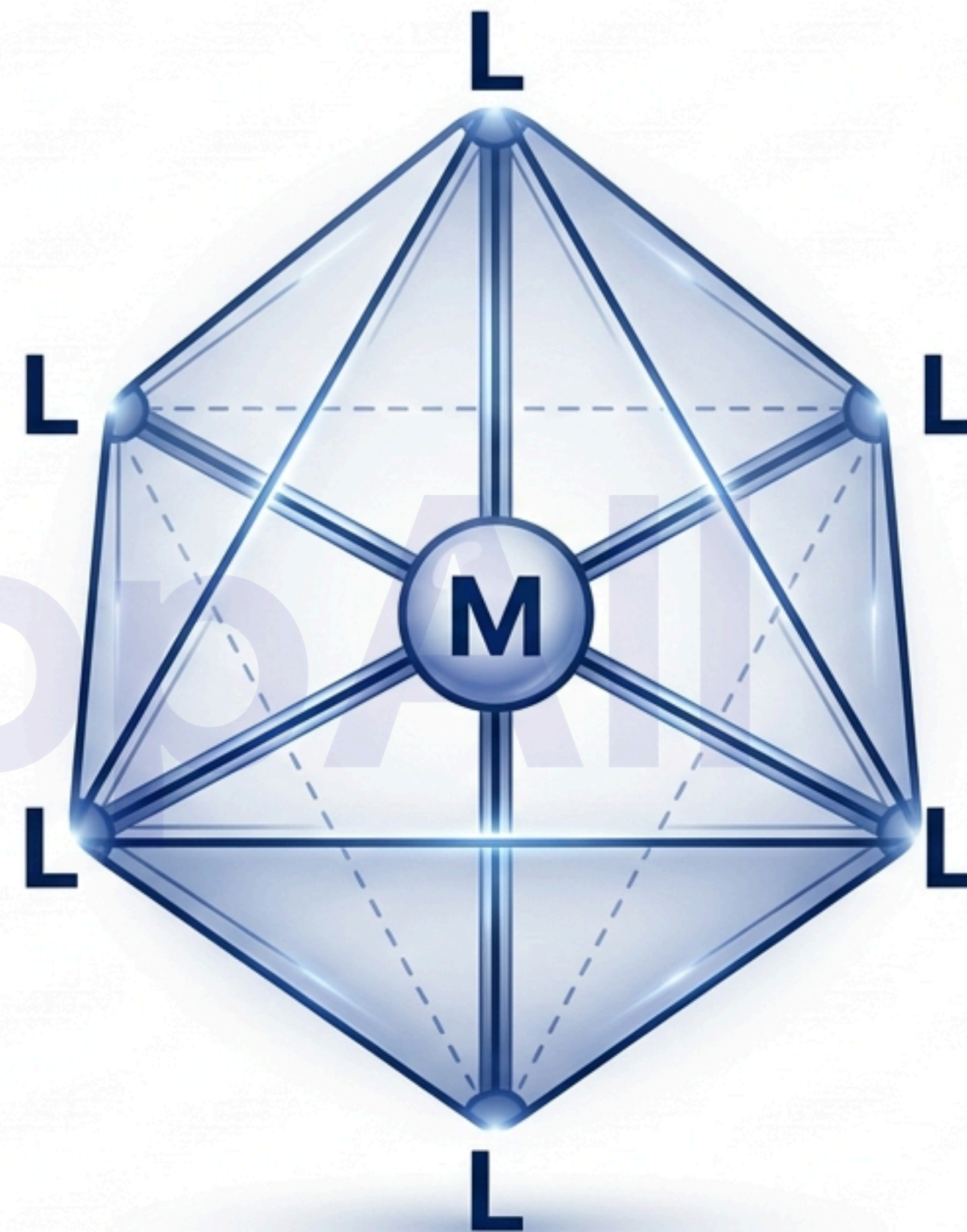


Definitions of Important Terms

The fundamental vocabulary and structural anatomy of coordination entities.



