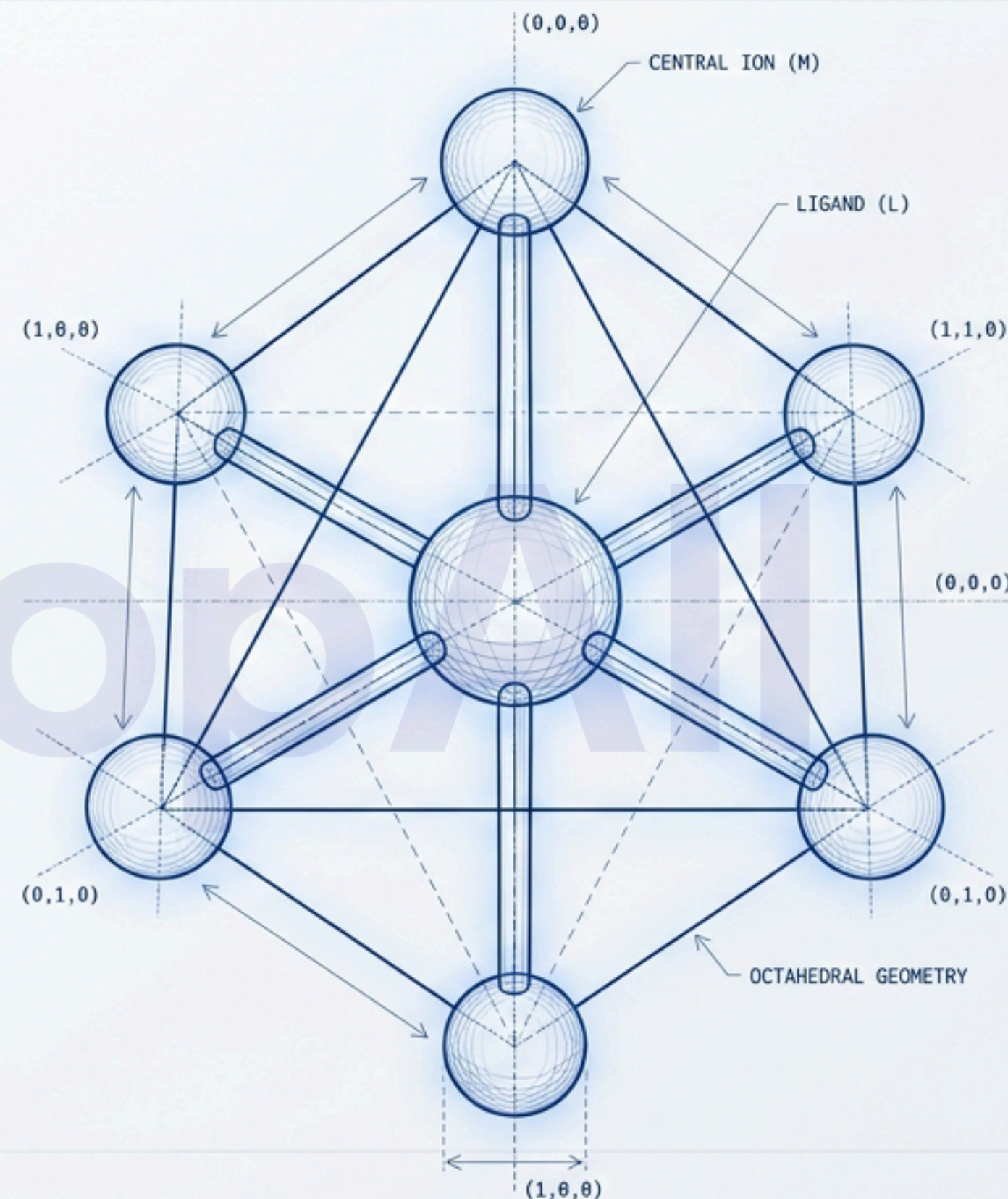


UNIT 4: THE d- AND f- BLOCK ELEMENTS

4.3.11 Formation of Complex Compounds

