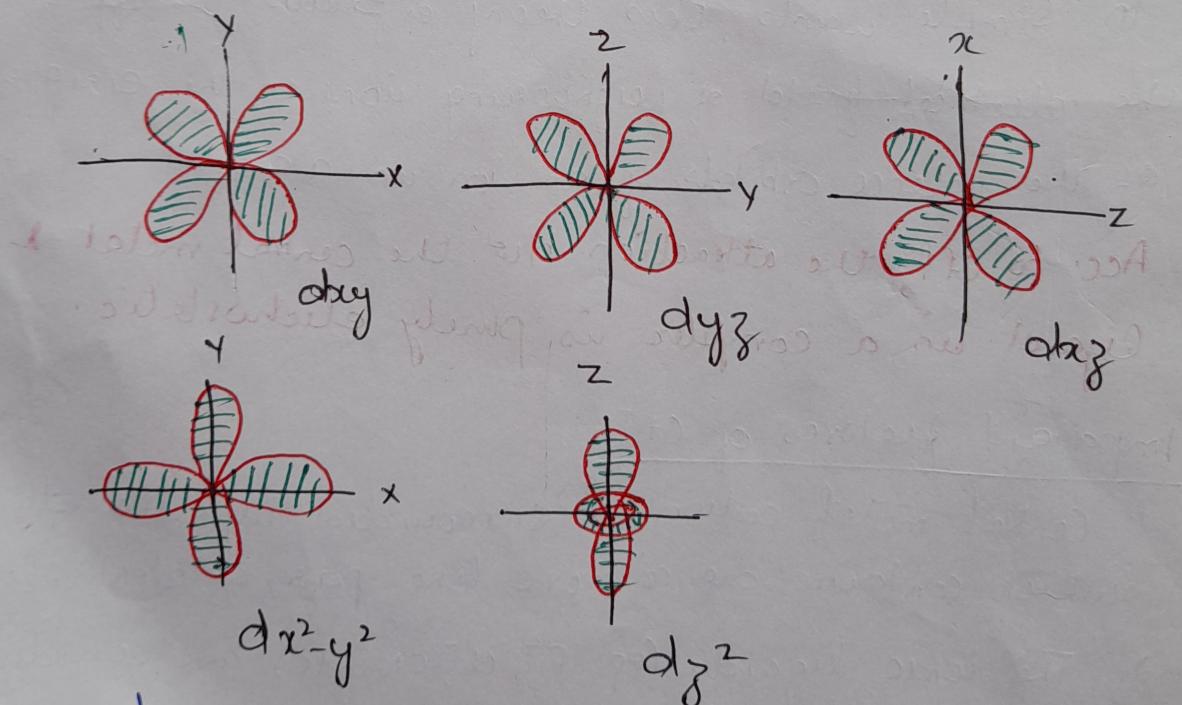
3. According to CFT, no overlapping of orbitals or mixing of orbitals takes place.

4. The bonding b/w the metal cation & ligand is not covalent, but it is purely electrostatic or Columbic attraction b/w cations & anions.

↓

"Complex form" takes place due to this electrostatic attractions of metal cation which is centrally situated and attracts -vely charged ligands or dipole molecules.

Description of d-orbitals:



- d_{xy} : lobes lie in b/w x & y axes
- d_{yz} : " " " " y & z axes
- d_{xz} : " " " " x & z axes
- $d_{x^2-y^2}$: lobes lie on the xy plane along x & y axes
- d_{z^2} : lobes lie on z -axis
 → Donut shaped ring which lies on xy plane around two lobes.

Depending upon orientation of the lobes, the 5 d-orbitals are grouped into two sets:

1. eg set of orbitals (d_{z^2} & $d_{x^2-y^2}$)

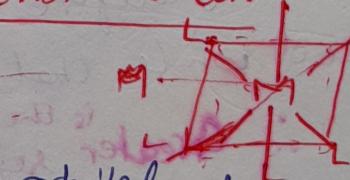
- consists two orbitals
- lobes are along the axes
- known as axial orbitals.
- Acc. to group theory, ^{also known as eg orbitals} i.e. refers to doubly degenerate set.

2. t_{2g} set of orbitals (d_{xy} , d_{yz} , d_{zx})

- includes three orbitals
- d_{xy} , d_{yz} , d_{zx}
- lobes lie b/w the axes
- non-axial orbitals
- Acc. to grp. theory, ^{known as t_{2g} orbitals} t refers to triply degenerate set.

Crystal field splitting of d-orbitals in octahedral complexes

In a single metal ion, all 5 d-orbitals have same energy.



When ligand \downarrow approaches the metal ion,

The e⁻s in d-orbitals of metal cation are repelled by -ve pt. charge or by -ve end of the dipole ligands.

\downarrow
this repulsion will raise the energy of the 5 d-orbitals.

If all the ligands approaching the central cation are at equal distance from each of the d-orbitals

the energy will raise (of all d-orbitals) by same amt.

i.e. all the d-orbitals will still remain although now will have higher energy than before.
(This is hypothetical situation)

As the lobes of eg orbitals ($d_{x^2-y^2}$ & d_{z^2}) lie directly in the path of approaching ligands, so electrons in these orbitals experience greater force of attraction repulsion than t_{2g} orbitals (lobes are b/w the axes) i.e. space b/w the path of approaching ligand.

Therefore energy of eg orbital is increased and that of t_{2g} is decreased.

Greater repulsion, greater will be the increase in energy.

