

H1. Solvate Isomerism

H2. The Architecture of Solvents

Solvate isomers occur when solvent molecules swap positions. The defining difference lies in the **exact physical location** of the solvent molecule relative to the central metal ion.

Directly Bonded

The Coordination Sphere

The solvent molecule is tightly attached directly to the central metal ion, acting as a ligand inside the coordination sphere.

Free Solvent

The Crystal Lattice

The solvent molecule sits outside the coordination sphere, existing merely as a free molecule trapped within the crystal lattice.

💡 Structurally similar to Ionisation Isomerism.

Hydrate Isomerism

When Water is the Solvent

While solvate isomerism is the universal term for this phenomenon, chemistry reserves a specific, widely used term when the solvent in question is water (H_2O).



Hydrate Isomerism

The exact same mechanism as solvate isomerism, strictly applied to aqueous systems where H_2O molecules migrate back and forth between the coordination sphere and the crystal lattice.

🔑 Understanding hydrate isomerism unlocks the visual color shifts we observe in transition metal complexes!



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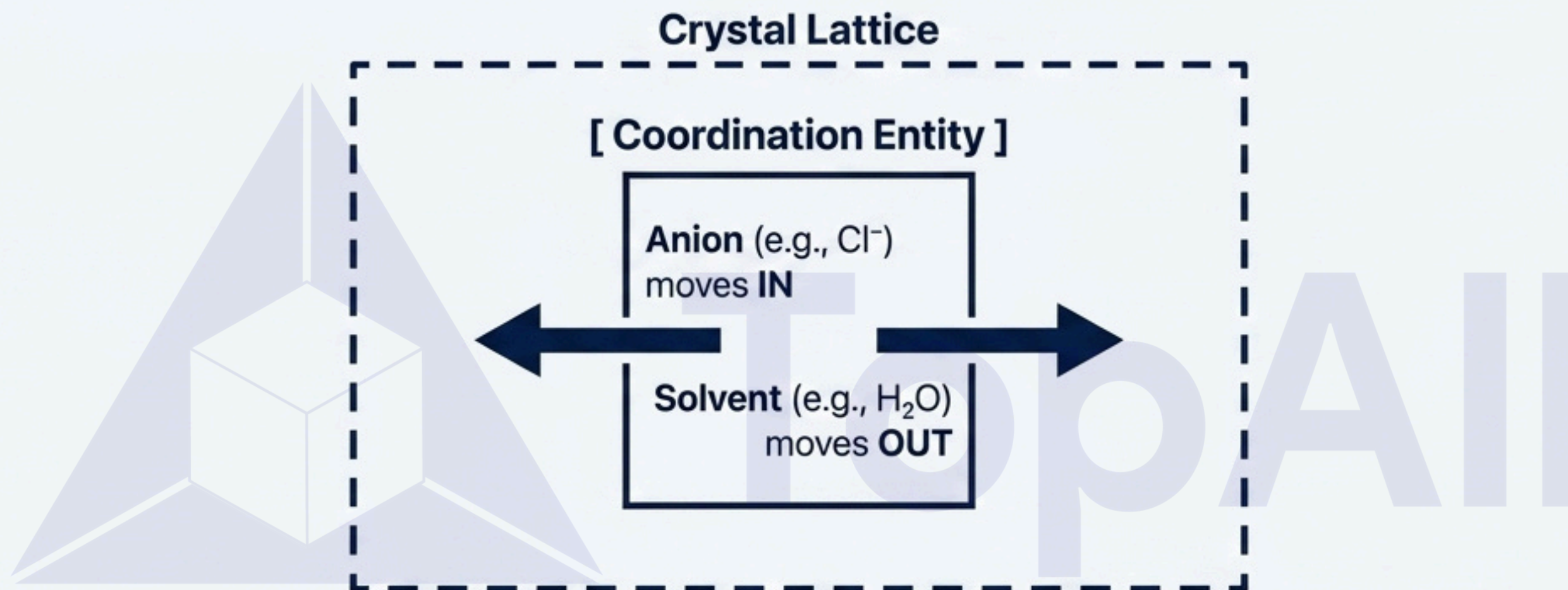
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The Mechanism of Exchange

Crossing the Brackets



1. The Swap

An anion from the lattice moves in to bond with the metal.

2. The Displacement

A solvent molecule moves out to sit in the lattice.

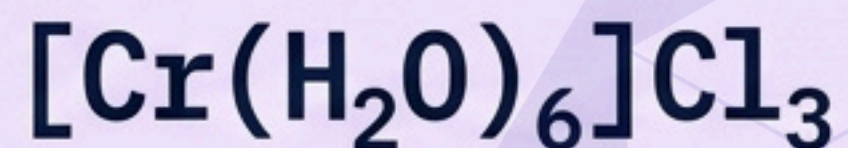
3. The Result

Identical empirical formulas, radically different physical properties.

The Chromium Aqua Complexes

H2 A Tale of Two Isomers

● Violet Form



Bonded Water:	6 H ₂ O molecules (Inside)
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Free Water:	0 H ₂ O molecules (Outside)
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Counter Ions:	3 Cl ⁻ ions
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● Grey-Green Form



Bonded Water:	5 H ₂ O molecules (Inside)
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Free Water:	1 H ₂ O molecule (Outside lattice)
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Counter Ions:	2 Cl ⁻ ions
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Notice how one H₂O and one Cl⁻ have swapped positions, completely altering the compound's optical properties from violet to grey-green.

Key Takeaways

Mastering Solvate Isomerism

[1] Location is Everything

Solvate isomers differ strictly by whether solvent molecules are bonded directly to the metal or sit free in the crystal lattice.

[2] The Water Rule

When the migrating solvent is water, the phenomenon is specifically termed Hydrate Isomerism.

[3] Visual Evidence

Small molecular swaps create massive macroscopic changes—evident in the stark shift from the violet $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ to the grey-green $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$.

[4] Structural Siblings

The physical mechanism of swapping ligands for lattice molecules makes solvate isomerism a close relative to ionization isomerism.



You've mastered Section 5.4.6!



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