Mastering Coordination Chemistry for NEET & JEE

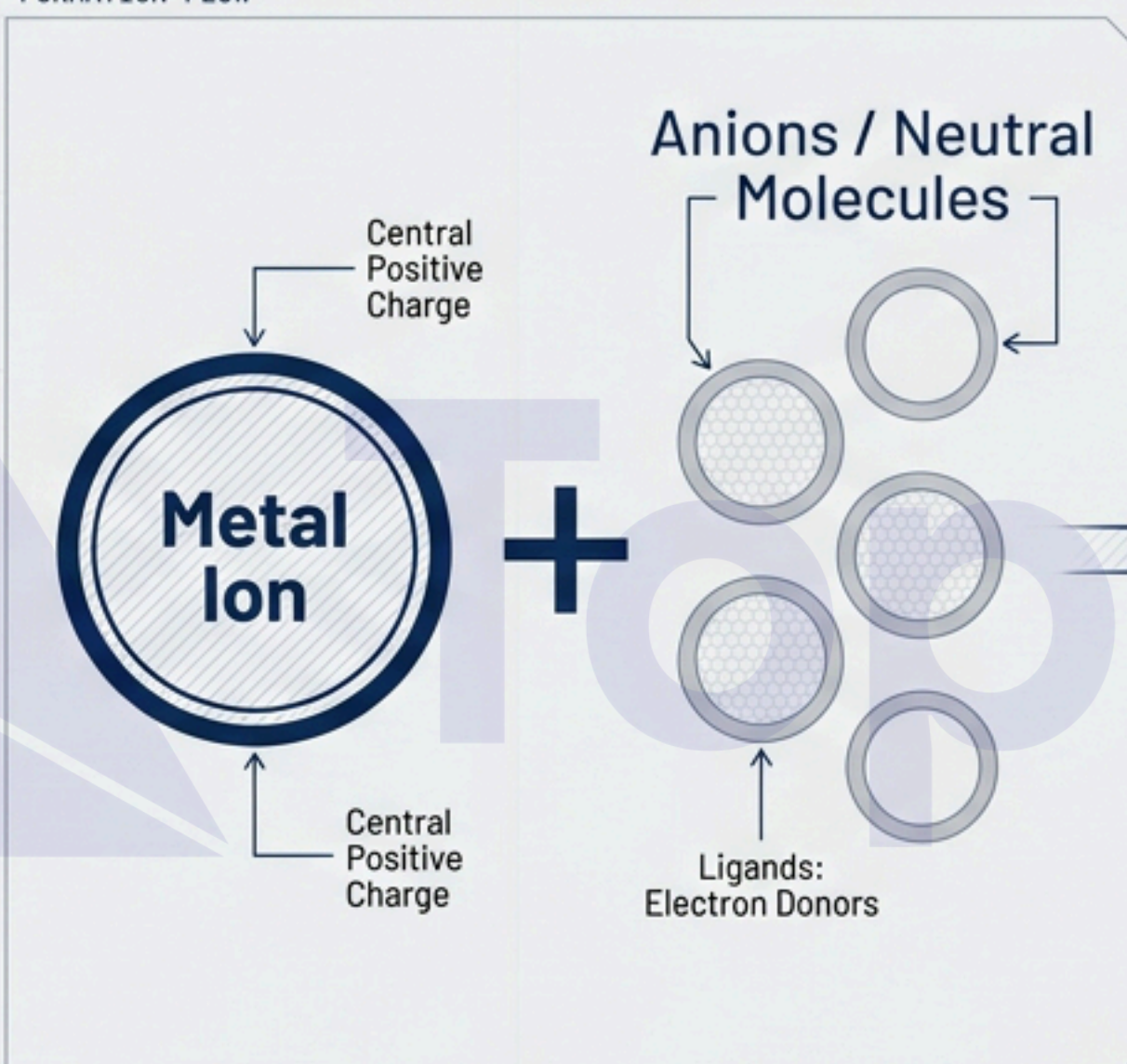


What is a Complex Compound?

