

CLASS 12 CHEMISTRY • SECTION 5.2(f)

The Coordination Polyhedron

Spatial Arrangements in Modern Inorganic Chemistry

A visual exploration of molecular architecture, from standard polyhedra shapes to real-world transition metal complexes.

[Octahedral]

[Tetrahedral]

[Square Planar]

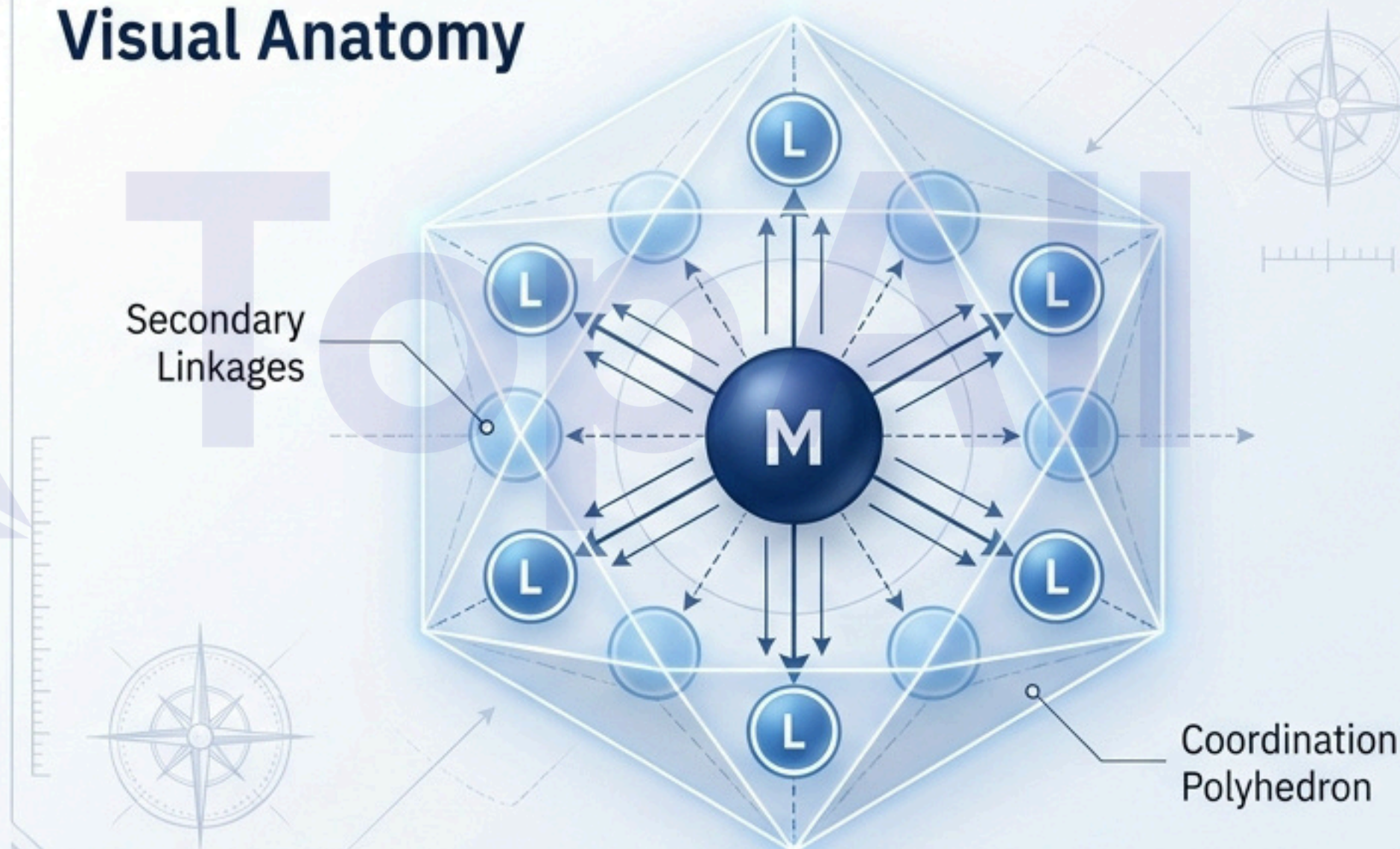
Decoding the Coordination Polyhedron

In modern formulations, a coordination polyhedron describes the precise 3D spatial arrangement of ligand atoms directly attached to a central metal atom or ion.

