

UNIT 5 • COORDINATION COMPOUNDS

Bonding in Metal Carbonyls

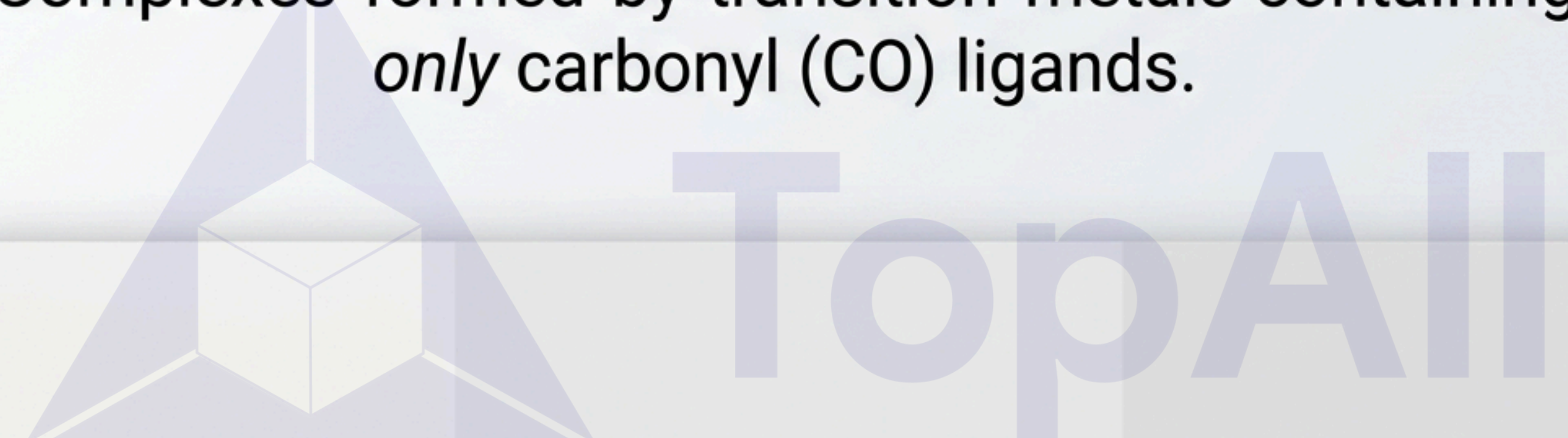
The Blueprint & The Engine of Synergic Bonding

homoleptic carbonyl

synergic bonding

The Blueprint: Homoleptic Carbonyls

Complexes formed by transition metals containing *only* carbonyl (CO) ligands.



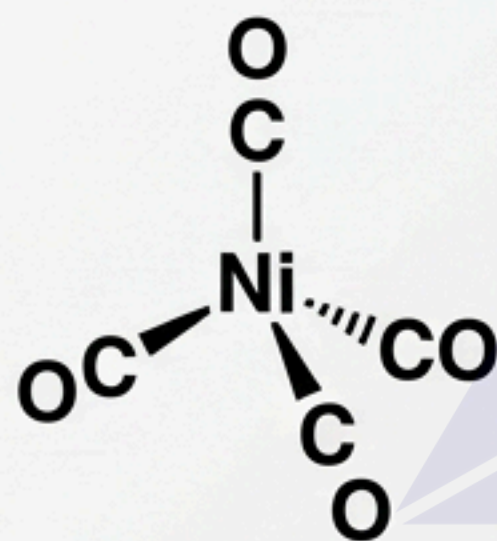
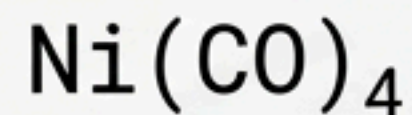
CN4 → Tetrahedral

CN5 → Trigonal
Bipyramidal

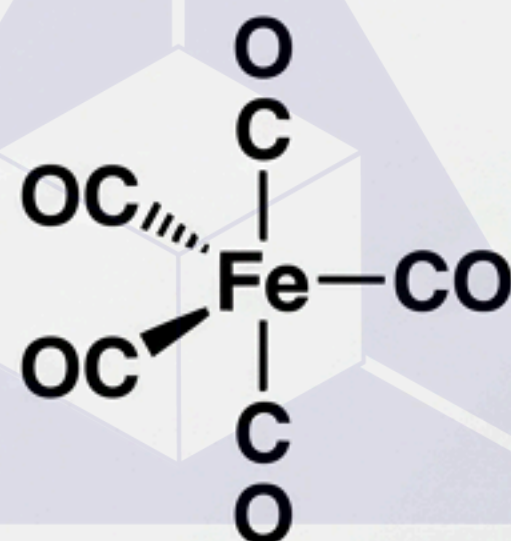
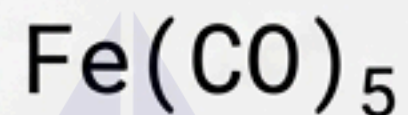
CN6 → Octahedral



