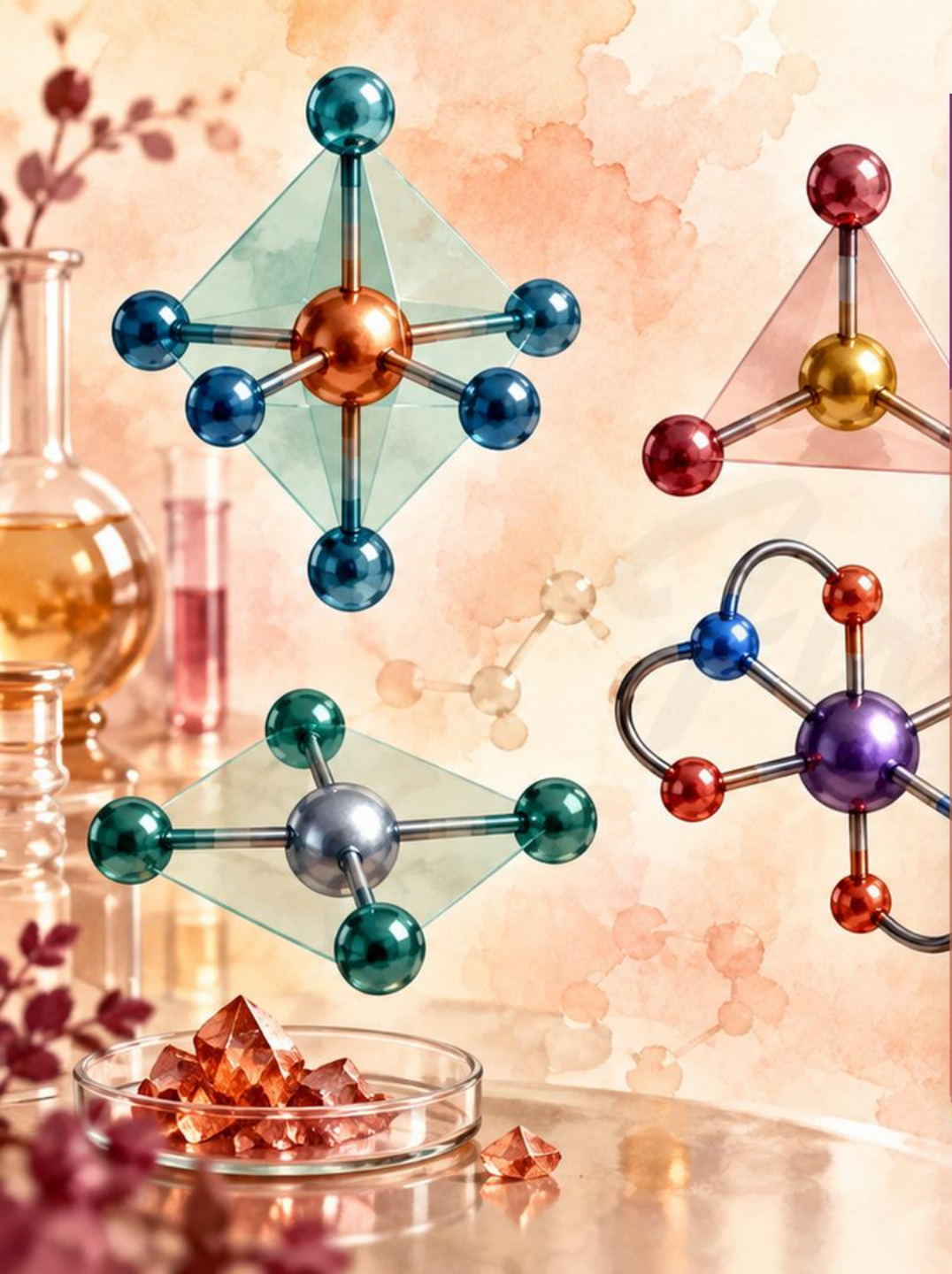




CHEMISTRY • CLASS 12

CHAPTER 5

Coordination Compounds

NCERT SOLUTIONS

WERNER'S POSTULATES

5.1 Explain bonding in coordination compounds using Werner's postulates.

Solution:

PRIMARY VALENCY equals metal oxidation state. It is ionisable and is satisfied by anions; some anions may be within the coordination sphere, so primary valency does NOT in general equal the number of counterions outside.

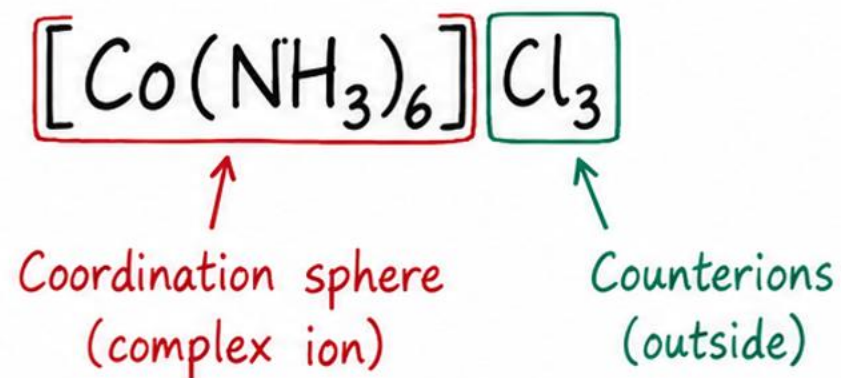
SECONDARY VALENCY equals coordination number (number of directly bound donor atoms). It is non-ionisable, may be satisfied by neutral molecules or anions, and gives a definite spatial arrangement.

Example: $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$:

Co oxidation state +3 (primary valency 3).

Six NH_3 directly surround Co (secondary valency 6).

Three Cl^- lie outside brackets and give AgCl with AgNO_3 .



DOUBLE SALT VS COORDINATION COMPLEX

5.2 Why does $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4$ show an Fe^{2+} test, but CuSO_4 with four NH_3 per Cu^{2+} does not show the usual Cu^{2+} test?

Solution:

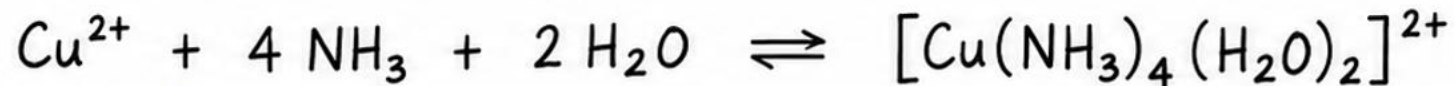
(i) $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4$ (Mohr's salt)

$\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4$ is a double salt which dissociates completely in water into simple ions. It gives free Fe^{2+} ions in solution, and hence shows the usual Fe^{2+} test.



(ii) CuSO_4 with four NH_3 per Cu^{2+}

Cu^{2+} ions react with ammonia to form a stable deep-blue coordination ion. In aqueous solution, the following equilibrium is established:



The concentration of free Cu^{2+} ions falls greatly due to complex formation, so the usual Cu^{2+} test is not observed. The sulfate ion is merely a counter-ion. The complex is often abbreviated as $[\text{Cu}(\text{NH}_3)_4]^{2+}$. Total copper remains present in solution.

THREE CORE COORDINATION TERMS

5.3 Explain coordination entity, ligand and coordination number; give two examples of each.

Solution:

- (1) Coordination entity: The coordination entity consists of a central metal atom or ion and the directly attached ligands, written within square brackets.
Examples: $[\text{Co}(\text{NH}_3)_6]^{3+}$ and $[\text{Fe}(\text{CN})_6]^{4-}$.
- (2) Ligand: A ligand is an ion or molecule that donates a pair of electrons to the central metal atom or ion to form a coordinate bond.
Examples: NH_3 and CN^- .
- (3) Coordination number: The coordination number is the number of donor atoms that are directly bonded to the central metal atom or ion.
Examples: In $[\text{Co}(\text{NH}_3)_6]^{3+}$, the coordination number is 6.
In $[\text{Ni}(\text{CN})_4]^{2-}$, the coordination number is 4.
A bidentate ligand counts as TWO donor atoms.

POLYHEDRON AND LIGAND MIX

5.3 Explain coordination polyhedron, homoleptic and heteroleptic; give two examples of each.

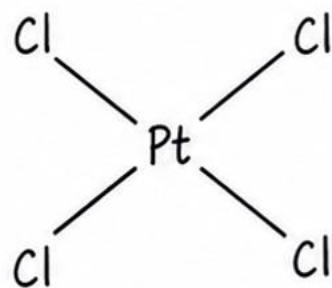
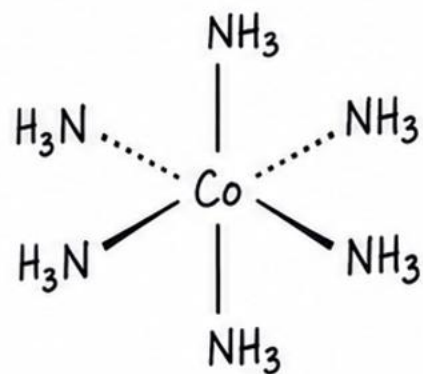
Solution:

(i) **Coordination polyhedron:**

The coordination polyhedron is the spatial arrangement of the donor atoms (ligating atoms) around the central metal ion in a coordination entity.

Examples:

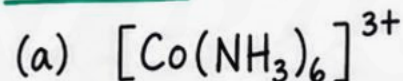
(a) Octahedral: $[\text{Co}(\text{NH}_3)_6]^{3+}$ (b) Square planar: $[\text{PtCl}_4]^{2-}$



(ii) **Homoleptic:**

A coordination entity is said to be homoleptic if it contains only one kind of ligand around the central metal ion.

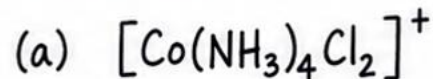
Examples:



(iii) **Heteroleptic:**

A coordination entity is said to be heteroleptic if it contains two or more kinds of ligands around the central metal ion.

Examples:





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