The Core Concept

Secondary linkages (valences) in coordination compounds dictate characteristic spatial arrangements. The ligands position themselves to minimize repulsion around the central Lewis acid.

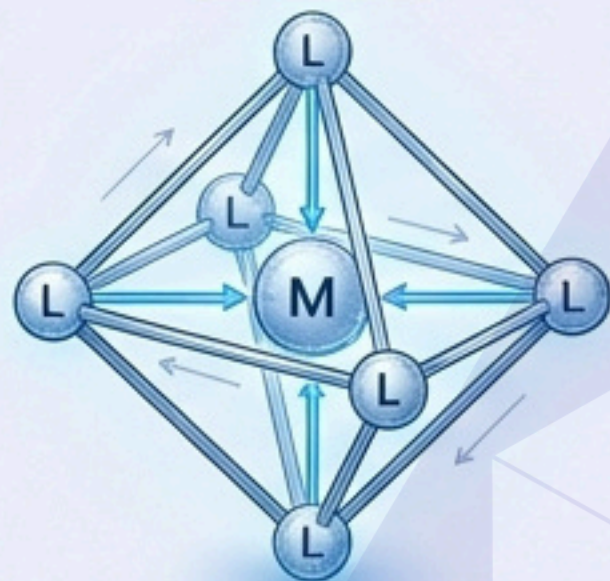
Visual Anatomy



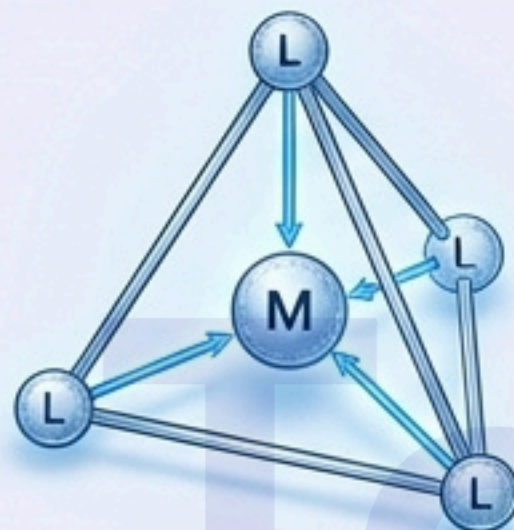
Standard Coordination Polyhedra

Transition metals commonly exhibit these five geometric shapes based on their coordination number (CN).

