ABC CHEMISTRY

Mr. Aniket Bhardwaj · 15+ Years Mentorship

Lanthanides & Actinides

Premium CSIR-NET PYQ Book

39 Previous-Year Questions · 36 with verified answers · Distractor Analysis

3-Slide Solutions | Distractor Analysis | Exam Tricks | Revision Sheets

CSIR-NET · GATE · IIT-JAM — 1 Topics · 39 Real PYQs

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Course Contents

1 Topics · 39 PYQs

1	**Lanthanides & Actinides – General** 39 Qs E 19 · M 13 · H 7	100%

Legend: **E** Easy **M** Medium **H** Hard · **%** = exam weightage (share of the chapter)

TOPIC 1

Lanthanides & Actinides – General

39 questions · Easy 19 | Medium 13 | Hard 7 · PYQ frequency: Very High

Q1

The actual magnetic moment shows a large deviation from the spin-only formula in the case of

A. Ti^{+}

B. V^{3+}

C. Gd^{3+}

D. Sm^{3+}

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Gd^{3+} f^{7}: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer D Sm^{3+}

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J (μ = g√J(J+1)), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Sm^{+} (f^5, $^6H_{/2}$) has low-lying J levels that are thermally populated, so the observed moment (≈1.5 BM) departs strongly from both the spin-only and the ground-J value; Ti^{+}, V^{+} and Gd^{+} do not.
- Therefore the answer is (D).

FINAL: (D) Sm^{3+}

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: D

A — **Ti^{+}**

Why (D) is the key — Sm^{+} (f^5, $^6H_{/2}$) has low-lying J levels that are thermally populated, so the observed moment (≈1.5 BM) departs strongly from both the spin-only and the ground-J value; Ti^{+}, V^{+} and Gd^{+} do not.

B — **V^{3+}**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

C — **Gd^{3+}**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q2

Which one of the following shows the highest solubility in hot concentrated aqueous NaOH ?

A. $La(OH)_3$

B. $Nd(OH)_3$

C. $Sm(OH)_3$

D. $Lu(OH)_3$

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer D $Lu(OH)_3$

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- The lanthanide hydroxides become less basic and more amphoteric with decreasing ionic radius; $Lu(OH)_3$, the smallest, dissolves in hot concentrated NaOH.
- Therefore the answer is (D).

FINAL: (D) $Lu(OH)_3$

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: D

A **$La(OH)_3$**

Why (D) is the key — The lanthanide hydroxides become less basic and more amphoteric with decreasing ionic radius; $Lu(OH)_3$, the smallest, dissolves in hot concentrated NaOH.

B **$Nd(OH)_3$**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

C **$Sm(OH)_3$**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q3

Consider the ions Eu(III), Gd(III), Sm(II) and Lu(III). The observed and calculated magnetic moment values are closest for the pair

A. Gd(III), Lu(III)

B. Eu(III), Lu(III)

C. Sm(III), Gd(III)

D. Sm(III), Eu(III)

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A Gd(III), Lu(III)

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Gd(III) (f^7, $^8S_{7/2}$, no orbital contribution) and Lu(III) (f^{14}, diamagnetic) have observed moments that match the calculated values; Sm(III) and Eu(III) deviate because of low-lying J states.
- Therefore the answer is (A).

FINAL: (A) Gd(III), Lu(III)

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **Eu(III), Lu(III)**

Why (A) is the key — Gd(III) (f^7, $^8S_{7/2}$, no orbital contribution) and Lu(III) (f^{14}, diamagnetic) have observed moments that match the calculated values; Sm(III) and Eu(III) deviate because of low-lying J states.

C **Sm(III), Gd(III)**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **Sm(III), Eu(III)**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q4

The ground state forms of Sm and Eu respectively, are

A. $^{7}F_{0}$ and $^{6}H_{5}/2$

B. $^{6}H_{5}/2$ and $^{7}F_{0}$

C. $^{2}F_{5}/2$ and $^{5}I_{4}$

D. $^{7}F_{6}$ and $^{2}F_{7}/2$

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^{7}: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer B $^6H_{5}/2$ and ^7F_o

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J (μ = g√J(J+1)), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Sm^{+} (f^5): ^6H /$_2$; Eu^{+} (f^6): $^7F_0$.
- Therefore the answer is (B).

FINAL: (B) $^6H_{5}/2$ and ^7F_o

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: B

A — **$^{7}F_{0}$ and $^{6}H_{5}/2$**

Why (B) is the key — Sm^{+} (f^{5}): $^{6}H\ /_{2}$; Eu^{+} (f^{6}): $^{7}F_{0}$.

C — **$^{2}F_{5}/2$ and $^{5}I_{4}$**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D — **$^{7}F_{6}$ and $^{2}F_{7}/2$**

Ruled out: Eu^{3+} (f^{6}, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^{7}F_{1}$ is thermally populated.

