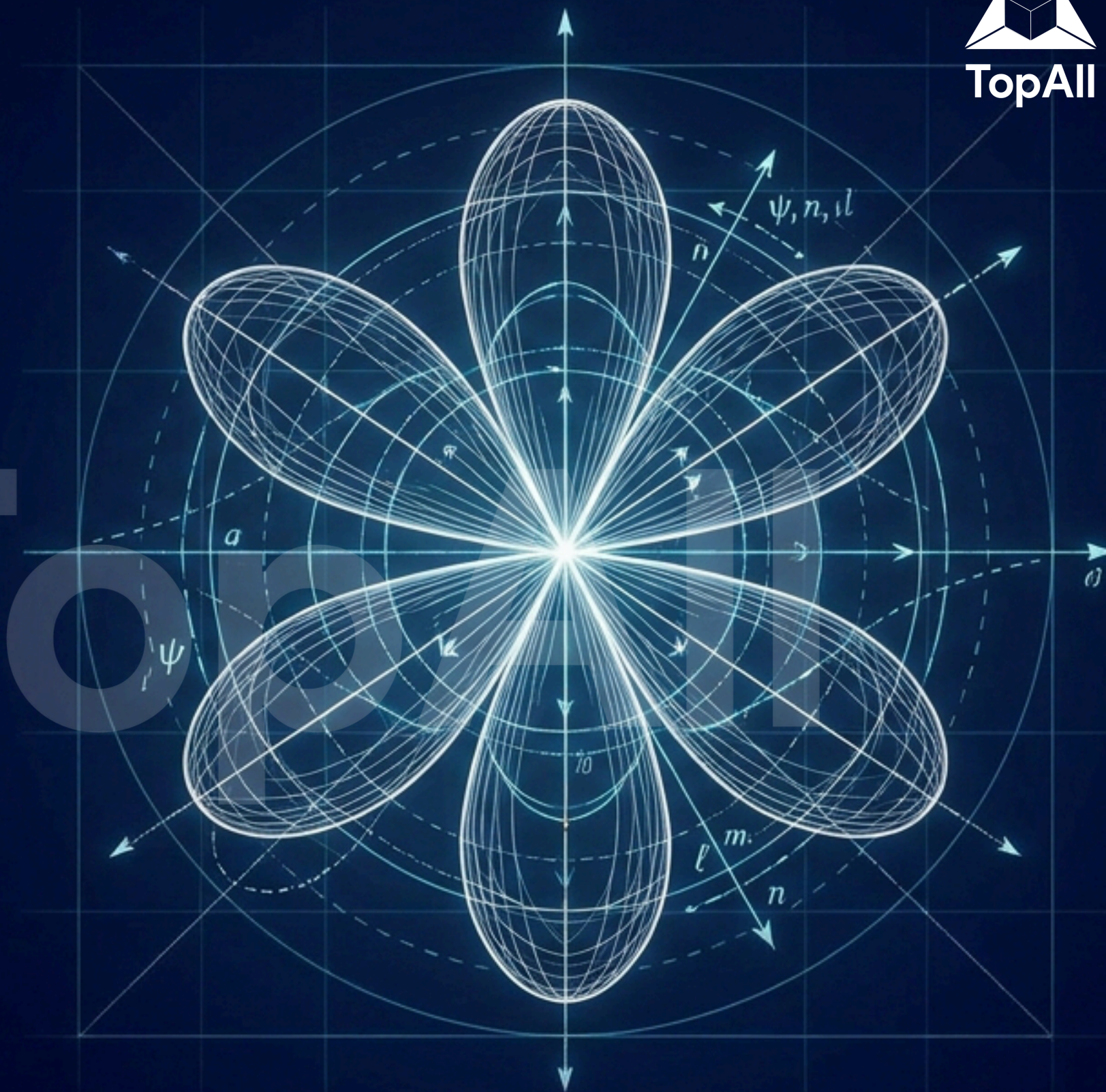


4.6.1 Electronic Configurations of Actinoids

Mastering the 5f series, structural anomalies, and stability rules for NEET/JEE.



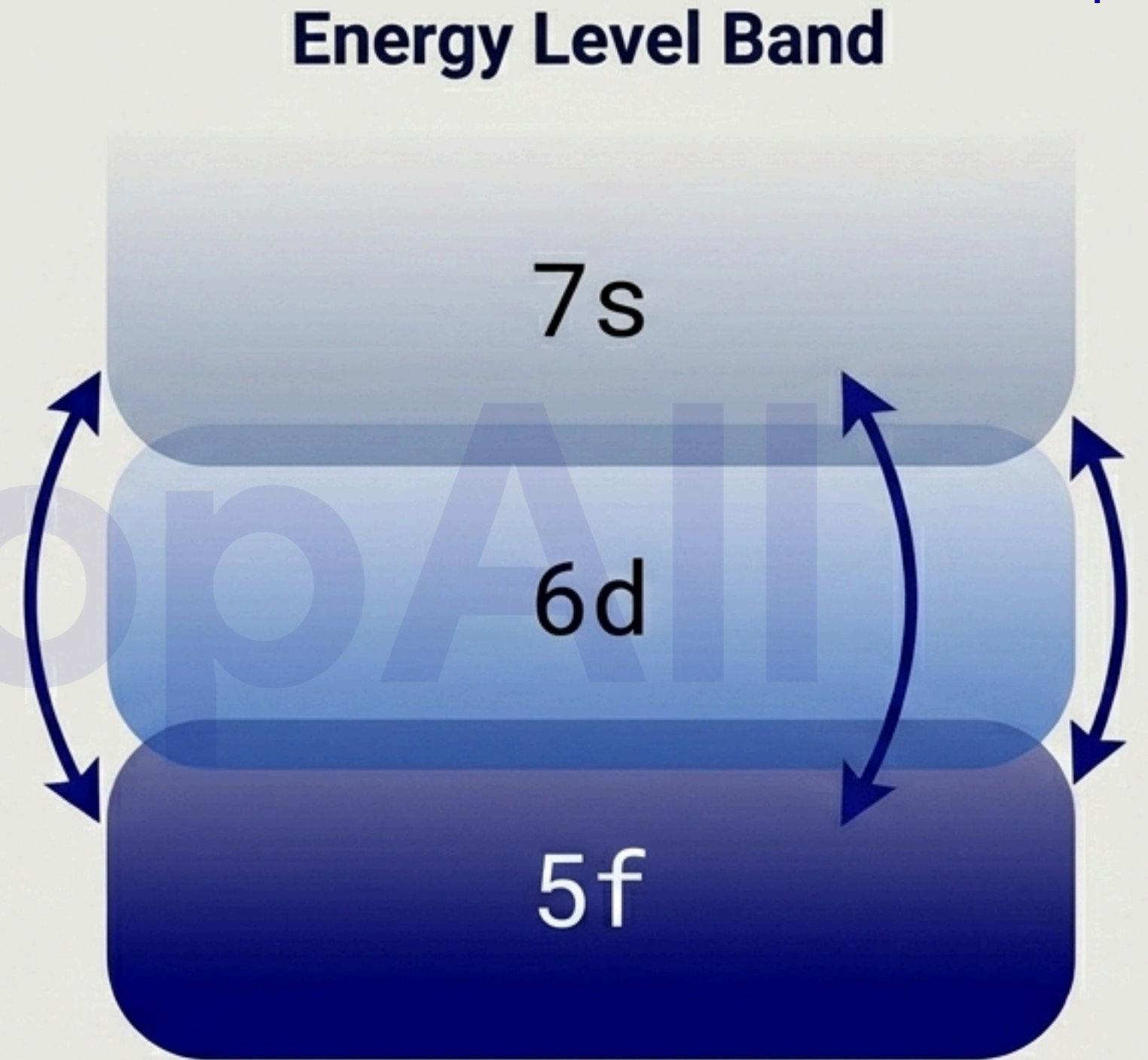
The actinoids include the fourteen elements from Thorium (Th, Z=90) to Lawrencium (Lr, Z=103), following Actinium (Ac, Z=89).

Core Feature: Fourteen electrons are formally added to the 5f subshell across the series.

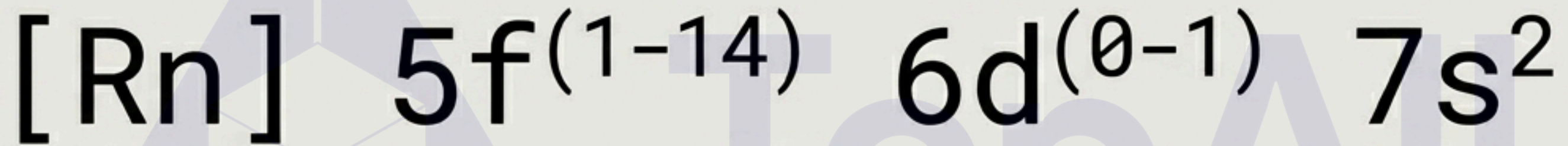
The Root of Complexity: Energy Overlap

The electronic configurations of actinoids show significant irregularities. This occurs because the 5f, 6d, and 7s energy levels are nearly identical (comparable energies).

Takeaway Chip: Electrons can easily shift between 5f and 6d orbitals to achieve greater atomic stability.



The General Configuration Rule



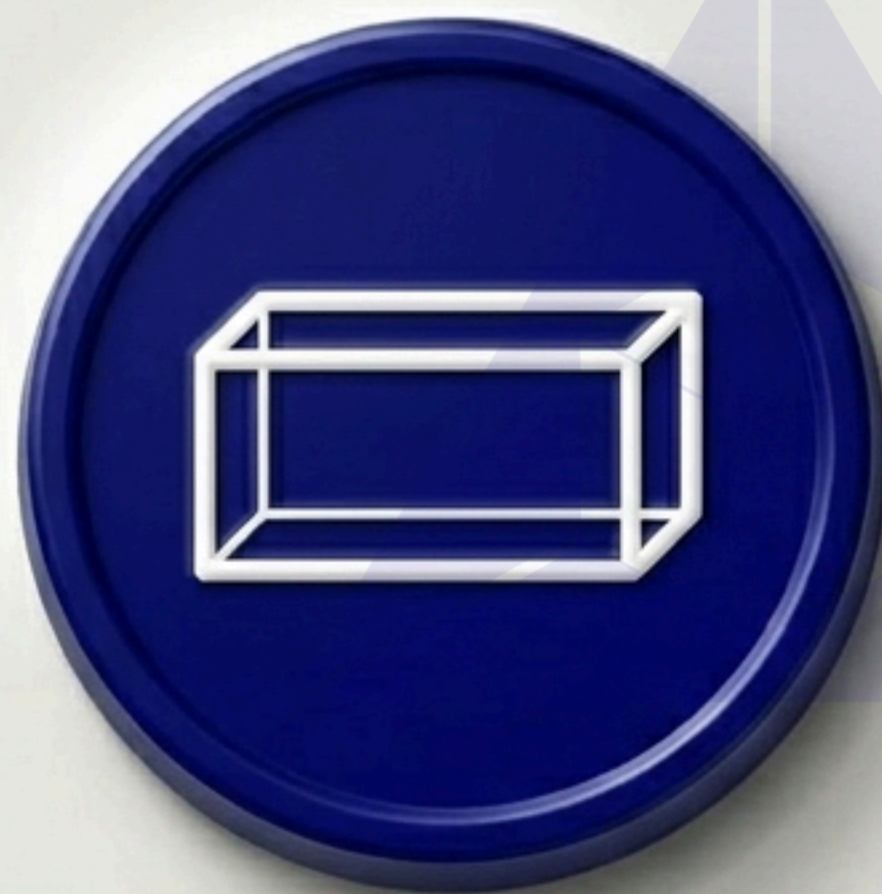
[Rn]: Radon core
(86 electrons).

5f & 6d: Variable
occupancy due to
energy overlap.

7s²: Believed to
be constant across
all actinoids.

The Three Pillars of Stability

Irregularities in the actinoid series are driven by the atom's attempt to achieve or protect one of these three highly stable states.



Empty Orbital
(f^0)



Half-Filled Orbital
(f^7)

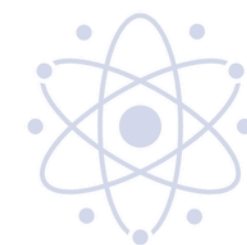


Fully-Filled Orbital
(f^{14})



**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.**

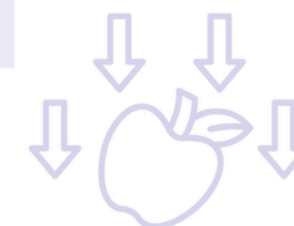
Practice Now



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 Thorium Anomaly (Z=90)

Thorium does not formally add its electron to the **5f** orbital. It places both variable electrons in the **6d** subshell to maintain the highly stable **f⁰** configuration.

Expected

~~[Rn] 5f¹ 6d¹ 7s²~~

Observed

[Rn] 5f⁰ 6d² 7s²



Stability Rule Applied: f⁰ (Empty Subshell)

Protactinium: The 5f Filling Begins

From Protactinium (Pa) onwards, the 5f orbitals formally begin to fill.

From Protactinium (Pa) onwards, the 5f orbitals formally begin to fill.

The electron configuration jumps to **5f²**, bypassing 5f¹ entirely.

Thorium (Z=90)

[Rn] **5f⁰** 6d² 7s²



Protactinium (Z=91)

[Rn] **5f²** 6d¹ 7s²

Americium & Curium: The f^7 Exceptions

Curium pushes its new electron into the 6d orbital rather than 5f, strictly to preserve the extra stability of the half-filled $5f^7$ core.

Americium (Am, Z=95)

[Rn] $5f^7 7s^2$



Perfectly Half-Filled

Curium (Cm, Z=96)

[Rn] $5f^7 6d^1 7s^2$



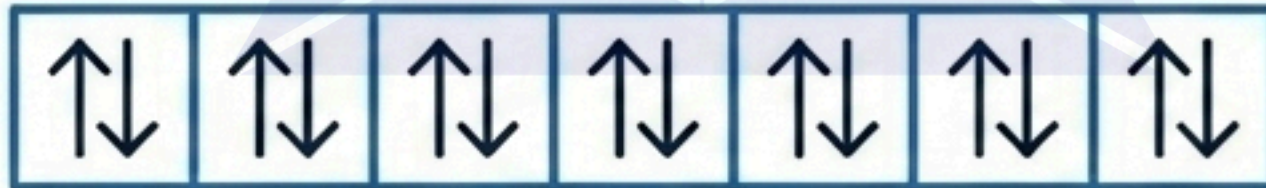
6d

Nobelium & Lawrencium: The f^{14} Exceptions

Element 103 marks the completion of the 5f subshell. Lawrencium places its final electron in the 6d orbital to maintain the fully-filled $5f^{14}$ stability.

Nobelium (No, Z=102)

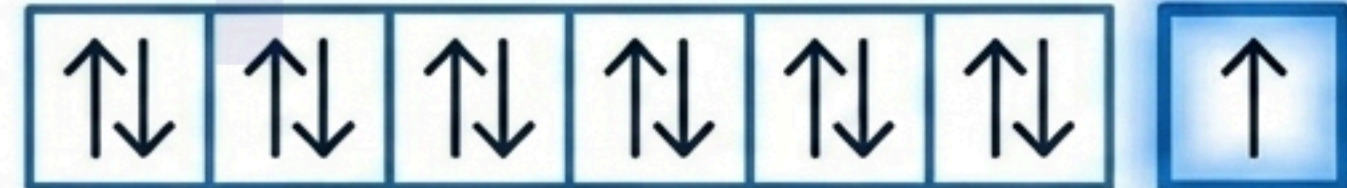
[Rn] $5f^{14} 7s^2$



Perfectly Filled

Lawrencium (Lr, Z=103)

[Rn] $5f^{14} 6d^1 7s^2$



6d

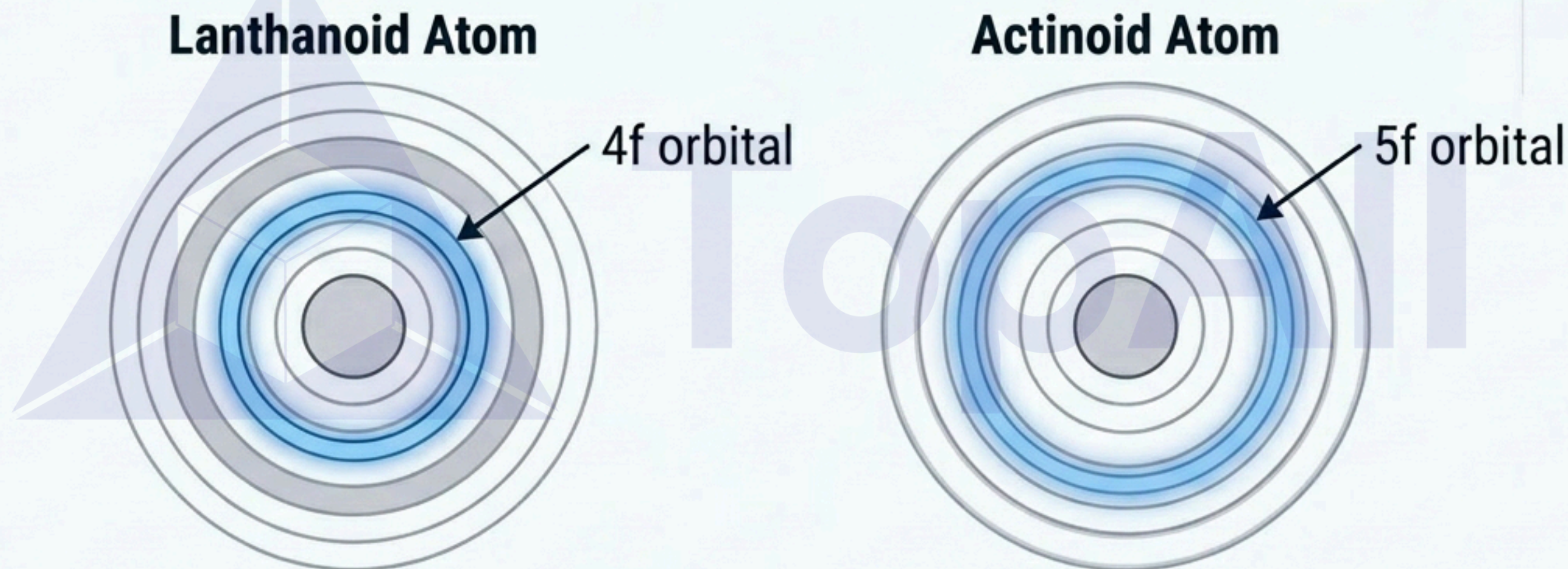
The Configuration Flow Matrix

Notice the pattern: The 6d orbital only holds electrons at the beginning (Ac-Np), at the exact middle (Cm), and at the very end (Lr) to manage orbital stabilities.

Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
0	0	2	3	4	6	7	7	9	10	11	12	13	14	14
1	2	1	1	1	0	0	1	0	0	0	0	0	0	1
d	d	1	d	1	d		d							d

Spatial Extent: 5f vs 4f

Although 5f and 4f orbitals have similar angular shapes, 5f orbitals are not as deeply buried in the atomic core.

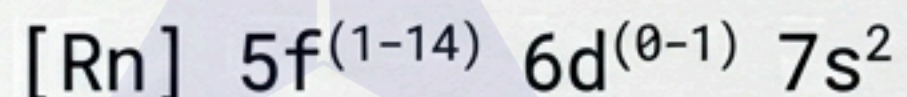


Chemical Consequence: Because 5f electrons are less firmly held and extend further, they can actively participate in bonding to a far greater extent than 4f electrons.

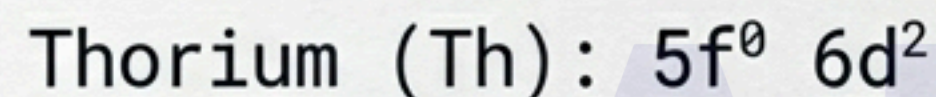
NEET / JEE Quick Revision

High-yield anomalies to memorize.

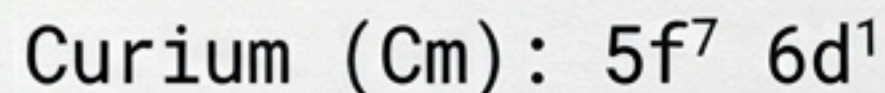
The Base Rule



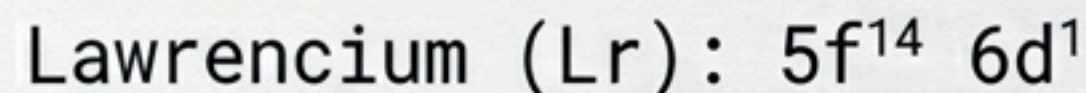
The Empty f Exception



The Half-Filled f Exception



The Fully-Filled f Exception



EXAM TIP: Always check for f^0 , f^7 , or f^{14} stability when predicting actinoid electron drops.



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