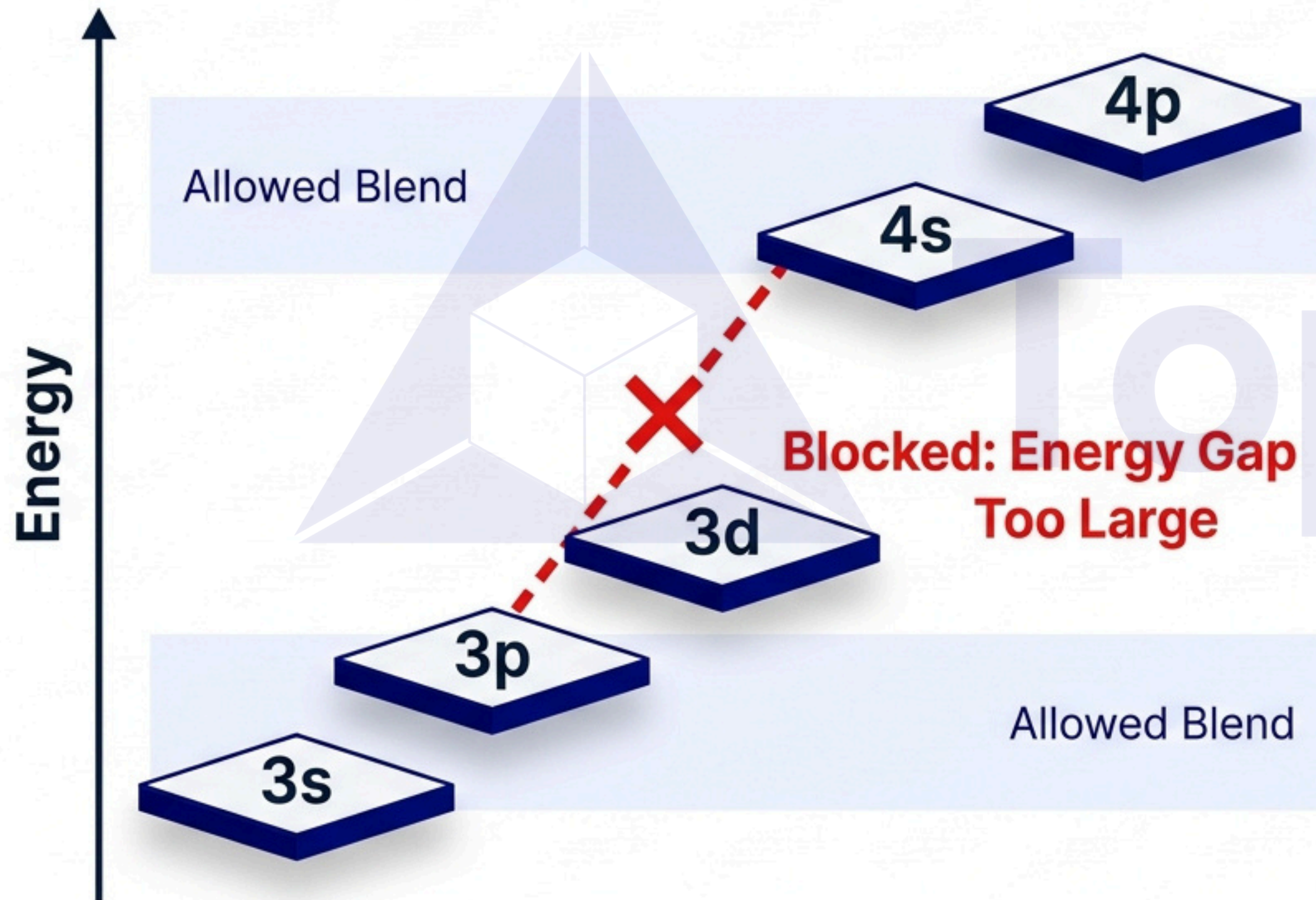


The Energetic Threshold: Why 3rd-Period Elements Use d-Orbitals



The Principle

Elements in the third period (and beyond) unlock d-orbitals for bonding.