Q5

The correct order of the retention of cations on a sulfonated cation exchange resin column is

A. $Ag^{+}>K^{+}>Na^{+}>Li^{+}$

B. $K^{+}>Na^{+}>Ag^{+}>Li^{+}$

C. $Li^{+}>Na^{+}>K^{+}>Ag^{+}$

D. $Li^{+}>Na^{+}>Ag^{+}>K^{+}$

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Gd^{3+} f^{7}: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A $Ag^{+}>K^{+}>Na^{+}>Li^{+}$

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J (μ = g√J(J+1)), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Retention on a sulfonated resin increases with the polarisability/charge density of the cation in its hydrated form: $Ag^{+} > K^{+} > Na^{+} > Li^{+}$ (the small, heavily hydrated Li^{+} is held least).
- Therefore the answer is (A).

FINAL: (A) $Ag^{+}>K^{+}>Na^{+}>Li^{+}$

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^{1}–f^{7}), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^{6}, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^{7}F_{1}$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^{7}: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B $K^+ > Na^+ > Ag^+ > Li^+$

Why (A) is the key — Retention on a sulfonated resin increases with the polarisability/charge density of the cation in its hydrated form: $Ag^+ > K^+ > Na^+ > Li^+$ (the small, heavily hydrated Li^+ is held least).

C $Li^+ > Na^+ > K^+ > Ag^+$

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D $Li^+ > Na^+ > Ag^+ > K^+$

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q6

Hindered β-diketonates like dpmH(dpmH= dipivaloylmethane) are used for the separation of lanthanides because complexes formed with dpmH can be separated by

A. Gel permeation chromatography

B. Gas chromatography

C. Gel filtration chromatography

D. Ion exchange chromatography

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer B Gas chromatography

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- The bulky t-butyl groups make $Ln(dpm)_3$ complexes volatile and monomeric, so they can be separated by gas chromatography.
- Therefore the answer is (B).

FINAL: (B) Gas chromatography

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: B

A — **Gel permeation chromatography**

Why (B) is the key — The bulky t-butyl groups make $Ln(dpm)_3$ complexes volatile and monomeric, so they can be separated by gas chromatography.

C — **Gel filtration chromatography**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D — **Ion exchange chromatography**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q7

The metallic radii are abnormally high for which of the following pairs?

A. Eu, Yb

B. Sm, Tm

C. Gd, Lu

D. Nd, Ho

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A Eu, Yb

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Eu and Yb contribute only two electrons to the metallic bond (keeping f^7 and f^{14}), so their metallic radii are anomalously large.
- Therefore the answer is (A).

FINAL: (A) Eu, Yb

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **Sm, Tm**

Why (A) is the key — Eu and Yb contribute only two electrons to the metallic bond (keeping f^7 and f^{14}), so their metallic radii are anomalously large.

C **Gd, Lu**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **Nd, Ho**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q8 **Which of the following statements are TRUE for the lanthanides? (A) the observed magnetic moment of Eu at room temperature is higher than that calculated from spin-orbit coupling (B) Lanthanide oxides are predominantly acidic in nature (C) The stability of Sm(II) is due to its half-filled sub-shell. (D) Lanthanide (III) ions can be separated by ion exchange chromatography**

A. A and D

B. A and B

C. A and C

D. B and C

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A A and D

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Eu^{3+} has low-lying J levels populated at room temperature, so its observed moment exceeds the ground-J value. Ln(III) are separated by ion-exchange chromatography. The oxides are basic, and it is Eu(II), not Sm(II), that is stabilised by a half-filled shell. A and D (a).
- Therefore the answer is (A).

FINAL: (A) A and D

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **A and B**

Why (A) is the key — Eu^{3+} has low-lying J levels populated at room temperature, so its observed moment exceeds the ground-J value. Ln(III) are separated by ion-exchange chromatography. The oxides are basic, and it is Eu(II), not Sm(II), that is stabilised by a half-filled shell. A and D (a).

C **A and C**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **B and C**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q9

Consider the following statement(s) for actinides (An): A. Oxidation states greater than +3 are more frequent in An compared to lathanides (Ln) B. Some An(III) ions show d-d transitions C. UO_2^{2+} and PuO_2^{2+} are stable D. Some of actinides do not have radioactive isotopes The correct answer is

(A) A and C

(B) B and D

(C) A, B and C

(D) B, C and D

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A A and C

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Early actinides show oxidation states above +3 far more often than lanthanides, and UO_2^{2+} and PuO_2^{2+} are stable actinyl ions. An(III) show f–f, not d–d, bands, and every actinide is radioactive. A and C (a).
- Therefore the answer is (A).

FINAL: (A) A and C

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B

B and D

Why (A) is the key — Early actinides show oxidation states above +3 far more often than lanthanides, and UO_2^{2+} and PuO_2^{2+} are stable actinyl ions. An(III) show f–f, not d–d, bands, and every actinide is radioactive. A and C (a).

C

A, B and C

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D

B, C and D

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q10

Consider following statements for Eu^{3+} (A) The positions of sharp bands in UV-vis spectra of its complexes depend heavily on the ligand environment (B) Its ground state term symbol is $^7F_0$ (C) The observed magnetic moment is due to populated higher level (D) At 2K its magnetic moment approaches to zero The set of correct statements is

A. A, C and D

B. B, C and D

C. A, B and D

D. A, B and C

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer B B, C and D

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Eu^{3+} (f^6) has a $^7F_0$ ground state with J = 0, so it is non-magnetic. Its room-temperature moment comes from the thermally populated $^7F_1$ and $^7F_2$ levels, and it approaches zero at 2 K. Its f–f bands barely depend on the ligand. B, C and D (b).
- Therefore the answer is (B).