Transition metal ions bind to a specific number of anions or neutral molecules, creating intricate, stable species.

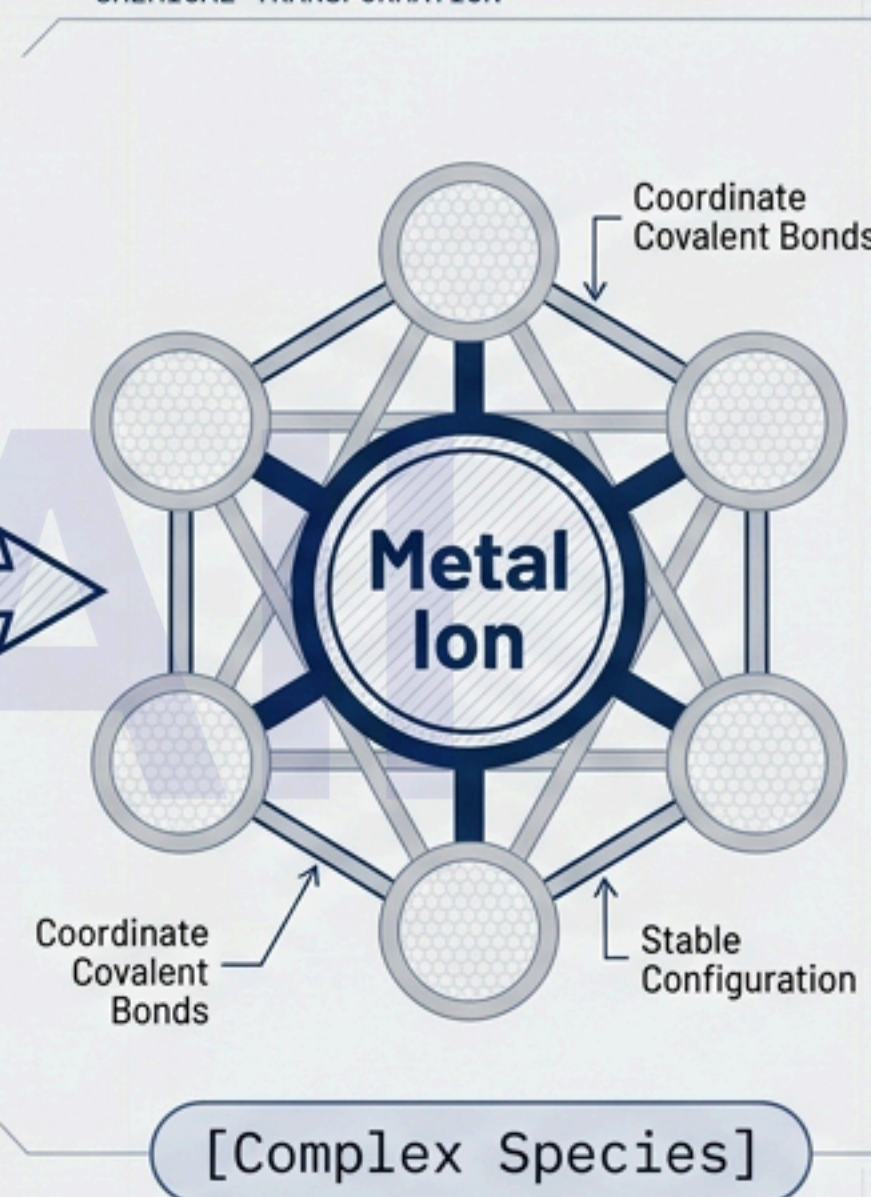
These complexes exhibit entirely new, characteristic properties distinct from their constituent ions.

