

The Golden Rule of Covalent Bonds

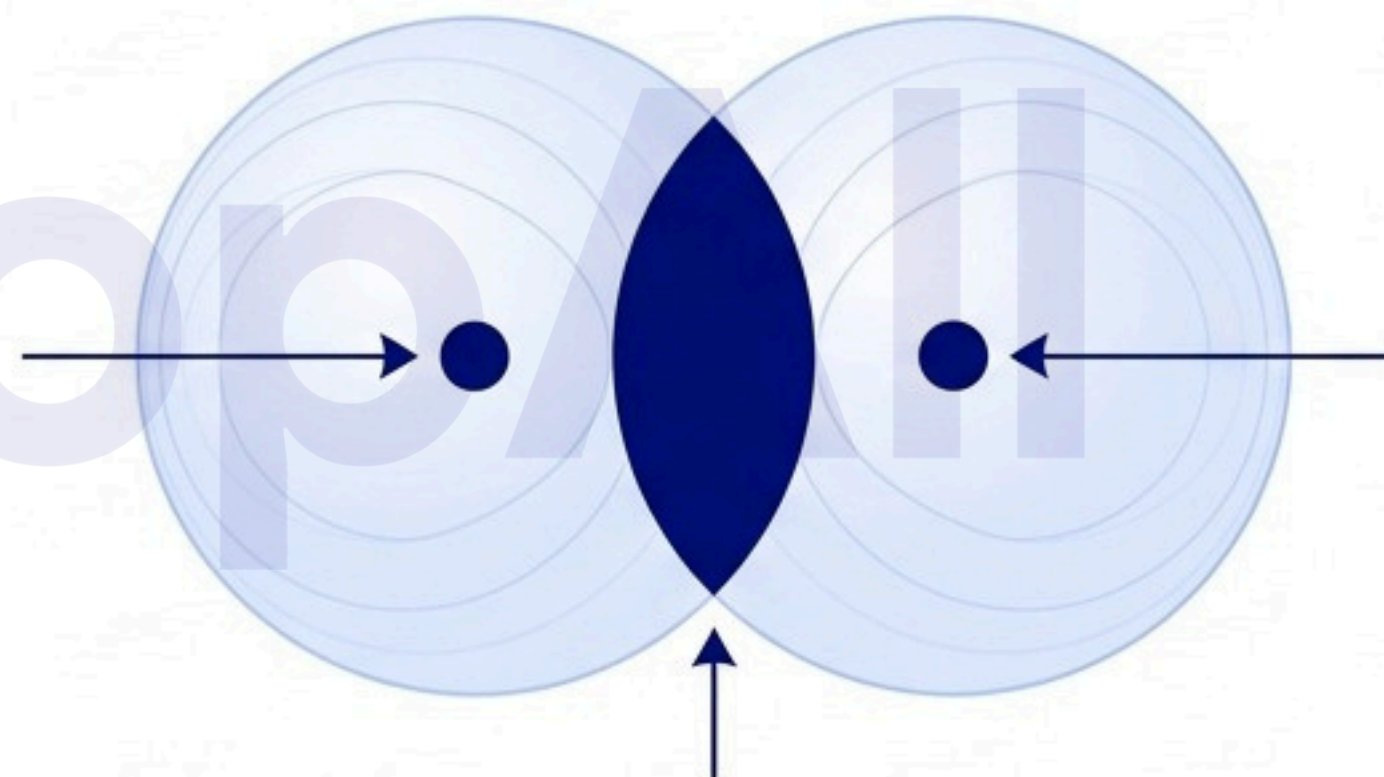
Extent of orbital overlap dictates bond strength

The Orbital Overlap Concept

Covalent bonds form when atomic orbitals partially interpenetrate or “overlap,” resulting in the pairing of electrons with opposite spins.