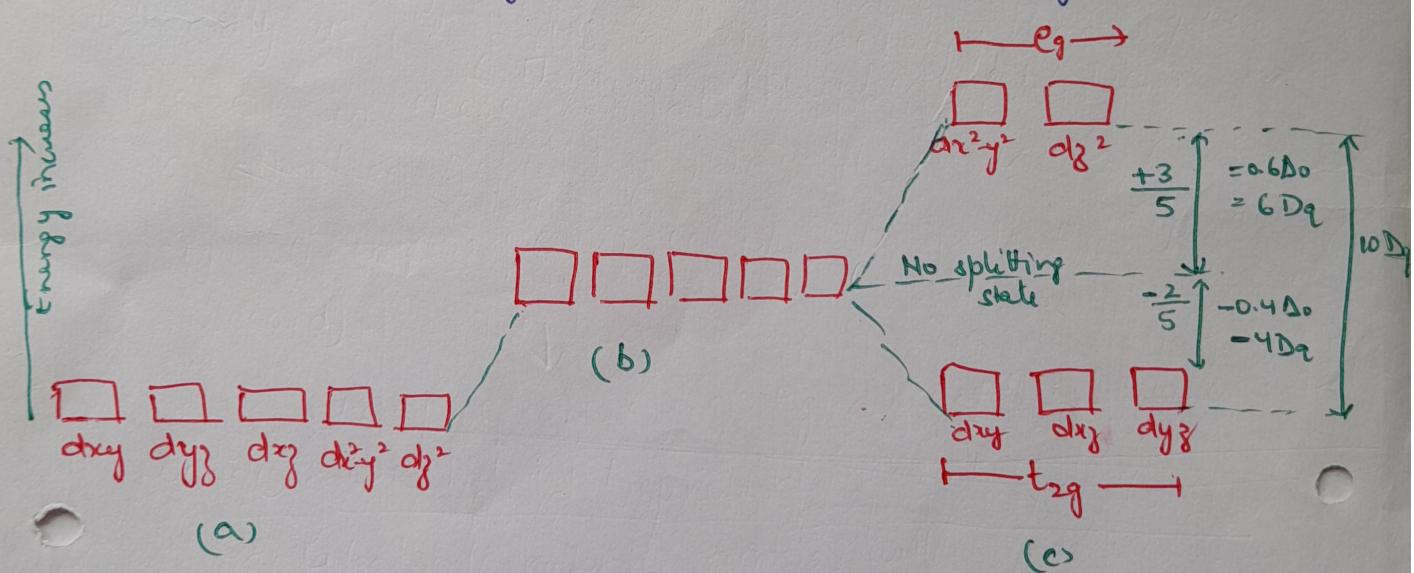
Thus, the 5 d-orbitals are now split into two levels viz., t_{2g} level which is triply degenerate and lower in energy and eg which is doubly degenerate and is of higher energy.

So, the degeneracy of 5 d-orbitals is removed under the influence of the ligands.

The Δ_e^o of 5 d-orbitals of the metal ion into two sets with different energies is known as crystal field splitting or energy level splitting. The concept of crystal field splitting makes the basis of CFT.

The energy gap b/w t_{2g} & $e_g \rightarrow \Delta_o$ or $10D_q$ where O in Δ_o indicates an octahedral arrangement of ligands round the metal cation.

$\Delta_o \rightarrow$ Crystal field splitting Energy (CFSE)



- a = five degenerate d-orbitals of the metal cation free from ligand field.
 b = hypothetical degenerate d-orbitals at a higher energy level.
 c = splitting of d-orbitals into t_{2g} & e_g under the influence of six ligands in octahedral complex.

$\therefore t_g$ Set loses energy = $0.4 D_o (4 D_q)$

c_g set gains energy = $0.6 D_o (6 D_q)$

+ sign & -ve sign indicates gain & loss of energy.

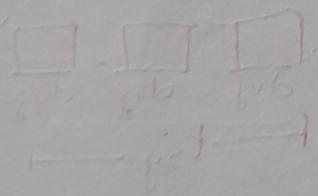
$$\Delta = \beta^2 \cdot \text{per. cycle period}$$

$\leftarrow p_1$



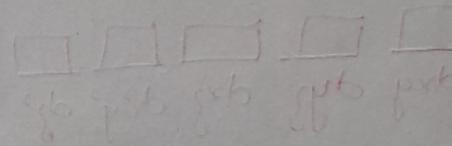
$\leftarrow p_4$

$\leftarrow p_5$



$\leftarrow p_7$

(d) ↓

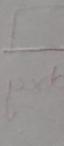


(e)