FORMATION FLOW



CHEMICAL TRANSFORMATION

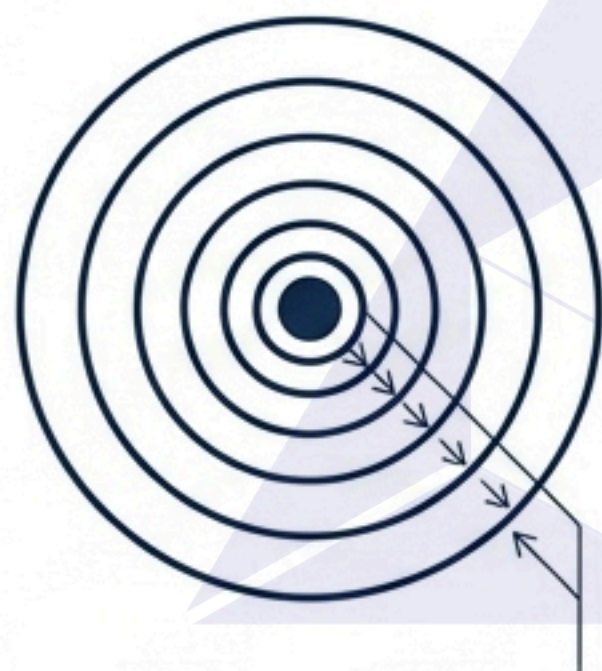
CHEMICAL TRANSFORMATION



The Transition Metal Advantage

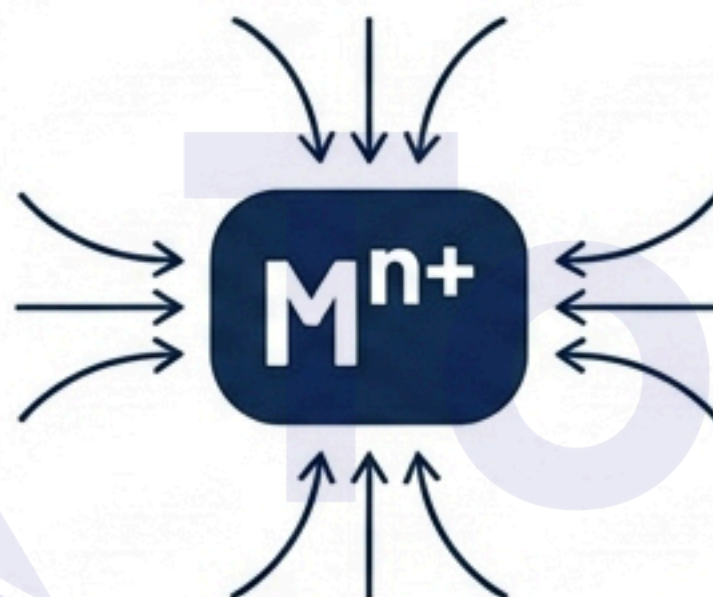
Why do d-block elements form large numbers of complex compounds?

Comparatively Smaller Size



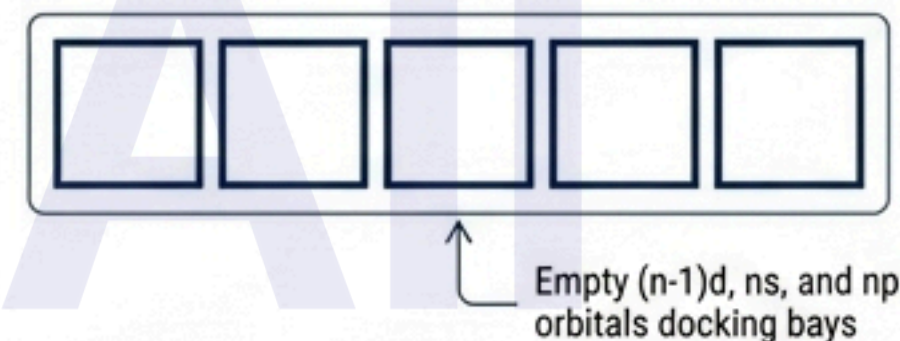
Transition metal ions have smaller atomic/ionic radii, creating a high charge density that attracts electron-rich ligands.

High Ionic Charge



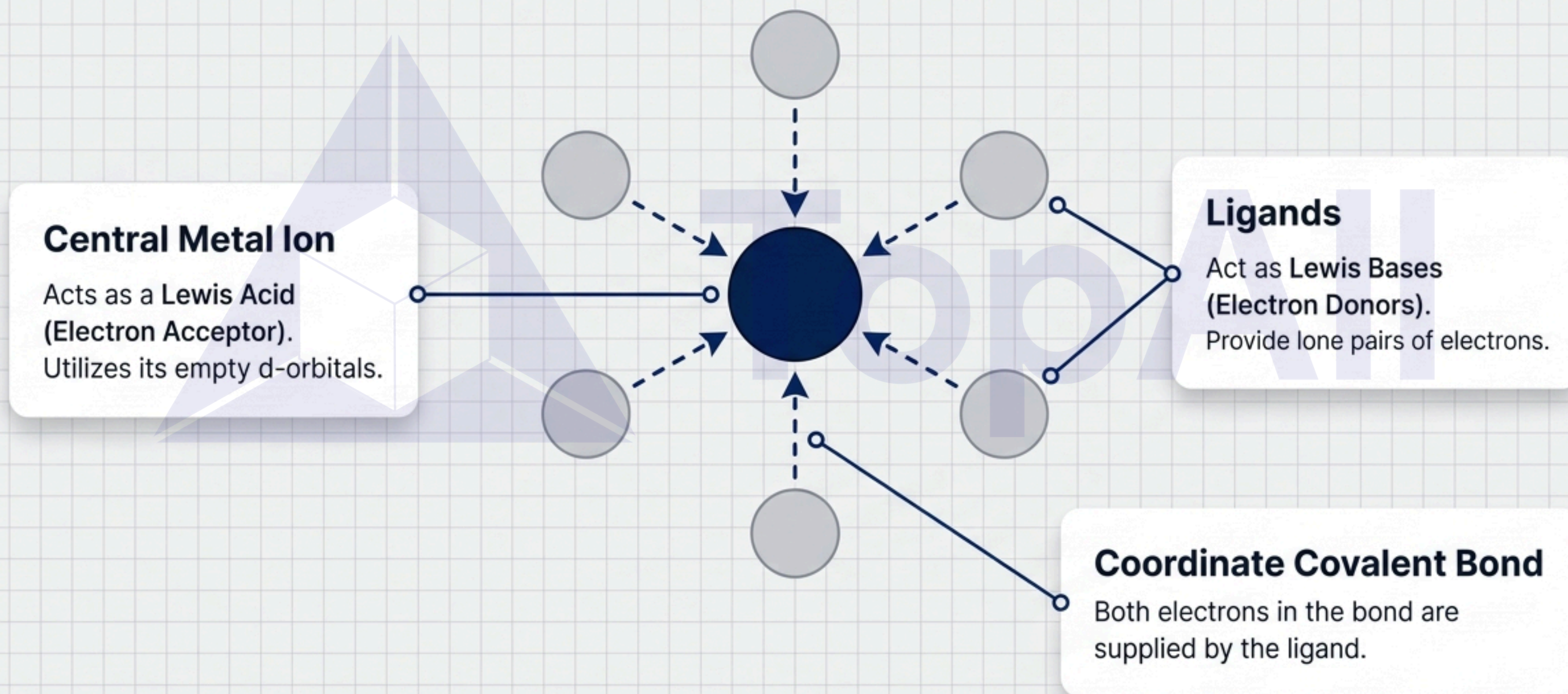
The high positive oxidation states exert a strong electrostatic pull on the lone pairs of surrounding molecules.

Available d-Orbitals



Empty (n-1)d, ns, and np orbitals provide the physical docking bays for coordinate covalent bond formation.

The Donor-Acceptor Mechanism





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

$$E=mc^2$$



Turn theory into marks with **unlimited MCQs, smart analysis, and focused revision.**

Practice Now



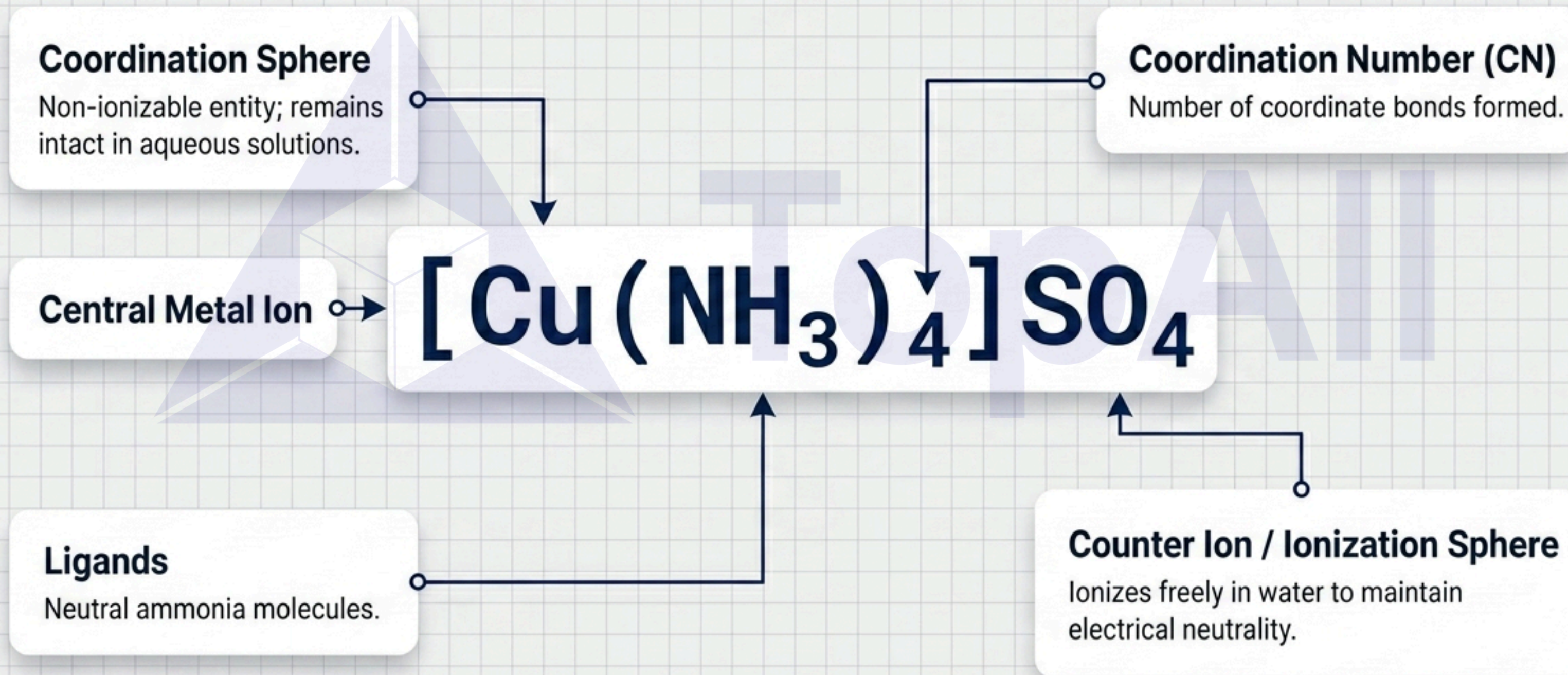
At prep.topall.app

Key Highlights

- » Free Study Material, Videos & Infographics
- » Push Your Limits with Level-Based Challenges
- » Climb the Leaderboard Among Fellow Aspirants
- » Practice Unlimited MCQs for NEET & JEE
- » Get Clear Explanations, Not Just Marks
- » Track Your Performance Smarter

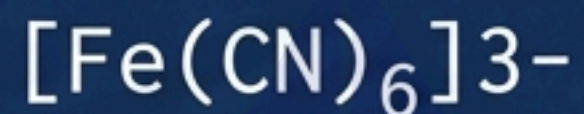


Parsing the Blueprint: The Coordination Sphere



Benchmark Examples

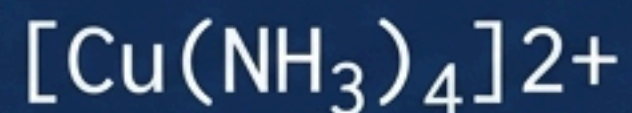
Characteristic complex species frequently tested from the source material.



Hexacyanoferrate(III).
Features a +3 Iron center.



Hexacyanoferrate(II).
Features a +2 Iron center.



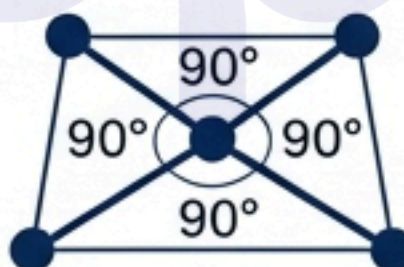
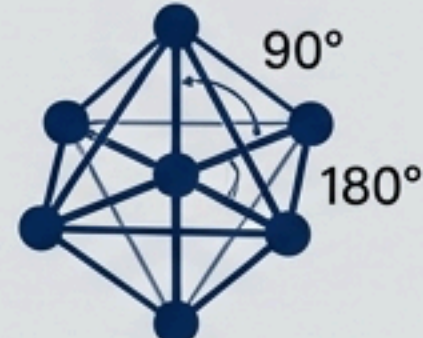
Tetraamminecopper(II). A deep blue complex utilizing neutral ammonia ligands.



Tetrachloridoplatinate(II). A classic square planar complex.

From Formula to Architecture

The spatial arrangement of ligands around the central metal ion defines the complex's geometry, driven by the **Coordination Number (CN)** and **orbital hybridization**.

Coordination Number (CN)	Geometry	Spatial Diagram	Example
CN = 4	Tetrahedral		$[\text{NiCl}_4]^{2-}$
CN = 4	Square Planar		$[\text{PtCl}_4]^{2-}$
CN = 6	Octahedral		$[\text{Fe}(\text{CN})_6]^{3-}$

Observable Evidence: Coloured Ions

Complexation profoundly alters physical properties. In aqueous solutions, water molecules act as ligands, resulting in distinct colors due to d-d electron transitions.



$[V^{4+}] \rightarrow$ Blue 

$[Mn^{2+}] \rightarrow$ Pink 

$[Fe^{3+}] \rightarrow$ Yellow 

$[Cu^{2+}] \rightarrow$ Blue 

Real-World Applications & Catalysis



Industrial Catalysis

The ability to adopt multiple oxidation states and form intermediate complexes makes transition metals exceptional catalysts.

Example: **Iron** in Haber's Process.



Biological Systems

Essential to life processes.

Examples: Hemoglobin ([Fe complex]),

Chlorophyll ([Mg complex]),
Vitamin B12 ([Co complex]).



Analytical Chemistry

Used extensively in qualitative analysis and metal extraction.

Example: **[Ag/Au]** processing.

High-Yield Exam Focus



Examiners frequently test the reactivity difference between the Coordination Sphere (inside brackets) and the Ionization Sphere (outside brackets). Only ions outside the brackets will yield positive tests in aqueous solutions.

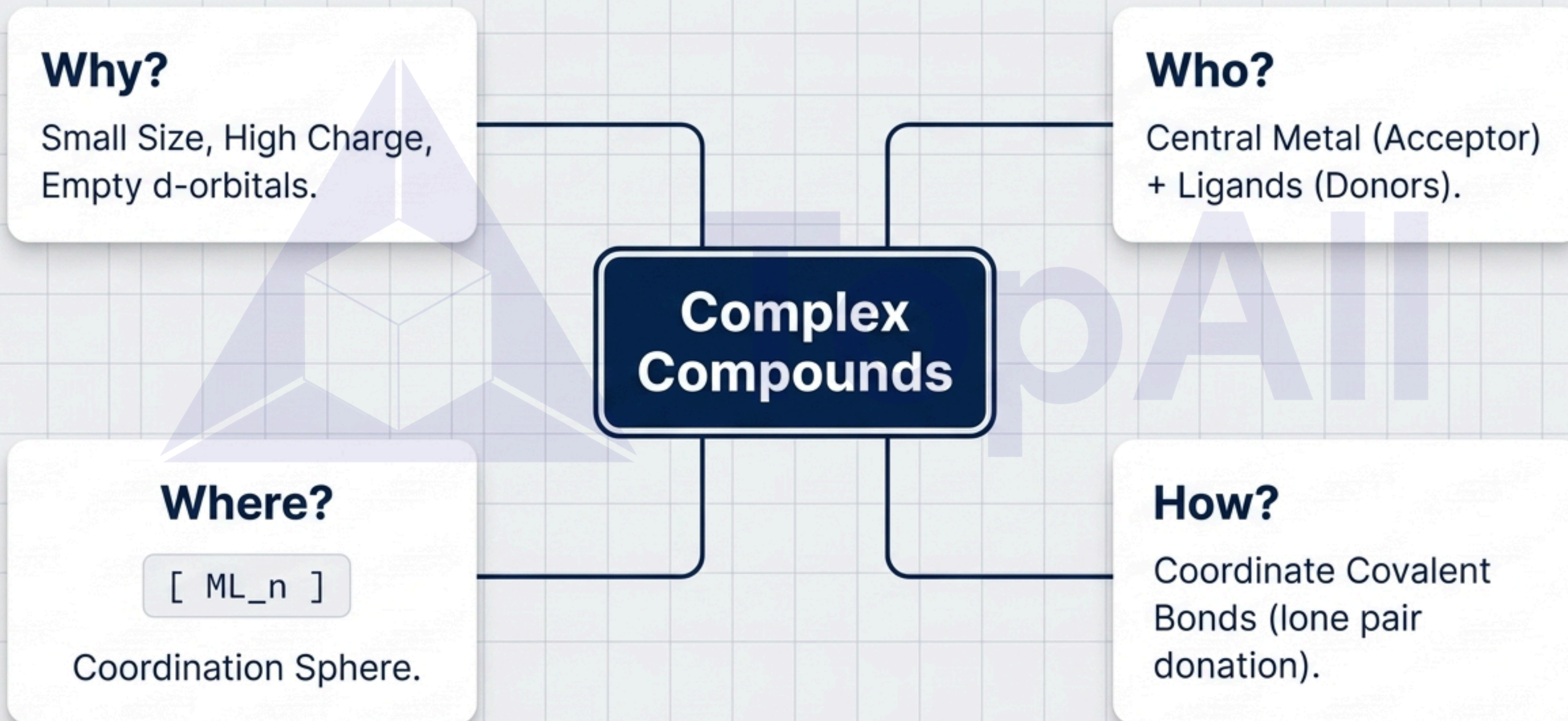


Yields a positive test for $[\text{SO}_4^{2-}]$ (precipitates with BaCl_2).



Does NOT yield a positive test for $[\text{Cl}^-]$ (no precipitate with AgNO_3 because the chloride is trapped inside the coordination sphere).

Quick Revision: Complex Compounds





You've Learned the Theory.

Now Let's Test It.

Reading notes gets you knowledge.

Practicing MCQs gets you marks.

That's exactly what TopAll Pro is built for.

Try TopAll Pro Now

What TopAll Pro Does Differently

-  **Stuck? Snap it. Solve it. — Doubts AI**
Photo → step-by-step solution in seconds, 24/7
-  **Your AI Coach finds your blind spots**
Concept-level weakness detection — not just chapter-level
-  **4.5 Lakh+ questions. Never run out.**
13× more content than any other prep app in India
-  **Build your own test in 60 seconds**
Pick a chapter, set difficulty — AI does the rest instantly.
-  **AI Recommendation that helps you improve**
AI Recommendation Analysis your Tests and tell you where you need to improve.



Practice the moment you finish studying
Jump in while the concept is still fresh in your head

4.5L+
MCQs

1.5L+
Students

AI Powered
In-Depth Analysis