FINAL: (B) B, C and D

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: B

A

A, C and D

Why (B) is the key — Eu^{3+} (f^6) has a $^7F_0$ ground state with J = 0, so it is non-magnetic. Its room-temperature moment comes from the thermally populated $^7F_1$ and $^7F_2$ levels, and it approaches zero at 2 K. Its f–f bands barely depend on the ligand. B, C and D (b).

C

A, B and D

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D

A, B and C

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q11

Pair of lanthanide ions which show significant deviation between the experimental and calculated magnetic moments, considering contribution from the ground state only

A. Gd and Lu

B. Sm and Th

C. Eu and Tb

D. Sm and Eu

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer D Sm and Eu

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Sm^{3+} and Eu^{3+} have low-lying excited J states, so their moments deviate from ground-state predictions (d).
- Therefore the answer is (D).

FINAL: (D) Sm and Eu

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: D

A **Gd and Lu**

Why (D) is the key — Sm^{3+} and Eu^{3+} have low-lying excited J states, so their moments deviate from ground-state predictions (d).

B **Sm and Th**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

C **Eu and Tb**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q12

The pair in which both actinides show +3 oxidation state only is

A. Ac and Lr

B. Ac and No

C. Cm and Bk

D. Cm and Lr

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A Ac and Lr

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Ac (f^0) and Lr (f^{14}) are locked at +3. Cm and Bk also show +4, and No prefers +2 (f^{14}).
- Therefore the answer is (A).

FINAL: (A) Ac and Lr

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **Ac and No**

Why (A) is the key — Ac (f^0) and Lr (f^{14}) are locked at +3. Cm and Bk also show +4, and No prefers +2 (f^{14}).

C **Cm and Bk**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **Cm and Lr**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q13

The electronic configuration for gadalonium (Gd) is $[Xe]4f^7\ 5d^1\ 6s^2$, where as that of Gd^{2+} is:

A. $[Xe]4f^5\ 5d\ 6s^2$

B. $[Xe]\ 4\ f^6\ 6\ s^2$

C. $[Xe]f^6\ 5d^1\ 6s^1$

D. $[Xe]\ 4\ f^7\ 5\ d^1$

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer D [Xe] 4 f^7 5 d^1

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J (μ = g√J(J+1)), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Ionisation removes the 6s electrons first: Gd^{2+} is [Xe]$4f^7 5d^1$, keeping the stable half-filled f shell.
- Therefore the answer is (D).

FINAL: (D) [Xe] 4 f^7 5 d^1

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: D

A **[Xe]4f⁵ 5d 6s²**

Why (D) is the key — Ionisation removes the 6s electrons first: Gd^{2+} is $[Xe]4f^{7}5d^{1}$, keeping the stable half-filled f shell.

B **[Xe] 4 f⁶ 6 s²**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

C **[Xe]f⁶ 5d¹ 6s¹**

Ruled out: Eu^{3+} (f^{6}, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^{7}F_{1}$ is thermally populated.

Q14

Uranium fluorides co-precipitate with

A. CaF_2

B. AgF

C. LiF

D. MgF_2

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A CaF_2

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J (μ = g√J(J+1)), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- [CSIR DEC 2011] Explanation as extracted from the printed page; notation may be imperfect.
- Therefore the answer is (A).

FINAL: (A) CaF_2

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **AgF**

Why (A) is the key — [CSIR DEC 2011] Explanation as extracted from the printed page; notation may be imperfect.

C **LiF**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **MgF_2**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q15

Among the following statements, identify the correct ones for complexes of lanthanide (III) ion. (A) Metal-ligand bond is significantly ionic. (B) Complexes rarely show isomerism. (C) The coordination number is not more than 8. (D) The magnetic moments are not accounted even approximately by spin only value for majority of lanthanides.

- **A** A, B and D only
- **B** A, B and C only
- **C** B and C only
- **D** A and D only

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A A, B and D only

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Ln(III)–ligand bonding is mainly ionic, and isomers are rare. Coordination numbers reach 12, so (C) is false. For most Ln(III) ions the spin-only formula fails because spin–orbit coupling gives J-based moments. A, B and D (a).
- Therefore the answer is (A).

FINAL: (A) A, B and D only

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **A, B and C only**

Why (A) is the key — Ln(III)–ligand bonding is mainly ionic, and isomers are rare. Coordination numbers reach 12, so (C) is false. For most Ln(III) ions the spin-only formula fails because spin–orbit coupling gives J-based moments. A, B and D (a).

C **B and C only**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **A and D only**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q16

Statement I: The sizes of Zr and Hf are similar
Statement II: Size of Hf is affected by lanthanide contraction.

A. Statement I and II are correct and II is correct explanation of 1

B. Statement I and II are correct but II is not a correct explanation of 1

C. Statement 1 is correct and II is incorrect

D. Statements I and II both are incorrect

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A Statement I and II are correct and II is correct explanation of 1

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J (μ = g√J(J+1)), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Zr and Hf have nearly identical radii (159 vs 156 pm) precisely because the lanthanide contraction that precedes Hf cancels the expected increase — statement II explains statement I.
- Therefore the answer is (A).