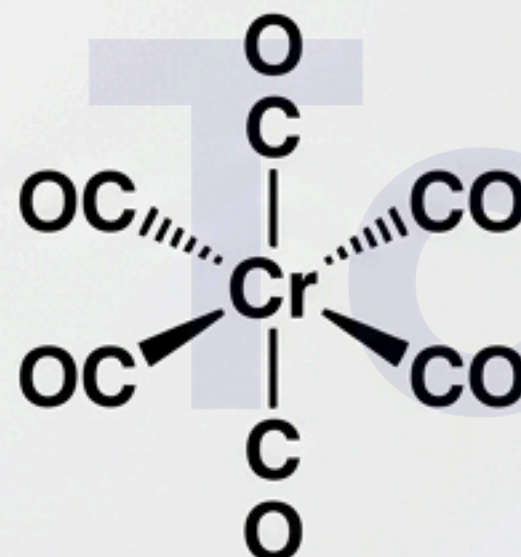
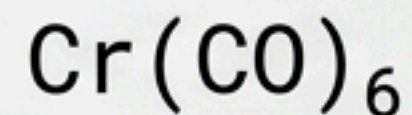
The Five Classic Structures



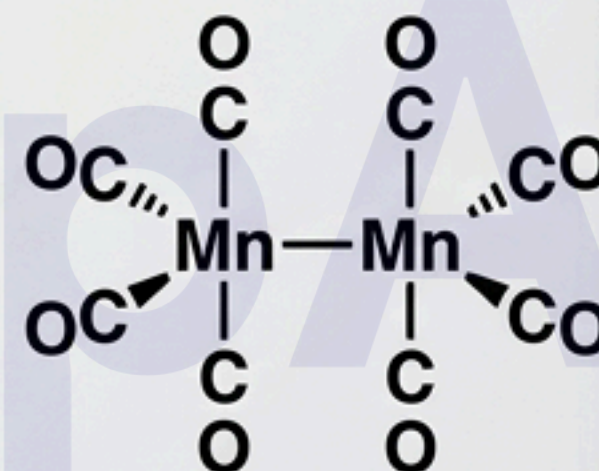
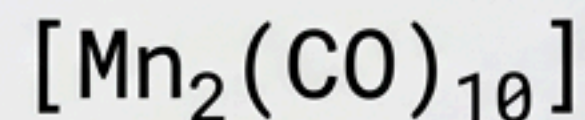
Tetrahedral



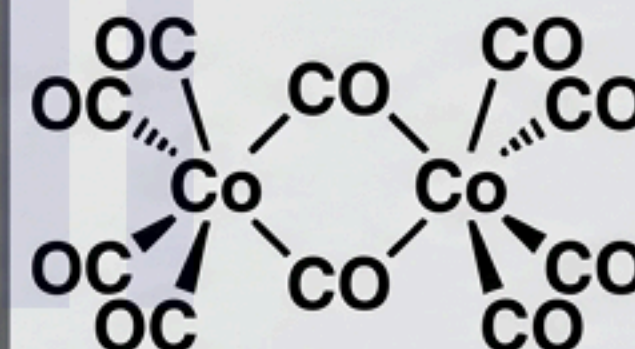
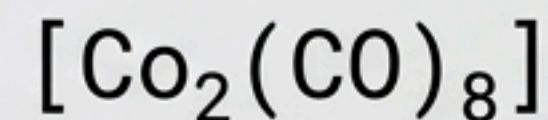
Trigonal
Bipyramidal



Octahedral



Dimanganese(0)



Dicobalt(0)



