CLASS 12 CHEMISTRY REVISION NOTES

Class 12 Chemistry Chapter 5 Coordination Compounds – Revision Notes

Quick revision notes for Class 12 Chemistry Chapter 5 – Coordination Compounds, covering Werner's theory, nomenclature, isomerism, bonding theories, and applications. Ideal for last-minute board exam revision.

Contents

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Werner's Theory and Basic Definitions

Werner's postulates distinguish a metal's **primary valence** (ionisable, = oxidation state) from its **secondary valence** (non-ionisable, = coordination number, fixed spatial geometry). A **ligand** is bonded to the central metal via a donor atom; ligands can be **unidentate** (one donor atom, e.g. NH_3), **didentate** (two, e.g. ethane-1,2-diamine), **polydentate/chelating** (several, e.g. EDTA), or **ambidentate** (two possible donor atoms, only one used at a time, e.g. NO_2^-, SCN^-). Complexes with only one type of ligand are **homoleptic**; those with more than one type are **heteroleptic**.

IUPAC Nomenclature

Key rules: cation is named before anion; ligands are named **alphabetically** (ignoring multiplying prefixes like di-, tri-, bis-, tris-); anionic ligand names end in **"-o"** (e.g. chlorido, cyanido, oxalato); the metal's oxidation state is written in **Roman numerals** in parentheses immediately after its name; and if the complex ion is an anion, the metal name takes the suffix **"-ate"** (e.g. ferrate, cobaltate, nickelate).

Isomerism

Structural isomerism: linkage (ambidentate ligand bonds via different atoms), ionisation (interchange of ligand and counter-ion), coordination (interchange of ligands between cationic and anionic complex parts), and solvate/hydrate isomerism. **Stereoisomerism:** geometrical (cis-trans, fac-mer, in square-planar and octahedral complexes) and optical (non-superimposable mirror images, common in octahedral chelate complexes like $[Cr(C_2O_4)_3]^{3-}$).

Bonding Theories: VBT and CFT

Valence Bond Theory (VBT) assigns hybridisation (d^2sp^3 or sp^3d^2 for octahedral, dsp^2 for square planar) based on whether the ligand forces electron pairing (strong field, low spin) or not (weak field, high spin). **Crystal Field Theory (CFT)** explains this via **d-orbital splitting**: in an octahedral field, the d-orbitals split into a lower $\mathbf{t_{2g}}$ set and a higher $\mathbf{e_g}$ set, separated by Δ_o. The **spectrochemical series** ranks ligands by field strength (weak: I^-, Br^-, Cl^-, F^-, H_2O … strong: NH_3, en, CN^-, CO); a large Δ_o (strong field) favours low spin, a small Δ_o (weak field) favours high spin. Colour arises from **d-d transitions** across this gap; magnetic behaviour follows from the number of unpaired electrons via $\mu=\sqrt{n(n+2)}$ BM.

Metal Carbonyls and Stability

Bonding in metal carbonyls is **synergic**: σ-donation from CO to the metal, plus π-backdonation from the metal's filled d-orbitals into CO's empty π* orbital. Complex **stability** is enhanced by the **chelate effect** — polydentate ligands (like en, oxalate, EDTA) form more stable complexes than equivalent unidentate ligands.

Applications

Coordination compounds are vital **biologically** (chlorophyll: Mg; haemoglobin: Fe; vitamin B_{12}: Co), in **medicine** (cisplatin as an anticancer drug, EDTA for heavy-metal poisoning), **analytically** (EDTA titrations

for water hardness), and **metallurgically** (extraction of Ag/Au as cyanide complexes, Ni purification via the Mond process).

One-Line Summary

Chapter 5 builds from Werner's foundational theory through modern IUPAC nomenclature, the several types of isomerism unique to coordination compounds, and the VBT/CFT bonding theories that together explain their colour, magnetism, and structure, closing with the wide biological, medicinal and industrial importance of these compounds.

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