

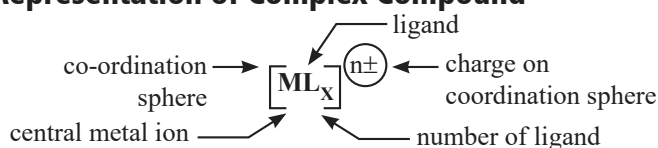


CHAPTER

11

Coordination Compounds

Representation of Complex Compound



Co-ordination number = Number of atoms surrounded to central metal ion.

Notes:

Bidentate and Polydentate are also called chelating ligand.

Bonding in Coordination Compound

Effective Atomic Number & Sidgwick Rule

Total number of electron present on central metal atom or ion after accepting the electron pair from ligand.

VBT

- ❖ Metal provide hybridised vacant orbital for the acceptance of lone pair from ligand.
- ❖ Hybridisation, shape and magnetic behaviour of complex depends upon the nature of ligand.
- ❖ Strong field ligand pair up the unpaired e^- of central metal atom where as weak field ligand does not.
- ❖ If unpaired e^- present in complex then complex is paramagnetic. If unpaired e^- is absent then diamagnetic.
eg. C.N. = 4; $[\text{NiCl}_4]^{2-}$

Series which shows the Relative Strength of Ligands

I^- (weakest) $< \text{Br}^- < \text{SCN}^- < \text{Cl}^- < \text{S}^{2-} < \text{F}^- < \text{OH}^- < \text{C}_2\text{O}_4^{2-} < \text{H}_2\text{O} < \text{NCS}^- < \text{edta}^{4-} < \text{NH}_3 < \text{en} < \text{CN}^- < \text{CO}$ (strongest)

Exception

$[\text{Co}(\text{OX})_3]^{3-}$	d^2sp^3	diamagnetic
$[\text{Co}(\text{H}_2\text{O})_6]^{3+}$	d^2sp^3	diamagnetic
$[\text{NiF}_6]^{2-}$	d^2sp^3	diamagnetic
$[\text{Cr}(\text{NH}_3)_6]^{2+}$	sp^3d^2	paramagnetic
$[\text{Mn}(\text{NH}_3)_6]^{2+}$	sp^3d^2	paramagnetic
$[\text{Fe}(\text{NH}_3)_6]^{2+}$	sp^3d^2	paramagnetic
$[\text{CoL}_6]^{4+}$ (L = $\text{NO}_2^- / \text{CN}^-$)	d^2sp^3	paramagnetic

Exception

- ❖ d^3 's hybridisation, Td, diamagnetic, inner orbital complex eg. $\text{MnO}_4^-, \text{CrO}_4^{2-}, \text{Cr}_2\text{O}_7^{2-}, \text{CrO}_2\text{Cl}_2, \text{CrO}_2\text{F}_2, \text{VO}_4^{3-}$
- ❖ Transference of electron
eg. Cu^{+2} in C.N. $\rightarrow 4$ with L
(where L = $\text{NO}_2^- / \text{CN}^- / \text{NH}_3$ etc.)

Organometallic Compounds

Compounds in which the less E.N. (Ge, Sb, B, Si, P, As) central metal atoms are bonded directly to carbon atoms are called organometallic compounds.

- ❖ σ -bonded compounds formed by nontransition elements.
 $\text{R-Mg-X}, (\text{CH}_3\text{-CH}_2)_2\text{Zn}$, Ziegler natta catalyst, etc.
- ❖ π -bonded organometallic compounds are generally formed by transition elements e.g. Zeise's salt, ferrocene, dibenzene chromium, etc.
- ❖ σ -and π -bonded organometallic compounds: Metal carbonyls compounds formed between metal and carbon monoxide belong to this class. $\text{Ni}(\text{CO})_4, \text{Fe}(\text{CO})_5$ etc.

Stereo Isomerism

Stereo Isomerism in Co-ordination Compound

CN-4

- ❖ Square planar complex does not show optical isomerism.
- ❖ Square planar complex show optical activity if the co-ordinated ligand having chiral center.
- ❖ Square planar complex
 $[\text{Ma}_2\text{b}_2]^{n\pm}, [\text{Ma}_2\text{bc}]^{n\pm}, [\text{Mabcd}]^{n\pm}, [\text{M}(\text{AB})\text{cd}]^{n\pm}$
- ❖ $[\text{M}(\text{AB})(\text{CD})]^{n\pm}$ show geometrical isomerism
- ❖ $[\text{Mabcd}]^{n\pm}$ form two cis and one trans.
- ❖ Tetrahedral complex $[\text{Mabcd}]^{n\pm}, [\text{M}(\text{AB})\text{cd}]^{n\pm}, [\text{M}(\text{AB})(\text{CD})]^{n\pm}$ show optical isomerism
- ❖ Tetrahedral complex does not show geometrical isomerism.