Greater Overlap = Stronger Bond

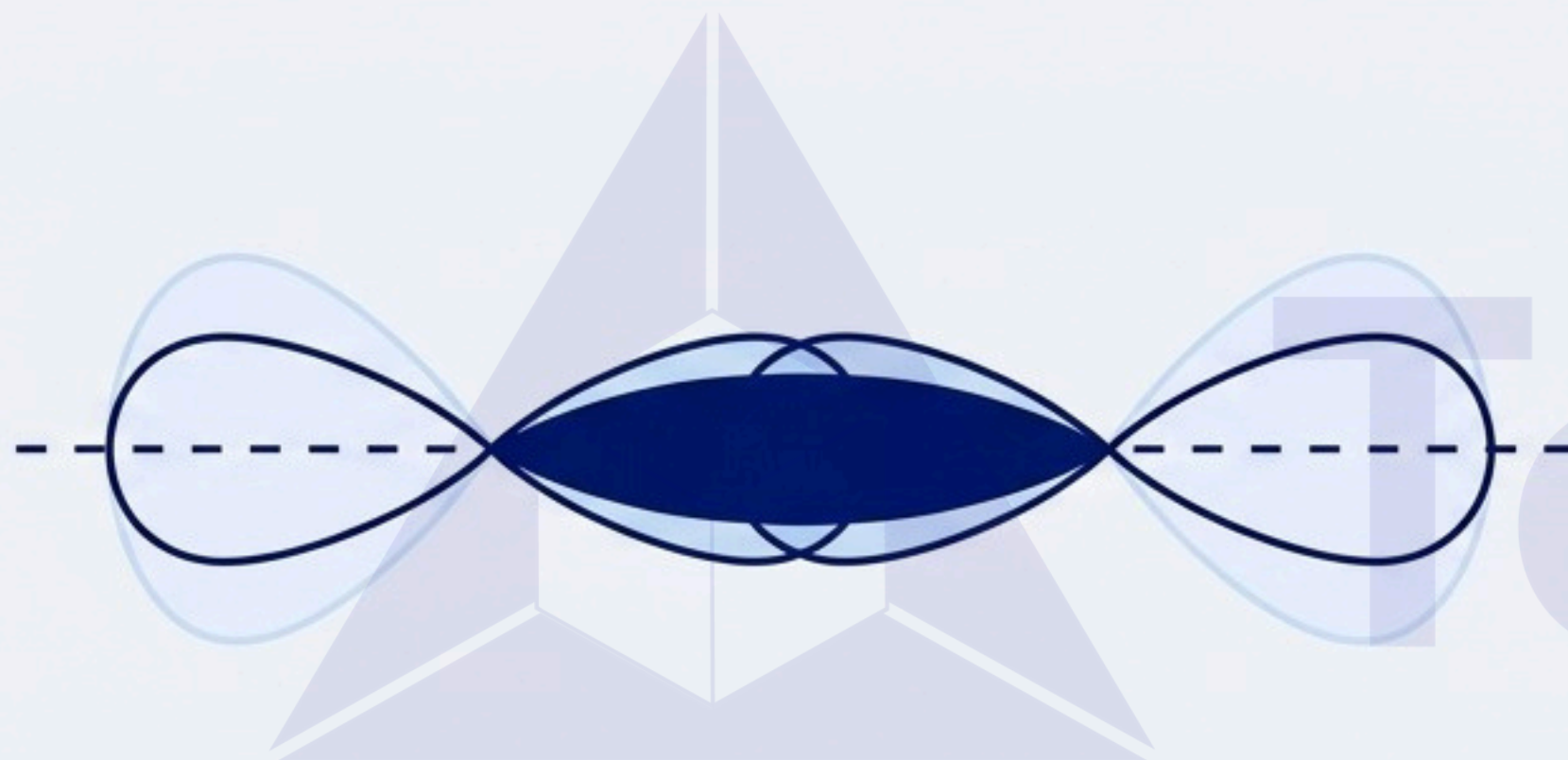
The physical extent to which orbitals merge determines the energy state and stability of the resulting bond.



Electron density is concentrated between the two nuclei, lowering the potential energy of the system and pulling the atoms together.

Sigma (σ) Bonds: Maximum Overlap

Head-on collision allows for deep orbital merging



Axial / Head-on Overlap

Electron density is highly concentrated symmetrically along the internuclear axis.

Formation

Formed by the end-to-end (axial) overlap of bonding orbitals (e.g., s-s, s-p, or p-p).

Extent of Overlap

Because orbitals approach directly along the axis connecting the nuclei, they penetrate deeply into each other.

Resulting Strength

This large extent of overlap makes the sigma (σ) bond incredibly strong and stable. It is the primary structural backbone.