The Rule of Proximity

Hybridisation strictly requires orbitals of almost equal energy.

The Consequence

Mixing 3s, 3p, and 3d is allowed.
Mixing 3d, 4s, and 4p is allowed. Mixing 3p, 3d, and 4s is strictly forbidden.

The Master Map of d-Orbital Geometries



Geometry Name		Hybridisation	Orbital Blend	Example Compounds
	Square Planar	dsp^2	$d + s + p(2)$	$[Ni(CN)_4]^{2-}$, $[Pt(Cl)_4]^{2-}$
	Trigonal Bipyramidal	sp^3d	$s + p(3) + d$	PF_5 , PCl_5
	Square Pyramidal	sp^3d^2	$s + p(3) + d(2)$	BrF_5
	Octahedral	sp^3d^2 or d^2sp^3	$s + p(3) + d(2)$ or $d(2) + s + p(3)$	SF_6 , $[CrF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$

Constructing PCl_5 : The sp^3d Blending Process



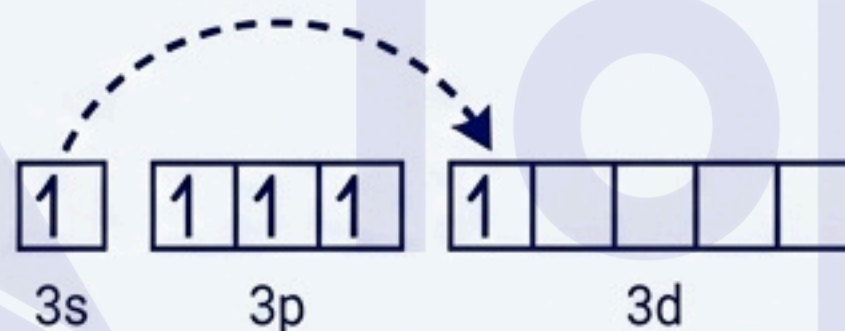
Target: Phosphorus ($Z=15$) shuffling electrons to accommodate 5 bonds.

1. Ground State



Outer configuration is $3s^2 3p^3$.

2. Excited State



One 3s electron promotes to 3d, yielding five unpaired electrons.

3. Hybridised State



The one s, three p, and one d orbitals blend to form five identical hybrid orbitals.



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

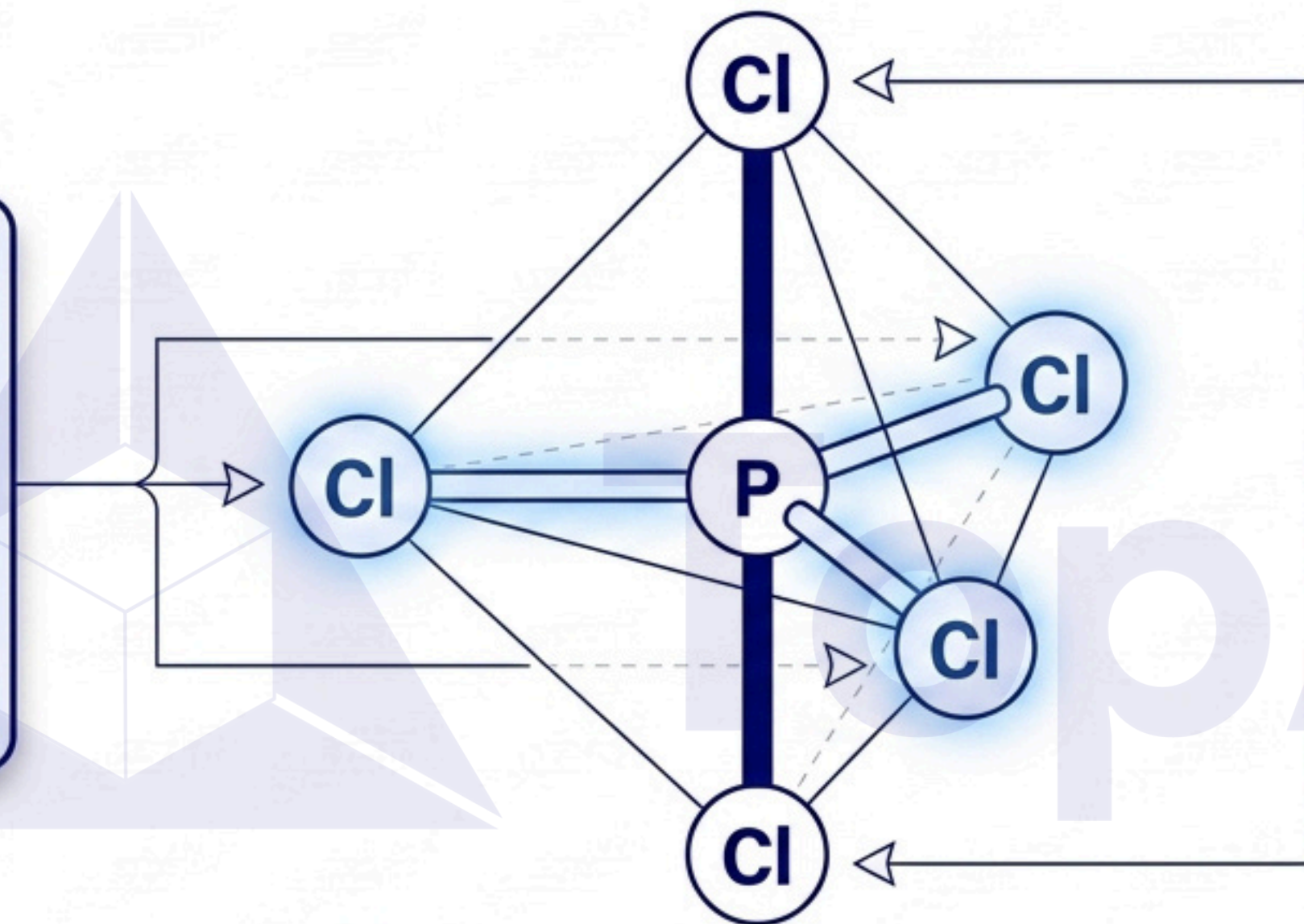
- » Free Study Material, Videos & Infographics
- » Push Your Limits with Level-Based Challenges
- » Climb the Leaderboard Among Fellow Aspirants
- » Practice Unlimited MCQs for NEET & JEE
- » Get Clear Explanations, Not Just Marks
- » Track Your Performance Smarter



The Structural Quirk of sp^3d : Asymmetrical Bonding

Equatorial Bonds (3)

Lie in a single horizontal plane, spaced at equal 120° angles.



Axial Bonds (2)

Project perpendicularly (90°) above and below the equatorial plane.

The Consequence

Because they sit at a tight 90° angle to the equatorial plane, axial bond pairs suffer greater repulsive interaction. This forces them to be longer and weaker, making PCl_5 highly reactive.

Constructing SF₆: The sp³d² Blending Process

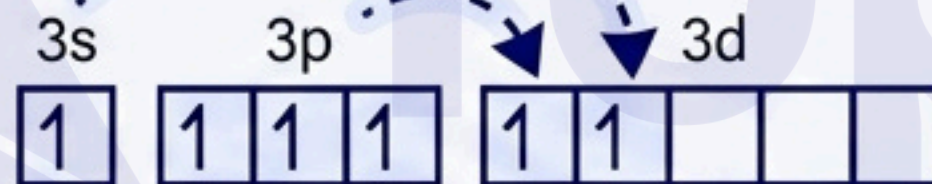
Target: Sulphur (Z=16) shuffling electrons to accommodate 6 bonds.

1. Ground State



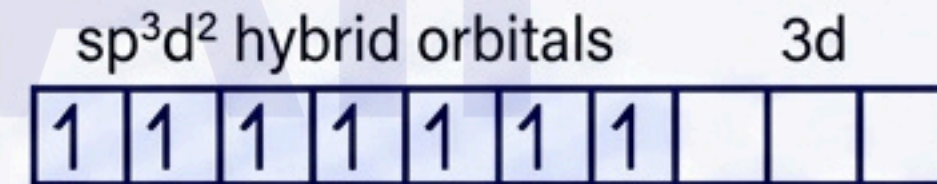
Outer configuration is
3s² 3p⁴.

2. Excited State



One 3s and one 3p electron
promote to 3d, yielding six
unpaired electrons.

3. Hybridised State

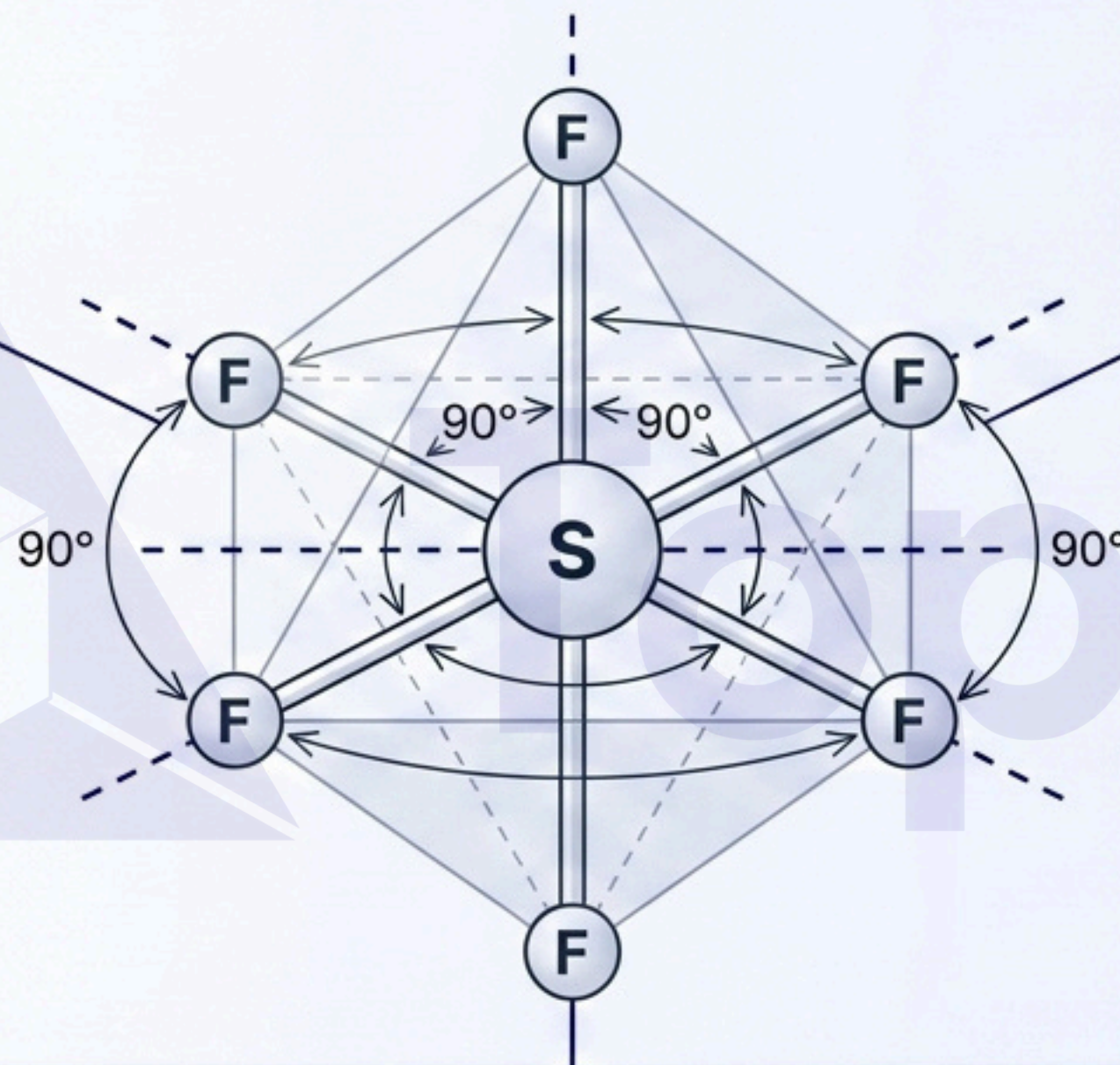


The six orbitals blend into
six identical sp³d² hybrid
orbitals.

The Perfection of sp^3d^2 : Octahedral Symmetry

The Geometry

Regular Octahedron. All six sp^3d^2 hybrid orbitals project towards the exact corners of this shape.



The Angles

Every angle between any adjacent bond is exactly 90° , creating perfect spatial equilibrium.

The Result

Unlike sp^3d , there is no distinction between axial and equatorial positions here. Every single S-F sigma bond is structurally identical, resulting in a highly stable, uniform structure.

Revision Frame: The Expanded Octet Architecture

sp^3d (PCl_5)



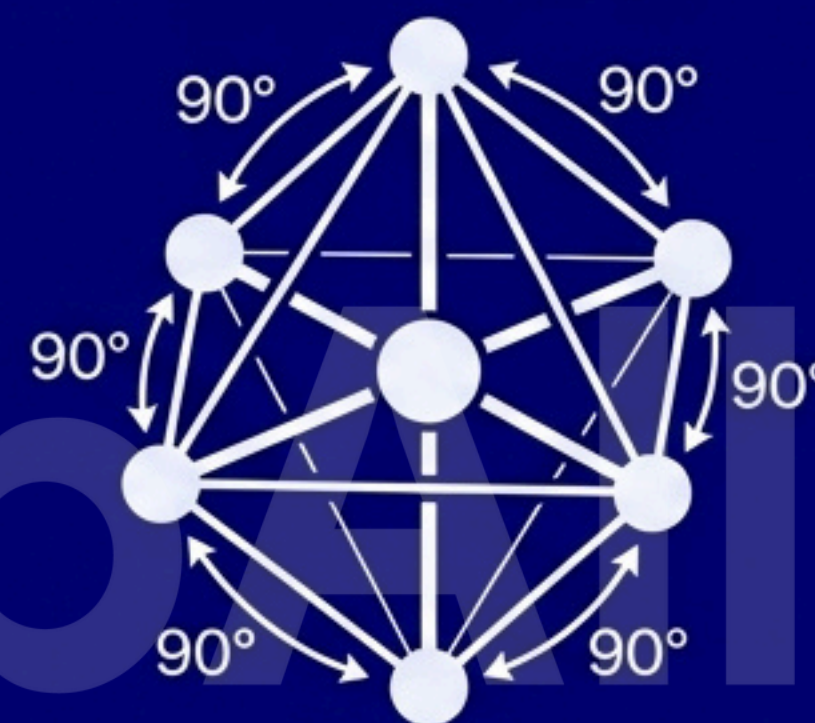
Geometry:	Trigonal Bipyramidal
------------------	----------------------

Orbitals:	$1s + 3p + 1d$
------------------	----------------

Angles:	120° (Equatorial) & 90° (Axial)
----------------	---

Key Trait:	Asymmetrical / Reactive (Axial bonds suffer higher repulsion).
-------------------	---

sp^3d^2 (SF_6)



Geometry:	Regular Octahedral
------------------	--------------------

Orbitals:	$1s + 3p + 2d$
------------------	----------------

Angles:	90° exclusively
----------------	------------------------

Key Trait:	Perfectly Symmetrical / Stable (All 6 bonds are identical).
-------------------	--



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