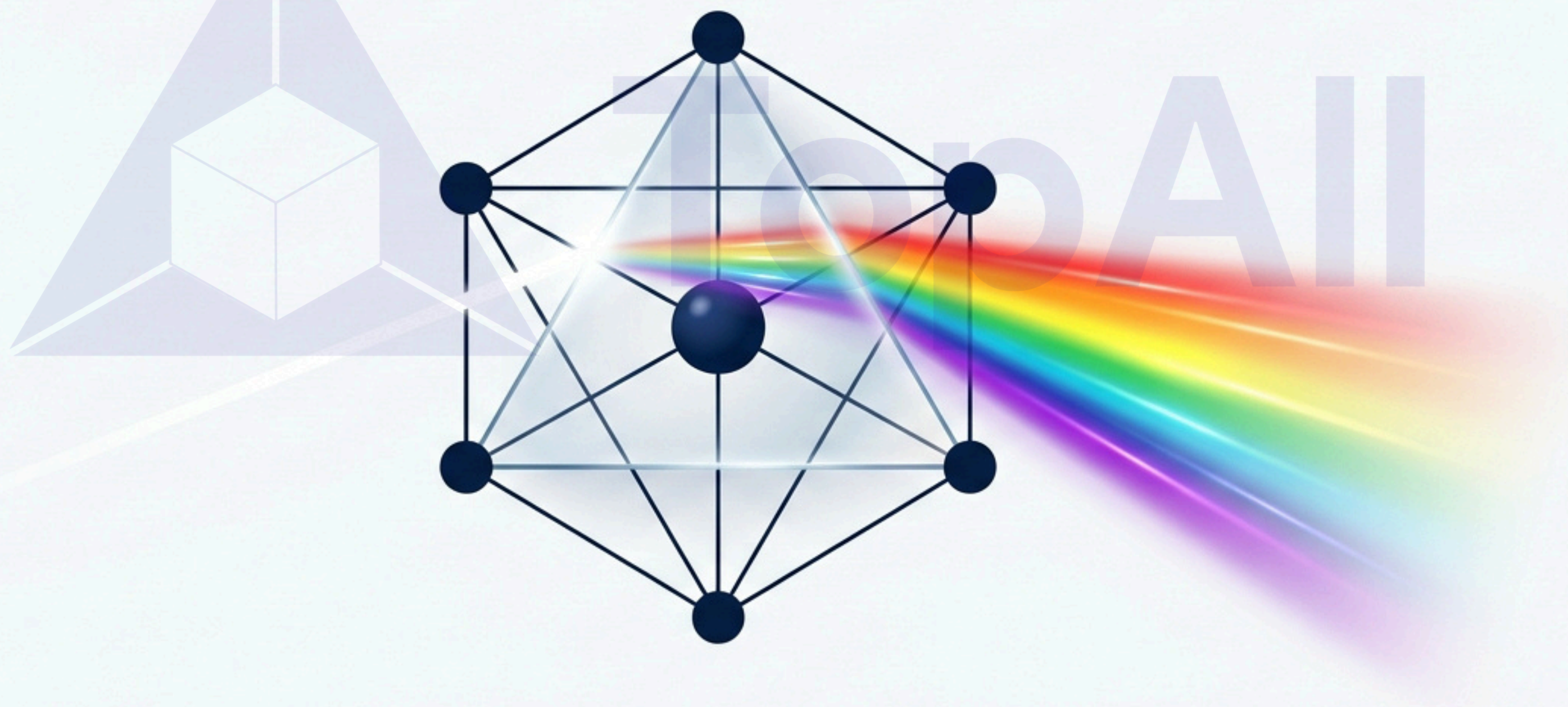


The Origin of Colour in Coordination Compounds

Understanding how subatomic d-d transitions and ligand fields create the vibrant colours of transition metal complexes and gemstones.



The Principle of Complementary Colours

Transition metal complexes act as selective optical filters. When white light passes through a sample, specific wavelengths of the visible spectrum are absorbed.

The colour we observe is the exact complementary colour left over.

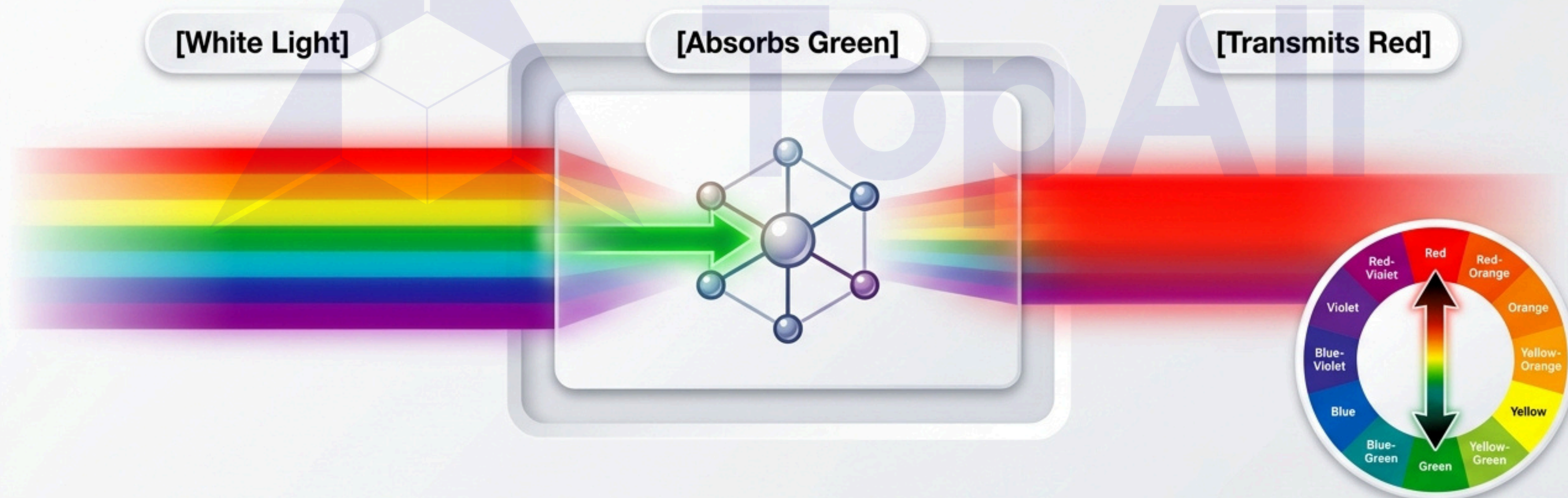
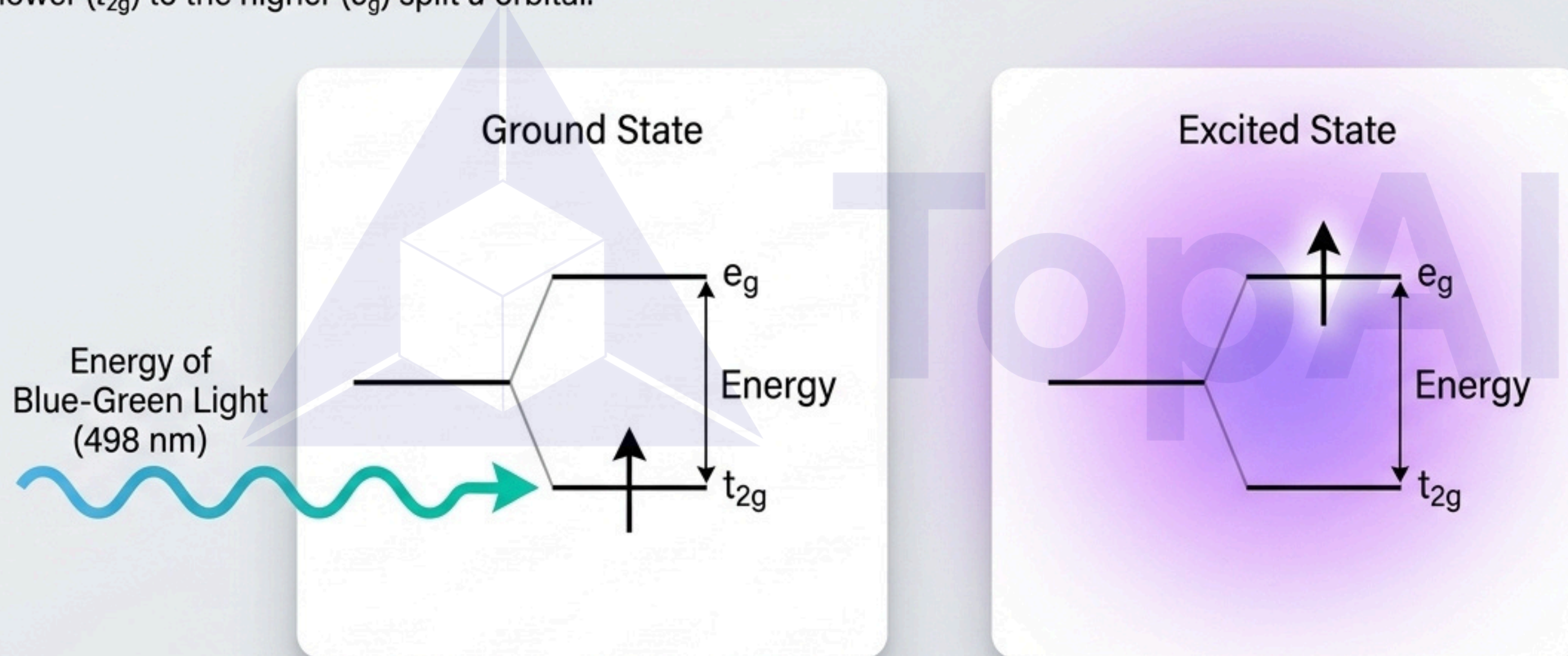


FIGURE 5.10 • THE VIOLET COLOUR OF $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$

The Mechanics of $d-d$ Transitions

Crystal field theory explains colour through electron excitation. In an octahedral complex, absorbing specific light energy forces an electron to jump from the lower (t_{2g}) to the higher (e_g) split d orbital.





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

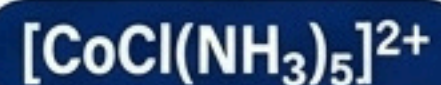
Key Highlights

- » 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



Mapping Wavelengths to Observed Colours

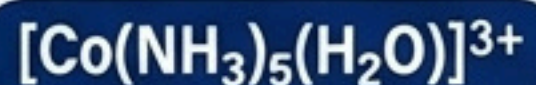
Experimental data confirms the direct, inverse relationship between the wavelength of energy a coordination entity absorbs and the visible colour it transmits.



Absorbs 535nm Yellow



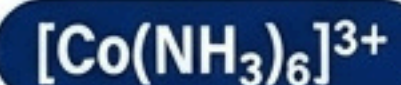
Appears Violet



Absorbs 500nm Blue Green



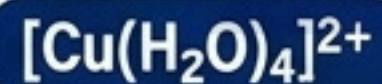
Appears Red



Absorbs 475nm Blue



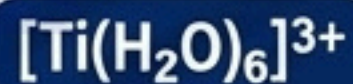
Appears Yellow Orange



Absorbs 600nm Red



Appears Blue



Absorbs 498nm Blue Green



Appears Violet



Absorbs 310nm Ultraviolet
(Not in visible region)



Appears Pale Yellow

No Ligand, No Colour

Because colour depends entirely on the splitting of *d* orbitals, a ligand is mandatory. Without ligands to create the crystal field, *d* orbitals remain degenerate (equal energy), no transitions occur, and the substance appears colourless.