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



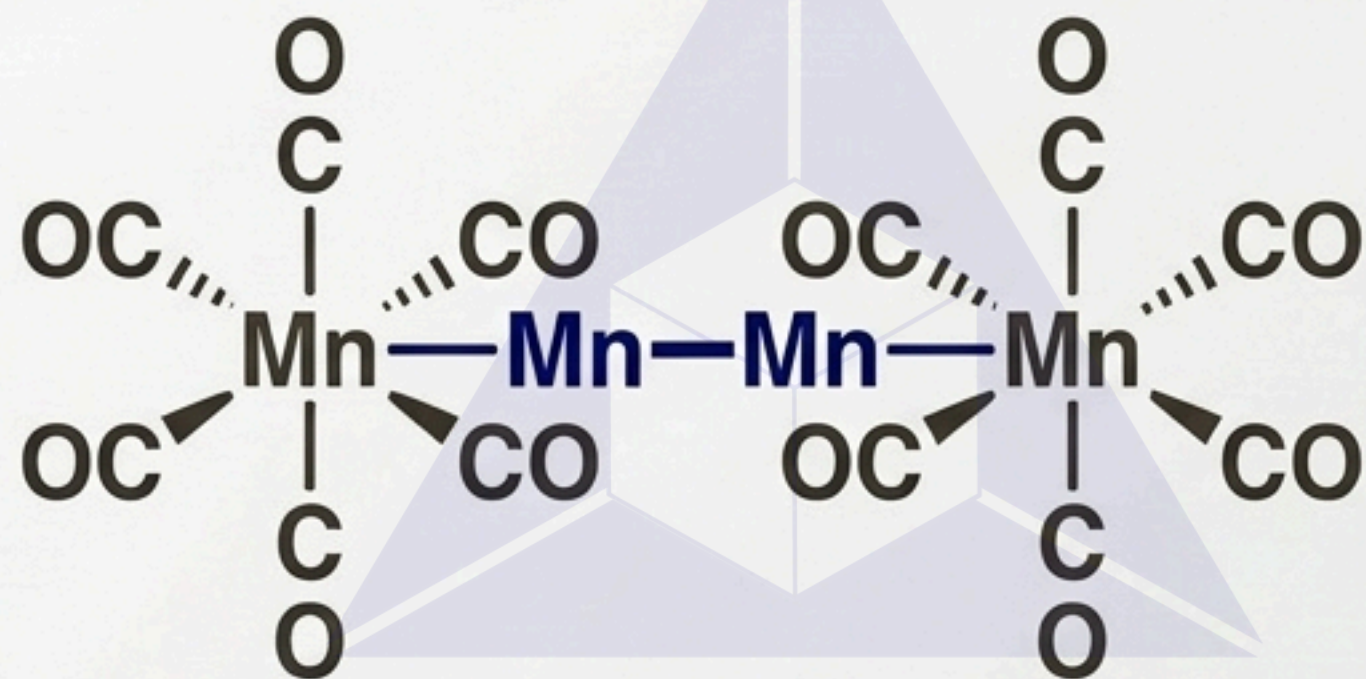
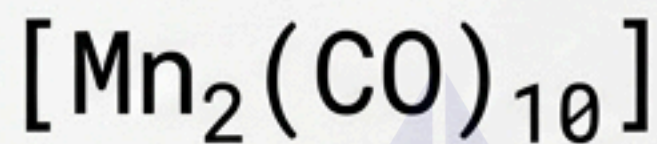
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Key Highlights

- » 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

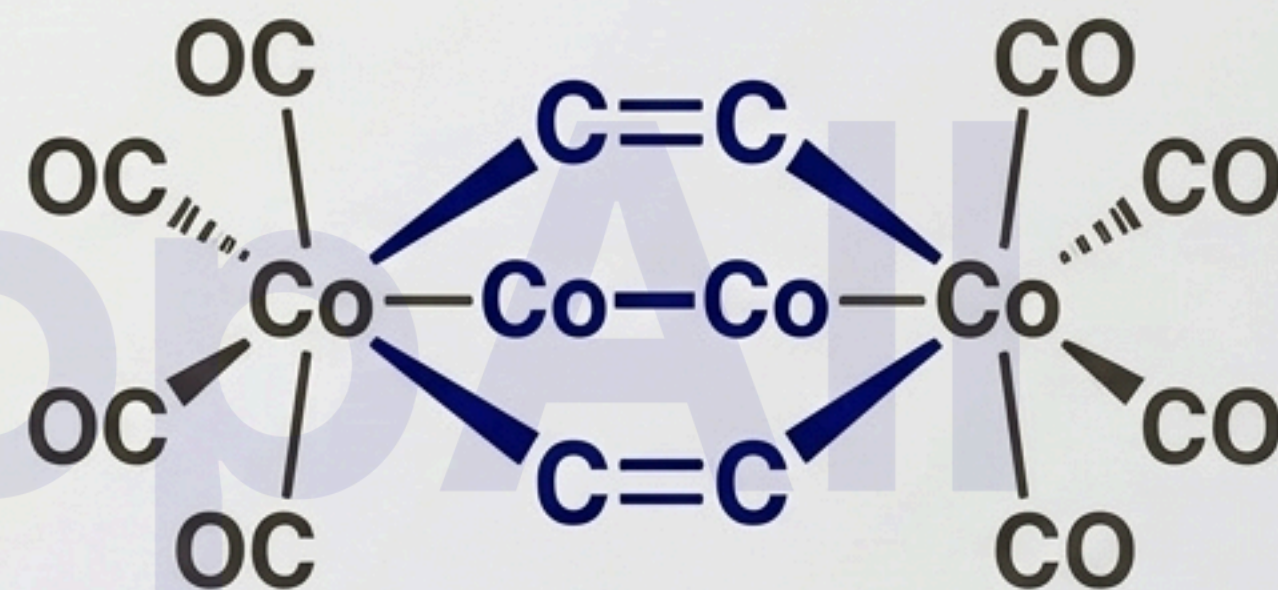
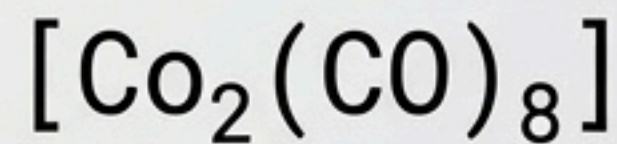


Dimer Spotlight: To Bridge or Not to Bridge?