FINAL: (A) Statement I and II are correct and II is correct explanation of 1

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **Statement I and II are correct but II is not a correct explanation of 1**

Why (A) is the key — Zr and Hf have nearly identical radii (159 vs 156 pm) precisely because the lanthanide contraction that precedes Hf cancels the expected increase — statement II explains statement I.

C **Statement 1 is correct and II is incorrect**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **Statements I and II both are incorrect**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q17

The least basic among the following is:

A. $Al(OH)_3$

B. $La(OH)_3$

C. $Ce(OH)_3$

D. $Lu(OH)_3$

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A $Al(OH)_3$

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Amphoteric $Al(OH)_3$ is the least basic (a).
- Therefore the answer is (A).

FINAL: (A) $Al(OH)_3$

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **$La(OH)_3$**

Why (A) is the key — Amphoteric $Al(OH)_3$ is the least basic (a).

C **$Ce(OH)_3$**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **$Lu(OH)_3$**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q18

The pair of lanthanides with the highest third-ionization energy is:

A. Eu, Gd

B. Eu, Yb

C. Dy, Yb

D. Lu, Yb

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer B Eu, Yb

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- The third ionisation removes an electron from the especially stable f^7 (Eu^{2+}) and f^{14} (Yb^{2+}) configurations, so Eu and Yb have the highest third IE.
- Therefore the answer is (B).

FINAL: (B) Eu, Yb

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: B

A **Eu, Gd**

Why (B) is the key — The third ionisation removes an electron from the especially stable f^7 (Eu^{2+}) and f^{14} (Yb^{2+}) configurations, so Eu and Yb have the highest third IE.

C **Dy, Yb**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **Lu, Yb**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q19

The lanthanide(III) ion having the highest partition coefficient between tri-n-butylphosphate and concentrated HNO_3 is:

A. La(III)

B. Eu(III)

C. Nd(III)

D. Lu(III)

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer D Lu(III)

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Extraction of $Ln(NO_3)_3$ into tri-n-butylphosphate improves steadily along the series as the ions shrink and become more strongly complexed: Lu(III) has the highest partition coefficient.
- Therefore the answer is (D).

FINAL: (D) Lu(III)

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: D

A **La(III)**

Why (D) is the key — Extraction of $Ln(NO_3)_3$ into tri-n-butylphosphate improves steadily along the series as the ions shrink and become more strongly complexed: Lu(III) has the highest partition coefficient.

B **Eu(III)**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

C **Nd(III)**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q20

Consider following lanthanide (III) ions (A) Nd(III) (B) Gd(III) (C) Dy(III) The magnetic moment closest to the spin only value is(are) for

A. B only

B. A and B only

C. A and C only

D. B and C only

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A B only

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Gd^{3+} is f^7 with L = 0, so its moment (≈ 7.94 BM) equals the spin-only value. Nd^{3+} and Dy^{3+} have large orbital contributions. B only (a).
- Therefore the answer is (A).

FINAL: (A) B only

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **A and B only**

Why (A) is the key — Gd^{3+} is f^7 with L = 0, so its moment (≈ 7.94 BM) equals the spin-only value. Nd^{3+} and Dy^{3+} have large orbital contributions. B only (a).

C **A and C only**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **B and C only**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q21

The ground state term symbol for Nb (atomic number 41) is ^6D. The electronic configuration corresponding to this term symbol is

A. $[Kr]4d^3 5s^2$

B. $[Kr]4d^4 5s^1$

C. $[Kr]4d^5 5s^0$

D. $[Kr]4d^3 5s^1 5p^1$

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer B [Kr]4d⁴5s¹

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J (μ = g√J(J+1)), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- ^6D needs S = 5/2 (five unpaired electrons) and L = 2: [Kr]4d⁴5s¹, the actual ground configuration of Nb.
- Therefore the answer is (B).

FINAL: (B) [Kr]4d⁴5s¹

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: B

A **$[Kr]4d^3 5s^2$**

Why (B) is the key — ^6D needs S = 5/2 (five unpaired electrons) and L = 2: $[Kr]4d^4 5s^1$, the actual ground configuration of Nb.

C **$[Kr]4d^5 5s^o$**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **$[Kr]4d^3 5s^1 5p^1$**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q22

A comparison of the valence electron configuration of the elements, Sm and Eu suggests that

A. Sm is a better one electron reductant than Eu

B. Sm is a better one electron oxidant than Eu

C. Facile oxidation state is +2 for both the elements

D. both of these display similar redox behaviour

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A Sm is a better one electron reductant than Eu

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Sm $4f^6 6s^2$, Eu $4f^7 6s^2$. Eu^{2+} ($4f^7$, half-filled) is stable, so Eu(II) is a poor reductant ($E°(Eu^{3+}/Eu^{2+}) = -0.35$ V), whereas Sm^{2+} ($4f^6$) readily loses an electron ($E° = -1.55$ V): Sm is the better one-electron reductant. (Bank key (b) — verify.)
- Therefore the answer is (A).

FINAL: (A) Sm is a better one electron reductant than Eu

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **Sm is a better one electron oxidant than Eu**

Why (A) is the key — Sm $4f^6 6s^2$, Eu $4f^7 6s^2$. Eu^{2+} ($4f^7$, half-filled) is stable, so Eu(II) is a poor reductant ($E°(Eu^{3+}/Eu^{2+}) = -0.35$ V), whereas Sm^{2+} ($4f^6$) readily loses an electron ($E° = -1.55$ V): Sm is the better one-electron reductant. (Bank key (b) — verify.)

C **Facile oxidation state is +2 for both the elements**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **both of these display similar redox behaviour**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q23

Consider the following statements with respect to uranium (A) UO_2^+ disproportionates more easily than UO_2^{2+} (B) U_3O_8 is its most stable oxide of U (C) Coordination number of U in $[UO_2(NO_3)_2(H_2O)_2]\cdot 4H_2O$ is six. (D) UO_2^{2+} is linear The correct set of statements is

A. A, B and D

B. A, C and D

C. B, C and D

D. A, B and C

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A A, B and D

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J (μ = g√J(J+1)), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- UO_2^+ disproportionates readily, U_3O_8 is the most stable oxide, and uranyl is linear O=U=O. In $[UO_2(NO_3)_2(H_2O)_2]$, U is 8-coordinate (hexagonal bipyramid), so (C) is false. A, B and D (a).
- Therefore the answer is (A).

FINAL: (A) A, B and D

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **A, C and D**

Why (A) is the key — UO_2^+ disproportionates readily, U_3O_8 is the most stable oxide, and uranyl is linear O=U=O. In $[UO_2(NO_3)_2(H_2O)_2]$, U is 8-coordinate (hexagonal bipyramid), so (C) is false. A, B and D (a).

C **B, C and D**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **A, B and C**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q24

For monoionic complex $[UO_2(NO_3)_3]^-$ the correct coordination number and geometry respectively, are

(A) 8 and hexagonal bipyramedal

(B) 5 and square pyramidal

(C) 8 and square antiprism

(D) 5 and trigonal bipyramidal

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A 8 and hexagonal bipyramedal

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Three bidentate nitrates in the equatorial plane plus the two axial oxo groups: coordination number 8, hexagonal bipyramidal.
- Therefore the answer is (A).

FINAL: (A) 8 and hexagonal bipyramedal

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **5 and square pyramidal**

Why (A) is the key — Three bidentate nitrates in the equatorial plane plus the two axial oxo groups: coordination number 8, hexagonal bipyramidal.

C **8 and square antiprism**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **5 and trigonal bipyramidal**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q25

The g values for Ce^{3+} ($4f^1$) and Pr^{3+} ($4f^2$) are, respectively

A. 3 / 7 and 2 / 5

B. 5 / 7 and 4 / 5

C. 6/7 and 3/5

D. 6/7 and 4/5

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer D 6/7 and 4/5

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Ce^{+} F $/_2$: g = 6/7; Pr^{+} H_4: g = 4/5 (Landé formula).
- Therefore the answer is (D).

FINAL: (D) 6/7 and 4/5

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: D

A **3 / 7 and 2 / 5**

Why (D) is the key — Ce^{+} $F_{/2}$: g = 6/7; Pr^{+} H_4: g = 4/5 (Landé formula).

B **5 / 7 and 4 / 5**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

C **6/7 and 3/5**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q26

Which one of the following pairs has two magic numbers for closed nuclear shells?

A. 8,10

B. 10, 20

C. 50,82

D. 82,130

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer C 50,82

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Magic numbers are 2, 8, 20, 28, 50, 82, 126; the pair 50, 82 are both magic.
- Therefore the answer is (C).

FINAL: (C) 50,82

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: C

A **8,10**

Why (C) is the key — Magic numbers are 2, 8, 20, 28, 50, 82, 126; the pair 50, 82 are both magic.

B **10, 20**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **82,130**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q27 **The calculated and observed magnetic moments (in B.M.) of aqua complex of a lanthanide ion are 0 and 3.5, respectively. The lanthanide ion is**

A Pm^{3+}

B Pr^{3+}

C Eu^{3+}

D Sm^{3+}

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer C Eu^{3+}

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Eu^{3+} ($^7F_0$) has zero calculated moment for the ground level, yet ≈3.4–3.5 BM is observed because $^7F_1$ and $^7F_2$ are thermally populated.
- Therefore the answer is (C).

FINAL: (C) Eu^{3+}

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: C

A **Pm^{3+}**

Why (C) is the key — Eu^{3+} ($^7F_0$) has zero calculated moment for the ground level, yet ≈3.4–3.5 BM is observed because $^7F_1$ and $^7F_2$ are thermally populated.

B **Pr^{3+}**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **Sm^{3+}**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q28

Trivalent lanthanide ion having isotropic magnetic susceptibility is

A. Eu^{+3}

B. Gd^{+3}

C. Yb^{+3}

D. Lu^{+3}

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer B Gd^{+3}

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Gd^{3+} is $4f^7$ ($^8S_{7/2}$): L = 0, so there is no orbital contribution and no anisotropy — the magnetic susceptibility is isotropic (spin-only, 7.94 BM). Eu^{3+} and Yb^{3+} have L ≠ 0; Lu^{3+} ($4f^{14}$) is diamagnetic.
- Therefore the answer is (B).

FINAL: (B) Gd^{+3}

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: B

A Eu^{+3}

Why (B) is the key — Gd^{3+} is $4f^7$ ($^8S_{7/2}$): L = 0, so there is no orbital contribution and no anisotropy — the magnetic susceptibility is isotropic (spin-only, 7.94 BM). Eu^{3+} and Yb^{3+} have L ≠ 0; Lu^{3+} ($4f^{14}$) is diamagnetic.

C Yb^{+3}

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D Lu^{+3}

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q29

The coordination number of Gd in $GdCl_3 .6 H_2O$ is

A. 3

B. 6

C. 8

D. 9

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer C 8

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- $GdCl_3 \cdot 6H_2O$ is $[GdCl_2(H_2O)_6]Cl$: six waters and two chlorides give coordination number 8.
- Therefore the answer is (C).

FINAL: (C) 8

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: C

A **3**

Why (C) is the key — $GdCl_3 \cdot 6H_2O$ is $[GdCl_2(H_2O)_6]Cl$: six waters and two chlorides give coordination number 8.

B **6**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **9**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q30

The effective magnetic moment (in BM) for a lanthanide f^{10} ion is approximately

A. 10.6

B. 9.92

C. 9.59

D. 7.94

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A 10.6

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- $4f^{10}$ (Ho^{3+}): S = 2, L = 6, J = 8 ($^5I_8$), $g_J = 1.25$. $\mu = g_J\sqrt{J(J+1)} = 1.25 \times \sqrt{72} = 10.6$ BM.
- Therefore the answer is (A).

FINAL: (A) 10.6

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **9.92**

Why (A) is the key — $4f^{1}$ (Ho^{3+}): S = 2, L = 6, J = 8 ($^{5}I_{8}$), g_J = 1.25. μ = g_J√(J(J+1)) = 1.25 × √72 = 10.6 BM.

C **9.59**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **7.94**

Ruled out: Eu^{3+} (f^{6}, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^{7}F_{1}$ is thermally populated.

Q31 **Consider the following statements for $(NH_4)_2[Ce(NO_3)_6]$ (Z) (A) Coordination number of Ce is 12 (B) Z is paramagnetic (C) Z is an oxidising agent (D) Reaction of Ph_3PO with Z gives a complex having coordination number 10 for Ce. The correct statements are**

(A) A, B and C

(B) B, A and D

(C) B, C and D

(D) A, C and D

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer D A, C and D

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- (NH4) 2[Ce(NO3) 6](Z) (1) NO-3 behaves as bidentate ligand. Hence, C.N = 12 (2) Ce+4 has no unpaired electron hence dimagnetic not paramagnetic. (3) Ce+4 has higher oxidation state hence behave as oxidising agent. (4) (NH4) 2[Ce(NO3) 6] on reaction with Ph3PO gives [Ce(NO3) 4(Ph3PO)2] having . C.N.=10. Hence correct statement. OPPh3 = mono dentate ligand; NO3= bidentate [CSIR DEC 2015] Explanation as extracted from the printed page; notation may be imperfect.
- Therefore the answer is (D).

FINAL: (D) A, C and D

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: D

A

A, B and C

Why (D) is the key — (NH4) 2[Ce(NO3) 6](Z) (1) NO-3 behaves as bidentate ligand. Hence, C.N = 12 (2) Ce+4 has no unpaired electron hence dimagnetic not paramagnetic. (3) Ce+4 has higher oxidation state hence behave as oxidising agent. (4) (NH4) 2[Ce(NO3) 6] on reaction with Ph3PO gives [Ce(NO3) 4(Ph3PO)2] having . C.N.=10. Hence correct statement. OPPh3 = mono dentate ligand; NO3= bidentate [CSIR DEC 2015] Explanation as extracted from the printed page; notation may be imperfect.

B

B, A and D

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

C

B, C and D

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q32 **Pair of lanthanide ions which show significant deviation between the experimental and calculated magnetic moments, considering contribution from the ground state only (1) Gd and Lu (2) Sm and Th (3) Eu and Tb (4) Sm and Eu**
(Numerical answer type — write the value.)

SELF-PRACTICE answer on record: (D) — options were not printed in the source.

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Q33

The correct electronic configuration and spin only magnetic moment of Gd^{3+} (atomic number 64) are

A. $[Xe]4f^7$ and 7.9 BM

B. $[Xe]4f^7$ and 8.9 BM

C. $[Xe]4f^6 5d^1$ and 7.9 BM

D. $[Rn]5f^7$ and 7.9 BM

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A [Xe]4f⁷ and 7.9 BM

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J (μ = g√J(J+1)), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Gd^{3+}: [Xe]$4f^7$, seven unpaired electrons, μ_so = √(7 × 9) = 7.94 ≈ 7.9 BM (L = 0, so spin-only is exact).
- Therefore the answer is (A).

FINAL: (A) [Xe]4f⁷ and 7.9 BM

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B **[Xe]4f⁷ and 8.9 BM**

Why (A) is the key — Gd^{3+}: [Xe]4f⁷, seven unpaired electrons, μ_so = √(7 × 9) = 7.94 ≈ 7.9 BM (L = 0, so spin-only is exact).

C **[Xe]4f⁶5d¹ and 7.9 BM**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **[Rn]5f⁷ and 7.9 BM**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q34

The calculated and observed magnetic moments differ considerably for an aqua complex of a Lanthanide (III) ion as a result of low lying states of high J. The ion, among the following, is

A. Ce^{3+}

B. Pr^{3+}

C. Eu^{3+}

D. yb^{3+}

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer C Eu^{3+}

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J (μ = g√J(J+1)), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Eu^{3+} ($^7F_0$ ground) has the $^7F_1$ and $^7F_2$ levels only a few hundred cm^{-1} higher, so they are thermally populated and the observed moment (≈3.4 BM) far exceeds the g_J√J(J+1) = 0 of the ground level. Sm^{3+} shows the same effect; Ce, Pr and Yb do not.
- Therefore the answer is (C).

FINAL: (C) Eu^{3+}

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: C

A **Ce^{3+}**

Why (C) is the key — Eu^{3+} ($^7F_0$ ground) has the $^7F_1$ and $^7F_2$ levels only a few hundred cm^{-1} higher, so they are thermally populated and the observed moment (≈3.4 BM) far exceeds the g_J√J(J+1) = 0 of the ground level. Sm^{3+} shows the same effect; Ce, Pr and Yb do not.

B **Pr^{3+}**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **yb^{3+}**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q35

The lanthanide ion the exhibits color in aqueous solution is

A. La (III)

B. Eu (III)

C. Gd (III)

D. Lu (III)

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer B Eu (III)

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- La^{3+} (f^0), Gd^{3+} (f^7, next level far above) and Lu^{3+} (f^{14}) have no accessible f→f transitions and are colourless; Eu^{3+} (f^6) is faintly pink.
- Therefore the answer is (B).

FINAL: (B) Eu (III)

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: B

A **La (III)**

Why (B) is the key — La^{3+} (f^0), Gd^{3+} (f^7, next level far above) and Lu^{3+} (f^{14}) have no accessible f→f transitions and are colourless; Eu^{3+} (f^6) is faintly pink.

C **Gd (III)**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **Lu (III)**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q36

Generally, the coordination number and the nature of the electronic absorption band (f → f transition)of lanthanide (III) ion in their complexes are respectively

A. greater than 6 and sharp

B. 6 and broad

C. less than 6 and sharp

D. greater than 6 and broad

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer A greater than 6 and sharp

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Ln(III) ions favour coordination numbers > 6, and their shielded f–f transitions are sharp, weak lines (a).
- Therefore the answer is (A).

FINAL: (A) greater than 6 and sharp

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: A

B — **6 and broad**

Why (A) is the key — Ln(III) ions favour coordination numbers > 6, and their shielded f–f transitions are sharp, weak lines (a).

C — **less than 6 and sharp**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D — **greater than 6 and broad**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q37

In a uranium recovery process, an aqueous solution of uranyl ion is evaporated, dried in air at 400^° C and subsequently reduced with hydrogen at 700^° C to obtain a uranium compound (X). The oxidation state of uranium in X is ___
(Given: atomic number of U is 92)
(Numerical answer type — write the value.)

ANSWER: +4 (UO_2)

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
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EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
UO_2^{2+} solution → evaporation/air drying at 400 °C gives UO_3/U_3O_8 → H_2 reduction at 700 °C gives UO_2 (uranium +4), the ceramic nuclear-fuel form.

Q38

The experimental magnetic moment (3.4 BM) of a hydrated salt of Eu^{3+} at 27°C is significantly different from the calculated value. The difference is due to (Given: atomic number of Eu is 63)

A. strong spin-orbit coupling

B. pairing of electrons in f-orbitals

C. population of electrons at higher J level(s) via thermal excitation

D. strong ligand field splitting of f-orbitals

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Correct Answer C population of electrons at higher J level(s) via thermal excitation

CONCEPT

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

↓

LOGIC / WORKING

- Eu^{3+} (f^6) has a $^7F_0$ ground level ($\mu = 0$) but $^7F_1$ and $^7F_2$ lie only a few hundred cm^{-1} higher and are thermally populated at 300 K, so the observed moment is ≈3.4 BM.
- Therefore the answer is (C).

FINAL: (C) population of electrons at higher J level(s) via thermal excitation

SHORTCUT / EXAM TRICK

Count f electrons n: L from filling (3,5,6,6,5,3,0 for f^1–f^7), S = n/2 up to 7/2; then J by Hund.

COMMON MISTAKE

Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

EXAM TIP

Eu^{3+} (f^6, J = 0) should be diamagnetic but shows $\mu \approx 3.4$ because $^7F_1$ is thermally populated.

MEMORY TRICK

'Gd^{3+} f^7: L = 0, so spin-only works — 7.9 μ_B'.