Hydrated
 $[\text{Ti}(\text{H}_2\text{O})_6]\text{Cl}_3$

Heat / Remove Water

Anhydrous
 Ti^{3+}

[Colourless]

Hydrated
 $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

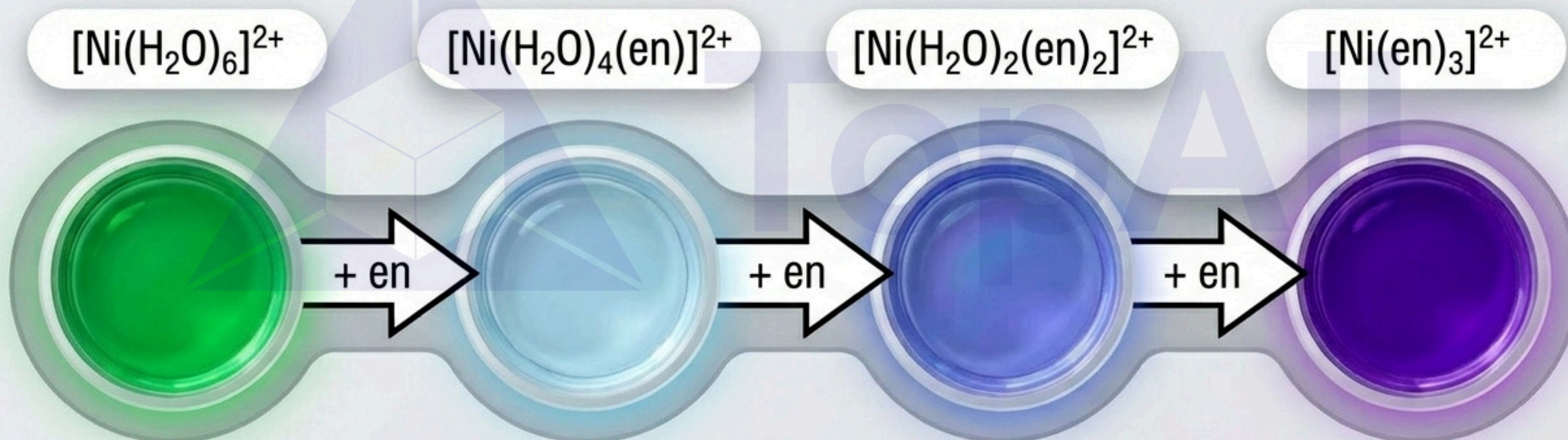
Heat / Remove Water

Anhydrous
 CuSO_4

[White]

Ligand Substitution Drives Colour Change

Changing the surrounding ligands alters the crystal field splitting energy (Δ_0). Adding ethane-1,2-diamine (en) to a Nickel(II) solution creates a progressive shift in the absorbed wavelength.



The Hidden Chemistry of Gemstones

The stunning colours of precious gemstones are d-d transitions occurring within solid mineral lattices. The exact same transition metal ion (Cr^{3+}) produces entirely different colours depending on its host lattice.



Ruby Lattice: Al_2O_3 (alumina)

- + 0.5-1% Cr^{3+} ions
- Octahedral chromium(III) complexes produce a red output.



Emerald Lattice: Beryl ($\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$)

- + Cr^{3+} ions
- The lattice environment shifts absorption to yellow-red/blue, transmitting green.

Core Concepts of Coordination Colour



Complementary Vision

Observed colour is the exact inverse of the visible light wavelength absorbed by the complex.



Orbital Mechanics

Colour is generated by electrons jumping between split d orbitals (d-d transitions) triggered by light energy.



Ligand Dictation

The presence and type of ligand determine the crystal field splitting size, which directly dictates the exact colour observed.
(No ligand = No colour).



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