Twins, Round by Round: Lanthanoids vs Actinoids

The two f-block rows below the periodic table (in line, it would be 32 columns wide) look like twins: both fill f orbitals, prefer +3 and contract across the row. But actinoid 5f lies close to 6d and 7s and extends further out, so actinoids reach +3 to +7 (lanthanoids never above +4), contract more, are more reactive, form more complexes and oxo ions such as UO_2^{2+}, have more complex magnetism and lower early ionisation enthalpies. Every actinoid is radioactive; among the lanthanoids only promethium is.

Name: Date: Score: ____ / 24

A. Fill in the blanks

1. Lanthanoids fill the ____ subshell; actinoids fill the 5f subshell.

2. The highest oxidation state shown by a lanthanoid is ____.

3. The highest oxidation state shown by an actinoid is ____.

4. The only lanthanoid with no stable isotope is ____.

5. With the f-block in line, the periodic table would be ____ columns wide.

B. True or False

6. The actinoid contraction is smaller than the lanthanoid contraction. True / False

7. All actinoids are radioactive. True / False

8. Lanthanoids form linear oxo ions like UO_2^{2+}. True / False

9. Actinoids have a greater tendency to form complexes than lanthanoids. True / False

10. The early actinoids have higher first ionisation enthalpies than the early lanthanoids. True / False

C. Assertion and reason

11. Assertion (A): Assertion: Actinoids show a wider range of oxidation states. Reason: 5f, 6d and 7s are close in energy.
Reason (R): Both true; the reason explains the assertion.

(a) Both A and R are true, and R explains A
(b) Both A and R are true, but R does not explain A
(c) A is true, R is false
(d) A is false, R is true

Answer: _____

12. Assertion (A): Assertion: Lanthanoids reach +7. Reason: 4f electrons are easily removed.
Reason (R): Both false: Ln stop at +4; 4f is buried.

(a) Both A and R are true, and R explains A
(b) Both A and R are true, but R does not explain A
(c) A is true, R is false
(d) A is false, R is true

Answer: _____

D. Choose the correct option

13. Which pair is correct?

(a) Ln: 4f
(b) An: 5f
(c) Ln: 5f
(d) An: 4f
(e) both 4f
(f) both 5d

Answer: _____

14. Actinoids show more oxidation states because:

(a) 5f, 6d and 7s energies are close
(b) they are radioactive
(c) they are larger
(d) they have no d electrons

Answer: _____

15. Which is radioactive?

(a) Pm
(b) Ce
(c) Gd
(d) Lu

Answer: _____

16. Which ion has no lanthanoid analogue?

(a) UO_2^{2+}
(b) M^{3+}
(c) M^{2+}
(d) MCl_3

Answer: _____

17. Magnetic properties are more complex for:

(a) actinoids
(b) lanthanoids
(c) both equally
(d) neither

Answer: _____

18. Which series is more reactive?

(a) actinoids
(b) lanthanoids
(c) both equal
(d) neither

Answer: _____

E. Numerical problems

19. How many elements are in each series (Ce to Lu)?

20. How many f electrons does Am^{3+} have? (Am: [Rn] $5f^7$ $7s^2$)

F. Short answer questions

21. Compare the oxidation states of lanthanoids and actinoids.

22. Why do actinoids form complexes more readily?

23. Compare radioactivity in the two series.

G. Match the columns

24. Match each item in Column A with the correct item in Column B.

Column A	Column B	Your answer
1. Lanthanoids	(a) 5f, +3 to +7, larger contraction, all radioactive, more complexes	1 → ____
2. Actinoids	(b) 4f, +3 (+2, +4), smaller contraction, only Pm radioactive	2 → ____

Detailed solutions

1. 4f

2. +4

3. +7

4. promethium

5. 32

6. False. It is greater (5f shields poorly).

7. True. Elements beyond U are man-made.

8. False. Only actinoids do.

9. True. 5f orbitals extend further out.

10. False. They are lower.

11. (a)

12. (a)

13. (a) Ln: 4f. f subshells.

14. (a) 5f, 6d and 7s energies are close. Comparable energies.

15. (a) Pm. Promethium.

16. (a) UO_2^{2+}. Uranyl.

17. (a) actinoids. NCERT 4.6.

18. (a) actinoids. An combine with non-metals at moderate temperatures.

19. 71 − 58 + 1. **Answer: 14**

20. 7 − 1. **Answer: 6**

21. Ln mainly +3 (+2, +4), never above +4; An +3 to +7 because 5f, 6d and 7s are close in energy.

22. Their 5f orbitals extend further out and take more part in bonding.

23. Among lanthanoids only promethium has no stable isotope; all actinoids are radioactive.

24. 1 → (b), 2 → (a).