▶ Video explanation (YouTube Short)

Lanthanoids vs Actinoids

The two f-block rows below the periodic table (placing them in line would make the table 32 columns wide) look like twins: both fill f orbitals, both prefer +3, both contract across the row. But the actinoids' 5f lies close in energy to 6d and 7s and extends further out, and that changes almost everything (NCERT 4.5–4.6, Exercise 4.30).

One table to revise

Property	Lanthanoids (Ce–Lu)	Actinoids (Th–Lr)
Configuration	[Xe] $4f^{1\text{-}14}$ $5d^{0\text{-}1}$ $6s^2$; 4f buried deep	[Rn] $5f^{1\text{-}14}$ $6d^{0\text{-}1}$ $7s^2$; 5f extends further out
Oxidation states	mainly +3; occasionally +2, +4 (Eu^{2+}, Ce^{4+}); never above +4	+3 to +7 (Np, Pu +7); 5f, 6d, 7s close in energy
Contraction	lanthanoid contraction	actinoid contraction, greater element to element (5f shields poorly)
Radioactivity	only promethium (no stable isotope)	all; elements beyond U are man-made
Reactivity	react with non-metals at higher temperatures	more reactive; combine with most non-metals at moderate temperatures
Complexes	less tendency	greater tendency; form oxo ions such as UO_2^{2+}, PuO_2^{2+}
Magnetism	simpler (4f well shielded)	more complex
Ionisation enthalpy	higher (early members)	lower for early members (5f electrons farther out, less tightly held)
Colour	f–f bands narrow	bands broader and more intense

Common mistakes

- ✗ "All f-block elements are radioactive." ✓ Among lanthanoids, only promethium.
- ✗ "Lanthanoids also reach +6 or +7." ✓ They stop at +4.
- ✗ "Twins behave alike." ✓ The 5f difference gives actinoids more states, more complexes and radioactivity.

Practice questions

1. (MCQ) The highest oxidation state of a lanthanoid is (a) +3 (b) +4 (c) +6 (d) +7
2. (MCQ) Which is radioactive? (a) Ce (b) Pm (c) Gd (d) Lu
3. (MCQ) Which forms UO_2^{2+}-type ions? (a) lanthanoids (b) actinoids (c) both (d) neither
4. (Very short) Why are the f-block rows placed below the table?
5. (Short) Compare the oxidation states of the two series and give the reason.
6. (Short) Why is the actinoid contraction greater?

7. (Short) Why do actinoids form complexes more readily?
8. (HOTS) Which has more f electrons, Eu^{2+} or Am^{3+}? (configurations: Eu [Xe] $4f^7\ 6s^2$, Am [Rn] $5f^7\ 7s^2$)

Answer key

1. (b) +4.
2. (b) Pm.
3. (b) actinoids.
4. In line, the table would be 32 columns wide.
5. Ln mainly +3 (+2, +4); An +3 to +7, because 5f, 6d and 7s are close in energy.
6. 5f electrons shield the outer electrons even more poorly than 4f.
7. Their 5f orbitals extend further out and take more part in bonding.
8. Eu^{2+} has 7 ($4f^7$); Am^{3+} has 6 ($5f^6$): Eu^{2+} has more.

▶ Watch the video explanation