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



Pi (π) Bonds: Restricted Overlap

Sideways orientation inherently limits interpenetration

Formation

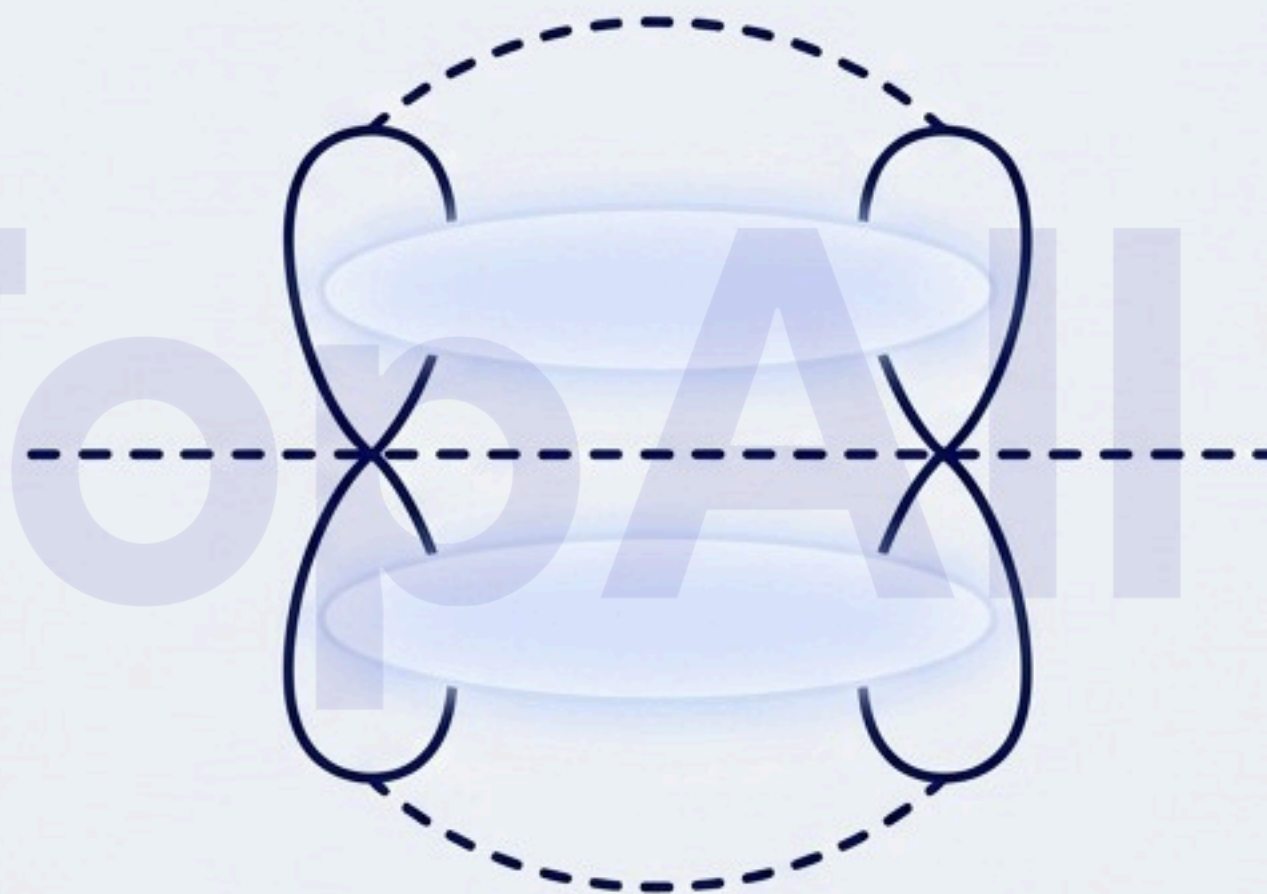
Formed when atomic orbitals overlap such that their axes remain parallel to each other and perpendicular to the internuclear axis.

Extent of Overlap

The established internuclear distance prevents these parallel orbitals from pushing deeply together. Overlap is purely lateral and partial.

Resulting Strength

Due to this much smaller extent of overlap, pi (π) bonds are fundamentally weaker than sigma (σ) bonds.



Sidewise / Lateral Overlap

Creates two saucer-like charged clouds above and below the plane of the atoms. Zero electron density exists on the axis itself.

The Anatomy of Multiple Bonds

Multiple bonds are layered combinations of σ and π bonds

Important Rule: There can only be ONE Sigma (σ) bond between any two atoms. Any additional bonds formed between those same two atoms must be Pi (π) bonds.

Single Bond



1 σ bond

0 π bonds

Double Bond



1 σ bond

+ 1 π bond

Triple Bond



1 σ bond

+ 2 π bonds

Revision Frame

Comparison Matrix: Sigma vs. Pi Bonds

Property	Sigma (σ) Bond	Pi (π) Bond
Orientation of Overlap	End-to-end / Head-on along the internuclear axis.	Sidewise / Lateral, perpendicular to the internuclear axis.
Extent of Overlap	Large extent of overlap due to direct approach.	Smaller extent of overlap due to parallel geometric restriction.
Relative Strength	STRONGER	WEAKER
Role in Bonding	Can exist independently. Every single bond is a σ bond.	Never exists independently. Always forms in addition to a σ bond.



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