$\leftarrow p_8$

$\leftarrow p_9$

$\leftarrow p_{10}$



$\leftarrow p_9$

$\leftarrow p_{10}$

$\leftarrow p_{11}$

$\leftarrow p_{12}$

$\leftarrow p_1$

Spectrochemical Series

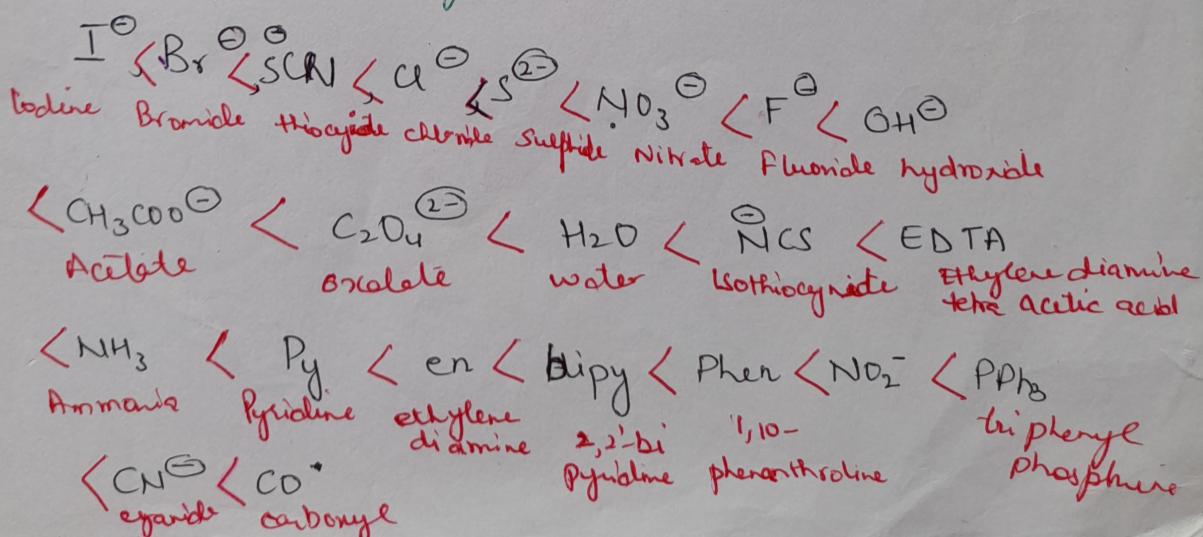
It is a list of ligands based on strength of their interaction with metal ions.

The nature of the metal plays a vital role in whether a transition metal complex is high-spin or low spin.

Interaction of ligand with metal influences d-orbital energy splitting.

If interaction of ligand with metal is weak or weak field ligand → little change in the d-orbital energy levels.

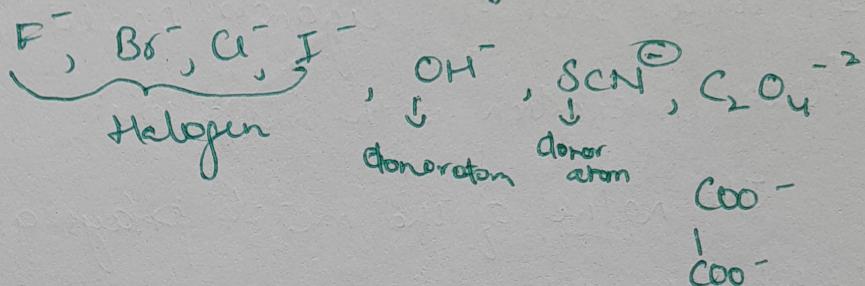
If interaction of ligand with metal is strong or strong field ligands. → large change in d-orbital energy levels.



Ligands in which donor atoms are Halogens,

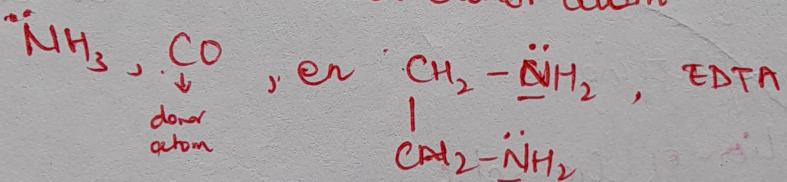
Oxygen OR Sulphur \rightarrow Weak ligands

Example:



Ligands in which donor atoms are C/N/P \rightarrow strong

e.g.: CN^- is ambidentate ligand, either C or N can be a donor atom OR N can be donor atom.



donor atom

donor atom

Donor atom

Donor atoms
Halogen atoms
Oxygen atoms
Sulphur atoms
Nitrogen atoms
Phosphorus atoms

$d_1 = t \frac{2g}{e} e^{\frac{-gt}{2}}$	$d_2 = t \frac{2g}{e} e^{\frac{-gt}{2}}$
$d_1 = t \frac{2g}{e} e^{\frac{-gt}{2}}$	$d_2 = t \frac{2g}{e} e^{\frac{-gt}{2}}$

permanently or temporarily :-

↑
long hair on tail by
end of sentence
↑
bright on
← hairy field composite
← hairy field composite
← hairy pointed composite

new spin electronic
computation

Outcomes of the elections in the leg of double member constituencies

High spun Orlon fibers

- ↳ Compaction
- ↳ Yarn per unit area
- ↳ weak fiber compaction
- ↳ more fiber compaction
- ↳ Interconnection of fibers
- ↑
↳ metall in melt
- ↳ the secondary effect by heat
- ↳ by shear stress on fiber
- ↳ small (supposed to be a small
- ↳ changeable effect on fiber

$$\overline{f_1} \quad \overline{f_2} \quad \overline{f_3} \quad \overline{f_4}$$

$$\frac{1}{11} \cdot \frac{1}{16} \cdot \frac{1}{11} = \frac{1}{176}$$

IV IV IV IV IV
I I I I I
f f f f f
C C C C C
G G G G G
P P P P P

$$\frac{d^2y}{dx^2} = \frac{e^x + e^{-x}}{e^{2x}}$$

$$\frac{\overline{II}}{\overline{I}} \quad \frac{\overline{IV}}{\overline{V}} \quad \text{log} \\ b_2 = b_1, t = P$$

$$\frac{t_1}{t_2} = \frac{t_1}{t_2} \cdot \frac{t_2}{t_2} = \frac{t_1 t_2}{t_2^2}$$