The Coordination Lexicon

Coordination Entity

A central metal bonded to a fixed number of ions/molecules (e.g., $[\text{CoCl}_3(\text{NH}_3)_3]$).

Central Atom/Ion

The core Lewis acid to which ligands bind in a definite geometry (e.g., Ni^{2+} , Fe^{3+}).

Ligand

Ions or molecules that donate electron pairs to the central atom.

Denticity

The number of donor atoms a single ligand uses to bind the metal simultaneously.

Coordination Number (CN)

Total number of ligand donor atoms directly bonded to the metal.

Coordination Sphere

The bracketed, non-ionizable central atom + ligands complex.

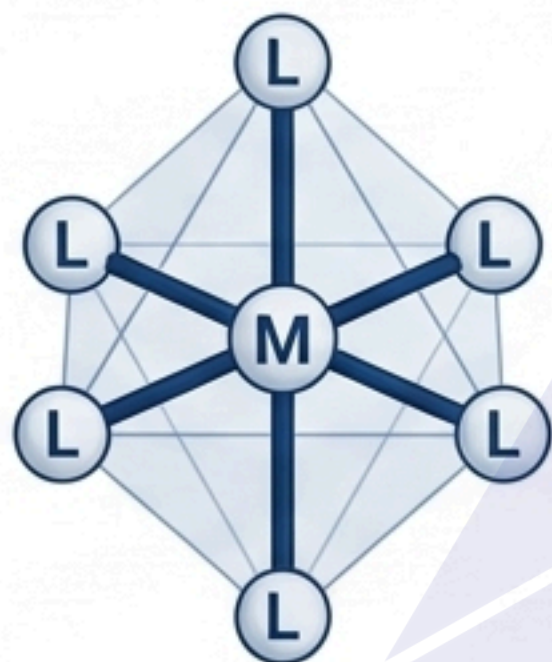
Oxidation Number

The theoretical charge of the metal if all ligands and shared electron pairs were removed.

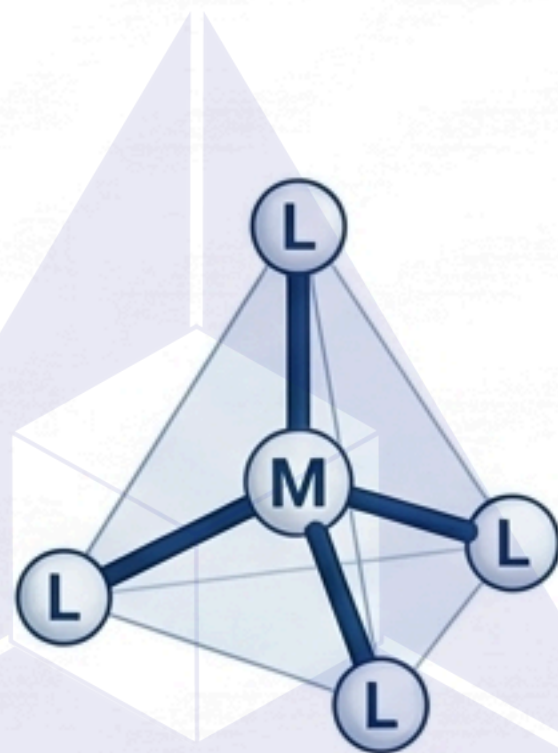
Coordination Polyhedron

The spatial, geometric arrangement of ligand atoms attached to the center.

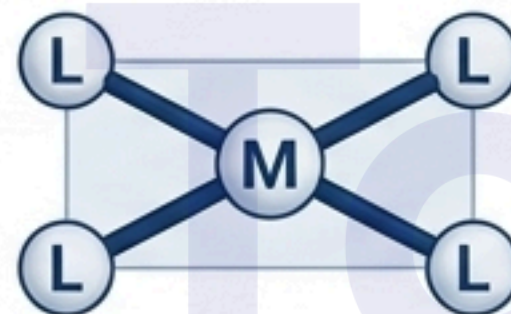
Spatial Arrangements (Polyhedra)