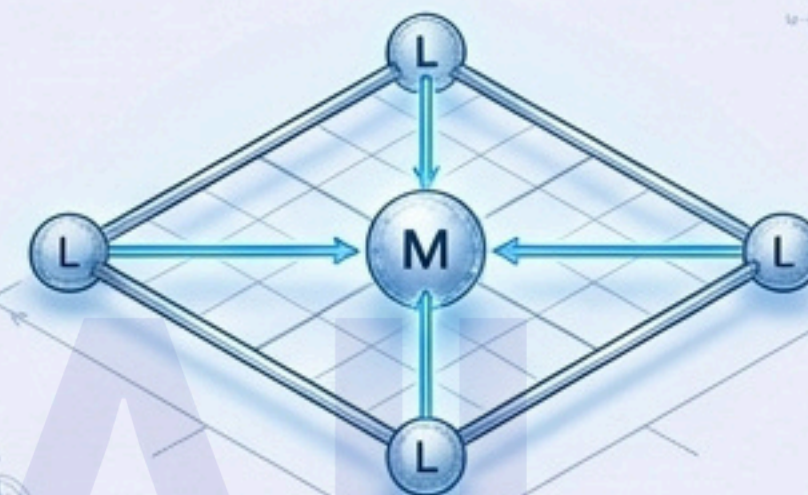
CN = 6



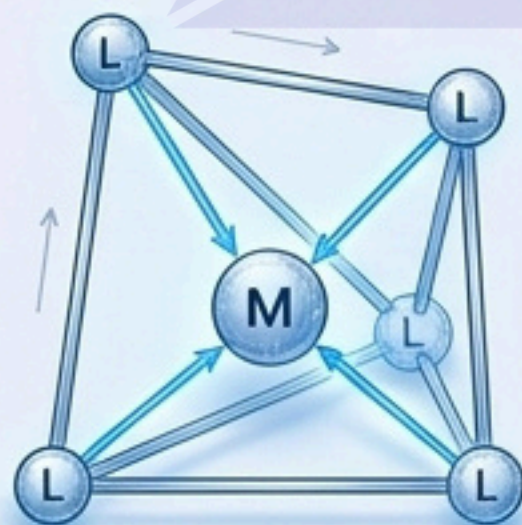
CN = 4



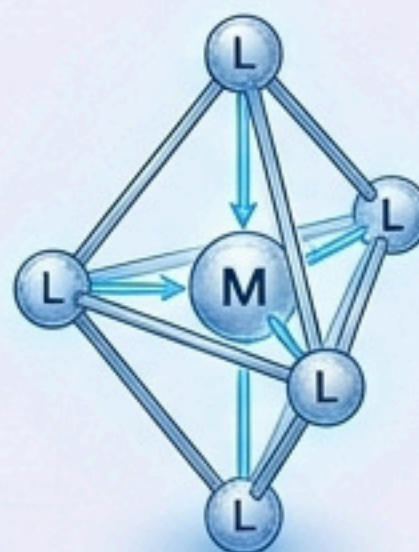
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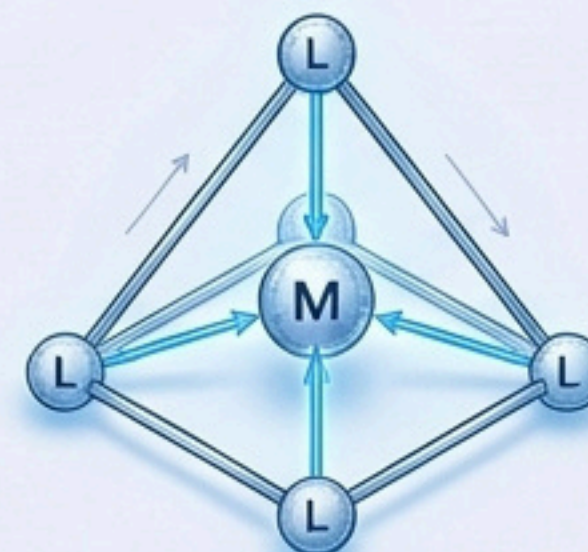
CN = 5



CN = 5



CN = 5





You've Learned the Theory. Let's Test Them Now.

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Key Highlights

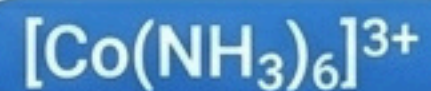
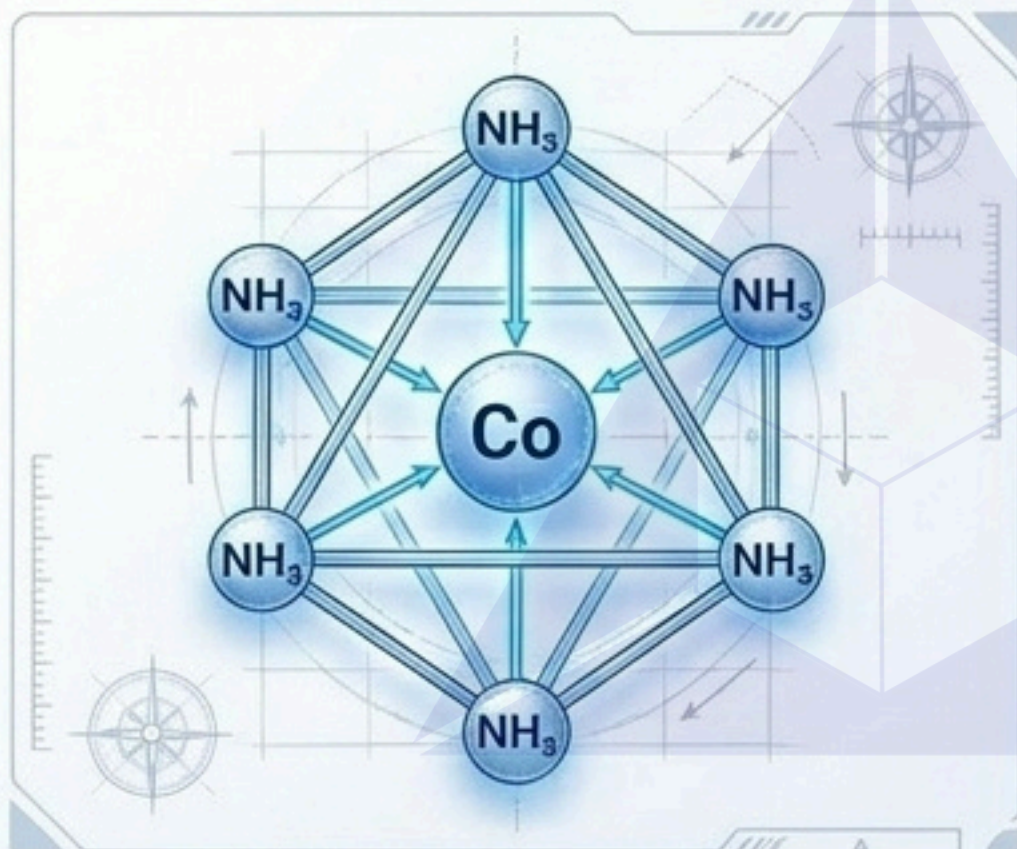
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Textbook Examples Matched to Shape