$$\frac{1}{11} \quad \frac{1}{11} \quad \frac{1}{11} \quad \frac{1}{11}$$

$$\pi \pi \pi - b_2 b_2 = p$$

$$\frac{t_1}{t_2} = \frac{e^{\frac{q}{kT}}}{e^{\frac{q}{kT_1}}} = e^{\frac{q}{k(T_1 - T_2)}}$$

$$\frac{1}{L} \frac{1}{L} \frac{1}{L} = \frac{b_{27}}{b_9}$$

$$\frac{1}{T} \frac{1}{T} \frac{1}{T} \frac{1}{T} \frac{1}{T} \frac{1}{T}$$

$$\frac{1}{T} \frac{1}{T} \frac{1}{T} \frac{1}{T} \frac{1}{T} \frac{1}{T}$$

$$\frac{1}{\log_{10} e} = \frac{1}{\log_e 10}$$

$$\frac{1}{T} \frac{1}{T} \frac{1}{T} = \frac{B_{\text{avg}}}{E}$$

$$\overline{D} \quad \overline{D} \quad \overline{D} \quad \overline{\text{big}} \\ \underline{-} \quad \underline{-} \quad \underline{\text{big}}$$

$$f_2 e^{f_2} = \rho$$

$$= t_{2g} e_g$$

As we know, Δ^o_{ion} having the form of octahedral complex, each electron occupying two orbital which is $-0.4 \Delta^o$ ($= -4D^o$) below the energy by $0.6 \Delta^o$ ($= +6D^o$) than the mean energy of Δ^o .
 Let us consider, Δ^o ion having $t_{2g} e_g$ configuration,
 where $P = n_0 \cdot g e^-$ in t_{2g}
 $E_g = P + q$ in e_g
 Now $\Delta^o = [-0.4P + 0.6q] \Delta^o + m_P$
 $CSE = (4P + 6q) \Delta^o + m_P$
 due CSE is given by the expression:
 where $P =$ pairing energy need to pair two electrons
 $\Delta^o =$ pair no. of paired electrons in t_{2g} & e_g orbitals
 $m_P =$ total no. of paired electrons in t_{2g} & e_g orbitals
 $\therefore CSE \text{ for } \Delta^o_{\text{ion}} = (-0.4P + 0.6q) \Delta^o + m_P$
 $P = 0, q = 0, n = 0, s = 0, m = 0$
 (i) $\Delta^o_{\text{ion}} = t_{2g} e_g$
 $\Delta^o =$ zero
 $= (-0.4 \Delta^o + 0.6 \times 0) \Delta^o + 0 \times 0$
 $\therefore CSE \text{ for } \Delta^o_{\text{ion}} = (-0.4P + 0.6q) \Delta^o + m_P$
 $P = 1, q = 0, n = 1, s = 1/2, m = 0$
 (ii) $\Delta^o_{\text{ion}} = t_{2g} e_g$
 $\Delta^o = -0.4 \Delta^o + 0.6 \times 1 \Delta^o + 0 \times 0$
 $\therefore CSE \text{ for } \Delta^o_{\text{ion}} = (-0.4 \times 1 + 0.6 \times 1) \Delta^o + 0 \times 1$
 $= -0.4 \Delta^o + 0.6 \Delta^o = 0.2 \Delta^o$

Octahedral Complexes

Octahedral Stabilization Energy calculation in

$$\begin{aligned}
 & = -12D^2 + 3P \\
 & = -1.2A^0 + 3P \\
 & \text{CFSE for } d^8 \text{ ion: } (-0.4 \times 6 + 0.6 \times 2) A^0 + 3P \\
 & \quad \left\{ p=6, q=2, n=2, m=0, s=\frac{1}{2} \right\} \\
 & \quad \overline{\overline{q_1 q_2 q_3}} \quad \overline{\overline{q_4 q_5 q_6}} \\
 & \quad \overline{q_1} \quad \overline{q_2} \\
 & \quad f_{d^8} \text{ Hf state} \quad f_{d^8} \text{ LS state} \\
 & \text{(v) } d^8 \text{ ion} \quad \text{CFSE for } d^8 \text{ ion: } -12D^2 + 3P \\
 & = -16D^2 + P \\
 & = -1.6A^0 + P
 \end{aligned}$$

CFSE for d₄ ion in HS state: $(-0.4 \times 4 + 0.6 \times 0) A^0 + 1 \times P$

$$\begin{aligned}
 d^4 \text{ ion} & = t_{2g}^4 e_g^2 \quad \left\{ p=4, q=0, n=4, m=1, s=\frac{1}{2} \right\} \quad A^0 + P \\
 & \text{in HS state} \\
 & = -0.6A^0 = -6D^2 \\
 & = -1.2 + 0.6A^0
 \end{aligned}$$

CFSE for d₄ ion in HS state: $(-0.4 \times 3 + 0.6 \times 1) A^0 + 0 \times P$

$$\begin{aligned}
 \text{(vi) } d^4 \text{ ion} & = t_{2g}^3 e_g^1 \quad \left\{ p=3, q=1, n=4, m=0, s=\frac{1}{2} \right\} \quad A^0 + P \\
 & \text{in HS state}
 \end{aligned}$$

If we denote nonbonding l-hu effect then CFSE of d₄ ion = -8D²

due to d-orbital splitting & unpaired electrons - electronic configuration
amongst d-orbitals.

$$\boxed{\text{Butachiral CFSE of } d^4 \text{ ion} = -6D^2}$$

$$= -0.8A^0 \text{ or } -8D^2$$

CFSE for d₂ ion = $(-0.4 \times 2 + 0.6 \times 0) A^0 + 0 \times P$

$$\begin{aligned}
 \text{(vii) } d^2 \text{ ion} & = t_{2g}^2 e_g^0 \quad \left\{ p=2, q=0, n=2, m=0, s=\frac{1}{2} \right\} \\
 & \text{in HS state}
 \end{aligned}$$

Δ	Zero	Zero	Δ
$-6.0 \Delta_a$	$-0.6 \Delta_0$	$-0.6 \Delta_0$	Δ_9
$-12 \Delta_a$	$-1.2 \Delta_0$	$-1.2 \Delta_0$	Δ_8
$-18 \Delta_a (HS)$	$-1.8 \Delta_0 (LS)$	$-1.8 \Delta_0 (LS)$	Δ_7
$-8 \Delta_a (HS)$	$-0.8 \Delta_0$	$-0.6 \Delta_0 (HS)$	Δ_6
$-4 \Delta_a (HS)$	$-0.4 \Delta_0 (HS)$	$-0.4 \Delta_0 (HS)$	Δ_5
$-3 \Delta_a (LS)$	$-0.3 \Delta_0 (LS)$	$-0.3 \Delta_0 (LS)$	Δ_4
$-6 \Delta_a (HS)$	$-0.6 \Delta_0 (HS)$	$-0.6 \Delta_0 (HS)$	Δ_3
$-12 \Delta_a$	$-1.2 \Delta_0$	$-1.2 \Delta_0$	Δ_2
$-8 \Delta_a$	$-0.8 \Delta_0$	$-0.6 \Delta_0$	Δ_1
Zero	Zero	Zero	Δ_0

CFSF value in Δ_a

CFSF value in Δ_0

$\Delta x = 1 \text{ to } 10$

CFSF values of diff. Δ_a are summarized below
C F S F e r r a r y o f d i f f . n o t c o n s i d e r e d

W61

Cubic field Theory of tetrahedral complex

A cube, an octahedron & a tetrahedron are related geometrically.

Octahedral voids will occur when liquids are placed in the cache & vice versa.

Tetrahedral voids will occur when liquids are placed out of parallel lines.

Corners of cubes.

Octahedron

Octahedron

Liquid

Tetrahedral voids will occur when liquids are placed out of parallel lines.

Liquid out of parallel lines

Corners of cubes.

Octahedron

Tetrahedral voids will occur when liquids are placed in the cache & vice versa.

Corners of cubes.

$\Delta t = \frac{d\theta}{dt}$ for energy due to the orbit.

Caused by α at from no splitting due to t_2 orbitals are formed by α at Δt & a orbital are combination.

The splitting of d-orbital is applicable to set of d-orbitals of the central atom due to spin of t_2 & e orbitals of H-ligands in a tetrahedral complex, EDO .

In other words, it can be said that due to the splitting of the ligands in octahedral manner the splitting of d-orbital is observed in combination of d-orbital in addition to a orbital.

So e-orbitals are at lower energy level than t₂ orbitals.

As a result, energy of t_2 -orbital increased to a larger extent than that of e-orbital.

Electron of t_2 -orbital experience greater repulsion than e-orbital.

Ligands than e orbitals

As t_2 -orbitals are closer to the other of approaching model atom, the energy of e & t_2 sets \downarrow .

In a tetrahedral complex, when H-ligands approach the ligands than e orbitals

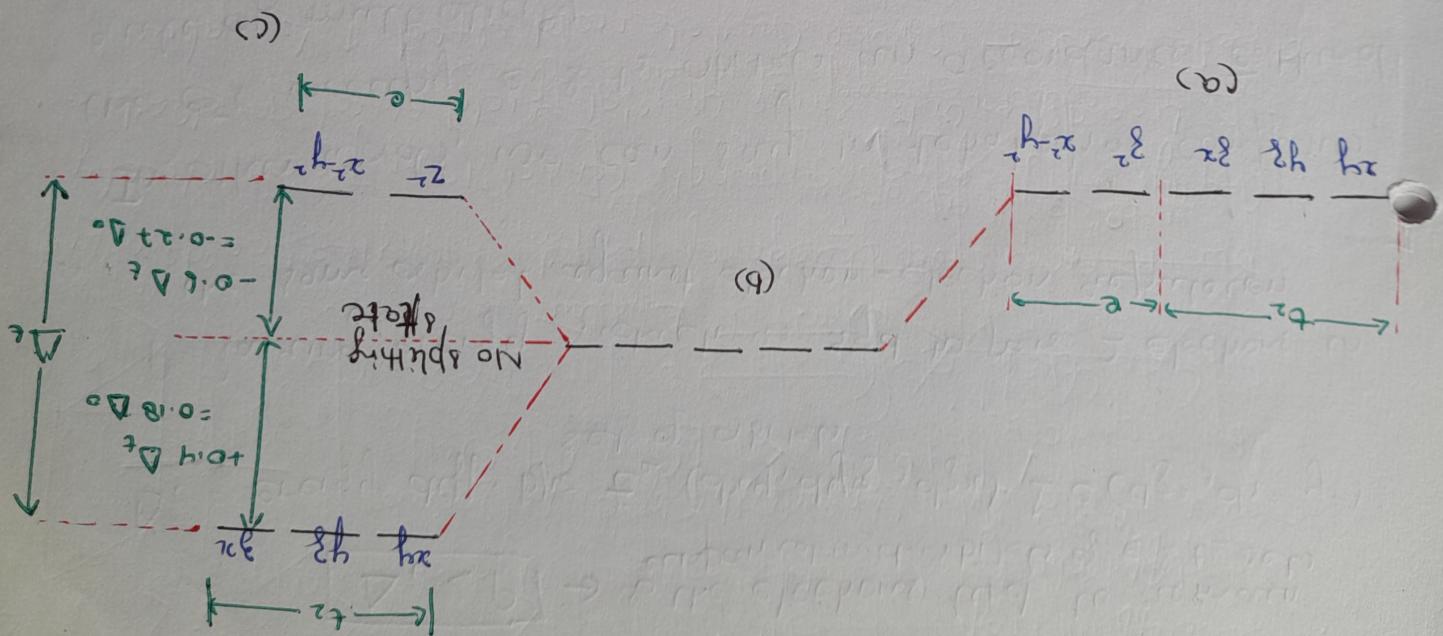
Reactorly more of the d-orbitals points directly towards

