Chemistry Study Materials for Class 12
(NCERT Based Notes of Chapter - 09)
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Co-ordination Compounds

Spectrochemical series

$$I^- < Br^- < SCN^- < Cl^- < S^{2-} < F^- < OH^- < C_2O_4^{2-} < H_2O < NCS^- < EDTA^{4-} < NH_3 < en < CN^- < CO.$$

Crystal field splitting in octahedral complexes

In case of octahedral complexes, energy separation is denoted by Δ_o (where subscript 0 is for octahedral).

In octahedral complexes, the six-ligands approach the central metal ion along the axis of $dx^2 - y^2$ and dz^2 orbitals.

Energy of e_g set of orbitals > energy of t_{2g} set of orbitals.

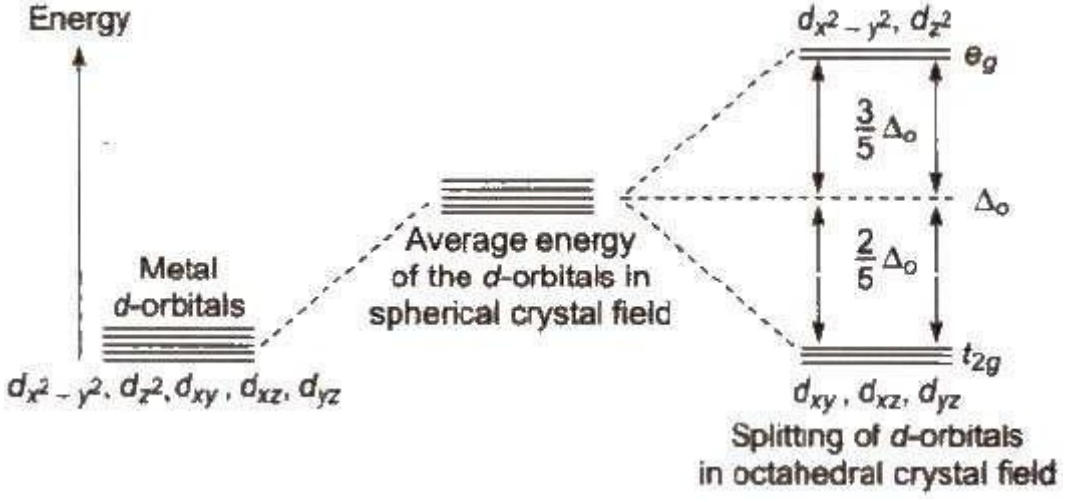
The energy of e_g orbitals will increase by (3/5) Δ_o and t_{2g} will decrease by (2/5) Δ_o.

If Δ_o < P, the fourth electron enters one of the e_g orbitals giving the configuration $t^3_{2g}\ e^1_g$. Ligands for which Δ_o < P are known as weak field ligands and form high spin complexes.

If Δ_o > P, it becomes more energetically favourable for the fourth electron to occupy a t_{2g} orbital with configuration $t^4_{2g}\ e^o_g$.

(where, P = energy required for e^- pairing in an orbital).

Ligands which produce this effect are known as strong field ligands and form low spin complexes.



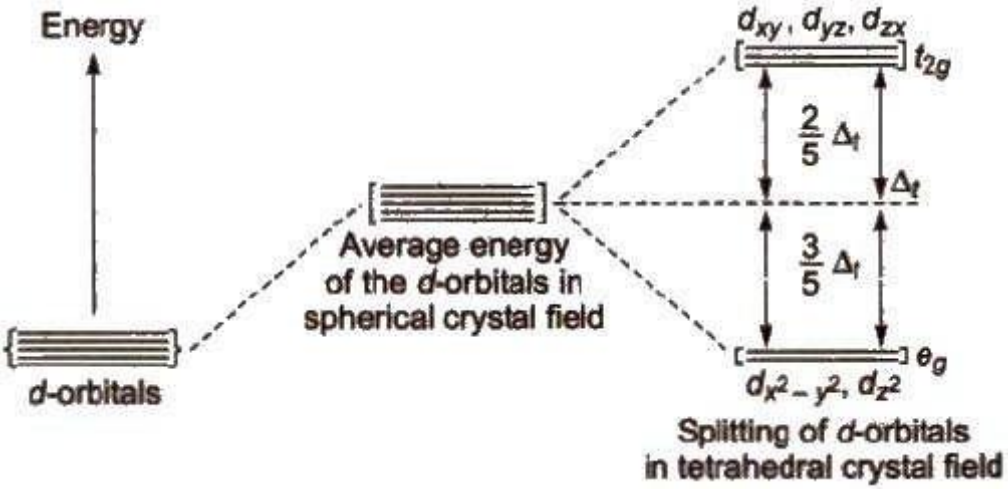
Crystal field splitting in tetrahedral complexes

In tetrahedral complexes, four ligands may be imagined to occupy the alternate comers of the cube and the metal ion at the center of the cube.

Energy of t_{2g} set of orbitals > Energy of e_g set of orbitals.

In such complexes d – orbital splitting is inverted and is smaller as compared to the octahedral field splitting.

Orbital splitting energies are so low that pairing of electrons are not possible so these are high spin complexes.



Colour in Coordination Compounds

The crystal field theory attributes the colour of the coordination compounds to d- d transition of the electron, i.e., electron jump from t_{2g} level to higher e_g level.

In the absence of ligands, crystal field splitting does not occur and hence the substance is colourless.

$[Ti(H_2O)_6]^{3+}$ — Violet in colour

$[Cu(H_2O)_4]^{2+}$ — Blue in colour, etc.

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