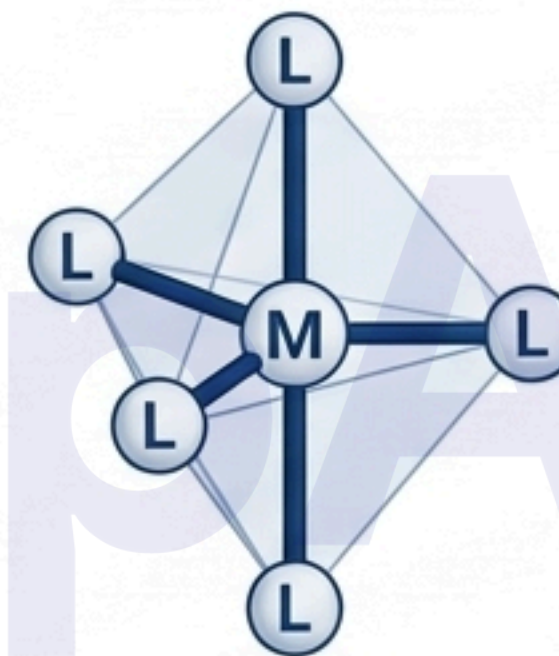
Octahedral



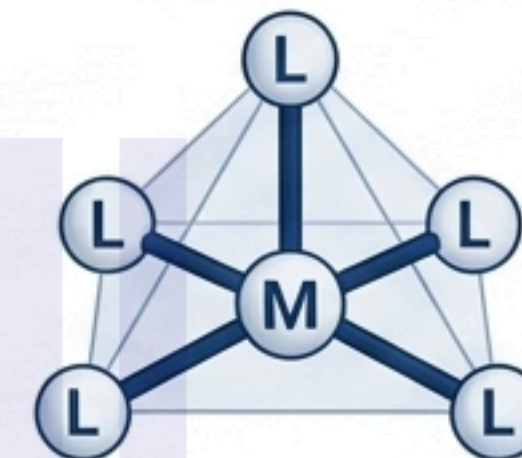
Tetrahedral



Square Planar



**Trigonal
Bipyramidal**



**Square
Pyramidal**



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$$E=mc^2$$



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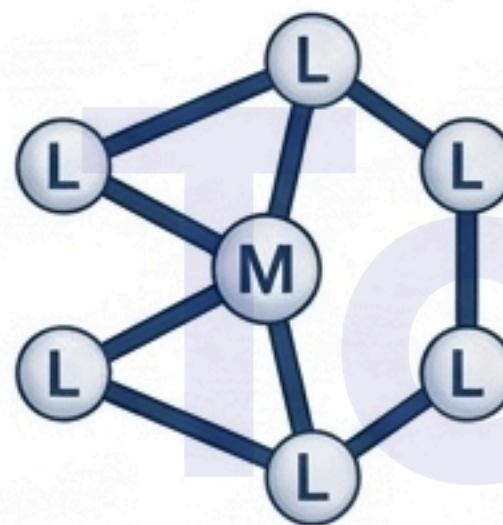


The Denticity Ladder



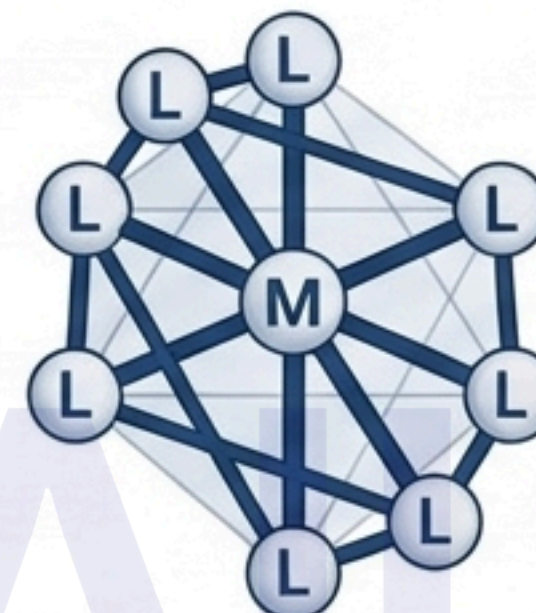
Unidentate

1 donor atom.
Examples: Cl^- , H_2O , NH_3 .



Didentate

2 donor atoms.
Examples: $\text{C}_2\text{O}_4^{2-}$ (oxalate),
ethane-1,2-diamine (en).



Polydentate / Hexadentate

6 donor atoms. Example:
EDTA 4^- (binds through 2
Nitrogen + 4 Oxygen atoms).

Ambidentate Ligands: The Two-Faced Donors

Ligands with two different donor atoms, where only one binds at a time.

Nitrite Ion (NO_2^-)



Thiocyanate Ion (SCN^-)



Calculating Oxidation Number



$$x + 4(-1) = -3$$

$$x - 4 = -3$$

$$x = +1$$

Oxidation number
of Cu = +1
(written as Cu(I))

Anatomy of the Coordination Sphere

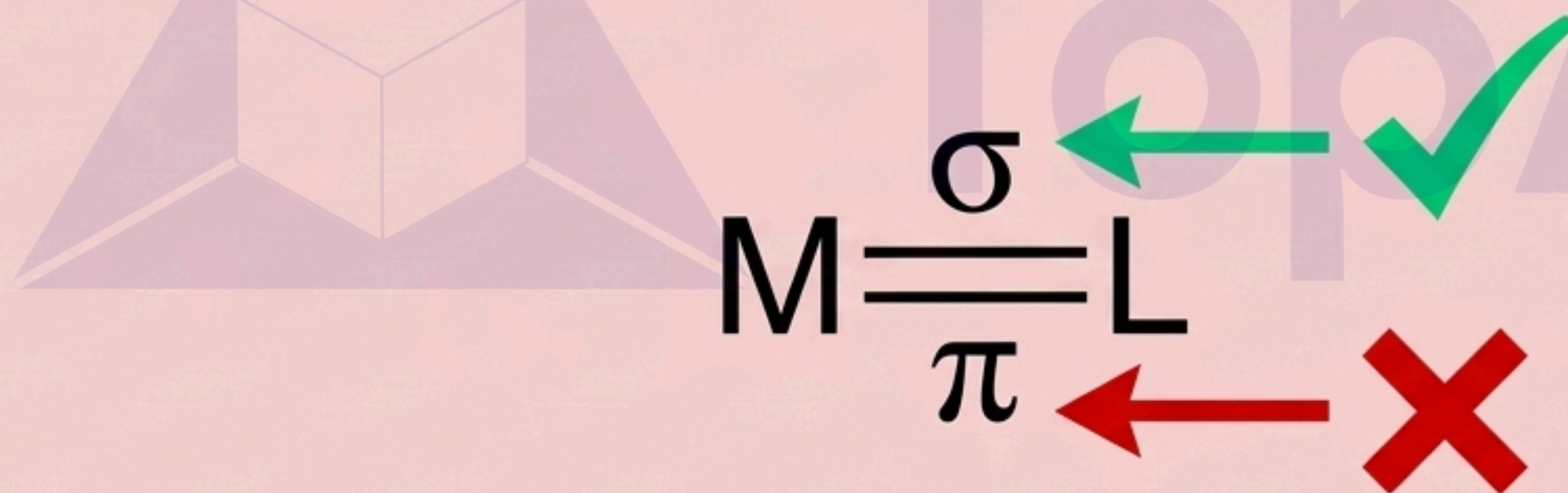


Counter Ions
(Ionizable groups
written outside)

Coordination Sphere
(Non-ionizable central atom + ligands)

Watch for this: Coordination Number

Coordination number counts SIGMA BONDS ONLY. Never count Pi bonds.



Only atoms directly bonded to the metal via sigma interactions contribute to the CN.

Key Takeaways

- A coordination entity consists of a central Lewis acid metal bound to a fixed number of ligands (electron donors) within a non-ionizable coordination sphere.
- **Denticity** defines the number of donor atoms a single ligand uses simultaneously, while coordination number is the absolute total of sigma bonds formed with the central metal.



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