



CHEMISTRY

FOR IIT JEE ASPIRANTS OF CLASS 12 FOR

CHEMISTRY

F-BLOCK ELEMENTS

Example

1. Lanthanide contraction occurs because

- (1) f-orbital are incompletely filled
- (2) f-orbital electrons are easily lost

(3) f-orbitals do not come out on the surface of atom and are buried inside

(4) f-orbital electrons are poor shields of nuclear charge



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2. Which of the following statements is not correct?

(1) $La(OH)_3$ is less basic than $Lu(OH)_3$

(2) In the lanthanide series, the ionic radius of Ln^{3+} ions decreases

(3) Zn, Cd, Hg are colourless and are diamagnetic

(4) Mn shows a maximum oxidation state of +7





Evaluate Yourself 2

1. Which of the following trivalent ion has the largest atomic radii in the lanthanide series?

A. Ce

B. Pm

C. La

D. Lu

Answer: C



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2. Across the lanthanide series, the basicity of the lanthanoid hydroxides:

A. increases

B. decreases

C. first increases and then decreases

D. first decreases and then increases

Answer: B



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3. The lanthanoid contraction is related to

- A. (1) atomic radii
- B. (2) atomic as well as M^{3+} radii
- C. (3) valence electrons
- D. (4) oxidation states

Answer: B



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Cuq Properties

1. Which-sub shell is filled up progressively in actinoids

A. 4f

B. 5f

C. 6d

D. 7s

Answer: B



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2. The electronic configuration of f-block elements is represented by

A. $(n - 2)f^{1-14}(n - 1)d^{0-1}ns^2$

B. $(n-2)f^{l-14}(n - 1)d^{0-5}ns^{0-2}$

C. $(n-2)f^{1-14}(n - 1)d^{0-10}ns^{1-2}$

D. $(n-2)f^{1-14}(n - 1)d^{0-2}(n - 1)s^2$

Answer: A



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3. The inner transition elements are the elements which the added electrons go to

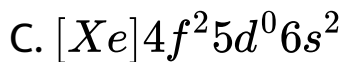
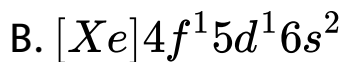
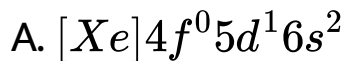
- A. $(n-1)d$ -orbitals
- B. $(n-2)f$ -orbitals
- C. $(n-1)$ d-orbitals and $(n-1)$ f-orbitals
- D. $(n-1)d$ -orbitals and $n s$ orbitals

Answer: B



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4. The electronic configuration of cerium is



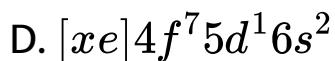
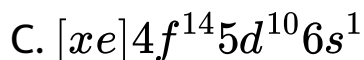
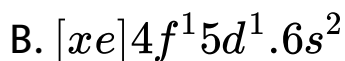
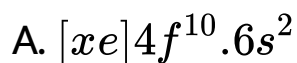
D. Both 2 and 3

Answer: B



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5. Which of the following is not the configuration of lanthanoid

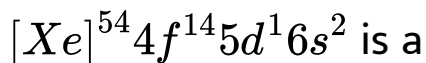


Answer: C



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6. The element with the electronic configuration



A. Representative element

B. Transition element

C. Actinide element

D. Lanthanide element

Answer: D



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7. Lanthanoids are

- A. 14 elements in the seventh period (At. no. 90 to 103) that are filling 5f sublevel.
- B. 14 elements in the sixth period (At.No. 58 to 71) that are filling 4f sublevel
- C. 14 elements in the seventh period (At.No.58 to 71) that are filling 4f sublevel.
- D. 14 elements in the sixth period (At.No.90 to 103)

Answer: B



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8. Which of the following Lanthanoid is radioactive

A. Cerium

B. Promethium

C. Thulium

D. Lutetium

Answer: B



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9. Which of the following are all radioactive elements.

A. Transition elements

B. P block elements

C. Lathanides.

D. Actinides.

Answer: D



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10. The most common lanthanoid is :

A. Lanthanum

B. Cerium

C. Samarium

D. Plutonium

Answer: B



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11. Non-Lanthanoid atom is

A. La

B. Lu

C. Pr

D. Pm

Answer: A



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12. Which of the following is a Lanthanoid

A. Ta

B. Rh

C. Th

D. Lu

Answer: D



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13. Lanthanides are characterized by the filling of the

- A. penultimate 4f energy level
- B. antepenultimate 4f energy level
- C. penultimate 5f energy level
- D. antepenultimate 5f energy level

Answer: B



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14. The most common oxidation state of Lanthanoids is

A. + 4

B. + 3

C. + 6

D. + 2

Answer: B



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Exercise 1 C W Properties

1. The most common oxidation states of cerium are

A. +2 and +4

B. +3 and +4

C. +3 and +5

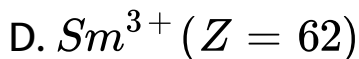
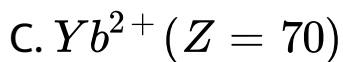
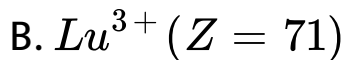
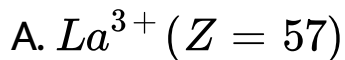
D. +2 and +3

Answer: B



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2. Which of the following ion is paramagnetic



Answer: D



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3. The atomic and ionic radii (M^{3+} ions) of Lanthanide elements decrease with increase in atomic number. This effect is called

A. Lanthanoid contraction

B. Lanthanoid expansion

C. Actinoid contraction

D. Actinoid expansion

Answer: A



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4. Lanthanoid contraction occurs because

- A. the 4f electrons, which are gradually added, create a strong shielding effect
- B. the 4f orbitals are greater in size than the 3d and 3f orbitals
- C. the 5f orbitals strongly penetrate into the 4f orbitals
- D. the poor shielding effect of 4f electrons is coupled with increased attraction between the nucleus and the added electrons.

Answer: D



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5. The Lanthanoids contraction is responsible for the fact that

- A. Zr and Y have about the same radius
- B. Zr and Nb have similar oxidation state
- C. Zr and Hf have about the same radius
- D. Zr and Zn have the same oxidation state

Answer: C



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6. Which element among the Lanthanides has the smallest atomic radius ?

A. Cerium

B. Lutetium

C. Europium

D. Gadolinium.

Answer: B



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7. Lanthanides are separated best by

- A. Fractional crystallisation
- B. Solvent extraction Lanthanoids is
- C. Complex formation using EDTA
- D. Ion exchange resins

Answer: D



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8. The separation of lanthanides by ion exchange method is based on

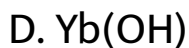
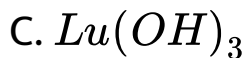
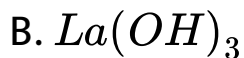
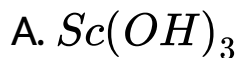
- A. The solubility of the nitrates
- B. Size of the hydrated M^{3+} ions
- C. Size of the unhydrated M^{3+} ions
- D. Basicity of the hydroxides

Answer: B



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9. Which of the following is the strongest base



Answer: B



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10. $KMnO_4$ and $K_2Cr_2O_7$ are replaced in volumetric analysis by

- A. La(III) salts
- B. Ce (III) salts
- C. Ce (IV) salts
- D. Gd (III) salts

Answer: C



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1. Assertion: Ce^{4+} is used as an oxidising agent in volumetric analysis.

Reason: Ce^{4+} has the tendency to attain +3 oxidation state.

A. Statement I is true, Statement II is true,

Statement II is a correct explanation of Statement I.

B. Statement I is true, Statement II is true,

Statement II is not the correct explanation of statement I

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: A



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2. Statement-I:- Sm^{3+} , Dy^{3+} have same colour (yellow)

Statement-II:-Both ions are having same number of unpaired electrons

A. Statement I is true, Statement II is true,

Statement II is a correct explanation of

Statement I.

B. Statement I is true, Statement II is true,

Statement II is not the correct explanation of

statement I

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: A



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3. Statement-I:- La^{3+}, Lu^{3+} ions are colourless

Statement-II:- They do not contain unpaired electrons

A. Statement I is true, Statement II is true,

Statement II is a correct explanation of

Statement I.

B. Statement I is true, Statement II is true,

Statement II is not the correct explanation of

statement I

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: A



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Exercise 2 C W Properties

1. The stable +2 ions of lanthanides in aqueous solution are



Answer: A



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2. SRP values of lanthanides lies between

A. -2.2 to -2.4 V

B. 4 to 2 V

C. 1 to 5 V

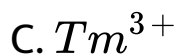
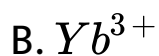
D. 0.1 to -0.2 V

Answer: A



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3. Ion with maximum number of unpaired electrons



Answer: D



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4. What factor make the separation of Lanthanides a formidable task

- A. Similarity in ionic size
- B. Constant charge of +3
- C. Small charge radius ratio
- D. All of these

Answer: D



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1. In the coinage metals (IB) group, the I.E decreases from Cu to Ag and the increases from Ag to Au this is attributed to

- A. Increased atomic size
- B. Increased ionic radius
- C. Increased nuclear density
- D. Lanthanide contraction

Answer: D



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2. Ionic radii of zirconium and hafnium become almost identical because

- A. They are 'd' block elements
- B. They belongs to the same group
- C. Of increased nuclear charge
- D. Of Lanthanide contraction

Answer: D



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3. Lanthanoids used in glass blower's goggles are

A. Pr and Nd

B. Eu and Gd

C. Tb and Dy

D. Em and Sm

Answer: A



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4. Which lanthanoide compounds is used as a most powerful liquid lasers after dissolving it in selenium oxychloride

- A. Cerium oxide
- B. Neodymium oxide
- C. Promethium sulphate
- D. Ceric sulphate

Answer: B



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5. Which one of the following pairs of elements is called chemical twins because of their very similar chemical properties

A. Mn and W

B. Mo and Tc

C. Fe and Re

D. Hf and Zr

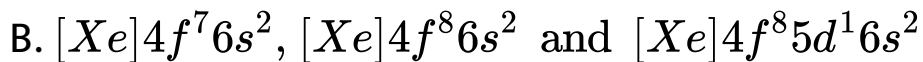
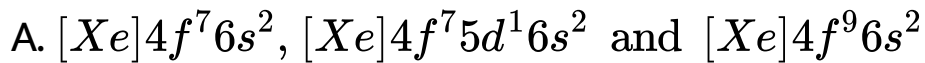
Answer: D



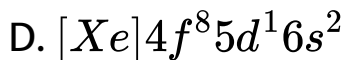
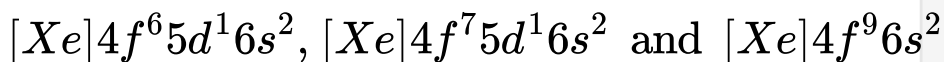
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Exercise 3

1. The electronic configuration of Eu (Atomic No. 63), Gd (Atomic No. 64) and Tb (Atomic No. 65) are:



C.



Answer: A



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2. Which one of the following statements related to lanthanons is incorrect ?

- A. Ce (+4) solutions are widely used as oxidizing agent in volumetric analysis
- B. Europium shows +2 oxidation state
- C. The basicity decreases as the ionic radius decreases from Pr to Lu
- D. All the lanthanons are much more reactive than aluminium

Answer: D



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3. Identify the incorrect statement among the following

A. There is a decrease in the radii of the atoms or ions as one proceeds from La to Lu.

B. Lanthanoid contraction is the accumulation of successive shrinkages

C. As a result of lanthanoid contraction, the properties of 4d-series of the transition elements have no similarities with the 5d-series of elements

D. Shielding power of 4f electrons is quite weak

Answer: C



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4. Which of the following is not an actinide?

A. Curium

B. Californium

C. Uranium

D. Terbium

Answer: D



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5. Which of the following is man-made element?

A. Ra

B. U

C. Np

D. C

Answer: C



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6. Which of the following lanthanoid ions is diamagnetic ?

(At nos . `Ce = 58 , Sm = 62, Eu = 63 , Yb =70)



Answer: D



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7. Reason of lanthanoid contraction is

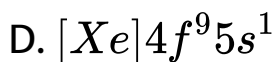
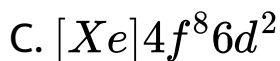
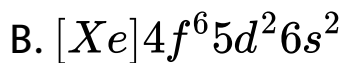
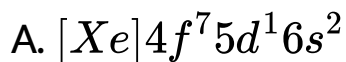
- A. Decreasing screening effect
- B. Negligible screening effect of 'f' orbitals
- C. Increasing nuclear charge
- D. Decreasing nuclear charge

Answer: B



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8. Gadolinium belongs to 4f series. Its atomic number is 64. Which of the following is the correct electronic configuration of gadolinium?



Answer: A



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9. Because of lanthanoid contraction, which of the following pairs of elements have nearly same atomic radii ? (Number in the parenthesis are atomic numbers)

- A. Zr(40) and Hf (72)
- B. Zr (40) and Ta (73)
- C. Ti (22) and Zr (40)
- D. Zr (40) and Nb (41)

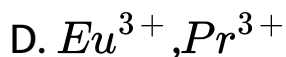
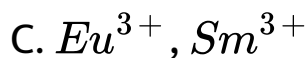
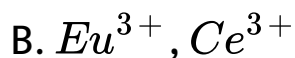
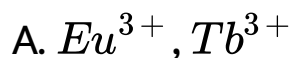
Answer: A



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Exercise 4 Properties

1. Pair of ions which are having same number of unpaired electrons

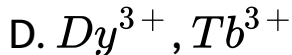
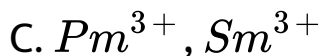
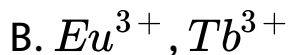
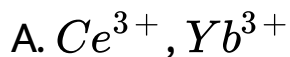


Answer: A



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2. Pair of ions which are having only one unpaired electron



Answer: A



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3. Cerium ($Z = 58$) is an important member of the lanthanoids . Which of the following statements about cerium is incorrect ?

A. The +3 oxidation state of cerium is more stable than the +4 oxidation state

B. The common oxidation states of cerium are +3 and +4

C. Cerium (IV) acts as an oxidizing agent

D. The +4 oxidation state of cerium is not known in solutions.

Answer: D



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4. In which of the following Lanthanoids oxidation state +2 is most stable ?

A. Ce

B. Eu

C. Tb

D. Dy

Answer: B



5. Lanthanoid contraction is caused due to:

- A. the 4f electrons, which are gradually added, create a strong shielding effect
- B. the 4f orbitals are greater in size than the 3d and 3f orbitals
- C. the 5f orbitals strongly penetrate into the 4f orbitals
- D. the poor shielding effect of 4f electrons is coupled with increased attraction between

the nucleus and the added electrons.

Answer: D



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6. The Lanthanoid contraction is responsible for the fact that

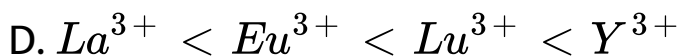
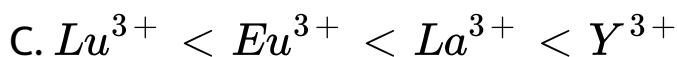
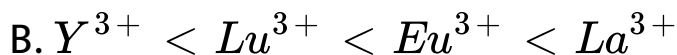
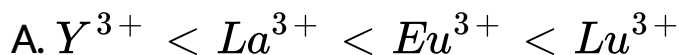
- A. Zr and Y have about the same radius
- B. Zr and Nb have similar oxidation state
- C. Zr and Hf have about the same radius
- D. Zr and Zn have the same oxidation state

Answer: C



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7. The correct order of ionic radii of Y^{3+} , La^{3+} , Eu^{3+} and Lu^{3+} is

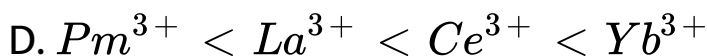
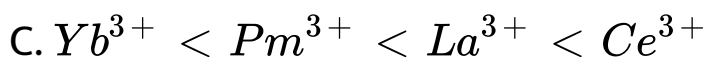
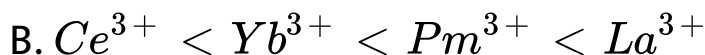
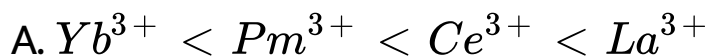


Answer: C



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8. Arrange Ce^{3+} , La^{3+} , Pm^{3+} and Yb^{3+} in increasing order of their size -

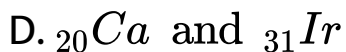
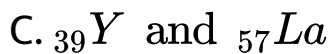
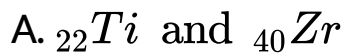


Answer: A



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9. Which of the two have almost similar size



Answer: B



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10. Identify the incorrect statement among the following :

A. d-block element show irregular and erratic chemical properties among themselves

B. La and Lu have partially filled d-orbitals and no other partially filled orbitals

C. The chemistry of various lanthanoids is very similar

D. 4f-and 5f-orbitals are equally shielded

Answer: D



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11. In context of the lanthanoids, which of the following statements about cerium is incorrect?

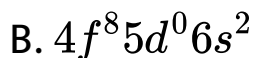
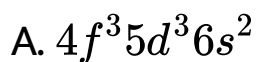
- A. There is a gradual decrease in the radii of the members with increasing atomic number in the series
- B. All the member exhibit +3 oxidation state
- C. because of similar properties the separation of lanthanoids is not easy

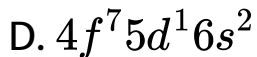
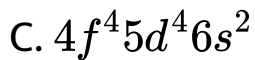
D. Availability of 4f electrons results in the formation of compounds in +4 state for all the members of the series.

Answer: D

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12. The outer electronic configuration of Gd (At.No. 64) is





Answer: D



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13. The actinoids exhibit more number of oxidation states in general than the lanthanoids. This is because

A. the 5f orbitals are more buried than the 4f orbitals

- B. there is a similarity between 4f and 5f orbitals in their angular part of the wave function
- C. actinoids are more reactive than lanthanoids
- D. the 5f orbitals extend farther from the nucleus than the 4f orbitals

Answer: D



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14. Larger number of oxidation state are exhibited by the actinoids than those by the lanthanoids ,

the main reason being.

- A. the 4f orbitals are more diffused than the 5f orbitals
- B. lesser energy difference between 5f and 6d than between 4f and 5d orbitals
- C. more energy difference between 5f and 6d than between 4f and 5d orbitals
- D. more reactive nature of actinoids than that of lanthanoids

Answer: B



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15. Knowing that the chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state, which of the following statement is incorrect?

- A. because of the large size of Ln (III) ions, the bonding in their compounds is predominantly ionic in character.
- B. the ionic size of Ln (III) decreases in general with increasing atomic number
- C. Ln(III) compounds are generally colourless

D. Ln(III) hydroxides are mainly basic in character.

Answer: C



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Check Your Grasp

1. Why $Ce(OH)_3$ is more basic than $Lu(OH)_3$?



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2. Which have maximum paramagnetism in M^{3+} ion for Lanthanoid (spin only) ?



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