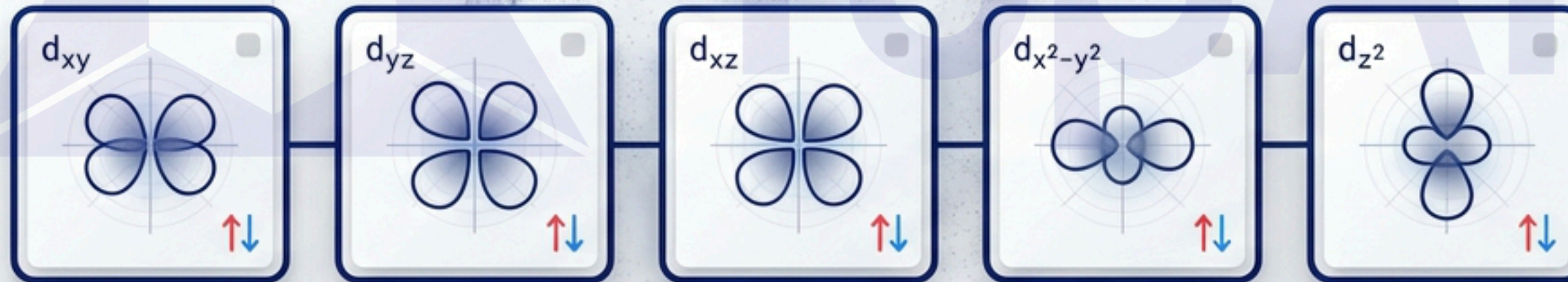


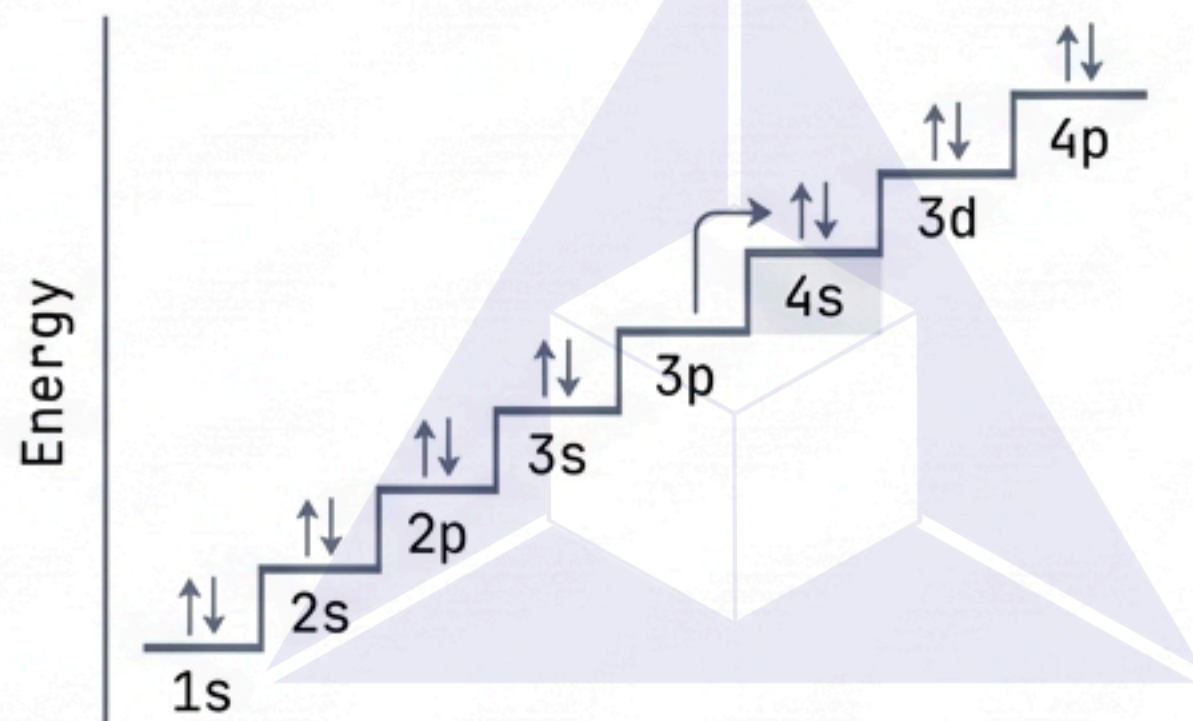
2.6.6 Stability of Completely Filled and Half Filled Subshells

#QuantumMechanics



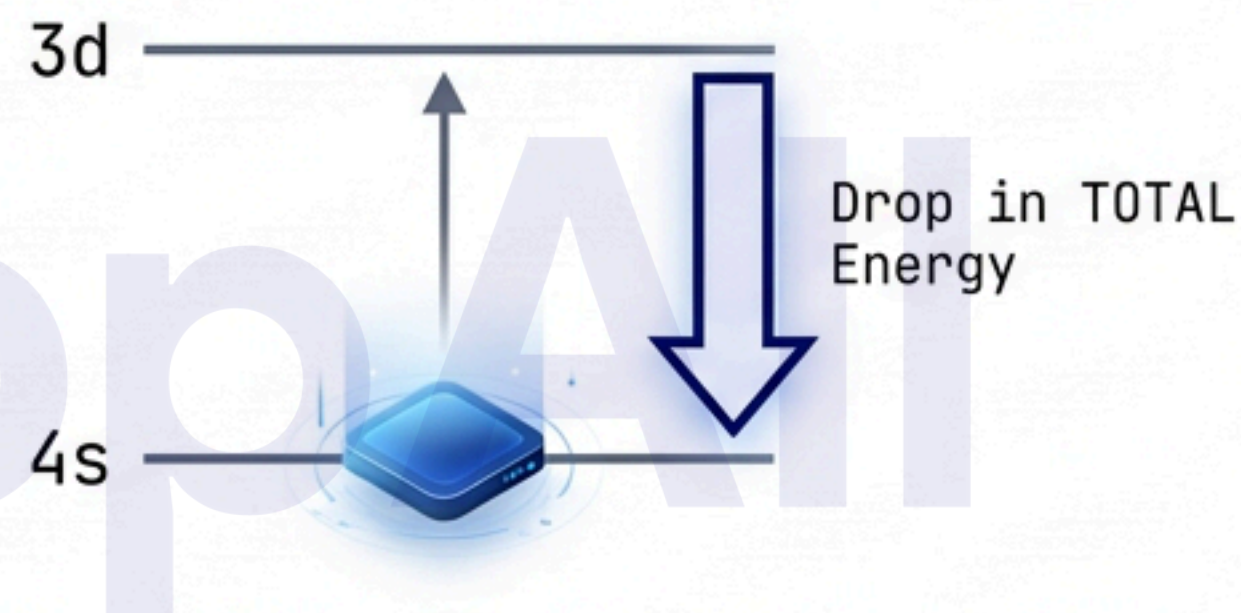
Why Some Configurations Show Exceptions

Expected (Aufbau)



Electrons fill orbitals in order of increasing energy.

Anomaly Detected

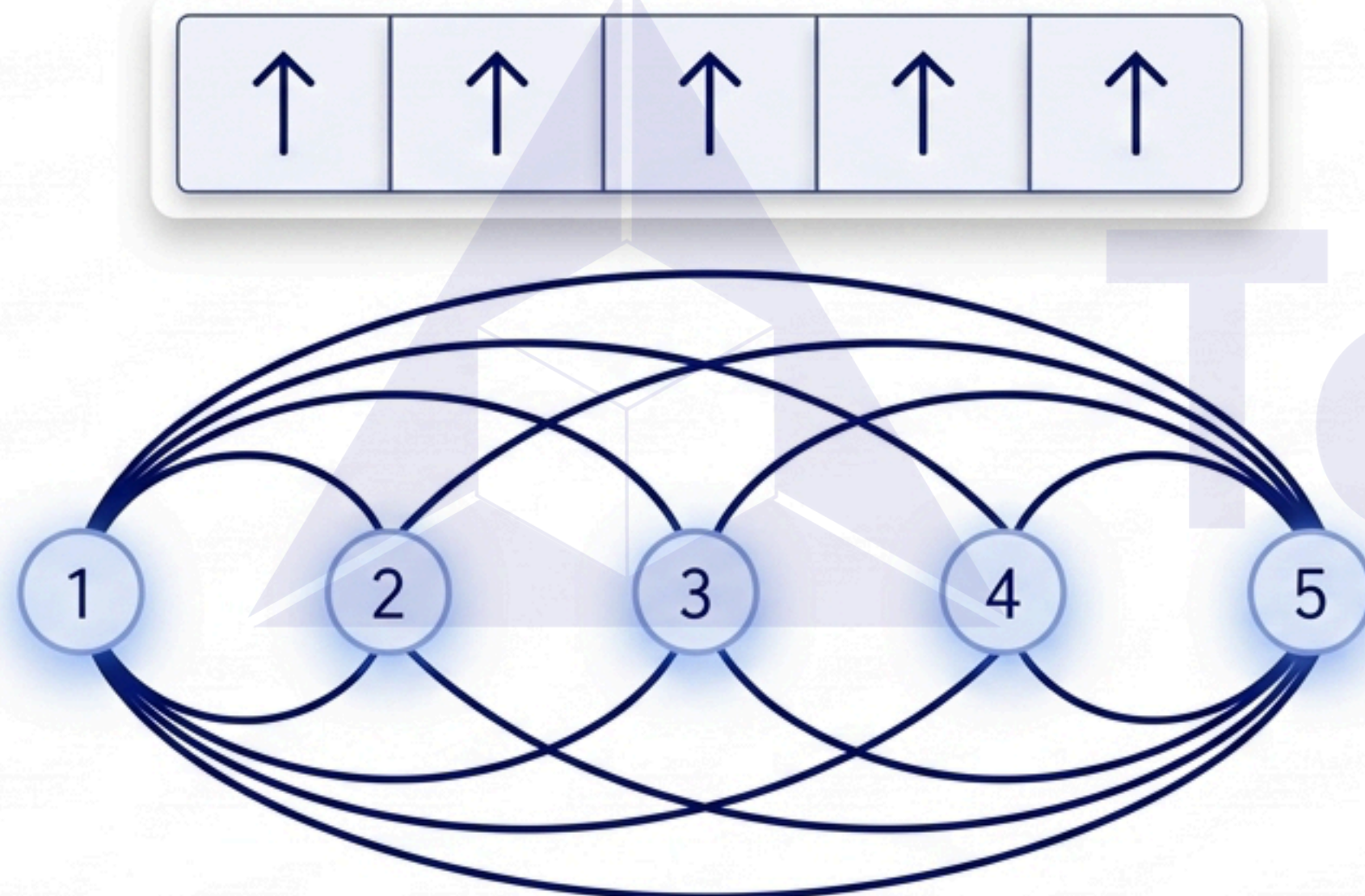


If the 4s and 3d subshells differ only slightly in energy, an electron will shift to the higher energy subshell if it results in a completely filled or half-filled state.

■ Key Takeaway

The Golden Rule: The ground state electronic configuration always corresponds to the state of the lowest total electronic energy.

Half-Filled Stability: Exchange Energy



5 parallel electrons = 10 possible positional exchanges

Degenerate Orbitals

Electrons with the same spin in degenerate (equal energy) orbitals tend to exchange positions.

The Energy Payoff

The energy released due to this positional swapping is called Exchange Energy.

Maximum Exchanges

A half-filled subshell maximizes the number of possible exchanges, thereby maximizing the released energy and overall stability.



**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



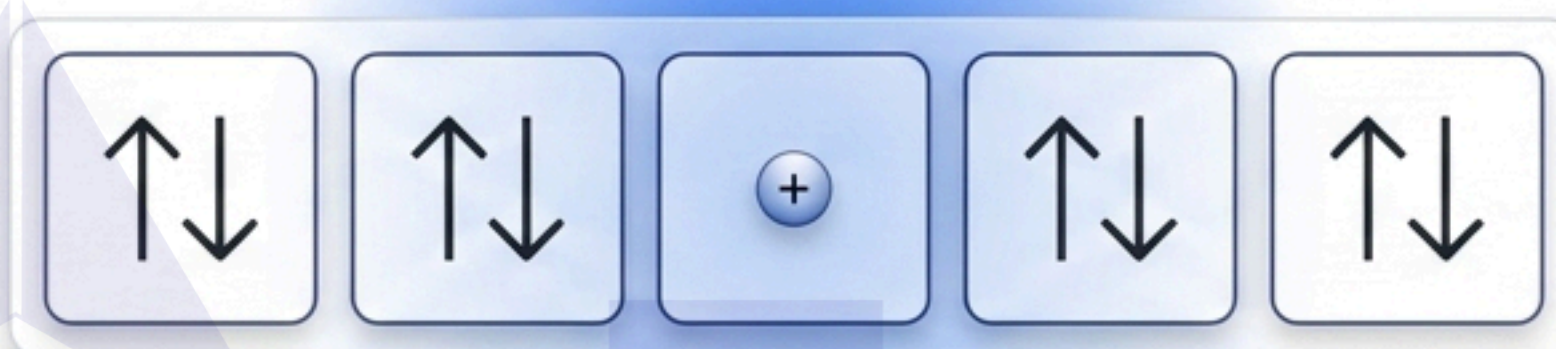
At prep.topall.app

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



Fully Filled Stability: Symmetrical Distribution



Perfect Symmetry

Completely filled subshells have a perfectly symmetrical distribution of electrons. In physics, symmetry inherently leads to stability.

Reduced Shielding

Because electrons in the same subshell have different spatial distributions, their mutual shielding is relatively small.

Z_{eff} (Effective Nuclear Charge)

With uniform distribution and low shielding, electrons are more strongly attracted to the nucleus, compacting the orbital and lowering total energy.

Chromium and Copper Examples

Chromium (Cr, Z=24) Before & After

Expected [Ar] 4s² 3d⁴



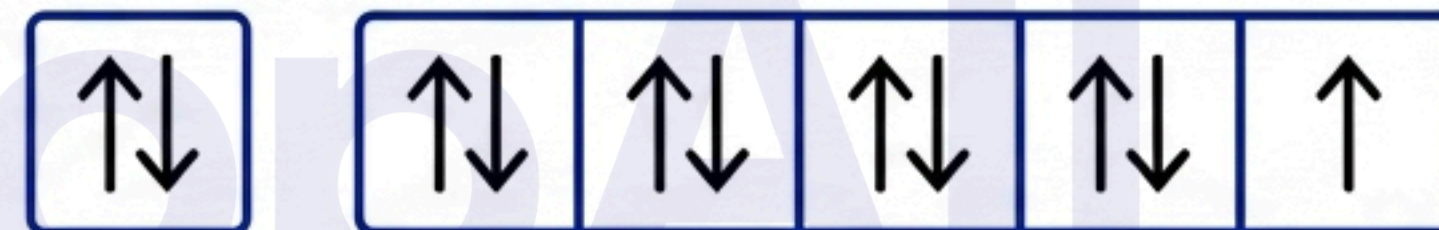
Actual [Ar] 4s¹ 3d⁵



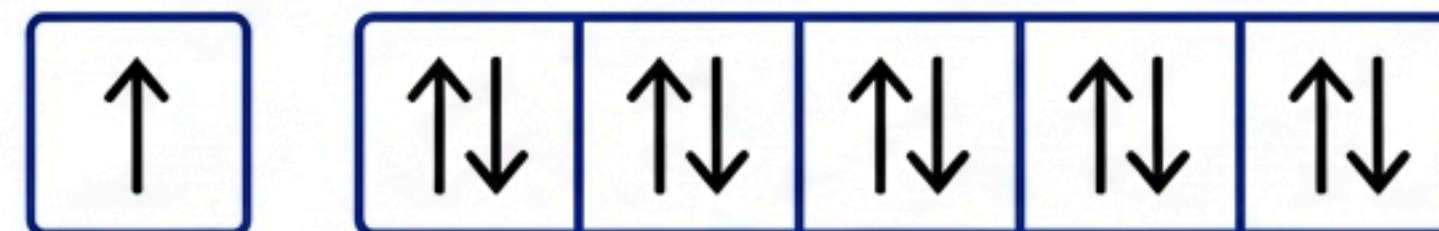
Gains Half-Filled Extra Stability

Copper (Cu, Z=29) Before & After

Expected [Ar] 4s² 3d⁹



Actual [Ar] 4s¹ 3d¹⁰



Gains Fully-Filled Extra Stability

The Three Pillars of Extra Stability

1

Relatively Small Shielding

Symmetrical spatial distribution minimizes how much electrons block each other from the nucleus's pull.

2

Smaller Coulombic Repulsion

Uniform arrangement keeps inter-electronic repulsion forces to an absolute minimum.

3

Larger Exchange Energy

Parallel spins in degenerate orbitals maximize positional swapping, releasing the maximum amount of stabilizing energy.

Rule of Thumb: If shifting one **s-electron** creates a **d⁵** or **d¹⁰** state, the thermodynamic gains from symmetry and exchange energy will always override the standard Aufbau order.



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