Central field Theory of Tetrahedral
Complexes

$$\Delta t = 0.45 \Delta \omega = 0.45 \Delta \alpha$$

Resultantly $\propto \Delta \omega, \Delta \alpha, \Delta \alpha$

- (a) Splitting of d -orbitals in tetrahedral complex
- (b) Hypercentral degeneracy of d -orbitals of a highly charged ion.
- (c) d diagonal d-orbitals in the central atom from ligand field
- (d) splitting of d -orbitals in a tetrahedral complex



	$D_8 = e^{2t_2}$	$D_9 = e^{2t_3}$
	$D_{10} = e^{2t_4}$	$D_{11} = e^{2t_5}$
	$D_{12} = e^{2t_6}$	$D_{13} = e^{2t_7}$
	$D_{14} = e^{2t_8}$	$D_{15} = e^{2t_9}$

b) Paving steps from e -orbital (with energy).

c), paving steps when each drivabilities in a fixed sequence given.

(a) Threaded connections

∴ Threaded connections are High spin (Hs)

In other words, we can say in threaded connections,
the e_g occupancy is $\frac{1}{2}$ & t_2 orbitals in accordance to Hund's rule of multiplicity.

P = Paving energy, which is said to pair 2 electrons in the same orbital about electron-electron repulsion

$\Delta E = \text{energy diff. b/w } t_2 (\text{dx}^2, \text{dy}^2, \text{dz}^2) \text{ & } e (\text{d}x^2, \text{dz}^2 - \text{y}^2)$

$\Delta E < P \rightarrow$ if the electrons tend to remain in same orbital

In case of threaded connections

e & t_2 sets of orbitals in threaded connections
Distribution of dx electrons ($n=10$) in Mn^{2+} is

Calculation of CFSE of d^2 ions w.r.t. Tetrahedral complexes
 In case of tetrahedral complexes, the energy of electrons is lowered by $0.6 \Delta_e - 2 \Delta_t$, i.e., total energy is reduced by $0.4 \Delta_e$. Let us consider d^2 ion with configuration $\{p=1, q=0\}$ w.r.t. $p+q$ hole. If we consider d^2 ion with configuration $\{p=0, q=1\}$ w.r.t. $p+q$ hole, then the energy of d^2 ion will be zero. So, CFSE of d^2 ion = $(-0.6 \times p + 0.4 \times q) \Delta_e$

CFSE value: $\Delta_e = (-0.6 \times p + 0.4 \times q) \times 0.45 D_g$
 $\Delta_t = (-0.6 \times p + 0.4 \times q) \Delta_e$

(i) $d^2_{10m} = e^{t_2} \{p=0, q=0\}$
 $\text{CFSE} = C(-0.6 \times 0 + 0.4 \times 0) \Delta_e = \text{Zero}$

(ii) $d^2_{10m} = e^{t_2} \{p=1, q=0\}$
 $\text{CFSE} = C(-0.6 \times 1 + 0.4 \times 0) \Delta_e = -0.6 \Delta_e$

(iii) $d^2_{10m} = e^{t_2} \{p=1, q=1\}$
 $\text{CFSE} = C(-0.6 \times 1 + 0.4 \times 1) \Delta_e = -0.2 \Delta_e$

or $(0.6 \times 1 + 0.4 \times 0) \times 0.45 D_g = -0.27 \Delta_e$

or $-0.2 \times 0.45 D_g = -0.27 \Delta_e$

or $-5.4 D_g$

$$= (-0.6 \times 4 + 0.4 \times 6) \Delta t = 2\pi$$

$$d_{10,im} = e^{4t_2} \quad \left\{ \begin{array}{l} p=4, q=6 \\ \alpha = 1.8 \Delta a \end{array} \right.$$

$$\alpha = 0.4 \times 0.45 \Delta a = -0.18 \Delta a$$

$$C_{ASE} = (-0.6 \times 4 + 0.4 \times 5) \Delta t = -0.4 \Delta t$$

$$d_{9,im} = e^{4t_2} \quad \left\{ \begin{array}{l} p=4, q=5 \\ \alpha = -8.6 \Delta a \end{array} \right.$$

$$\alpha = -0.8 \times 0.45 \Delta a = -0.36 \Delta a$$

$$C_{ASE} = (-0.6 \times 4 + 0.4 \times 4) \Delta t = -0.8 \Delta t$$

$$d_{8,im} = e^{4t_2} \quad \left\{ \begin{array}{l} p=4, q=4 \\ \alpha = -5.4 \Delta a \end{array} \right.$$

$$\alpha = -1.2 \times 0.45 \Delta a = -0.54 \Delta a$$

$$C_{ASE} = (-0.6 \times 4 + 0.4 \times 3) \Delta t = -1.2 \Delta t$$

$$d_{7,im} = e^{4t_2} \quad \left\{ \begin{array}{l} p=4, q=3 \\ \alpha = -8.7 \Delta a \end{array} \right.$$

$$\alpha = -0.6 \times 0.45 \Delta a = -0.27 \Delta a$$

$$C_{ASE} = (-0.6 \times 3 + 0.4 \times 3) \Delta t = -0.6 \Delta t$$

$$d_{6,im} = e^{3t_2} \quad \left\{ \begin{array}{l} p=3, q=3 \\ \alpha = -0.2 \Delta a \end{array} \right.$$

$$= \alpha \times 0.45 \Delta a = 0 \quad (3\pi)$$

$$C_{ASE} = (-0.6 \times 2 + 0.4 \times 3) \Delta t = 0$$

$$d_{5,im} = e^{2t_2} \quad \left\{ \begin{array}{l} p=2, q=3 \\ \alpha = -1.8 \Delta a \end{array} \right.$$

$$\alpha = (-0.6 \times 2 + 0.4 \times 2) \times 0.45 \Delta a = -0.18 \Delta a$$

$$C_{ASE} = (-0.6 \times 2 + 0.4 \times 2) \Delta t = -0.4 \Delta t$$

$$d_{4,im} = e^{2t_2} \quad \left\{ \begin{array}{l} p=2, q=2 \\ \alpha = 8.6 \Delta a \end{array} \right.$$

$$\alpha = (0.6 \times 2 + 0.4 \times 1) \times 0.45 \Delta a = 0.36 \Delta a$$

$$C_{ASE} = (0.6 \times 2 + 0.4 \times 1) \Delta t = -0.18 \Delta t$$

$$d_{3,im} = e^{2t_1} \quad \left\{ \begin{array}{l} p=2, q=1 \\ \alpha = 8.6 \Delta a \end{array} \right.$$

↳ Value of confidence = sum of goods and services
↳ diff. in income some extra effort belongs to same
ref. in sources as we move from it towards some
to II & III result in double ad then to the IIIrd.

Volume of Δ & Planck's law Quantum also (n) of orbitals

(ii) Coulomb M ions belonging to the same group

3. Nature of Centralization

b) In electrodeatal combustion \rightarrow Legendre polynomial effectively in the partials of set of orbitals (dx^2, dy^2, dz^2) will be in the spherical coordinates $\left(\theta, \phi \right)$ due to a rotation of the molecule.

a) In Osteohelial complex, 6 ligaments are involved but in terahedral complex, 4 ligaments are involved \Leftarrow result

↳ zijgenoed bij verschillende gezondheden

or $1.3\Delta_0 < \Delta_0 < 0.45\Delta_0$ $\therefore \Delta_0 = 4.5\Delta_1$

$$\Delta_0 = 10 \Delta_a$$

上 2

$$\Sigma \frac{b}{n} = 75$$

$$\Delta_{sp} < \Delta_t < \Delta^*$$

amount of complex ion

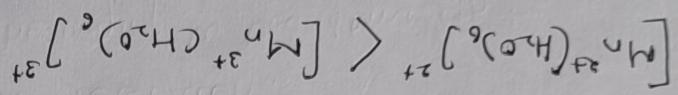
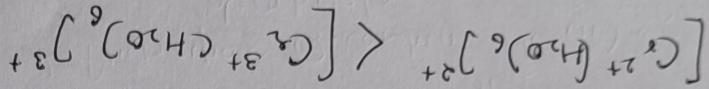
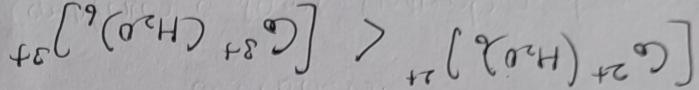
Factors affecting the magnitude of A.

Hence effect will be greater and finally have equilibrium.

The addition of the ligand increases the charge density in solution which is due to delocalization \downarrow in σ -bonding which is due to \uparrow

$\Delta \text{value in cm}^{-1}$

$\Delta \text{value in cm}^{-1}$

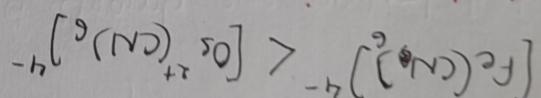


$\Delta \text{value } \text{Ti}^3 \text{ with } \text{Ti}^2 \text{ in Dlal}$

- Δvalue same
- Δvalue same
- Δvalue same
- Δvalue same

Q) certain metal ions of same metal ∞ alloy could react

Effect due to same ligand CN^- , $\text{Hd} \& \text{SO}_4^-$ orbital interaction
more effectiveness ∞ than SO_4^{2-} . In moving down
metals change of Δvalue increase, which also have an
 Δvalue in the magnitude of AO .



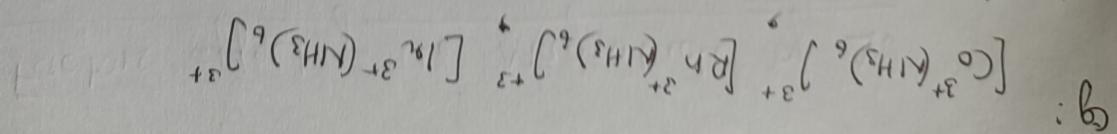
$\text{AO} \rightarrow \infty$ we move down the gp

same ionicity, bond of some ligands

All above examples have down ligands, same ionicity,

$\Delta \text{value in cm}^{-1}$

$\Delta \text{value } 23000 < 34000 < 41000 \text{ cm}^{-1}$



Some common liquids are arranged in the following order of specific dielectric常数.

Water → less CFS strength → less ΔV_{value}

Strong liquid → more CFS strength → more ΔV_{value}

Stronger the splitting strength more will be ΔV_{value} .

Liquid has different capacities for splitting strengths changes the ΔV_{value} .

Diff. in capacity
Same molecule
Same molecule

3. Nature of liquids: Specific dielectric常数

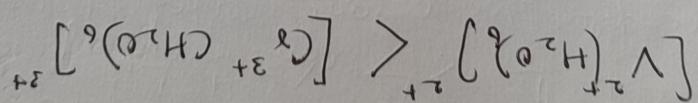
To be high the capacity of ΔV_{value} electrons more strongly. and a good approach charge will be more closely.

$\Delta V_{\text{value}} \rightarrow$ short range field effect $\rightarrow \Delta V_{\text{value}}$.

∴ liquids have short range field effect on density.

∴ liquids have short range field effect on density.

$\Delta V_{\text{value}} \rightarrow$ O.S. interaction



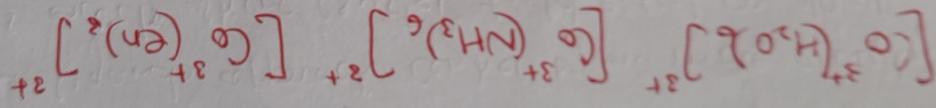
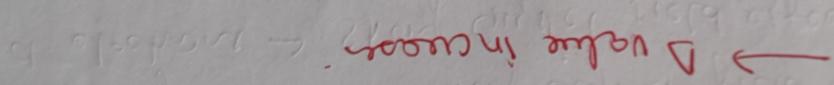
Diff. O.S.

$\Delta V_{\text{value}} \rightarrow$ $\epsilon \rightarrow$ in 0.1 M.l.m.

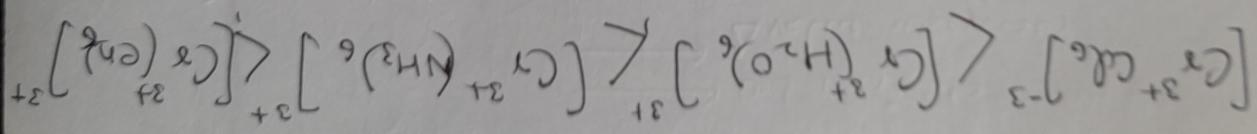
Diff. in ϵ
Same molecule
Same molecule

c) Several molecules of different ions having diff. O.S.

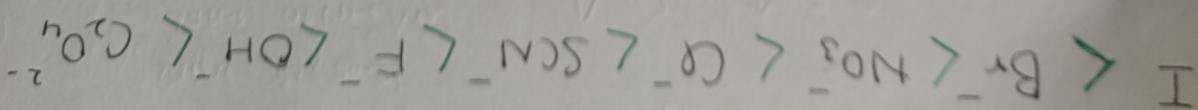
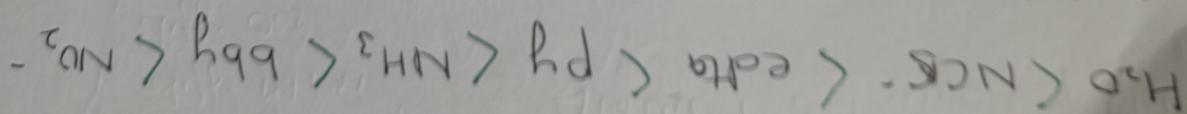
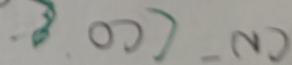
monopodium



Δ^0 value increases \leftarrow



boys



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Yellow	Blue	Red
Copper	Yellow-green	Orange
Honey	Yellow	Yellow-orange
Yellow-orange	Yellow	Orange-red
Purple	Blue	Red
Blue	Blue	Red
Green	Blue-green	Orange
Blue-green	Blue	Orange
Blue	Blue	Orange
Green-blue	Blue	Orange
Blue	Blue	Orange
Yellow	Yellow	Orange
Yellow-orange	Yellow	Orange
Orange	Yellow	Orange
Orange-red	Yellow	Orange
Red	Blue	Red
Red	Blue	Red
Orange	Blue	Red
Orange	Blue	Red
Yellow	Blue	Red
Yellow	Blue	Red

Every colour corresponds to a range of particular wavelengths which are absorbed by the other colour. Which on complementary colour and therefore the other colour will be reflected.

Every colour corresponds to a range of particular wavelengths which appear as an evenly gradated colour. Every colour absorbs light of particular wavelength which is not absorbed by the other colour. The Ao of Trans. Refl. Compt. is to a series which makes it possible to absorb visible light.

3. Color of Compton:

Electron paired \rightarrow diamagnetic { Bohr's model
not paired \rightarrow paramagnetic } Magnetic

weak field applied \rightarrow high spin state

more splitting

strong field applied \rightarrow low spin state

2. Magnetic properties of Compton:

1. Pauli's HS & LS States of Compton:

Application of CFT: