

UNIT 4 • d- AND f-BLOCK ELEMENTS

Oxidation States of the Lanthanoids

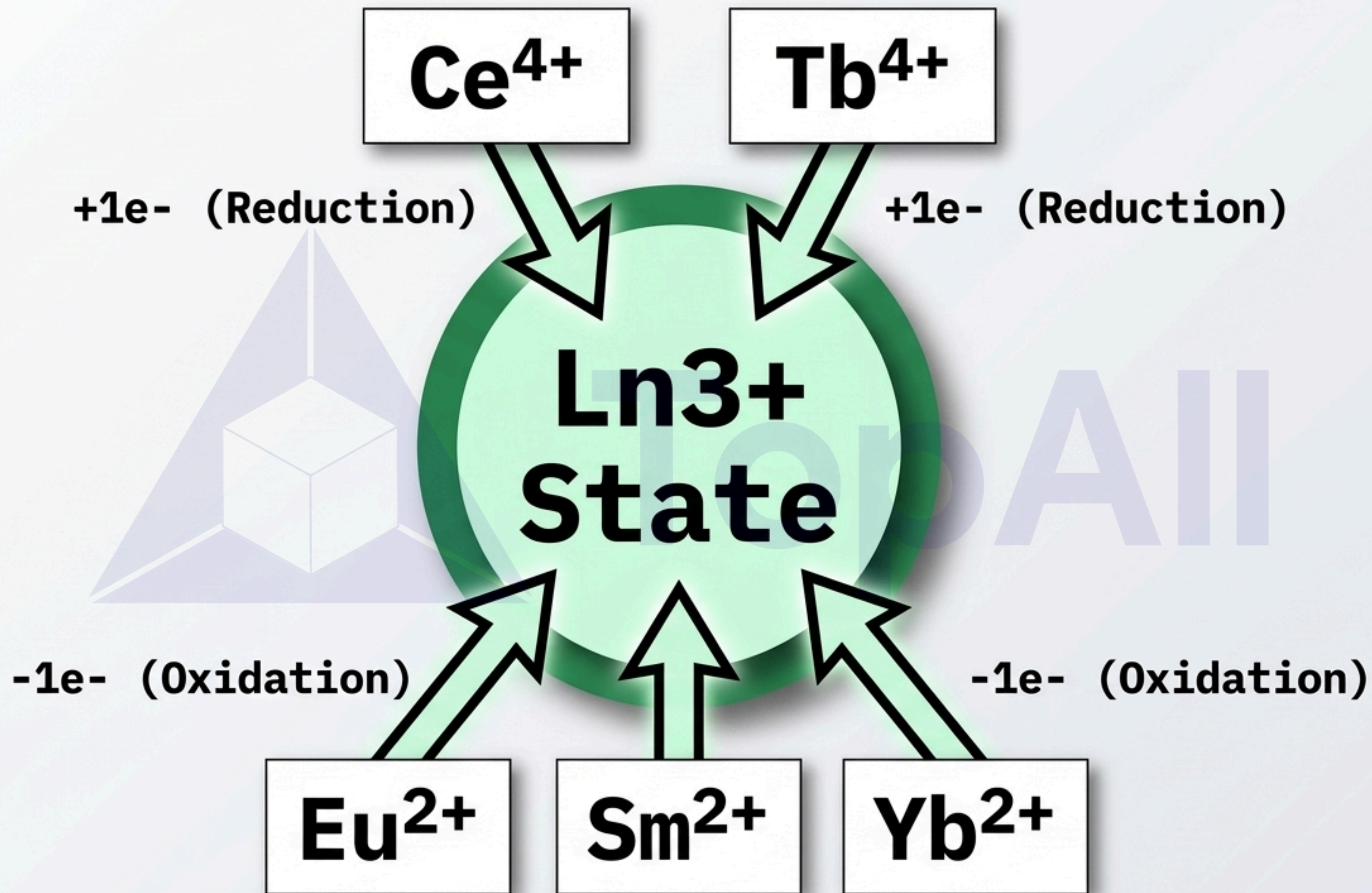


Predominant +3 State

The thermodynamic anchor for all lanthanoids. Regardless of temporary deviations, **Ln^{3+}** is the universal destination.

f0 / f7 / f14
Stability

The quantum safe harbors. Empty, half-filled, and fully-filled subshells provide enough extra stability to temporarily park elements in +2 or +4 states.





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



Empty Subshell

Key Ion: Ce⁴⁺

Achieves noble gas configuration (isoelectronic with Xenon).

f0

Half-Filled Subshell

Key Ions: Eu²⁺ and Tb⁴⁺

Maximizes exchange energy; extra stability allows both +2 (Eu) and +4 (Tb) states.

f7

Fully-Filled Subshell

Key Ion: Yb²⁺

Complete subshell shielding provides a stable temporary +2 state.

f14

$$E^{\circ}(\text{Ce}^{4+}/\text{Ce}^{3+}) = +1.74 \text{ V}$$

Favored by its noble gas configuration, yet acts as a strong oxidant to revert to the common +3 state.

Thermodynamic Potential

With $E^\circ = +1.74 \text{ V}$,
Ce(IV) is theoretically
strong enough to
oxidize water.



Kinetic Reality

The actual reaction rate with
water is exceedingly slow.

Therefore, Ce(IV) solutions are highly stable, making it an excellent analytical reagent for volumetric analysis.

Watch for this: Sort by gain vs. loss of electrons.

Both +4 and +2 states have the same destination (+3) but travel in opposite directions.

Ce⁴⁺, Tb⁴⁺



Must GAIN an electron to reach +3

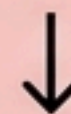


Acts as an Oxidant

Eu²⁺, Yb²⁺



Must LOSE an electron to reach +3



Acts as a Reductant

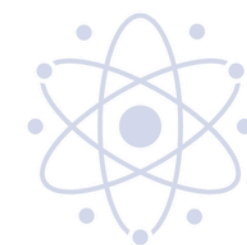
Key Takeaways

- The +3 oxidation state is universally predominant for lanthanoids; deviations are strictly driven by the quantum stability of f^0 , f^7 , and f^{14} configurations.
- Ions outside the +3 state act as strong redox agents to return to +3: +4 ions (like Ce^{4+}) act as oxidants, while +2 ions (like Eu^{2+}) act as reductants.



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