Why the Other Options Are Wrong

Correct answer: C

A **strong spin-orbit coupling**

Why (C) is the key — Eu^{3+} (f^6) has a $^7F_0$ ground level (μ = 0) but $^7F_1$ and $^7F_2$ lie only a few hundred cm^{-1} higher and are thermally populated at 300 K, so the observed moment is ≈3.4 BM.

B **pairing of electrons in f-orbitals**

Ruled out: Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).

D **strong ligand field splitting of f-orbitals**

Ruled out: Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

Q39

The correct statement(s) about actinides is/are:

A. The trans uranium elements are prepared artificially

B. The 5f electrons of actinides are bound less tightly than the 4f electrons

C. All the actinides are radioactive

D. Actinides do not exhibit actinide contraction

ANSWER: (a), (b), (c)

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Lanthanides & Actinides – General

PYQ FREQUENCY
Very High · 21 paper

REVISION PRIORITY
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EXPECTED LEVEL
Part B

MEMORY HOOK
Transuranium elements are synthetic; 5f electrons are more diffuse and less tightly bound (hence more oxidation states) than 4f; every actinide is radioactive. Actinides do show an actinide contraction, so (d) is false.

TOPIC REVISION

Lanthanides & Actinides – General

39 PYQs · Last-minute revision

TOPIC SUMMARY

4f/5f elements: +3 dominant for Ln (Ce^{4+}, Eu^{2+} exceptions), variable for An; lanthanide contraction (shielding poor); magnetic moments from J ($\mu = g\sqrt{J(J+1)}$), sharp f–f spectra (Laporte-forbidden, weak); separation by ion exchange/solvent extraction; Eu^{2+}/Yb^{2+} stability (half/filled shells).

IMPORTANT FORMULA SHEET

- $\mu_{eff} = g_J \sqrt{(J(J+1))}\ \mu_B$; $g_J = 1 + [J(J+1)+S(S+1)-L(L+1)]/2J(J+1)$
- Hund's third rule: J = L−S (< half), L+S (> half)
- La^{3+}–Lu^{3+} radius: 1.03 → 0.86 Å

FREQUENTLY ASKED CONCEPTS

- Ground term and μ of Pr^{3+}, Nd^{3+}, Sm^{3+}, Eu^{3+}, Gd^{3+}, Tb^{3+}, Dy^{3+}
- Why Sm^{3+}/Eu^{3+} deviate (low-lying J states)
- Consequences of lanthanide contraction (Zr/Hf similarity)
- Separation methods
- Uranium chemistry (UO_2^{2+})

COMMON MISTAKES & QUICK NOTES

Watch out:
Using the spin-only formula for lanthanides (orbital contribution is large; only Gd^{3+} coincides).
Eu^{3+} (f^6, J = 0) should be diamagnetic but shows μ ≈ 3.4 because $^7F_1$ is thermally populated.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 …

Expect 2 question(s) next session on Lanthanides & Actinides – General.

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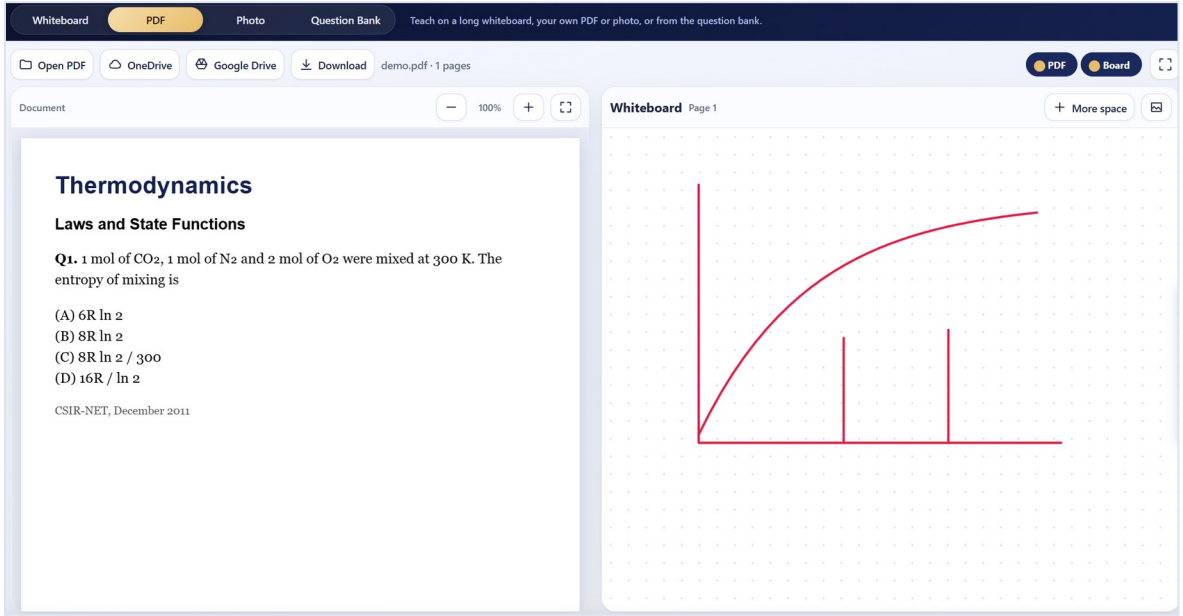
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