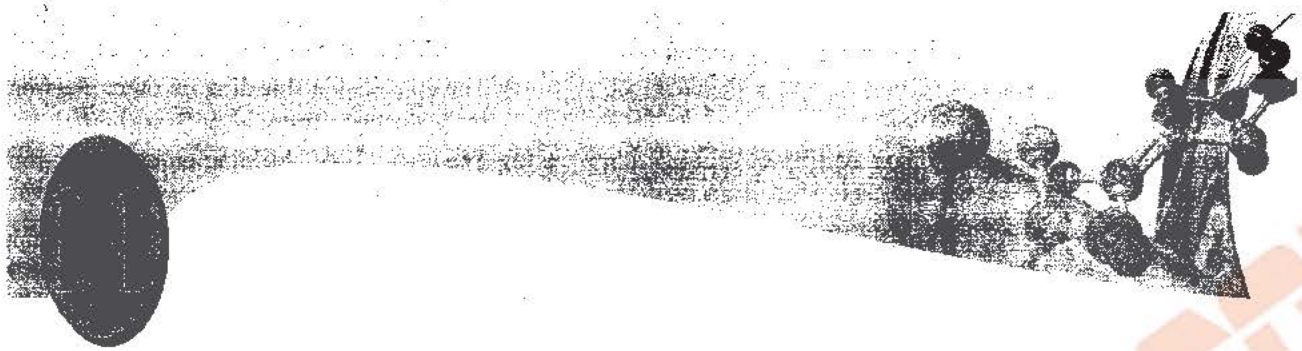


f-Block Elements

JEE (Main) Exercises

Single Correct Answer Type

1. Lanthanoids used in glass blower's goggles are:
   (a) Pr and Nd (b) Eu and Gd
   (c) Tb and Dy (d) Pm and Sm
2. Most common oxidation state of lanthanoid series is:
   (a) +2 (b) +3
   (c) +4 (d) +1
3. The electronic configuration of actinoids cannot be assigned with degree of certainty because of:
   (a) Overlapping of inner orbitals
   (b) Free movement of electrons over all the orbitals
   (c) Small energy difference between 5*f* and 6*d* levels
   (d) None of above
4. Consider the following statements in respect of lanthanoids:
   (i) The basic strength of hydroxides of lanthanoids increases from $La(OH)_3$ to $Lu(OH)_3$.
   (ii) The lanthanoid ions Lu^{3+}, Yb^{2+}, and Ce^{4+} are diamagnetic. Which of the statement(s) given above is/are correct?
   (a) (i) Only (b) (ii) Only
   (c) Both (i) and (ii) (d) Neither (i) nor (ii)
5. Lanthanoid contraction implies:
   (a) Decrease in density
   (b) Decrease in mass
   (c) Decrease in ionic radii
   (d) Decrease in radioactivity
6. If the lanthanoid element with x *f* electrons has a pink color, then the lanthanoid with $(14 - x)$ *f* electrons will have the color as:
   (a) Blue (b) Red
   (c) Green (d) Pink
7. In aqueous solution, Eu^{2+} ion acts as:
   (a) An oxidizing agent (b) A reducing agent
   (c) Either (a) or (b) (d) None of these
8. The actinoids showing +7 oxidation state are:
   (a) U, Np (b) Pu, Am
   (c) Np, Pu (d) Am, Cm
9. Among the lanthanoids the one obtained by synthetic method is:
   (a) Lu (b) Pm
   (c) Pr (d) Gd
10. Across the lanthanoid series, the basicity of the lanthanoid hydroxides:
   (a) Increases
   (b) Decreases
   (c) First increases and then decreases
   (d) First decreases and then increases
11. The reason for the stability of Gd^{3+} ion is:
   (a) 4*f* subshell—half filled

(b) 4*f* subshell—completely filled
(c) Possesses the general electronic configuration of noble gases
(d) 4*f* subshell empty

12. Most common oxidation states shown by cerium are:
(a) +2, +4 (b) +3, +4
(c) +3, +5 (d) +2, +3

13. The +3 ion of which one of the following has half filled 4*f* subshell?
(a) La (b) Lu
(c) Gd (d) Ac

14. Arrange Ce^{3+}, La^{3+}, Pm^{3+}, and Yb^{3+} in *increasing order* of their ionic radii:
(a) $Yb^{3+} < Pm^{3+} < Ce^{3+} < La^{3+}$
(b) $Ce^{3+} < Yb^{3+} < Pm^{3+} < La^{3+}$
(c) $Yb^{3+} < Pm^{3+} < La^{3+} < Ce^{3+}$
(d) $Pm^{3+} < La^{3+} < Ce^{3+} < Yb^{3+}$