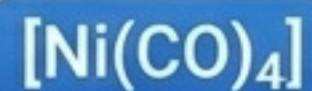
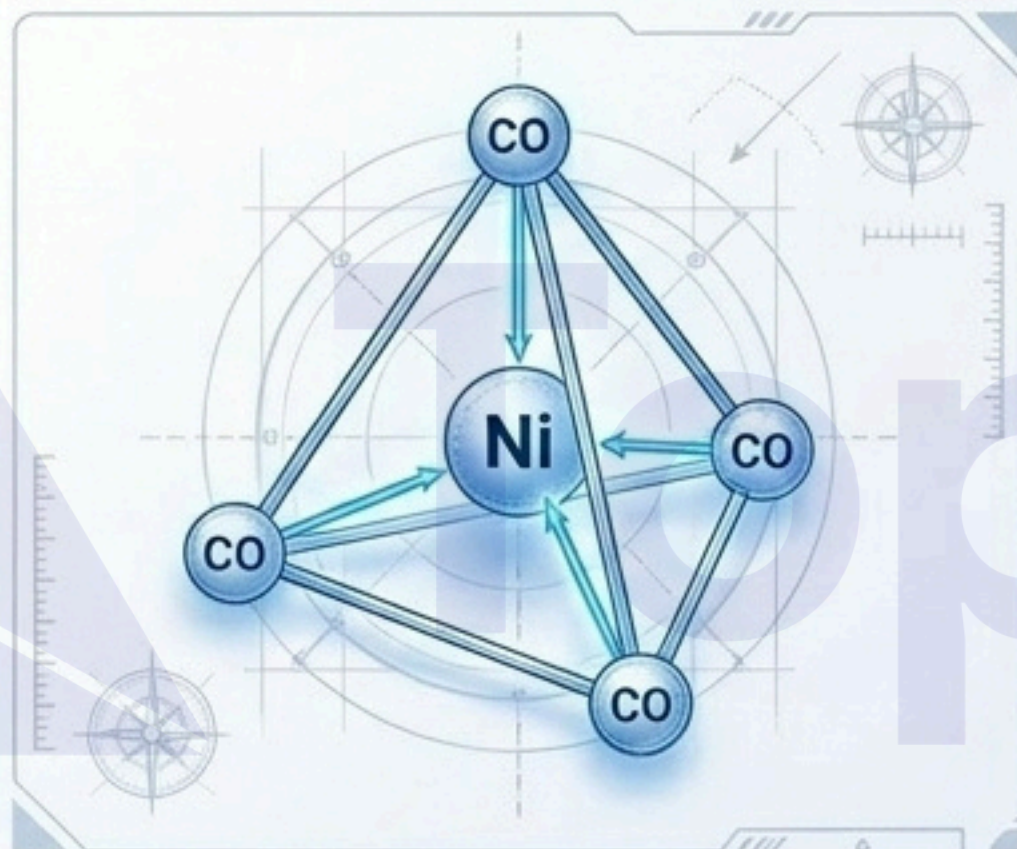
Applying the abstract geometries to actual coordination entities of transition metals.

Octahedral Entity



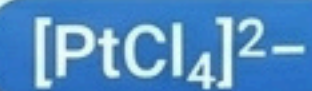
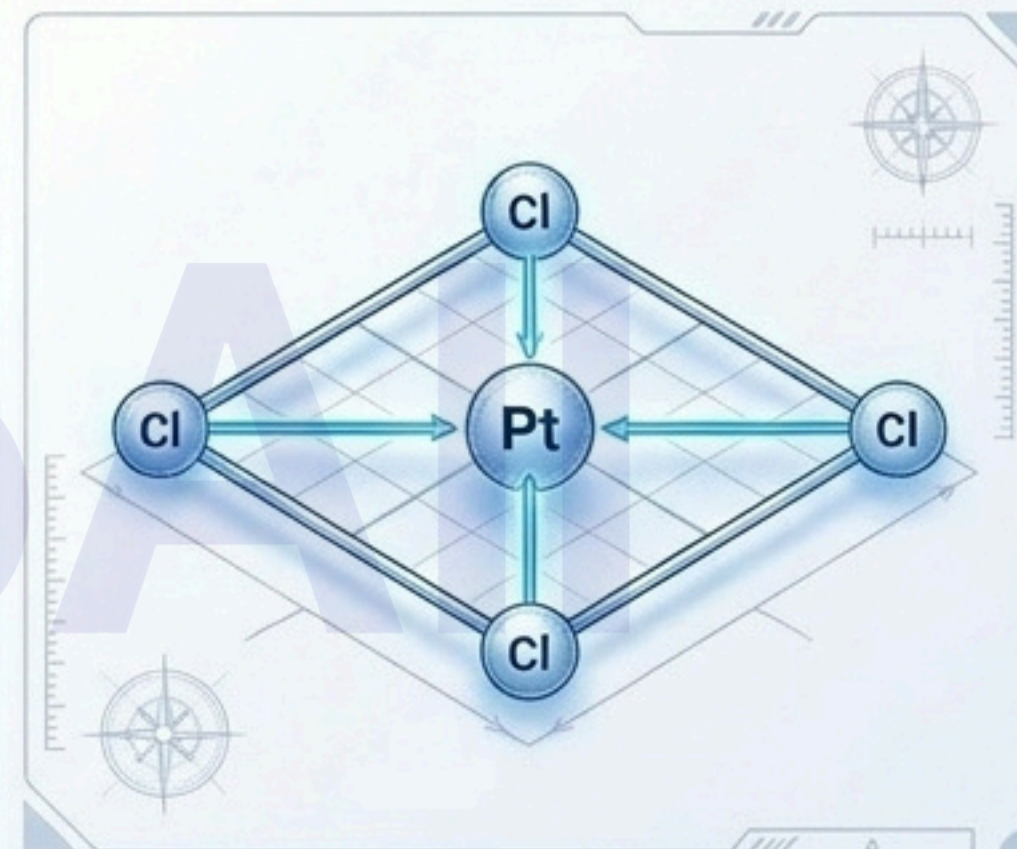
Six ammonia ligands symmetrically surrounding a central Cobalt(III) ion.

Tetrahedral Entity



Four carbonyl ligands arranged in a tetrahedron around a Nickel(0) atom.

Square Planar Entity



Four chloride ions occupying the corners of a flat square around Platinum(II).

Comparative Structural Analysis

A side-by-side look at the spatial distributions of the three most common polyhedra in transition metal chemistry.

Dimensions	Octahedral	Tetrahedral	Square Planar
Coordination Number	6	4	4
Spatial Arrangement	3D (Along x, y, z axes)	3D (Between axes)	2D (Flat plane)
Example Entity	$[\text{Co}(\text{NH}_3)_6]^{3+}$	$[\text{Ni}(\text{CO})_4]$	$[\text{PtCl}_4]^{2-}$

SUMMARY & INSIGHTS

Key Takeaways

You have successfully covered the core concepts of coordination polyhedra.



Definition: A coordination polyhedron is the spatial arrangement of ligand atoms directly attached to the central metal atom/ion.



Primary Geometries: Octahedral, Tetrahedral, and Square Planar are the most common shapes in transition metal coordination compounds.



Coordination Number dictates Shape: A CN of 6 yields Octahedral shapes (e.g., $[\text{Co}(\text{NH}_3)_6]^{3+}$), while a CN of 4 can yield either Tetrahedral (e.g., $[\text{Ni}(\text{CO})_4]$) or Square Planar shapes (e.g., $[\text{PtCl}_4]^{2-}$).



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