Mn—Mn Bond Only

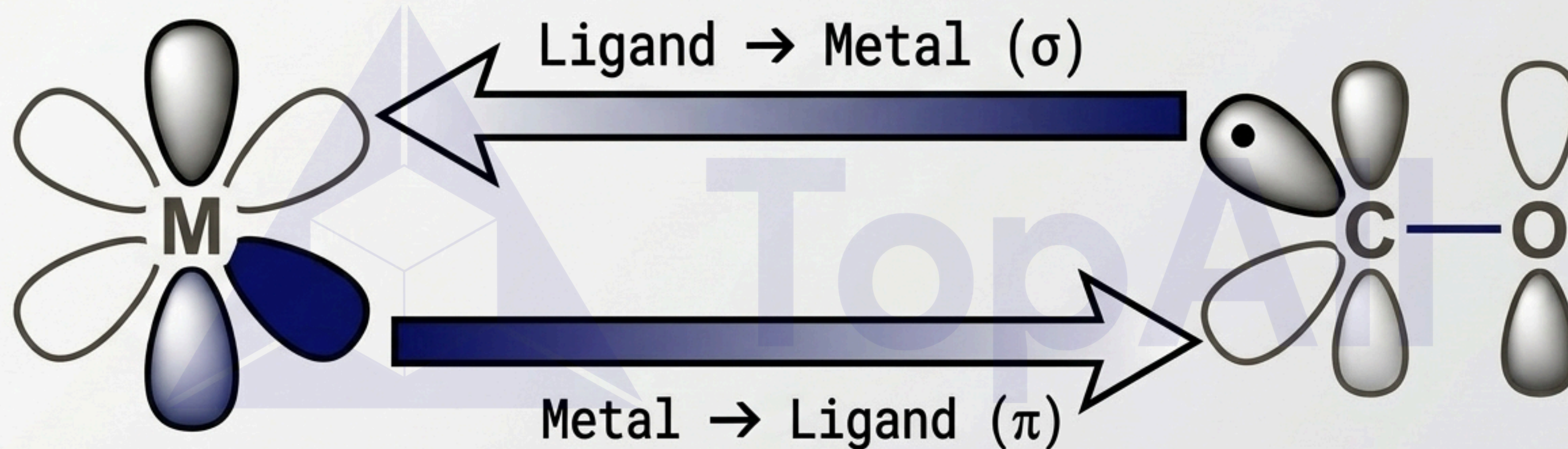
Two square pyramidal $\text{Mn}(\text{CO})_5$ units joined directly. Zero bridging CO groups.



Co—Co Bond + 2 Bridging CO

The cobalt centers are joined by a metal-metal bond and bridged by two shared carbonyl groups.

The Engine: Synergic Bonding



This push-pull electron flow creates a re-**re-engineered** engine, This push-pull electron flow creates a synergic effect, dramatically strengthening the bond between the metal and the CO ligand.

Exam Strategy

Watch for this common trap:

Sigma and Pi bonds run in opposite directions.

σ bond = Ligand $\rightarrow$ Metal (Standard donation)

π bond = Metal $\rightarrow$ Ligand (**Backdonation**)

Do not let exam options trick you into assuming all electron flow moves toward the metal. The π bond is an explicit reversal of standard ligand donation.

Knowledge Check

In the synergic bonding of metal carbonyls, the π bond is formed by electron donation from the...

[A] Carbonyl ligand's lone pair to the metal's vacant orbital.

✓ [B] Metal's filled d orbital to the carbonyl's vacant π^* antibonding orbital.

[C] Metal's filled d orbital to the metal's vacant p orbital.

[D] Carbonyl ligand's π orbital to the metal's filled orbital.

Summary

Mastery Unlocked: Metal Carbonyls

- **The Blueprint (Geometry):** Mononuclear carbonyl geometries map directly to Coordination Number (CN4 = Tetrahedral, CN5 = Trigonal Bipyramidal, CN6 = Octahedral). Dimers differ by bridging (Mn₂ has none, Co₂ has two).
- **The Engine (Synergic Bonding):** Bond stability relies on a dual pathway. σ bonds push electrons (Ligand $\rightarrow$ Metal), while π backbonding pulls them back (Metal $\rightarrow$ Ligand) into vacant π^* orbitals.



You've Learned the Theory.

Now Let's Test It.

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

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