15. The radius of La^{3+} (At. No. of La = 57) is 1.06 Å. Which one of the following given values will be closest to the radius of Lu^{3+} (At. No. of Lu = 71)?
(a) 1.40 Å (b) 1.06 Å
(c) 0.85 Å (d) 1.60 Å

16. A reduction in atomic size with increase in atomic number is a characteristic of elements of:
(a) *d*-block (b) *f*-block
(c) Radioactive series (d) High atomic masses

17. Cerium (Z = 58) is an important member of the lanthanoids. Which of the following statement about cerium is incorrect?
(a) The common oxidation states of cerium are +3 and +4
(b) Cerium(IV) acts as an oxidizing agent
(c) The +4 oxidation state of cerium is more stable in solutions
(d) The +3 oxidation state of cerium is more stable than the +4 oxidation state

18. The lanthanoid contraction is responsible for the fact that:
(a) Zr and Nb have similar oxidation state
(b) Zr and Y have about the same radius
(c) Zr and Zn have the same oxidation state
(d) Zr and Hf have about the same radius

19. Lanthanoid contraction is caused due to
(a) The same effective nuclear charge from Ce to Lu
(b) The imperfect shielding on outer electrons by 4*f* electrons from the nuclear charge
(c) The appreciable shielding on outer electrons by 4*f* electrons from the nuclear charge
(d) The appreciable shielding on outer electrons by 5*d* electrons from the nuclear charge

20. The actinoids exhibit more number of oxidation states in general than the lanthanoids. This is because:
(a) The 5*f* orbitals extend further from the nucleus than the 4*f* orbitals
(b) The 5*f* orbitals are more buried than the 4*f* orbitals
(c) There is a similarity between 4*f* and 5*f* orbitals in their angular part of the wave function
(d) The actinoids are more reactive than the lanthanoids

21. The group of elements in which the differentiating electron enters into the antepenultimate shell of atoms is called:
(a) *f*-block elements (b) *p*-block elements
(c) *s*-block elements (d) *d*-block elements

22. Knowing that the chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state, which of the following statement is incorrect?
(a) The ionic sizes of Ln(III) decrease in general with increasing atomic number
(b) Ln(III) compounds are generally colorless
(c) Ln(III) hydroxides are mainly basic in character
(d) Because of the large size of the Ln(III) ions, the bonding in its compounds is predominantly ionic in character

23. Which is *not correct* statement about the chemistry of 3*d* and 4*f* series elements?
(a) 3*d*-elements show more oxidation states than 4*f*-series elements
(b) The energy difference between 3*d* and 4*s* orbitals is very little
(c) Europium(II) is more stable than Ce(II)
(d) The paramagnetic character in 3*d*-series elements increases from scandium to copper

24. The maximum oxidation state exhibited by actinoid elements is:
(a) +5 (b) +4
(c) +7 (d) +8

25. Which of the following lanthanoid ion is paramagnetic?

(a) Ce^{4+} (b) Yb^{2+}
(c) Lu^{3+} (d) Eu^{2+}

26. In context of the lanthanoids, which of the following statement is not correct?
(a) There is a gradual decrease in the radii of the members with increasing atomic number in the series
(b) All the members exhibit +3 oxidation state
(c) Because of similar properties, the separation of lanthanoids is not easy
(d) Availability of 4*f* electrons results in the formation of compounds in +4 state for all the members of the series

27. The outer electronic configuration of Gd (At. No. = 64) is:
(a) $4f^3\ 5d^5\ 6s^2$ (b) $4f^8\ 5d^0\ 6s^2$
(c) $4f^4\ 5d^4\ 6s^2$ (d) $4f^7\ 5d^1\ 6s^2$

28. Consider the following statements:
(i) $La(OH)_3$ is the least basic among hydroxides of lanthanoid.
(ii) Zr^{4+} and Hf^{4+} possess almost the same ionic radii.
(iii) Ce^{4+} can act as an oxidizing agent.
Which of the above is/are true?
(a) (i) and (iii) (b) (ii) and (iii)
(c) (ii) only (d) (i) and (ii)
(e) (i) only

29. On which factors, the stability of oxidation states of lanthanoid elements depends?
(a) Enthalpy
(b) Internal energy
(c) Combined effects of hydration enthanlpy and ionization enthalpy
(d) Electronic configuration

NCERT Exemplar Exercises

Single Correct Answer Type

1. Which of the following oxidation state is common for all lanthanoids?
(a) +2 (b) +3
(c) +4 (d) +5

2. There are 14 elements in actinoid series. Which of the following elements does not belong to this series?
(a) U (b) Np
(c) Tm (d) Fm

3. Gadolinium belongs to 4*f* series. Its atomic number is 64. Which of the following is the correct electronic configuration of gadolinium?
(a) [Xe] $4f^7 5d^1 6s^2$ (b) [Xe] $4f^6 5d^2 6s^2$
(c) [Xe] $4f^8 6d^2$ (d) [Xe] $4f^9 5s^1$

4. Although Zirconium belongs to 4*d* transition series and Hafnium to 5*d* transition series even then they show similar physical and chemical properties because _____.
(a) Both belong to *d*-block
(b) Both have same number of electrons
(c) Both have similar atomic radius
(d) Both belong to the same group of the periodic table

Multiple Correct Answers Type

1. Generally transition elements and their salts are colored due to the presence of unpaired electrons in metal ions. Which of the following compounds are colored?
(a) $KMnO_4$ (b) $Ce(SO_4)_2$
(c) $TiCl_4$ (d) Cu_2Cl_2

2. Which of the following actinoids show oxidation states up to +7?
(a) Am (b) Pu
(c) U (d) Np

3. General electronic configuration of actionoids is $(n-2)f^{1-14}\ (n-1)d^{0-2}ns^2$. Which of the following actinoids have one electron in 6*d* orbital?
(a) U (Atomic no. 92) (b) Np (Atomic no. 93)
(c) Pu (Atomic no. 94) (d) Am (Atomic no. 95)

4. Which of the following lanthanoids show +2 oxidation state besides the characteristic oxidation state +3 of lanthanoids?
(a) Ce (b) Eu
(c) Yb (d) Ho

5. Although +3 is the characteristic oxidation state for lanthanoids but cerium also shows +4 oxidation state because _____.
(a) It has variable ionization enthalpy
(b) It has a tendency to attain noble gas configuration
(c) It has a tendency to attain f^0 configuration
(d) It resembles Pb^{4+}

Short Answer Type

1. Ionization enthalpies of Ce, Pr, and Nd are higher than Th, Pa, and U. Why?
2. Although Zr belongs to 4*d* and Hf belongs to 5*d* transition series but it is quite difficult to separate them. Why?
3. Although +3 oxidation state is the characteristic oxidation state of lanthanoids but cerium shows +4 oxidation state also. Why?
4. The second and third rows of transition elements resemble each other much more than they resemble the first row. Explain why?

Matching Column Type

1. Match the compounds/elements given in Column-I with uses given in Column-II.

Column-I (Compound/element)	Column-II (Use)
(a) Lanthanoid oxide	(p) Production of iron alloy
(b) Lanthanoid	(q) Television screen
(c) Misch metal	(r) Petroleum cracking
(d) Magnesium-based alloy is	(s) Lanthanoid metal + iron constituent of
(e) Mixed oxides of	(t) Bullet lanthanoids are employed
	(u) In X-ray screen

2. Match the statements given in Column-I with the oxidation states given in Column-II.

Column-I	Column-II
(a) Oxidation state of Mn in MnO_2 is	(p) + 2
(b) Most stable oxidation state of Mn is	(q) + 3
(c) Most stable oxidation state of Mn in oxides is	(r) + 4
(d) Characteristic oxidation state of lanthanoids is	(s) + 5
	(t) + 7

3. Match the property given in Column-I with the element given in Column-II.

Column-I (Property)	Column-II (Element)
(a) Lanthanoid which shows +4 oxidation state	(p) Pm
(b) Lanthanoid which can show +2 oxidation state	(q) Ce
(c) Radioactive lanthanoid	(r) Lu
(d) Lanthanoid which has $4f^7$ electronic configuration in +3 oxidation state	(s) Eu
(e) Lanthanoid which has $4f^{14}$ electronic configuration in +3 oxidation state	(t) Gd
	(u) Dy

Assertion-Reasoning Type

Note: In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Both assertion and reason are true, and reason is the correct explanation of the assertion.

(b) Both assertion and reason are true but reason is not the correct explanation of assertion.

(c) Assertion is not true but reason is true.

(d) Both assertion and reason are false.

1. **Assertion:** Separation of Zr and Hf is difficult.

   Reason: Because Zr and Hf lie in the same group of the periodic table.

2. **Assertion:** Actinoids form relatively less stable complexes as compared to lanthanoids.

   Reason: Actinoids can utilize their 5*f* orbitals along with 6*d* orbitals in bonding but lanthanoids do not use their 4*f* orbital for bonding.

3. On the basis of lanthanoid contraction, explain the following:
   (a) Nature of bonding in La_2O_3 and Lu_2O_3
   (b) Trends in the stability of oxo salts of lanthanoids from La to Lu
   (c) Stability of the complexes of lanthanoids
   (d) Radii of 4*d* and 5*d*-block elements
   (e) Trends in acidic character of lanthanoid oxides

Archives

JEE (Main) Exercises

Single Correct Answer Type

1. Most common oxidation states of Ce (cerium) are:
   (a) +2, +3 (b) +2, +4
   (c) +3, +4 (d) +3, +5

(AIEEE, 2002)

2. Arrange Ce^{+3}, La^{+3}, Pm^{+3}, and Yb^{+3} in increasing order of their ionic radii:
   (a) $Yb^{+3} < Pm^{+3} < Ce^{+3} < La^{+3}$
   (b) $Yb^{+3} < Pm^{+3} < La^{+3} < Ce^{+3}$
   (c) $La^{3+} < Ce^{3+} < Yb^{3+} < Pm^{3+}$
   (d) $Pm^{+3} < La^{+3} < Ce^{+3} < Yb^{+3}$

(AIEEE, 2002)

3. The radius of La^{3+} (atomic number of La = 57) is 1.06 Å. Which one of the following given values will be closest to the radius of Lu^{3+} (Atomic number of Lu = 71)?
   (a) 1.40 Å (b) 1.06 Å
   (c) 0.85 Å (d) 1.60 Å

(AIEEE, 2002)

4. A reduction in atomic size with increase in atomic number is a characteristic of:
   (a) *d*-block elements
   (b) *f*-block elements
   (c) Radioactive series elements
   (d) High atomic mass elements

(AIEEE, 2003)

5. Cerium ($Z = 58$) is an important member of the lanthanides. Which of the following statements about cerium is incorrect?
   (a) The +4 oxidation state of cerium is not known in solutions
   (b) The +3 oxidation state of cerium is more stable than the +4 oxidation state
   (c) The common oxidation states of cerium are +3 and +4
   (d) Cerium (IV) acts as an oxidizing agent

(AIEEE, 2004)

6. The lanthanide contraction is responsible for the fact that:
   (a) Zr and Zn have the same oxidation state
   (b) Zr and Hf have about the same radius
   (c) Zr and Nb have similar oxidation state
   (d) Zr and Y have about the same radius

(AIEEE, 2005)

7. Which of the following factors may be regarded as the main cause of lanthanide contraction?
   (a) Greater shielding of 5*d*-electrons by 4*f*-electrons
   (b) Poorer shielding of 5*d*-electrons by 4*f*-electrons
   (c) Effective shielding of one of 4*f*-electrons by another in the subshell
   (d) Poor shielding of one of 4*f*-electrons by another in the subshell

(AIEEE, 2005)

8. Lanthanide contraction is caused due to:
   (a) The same effective nuclear charge from Ce to Lu
   (b) The imperfect shielding on outer electrons by 4*f*-electrons from the nuclear charge
   (c) The appreciable shielding on outer electrons by 4*f*-electrons from the nuclear charge
   (d) The appreciable shielding on outer electrons by 5*d*-electrons from the nuclear charge

(AIEEE, 2006)

9. Identify the incorrect statement among the following statements:
   (a) 4*f*- and 5*f*-orbitals are equally shielded
   (b) *d*-block elements show irregular and erratic chemical properties among themselves
   (c) La and Lu have partially filled *d*-orbitals and no other partially filled orbitals
   (d) The chemistry of various lanthanides is very similar

(AIEEE, 2007)

10. The actinides exhibit more number of oxidation states in general than the lanthanides. This is because:
   (a) The 5*f*-orbitals extend further from the nucleus than the 4*f*-orbitals
   (b) The 5*f*-orbitals are more buried than the 4*f*-orbitals
   (c) There is a similarity between 4*f*- and 5*f*-orbitals in their angular part of the wave function
   (d) The actinides are more reactive than the lanthanides

(AIEEE, 2007)

11. Larger number of oxidation states is exhibited by the actinides than those by the lanthnides because:
   (a) 4*f*-orbitals are more diffused than the 5*f* orbitals
   (b) Of lesser energy difference between 5*f*- and 6*d*-orbitals than between 4*f*- and 5*d*-orbitals
   (c) Of more energy difference between 5*f*- and 6*d*-orbitals than between 4*f*- and 5*d*-orbitals
   (d) Of more reactive nature of the actinides than the lanthanides

(AIEEE, 2008)

12. Knowing that the chemistry of lanthanides (Ln) is dominated by its +3 oxidation state, which of the following statements is incorrect?
   (a) The ionic size of Ln(III) decreases in general with increasing atomic number

(b) Ln(III) compounds are generally colorless
(c) Ln(III) hydroxide is mainly basic in character
(d) Because of the large size of the Ln(III) ions, the bonding in its compounds is predominantly ionic in character

(AIEEE, 2009)

13. In context of the lanthanides, which of the following statements is not correct?
(a) There is a gradual decrease in the radii of the members with increasing atomic number in the series
(b) All the members exhibit +3 oxidation state
(c) Because of similar properties, the separation of lanthanides is not easy
(d) Availability of 4*f*-electrons results in the formation of compounds in +4 oxidation state for all the members of the series

(AIEEE, 2011)

14. The outer electron configuration of Gd (Atomic No. = 64) is:
(a) $4f^3\ 5d^6\ 6s^2$ (b) $4f^8\ 5d^{10}\ 6s^2$
(c) $4f^4\ 5d^4\ 6s^2$ (d) $4f^7\ 5d^1\ 6s^2$

(AIEEE, 2011)

Hints & Solutions

JEE (Main) Exercises

Single Correct Answer Type

1. (a) Pr and Nd: Lantharoids used in glass blower's goggles.
2. (b) +3 Most common oxidation state of larthanoid series.
3. (c) The electronic configuration of actinoids cannot be assigned with degree of certainty because of small energy difference between *sf* and *bd* levels.
4. (b) $La(OH)_3$ is most basic in nature while $Lu(OH)_3$ least basic.
5. (c) Lanthanoid contraction implies decrease in ionic radii.
6. (d) The ions often with $4f^n$ configuration have similar color to those ions having $4f^{14-n}$ configuration.
7. (b) In aqueous solution, E_4^{+2} ions acts as a reducing agent.
8. (c) Np and PU actinoids showing +7 oxidation state.
11. (a) $Gd = 4f^7\ 5d^1\ 6s^2$
$Gd^{+2} = 4f^7$
$4f$ subshell half filled
12. (b) The formation of Ce^{+4} is favored by its noble gas configuration, but it is a strong oxidant reverting to the common +3 0.5. The value of E° for Ce^{+4}/Ce^{+3} is 1.74 V which suggests that it can oxidize water.
13. (c) $Gd = 4f^7\ 5d^1\ 6s^2$
$Gd^{+3} = 4f^7$
14. (a) The overall decrease in atomic and ionic radii from lanthanum to lutetium
$Yb^{+3} < Pm^{+3} < Ce^{+3} < La^{+3}$
15. (c) The overall decreases in atomic and ionic radii from lanthanum to lutetium
$La^{+3} = 1.06$ Å
$Lu^{+3} = 0.85$ Å
17. (c) The E° value for Ce^{+4}/Ce^{+3} is 1.74 V which suggests that it can oxidize water.
20. (a) There is a greater range of oxidation states, which is in part attributed to the fact that the 5*f*, 6*d*, and 7*s* levels are of comparable energies.
22. (b) The lanthanide ions have unpaired electrons in their orbitals, thus these ions absorb visible region of light and undergo *f-f* transition and hence exhibit color.
29. (c) The stability of oxidation states of lanthanoid elements depends on combined effects of hydration enthalpy and ionization enthalpy.

NCERT Exemplar Exercises

Short Answer Type

1. **Hint:** It is because in the beginning, when 5*f* orbitals begin to be occupied, they will penetrate less into the inner core of electrons. The 5*f* electrons will therefore, be more effectively shielded from the nuclear charge than 4*f* electrons of the corresponding lanthanoids. Therefore outer electrons are less firmly held and they are available for bonding in the actinoids.
2. **Hint:** Due to lanthanoid contraction, they have almost same size (Zr, 160 pm) and (Hf, 159 pm).
3. It is because after losing one more electron, Ce acquires stable $4f^0$ electronic configuration.
4. Due to lanthanoid contraction, the atomic radii of the second and third row transition elements is almost same. So, they resemble each other much more as compared to first row elements.

Assertion-Reasoning Type

3. **Hint:**
   (a) As the size decreases, covalent character increases. Therefore, La_2O_3 is more ionic and Lu_2O_3 is more covalent.
   (a) As the size decreases from La to Lu, stability of oxosalts also decreases.
   (c) Stability of complexes increases as the size of lanthanoids decreases.
   (d) Radii of 4*d*- and 5*d*-block elements will be almost same.
   (e) Acidic character of oxides increases from La to Lu.

Archives

JEE (Main) Exercises

Single Correct Answer Type

1. (c) +3, +4
2. (a) $La^{3+} > Ce^{3+} > Pm^{3+} > Yb^{3+}$

   In lanthanides, there is fairly regular decrease in the sizes with increasing atomic numbers.
3. (c) Refer Solution 2.
4. (b) Refer Solution 2.

   The overall decrease in atomic and ionic radii from lanthanum to lutetium (the lanthanide contraction) is a unique feature in the chemistry of the lanthanides.
5. (a) Formation of Ce^{+4} is favored due to its noble gas configuration. Thus, answer is (a). +3 is the common most oxidation state though for cerium.
6. (b) The filling of 4*f* before 5*d*-orbital results in a regular decrease in atomic radii called lanthanide contraction, which essentially compensates for the expected increase in atomic size with increasing atomic number. The net result of the lanthanide contractions is that the corresponding elements of second and the third *d*-series exhibit similar radii (e.g., Zr 160 pm, Hf 159 pm) and have very similar physical and chemical properties.
7. (d) Lanthanide contraction can be defined as the following:

   Due to high electrostatic attraction of protons on *ns* and *np* electrons, coupled with poor shielding of $(n-1)$ of electrons, there is continuous decrease in size from left to right in the series. As a result of lanthanide contraction, the radii of the members of the third transition series are very similar to those of the corresponding members of the second series.
8. (c) Refer Solution 7, $m = \sqrt{n(n+2)}$

   In Ni^{2+}, unpaired electrons is 2.

   $\therefore m = \sqrt{2(2+2)} = \sqrt{8}$

   $= 2.828$

   $= 2.84$
9. (a) Shielding of 5*f* is low as compared with 4*f*.
10. (a) Due to lesser energy differences between 5*f* and 6*d* than between 4*f*- and 5*d*-orbitals.
11. (b) Lesser energy difference between 5*f*- and 6*d*-orbitals as compared with 4*f*- and 5*d*-orbitals.
12. (b) Most of Ln^{3+} compounds are colored.
13. (d) Because +4 state, 0.5 for lanthanides is occasional.
14. (d) It is a fact.

Answers

JEE (Main) Exercises

Single Correct Answer Type

1. (a)	2. (b)	3. (c)	4. (b)	5. (c)	6. (d)	7. (b)	8. (c)	9. (b)	10. (b)
11. (a)	12. (b)	13. (c)	14. (a)	15. (c)	16. (b)	17. (c)	18. (d)	19. (b)	20. (a)
21. (a)	22. (b)	23. (d)	24. (c)	25. (d)	26. (d)	27. (d)	28. (b)	29. (c)	

NCERT Exemplar Exercises

Single Correct Answer Type

1. (b) 2. (c) 3. (a) 4. (c)

Multiple Correct Answers Type

1. (a), (b) 2. (b), (d) 3. (a), (b) 4. (b), (c) 5. (b), (c)

Matching Column Type

1. (a) → (q); (b) → (p); (c) → (s); (d) → (t); (e) → (r)
2. (a) → (r); (b) → (p); (c) → (t); (d) → (q)
3. (a) → (q); (b) → (s); (c) → (p); (d) → (t); (e) → (r)

Assertion-Reasoning Type

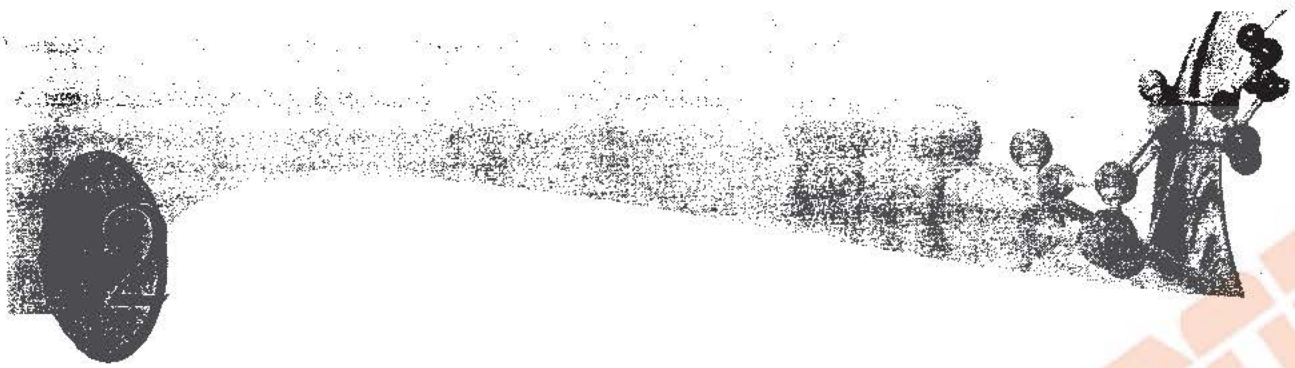
1. (a) 2. (b)

Archives

JEE (Main) Exercises

Single Correct Answer Type

1. (c) 2. (a) 3. (c) 4. (b) 5. (a) 6. (b) 7. (d) 8. (c) 9. (a) 10. (a)
11. (b) 12. (b) 13. (d) 14. (d)



Quantum Number

JEE (Advanced) Exercises

Single Correct Answer Type

1. Spin only magnetic moment of dipositive ion of Zn is:
   (a) 0 (b) $\sqrt{8}$ BM
   (c) $\sqrt{24}$ BM (d) $\sqrt{35}$ BM

2. In boron atom screening on the last electron is due to:
   (a) Electrons of 'K' shell only
   (b) All the electrons of K and L shell
   (c) 2-Electrons of 1*s* and 2*s* each
   (d) All the electrons of L shell only

3. The zero probability of finding the electron in p_x orbitals:
   (a) Two opposite sides of the nucleus along *x*-axis
   (b) In the nucleus
   (c) Same on all the sides around the nucleus
   (d) None of these

4. Which electronic configuration does not follow the Pauli's exclusion principle?
   (a) $1s^2, 2s^2, 2p^4$ (b) $1s^2, 2s^2, 2p^4, 3s^2$
   (c) $1s^2, 2p^4$ (d) $1s^2, 2s^2\ 2p^6, 3s^3$

5. In which of the following orbitals, there is zero probability of finding electron in *XY* plane:
   (a) p_x (b) p_y
   (c) d_{xy} (d) d_{xz}

6. Choose the correct set of quantum number of last electron of $_{29}$Cu:
   (a) $3, 1, 0, +\frac{1}{2}$ (b) $3, 2, -3, +\frac{1}{2}$
   (c) $3, 2, -2, -\frac{1}{2}$ (d) None of these

7. Which of the following statement is **Correct**?
   (a) Total number of electrons in a subshell is $2\ell + 1$
   (b) p_z, $d_{x^2-y^2}$ and d_{z^2} orbitals are non-axial
   (c) Only *s*-orbitals has directional orientation while p_z, *d*, and *f*-orbitals have non-directional properties
   (d) Spin multiplicity of N-atom is 4

8. Find the sum of maximum number of electrons having +1 and –1 value of '*m*' in Ti:
   (a) 6 (b) 8
   (c) 10 (d) 12

9. Imagine a Universe in which four quantum numbers can have same possible value as in our universe except the magnetic quantum number (*m*) can have integral values from 0 to $\pm(\ell + 1)$. Find the electronic configuration of atomic number 20.
   (a) $1s^6\ 2s^6\ 2p^8$
   (b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$
   (c) $1s^4\ 2s^4\ 2p^6\ 3s^4\ 3p^2$
   (d) $1s^2\ 1p^6\ 2s^2\ 1d^{10}$

10. Choose the correct set of quantum number of last electron entered of $_{29}$Cu: