

d & f Block Metals

1. Elemental Properties of d block Elements

- Q 1. Which of the following element is called pseudo transition metal?
(A) Cu (B) Zn (C) Fe (D) Cr
- Q 2. Which groups elements are called non – typical transition metal?
(A) IIIB (B) IIB
(C) IIB & IIIB both (D) IVB & IIIB
- Q 3. The maximum number of exceptions in electronic configuration is present in
(A) 3d series (B) 4d series
(C) 5d series (D) 6d series
- Q 4. Identify the incorrect statement among the following. [CBSE PMT 2007]
(A) There is a decrease in the radii of the atoms or ions as one proceeds from La to Lu
(B) Lanthanide contraction is the accumulation of successive shrinkages
(C) As a result of lanthanide 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
- Q 5. Which of the following pair have similar ionic radii due to lanthanide contraction?
I : Zr, Hf II : Mo, W
III : Ag, Au IV : Zn, Ag
(A) I, IV (B) II, IV
(C) III, IV (D) I, II, III
- Q 6. **Assertion (A)** : Separation of Zr & Hf is difficult
Reason (R) : Zr & Hf lie in the same group of the periodic table. [AIIMS 2017]
(A) Both A & R are true and R is the correct explanation of A
(B) Both A & R are true but R is not correct explanation of A
(C) A is true but R is false
(D) Both A & R are false
- Q 7. Which has the largest radii?
(A) Cr^{3+} (B) Mn^{3+} (C) Fe^{3+} (D) Co^{3+}
- Q 8. The wrong statement regarding transition metals among the following is
(A) 4s electrons penetrate towards the nucleus more than 3d electrons
(B) atomic radii of transition metals increase rapidly with increase in atomic number because of poor shielding of nuclear attraction by (n-1)e
(C) Second and third transition series elements have nearly the same size
(D) the ionisation potential of 5d transition metals are much higher than those of 3d, and 4d transition metals
- Q 9. In d block metals, energy order of 4s & 3d orbitals are
(A) $E_{4s} > E_{3d}$ (B) $E_{4s} < E_{3d}$
(C) $E_{4s} = E_{3d}$ (D) None of these
- Q 10. Which of the following statement is false?
I : $\epsilon_{M^{3+}/M^{2+}}^{\circ}$ values shows that Mn^{3+} and Co^{3+} ions are the strongest oxidising agent in aqueous solution
II : The ions Ti^{2+} , V^{2+} , & Cr^{2+} are strong reducing agents will liberate hydrogen from dilute acid
III : FeO_4^{2-} readily decomposes to Fe_2O_3 & O_2
IV : In the series Sc to Zn, the enthalpy of atomization of Zn is maximum
(A) I, IV (B) I, II, IV
(C) II, III, IV (D) I, II, III
- Q 11. Which of the following does not represent the correct order of the properties indicated? [CBSE PMT 1997]
(A) $\text{Ni}^{2+} > \text{Cr}^{2+} > \text{Fe}^{2+} > \text{Mn}^{2+}$ (Size)
(B) $\text{Sc} > \text{Ti} > \text{Cr} > \text{Mn}$ (Size)
(C) $\text{Mn}^{2+} > \text{Ni}^{2+} > \text{Co}^{2+} > \text{Fe}^{2+}$ (unpaired e)
(D) $\text{Fe}^{2+} > \text{Co}^{2+} > \text{Ni}^{2+} > \text{Cu}^{2+}$ (unpaired e)
- Q 12. Which of the following arrangement does not represent the correct order of the property stated against it? [JEE Main 2013]
(A) $\text{V}^{2+} < \text{Cr}^{2+} < \text{Mn}^{2+} < \text{Fe}^{2+}$: Paramagnetic property
(B) $\text{Ni}^{2+} < \text{Co}^{2+} < \text{Fe}^{2+} < \text{Mn}^{2+}$: Size
(C) $\text{Co}^{3+} < \text{Fe}^{3+} < \text{Cr}^{3+} < \text{Sc}^{3+}$: Stability in aqueous solution
(D) $\text{Sc} < \text{Ti} < \text{Cr} < \text{Mn}$: no of oxidation state
- Q 13. Which of the following relation is wrong?
(A) $\text{Cr} > \text{V} > \text{Ti} > \text{Mn}$ (M.P.)
(B) $\text{Mn}_2\text{O}_7 > \text{MnO}_2 > \text{MnO}$ (acidic strength)
(C) $\text{W} > \text{Cr} > \text{Mo}$ (M.P.)
(D) $\text{Hg} > \text{Zn} > \text{Cd}$ (I.E.)
- Q 14. Four successive members of first row transition elements are listed below with their atomic

numbers. Which one of them is expected to have highest third I.E.?

[CBSE PMT 2005]

- (A) Vanadium (Z = 23) (B) Chromium (Z = 24)
(C) Iron (Z = 26) (D) Manganese (Z = 25)

2. Elemental Properties of d block Elements

- Q 1. Metallic radii of some metals are given below, which of the following has highest density?

[NCERT Exemplar]

Element	Fe	Co	Ni	Cu
Metallic radius	126	125	125	128

- (A) Fe (B) Ni (C) Co (D) Cu

- Q 2. Which of the following elements have generally maximum density?

- (A) S block (B) P block
(C) d block (D) f block

- Q 3. Generally Transition metals form coloured salts due to presence of unpaired electrons. Which of the following compounds will be coloured in solid state?

[NCERT Exemplar]

- (A) Ag_2SO_4 (B) CuF_2
(C) ZnF_2 (D) Cu_2Cl_2

- Q 4. Which of the following element has lowest I.E.₁ value?

- (A) Ti (B) V (C) Cr (D) Fe

- Q 5. The basic character of the transition metal monoxide follows the order

[AIIMS 2007]

- (A) $\text{VO} > \text{CrO} > \text{TiO} > \text{FeO}$
(B) $\text{CrO} > \text{VO} > \text{FeO} > \text{TiO}$
(C) $\text{TiO} > \text{FeO} > \text{VO} > \text{CrO}$
(D) $\text{TiO} > \text{VO} > \text{CrO} > \text{FeO}$

- Q 6. Which of the following pair is Amphoteric in nature?

- (A) $\text{Cr}_2\text{O}_3, \text{V}_2\text{O}_3$ (B) $\text{CrO}_3, \text{Mn}_2\text{O}_7$
(C) $\text{CrO}, \text{V}_2\text{O}_5$ (D) $\text{MnO}, \text{Mn}_2\text{O}_3$

- Q 7. Which of the following are Amphoteric in nature?

[NCERT Exemplar]

$\text{Mn}_2\text{O}_7, \text{CrO}_3, \text{Cr}_2\text{O}_3, \text{CrO}, \text{V}_2\text{O}_5, \text{V}_2\text{O}_4$

- (A) $\text{Cr}_2\text{O}_3, \text{V}_2\text{O}_5$ (B) $\text{Mn}_2\text{O}_7, \text{CrO}_3$
(C) $\text{CrO}, \text{V}_2\text{O}_5$ (D) $\text{V}_2\text{O}_5, \text{V}_2\text{O}_4$

- Q 8. Which of the following oxide of Mn is Amphoteric?

- (A) MnO (B) MnO_2
(C) MnO_3 (D) None of these

- Q 9. A pair amphoteric oxides from the following is
(A) VO and V_2O_5 (B) VO_2 and CrO
(C) VO_2 and Cr_2O_3 (D) VO_2 and CrO_3

- Q 10. Arrange the following hydroxyl compounds in order of increasing acid strength.

$\text{CrO}_2(\text{OH})_2$ (I); $\text{Cr}(\text{OH})_2$ (II); $\text{Cr}(\text{OH})_3$ (III)

- (A) $\text{I} < \text{II} < \text{III}$ (B) $\text{II} < \text{III} < \text{I}$
(C) $\text{III} < \text{II} < \text{I}$ (D) $\text{III} < \text{I} < \text{II}$

- Q 11. Nonstoichiometry is

(A) found in oxides and sulphides, where the transition metal is found in more than one oxidation state

(B) associated with unpaired electrons

(C) defects in solid structure
(D) the complex formation of transition metal ions is often accompanied by a change of colour and sometimes by a change in the intensity of the colour

- Q 12. Which of the following statements about the interstitial compound is incorrect?

[NEET 2013]

- (A) They retain metallic conductivity
(B) They are chemically reactive
(C) They are much harder than the pure metal
(D) They have higher melting points than the pure metal

- Q 13. Interstitial compounds are formed when small atoms are trapped inside the crystal lattice of the metals. Which of the following is not the characteristic property of interstitial compounds?

[NCERT Exemplar]

- (A) They have high Melting point in comparison to pure metal
(B) they are very hard
(C) They retain metallic conductivity
(D) They are chemically very reactive

- Q 14. Which one of the following characteristics of the transition metals is associated with their catalytic activity?

[CBSE PMT 2003]

- (A) Colour of hydrated ions
(B) Variable oxidation state
(C) High enthalpy of atomization
(D) Paramagnetic character

- Q 15. Which one is solder? [IIT JEE 1993S]
 (A) Cu & Pb (B) Zn & Cu
 (C) Pb & Sn (D) Fe & Zn
- Q 16. How do you account for oxidising power in the series VO_2^+ , $Cr_2O_7^{2-}$, MnO_4^- ? [NCERT]

3. Potentials & Stability of Metal ions

- Q 1. **Assertion (A)** : The free gaseous Cr atom has six unpaired electrons.
Reason (R) : Half filled S orbitals has greater stability. [AIIMS 2012, 04]
 (A) Both A & R are true and R is the correct explanation of A
 (B) Both A & R are true but R is not correct explanation of A
 (C) A is true but R is false
 (D) Both A & R are false
- Q 2. For the four successive transition elements (Cr, Mn, Fe & Co) the stability of +2 oxidation state will be there in which of the following order? [CBSE PMT 2011]
 (A) Fe > Mn > Co > Cr (B) Co > Mn > Fe > Cr
 (C) Cr > Mn > Co > Fe (D) Mn > Fe > Cr > Co
- Q 3. Which of the following have positive value of $\epsilon_{M^{2+}/M}^{\circ}$?
 (A) V (B) Cr (C) Cu (D) Zn
- Q 4. Which of the following metal has higher $\epsilon_{M^{3+}/M^{2+}}^{\circ}$ value?
 (A) Fe (B) Mn (C) V (D) Sc
- Q 5. For the 1st row transition metals, the E° values are [NCERT]

E°	V	Cr	Mn	Fe	Co	Ni	Cu
M^{2+}/M	-	-	-	-	-	-	+
	1.18	0.91	1.18	0.44	0.28	0.25	0.34

Explain the irregularity in the above values.

- Q 6. Why is the E° value for the Mn^{3+}/Mn^{2+} couple much more positive than that for Cr^{3+}/Cr^{2+} or Fe^{3+}/Fe^{2+} ? Explain. [NCERT]
- Q 7. Four successive members of 1st row of transition elements are listed below with their atomic

numbers. Which of the following have expected to have highest value of $\epsilon_{M^{3+}/M^{2+}}^{\circ}$?

[JEE Main 2003]

- (A) Cr (Z = 24) (B) Mn (Z = 25)
 (C) Fe (Z = 26) (D) Co (Z = 27)
- Q 8. **Assertion (A)** : ϵ° for Mn^{3+}/Mn^{2+} is more positive than Cr^{3+}/Cr^{2+} .
Reason (R) : The third ionisation energy of Mn is larger than that of Cr [AIIMS 2006]
 (A) Both A & R are true and R is the correct explanation of A
 (B) Both A & R are true but R is not correct explanation of A
 (C) A is true but R is false
 (D) Both A & R are false
- Q 9. Among the following pairs of ions, the lower oxidation state in aqueous solution is more stable than the other in [AIIMS 2005]
 (A) Tl^+ , Tl^{3+} (B) Cu^+ , Cu^{2+}
 (C) Cr^{2+} , Cr^{3+} (D) V^{2+} , VO^{2+}
- Q 10. Which of the Halogen can form compounds with transition metal in maximum oxidation state?
 (A) F_2 (B) Cl_2 (C) Br_2 (D) I_2
- Q 11. The colour in a compound occur due to
 (A) d – d transition
 (B) charge transfer between ions
 (C) defect in solids
 (D) All of these
- Q 12. Transition metals have catalytic property due to
 (A) ability to form intermediate species
 (B) Large surface area of transition metals
 (C) Both A & B
 (D) None of these

4. Chemical Properties of d block Elements

- Q 1. Which of the following is not property of transition metal?
 (A) Alloy formation
 (B) Complex formation
 (C) Coloured compound formation
 (D) Peroxide compound formation
- Q 2. Which of the following compound does not exist?
 (A) CuI_2 (B) Cu_2I_2
 (C) $CuCl_2$ (D) $CuCl$

- Q 3. Which of the following reaction is correct?
 (A) $Cu^{2+} + I^- \longrightarrow CuI_2$
 (B) $Fe^{3+} + I^- \longrightarrow FeI_2 + I_2$
 (C) $Fe^{3+} + I^- \longrightarrow FeI_3$
 (D) $Cu^{2+} + NH_3(excess) \longrightarrow [Cu(NH_3)_6]^{2+}$
- Q 4. Which of the following statements are is false?
 (A) Cr^{2+} is stronger oxidising agent than Fe^{2+}
 (B) Highest Mn fluorides in MnF_4 whereas the highest Mn oxide is Mn_2O_7
 (C) Oxidation state of Fe is FeO_4^{2-} is +6
 (D) Mn_2O_7 contains two (Mn–O–Mn) bridge bonds
- Q 5. Which of the following pairs have tetrahedral geometry?
 (A) VO_4^{3-}, CrO_4^{2-} (B) MnO_4^-, MnO_4^{2-}
 (C) $MnO_4^{3-}, Cr_2O_7^{2-}$ (D) All of these
- Q 6. Complete the following
 (I) $FeCr_2O_4 + C \xrightarrow{\Delta}$
 (II) $CrO_3 + Mn \xrightarrow{\Delta}$
- | | |
|----------------------|--------------------|
| (I) | (II) |
| (A) Fe_2O_3, Cr, C | Cr_2O_3, Mn_3O_4 |
| (B) Fe, Cr, CO | Cr_2O_3, Mn_3O_4 |
| (C) Fe, Cr, CO | Cr_2O_3, MnO_2 |
| (D) Fe, Cr, CO_2 | Cr_2O_3, MnO_2 |
- Q 7. When Cu is heated with conc. HNO_3 , it produces
[NEET 2016, Phase II]
 (A) $Cu(NO_3)_2$ & NO (B) $Cu(NO_3)_2, NO$ & NO_2
 (C) $Cu(NO_3)_2$ & N_2O (D) $Cu(NO_3)_2$ & NO_2
- Q 8. Identify the statement which is not correct regarding $CuSO_4$
 (A) It reacts with KI to gives iodine.
 (B) It reacts with KCl to give Cu_2Cl_2 .
 (C) It reacts with NaOH & glucose to give Cu_2O .
 (D) It gives CuO on strong heating in air.
- Q 9. **Assertion (A)** : Cu^{2+} iodide is not known
Reason (R) : Cu^{2+} oxidizes I^- to iodine
[NCERT Exemplar]
 (A) Both A & R are true and R is the correct explanation of A
 (B) Both A & R are true but R is not correct explanation of A
 (C) A is true but R is false
 (D) Both A & R are false
- Q 10. Copper sulphate solution reacts with KCN to give
 (A) $Cu(CN)_2$ (B) $CuCN$
 (C) $K_2[Cu(CN)_4]$ (D) $K_2[Cu(CN)_4]$
- Q 11. $HgCl_2$ is soluble in KI solution due to
[AIIMS 1997]
 (A) the formation of complex ion
 (B) common iodide ion
 (C) Both A & B
 (D) None of the above
- Q 12. Which pair gives Cl_2 at room temperature?
[IIT JEE 1995S]
 (A) $HCl(Conc.) + KMnO_4$
 (B) $NaCl + H_2SO_4$
 (C) $NaCl + MnO_2$
 (D) $NaCl + HNO_3(Conc)$

5. $K_2Cr_2O_7$ & $KMnO_4$

- Q 1. $K_2Cr_2O_7$ is prepared from
 (A) $FeCr_2O_4$ (B) $FeCrO_4$
 (C) $Fe_2O_3 + Cr_2O_3$ mixt. (D) None of these
- Q 2. At pH = 4, $Cr_2O_7^{2-}$ exist as
 (A) CrO_4^{2-} (B) CrO_3
 (C) CrO_2^{2+} (D) $Cr_2O_7^{2-}$
- Q 3. At pH = 12, $Cr_2O_7^{2-}$ exist as
 (A) CrO_4^{2-} (B) CrO_3
 (C) CrO_2^{2+} (D) $Cr_2O_7^{2-}$
- Q 4. In the reaction
 $Cr_2O_7^{2-} \xrightarrow{pH=x} CrO_4^{2-} \xrightarrow{pH=y} Cr_2O_7^{2-}$
 pH values X & Y can be **[AIIMS 2017]**
 (A) 4 & 5 (B) 4 & 8
 (C) 8 & 4 (D) 8 & 9
- Q 5. In acidic medium H_2O_2 changes $K_2Cr_2O_7$ to CrO_5 . In CrO_5 , oxidation no. of Cr in CrO_5 is
 (A) +10 (B) +5
 (C) +6 (D) none of these
- Q 6. $CrO_3 + H_2O \longrightarrow A \xrightarrow{OH^-} B$. A and B are
 (A) $H_2CrO_4; H_2Cr_2O_7$ (B) $H_2Cr_2O_7; Cr_2O_3$
 (C) $CrO_4^{2-}; Cr_2(OH)_3$ (D) $H_2Cr_2O_7; H_2CrO_4$
- Q 7. In the dichromate dianion **[IIT JEE 1999]**
 (A) 4 Cr–O bonds are equivalent
 (B) 6 Cr–O bonds are equivalent

- (C) all Cr–O bonds are equivalent
(D) all Cr–O bonds are non- equivalent
- Q 8. **Assertion (A)** : A solution of Na_2CrO_4 in water is intensely coloured.
Reason (R) : Oxidation state of Na_2CrO_4 is +6
[AIIMS 2003]
(A) Both A & R are true and R is the correct explanation of A
(B) Both A & R are true but R is not correct explanation of A
(C) A is true but R is false
(D) Both A & R are false
- Q 9. A mixture of NaCl , NaBr and $\text{K}_2\text{Cr}_2\text{O}_7$ on heating with conc. H_2SO_4 produces redish-brown vapours consisting of
(A) $\text{CrO}_2\text{Cl}_2 + \text{Br}_2$ (B) $\text{CrO}_2\text{Cl}_2 + \text{CrO}_2\text{Br}_2$
(C) $\text{CrO}_3 + \text{CrO}_2\text{Br}_2$ (D) $\text{Br}_2 + \text{Cl}_2\text{O}$
- Q 10. An aqueous solution of FeSO_4 , $\text{Al}_2(\text{SO}_4)_3$ and Chrome alum is heated with excess of Na_2O_2 and filtered. The materials obtained are
[IIT JEE 1996S]
(A) A colourless filtrate & a green residue
(B) A yellow filtrate & a green residue
(C) A yellow filtrate & a brown residue
(D) A green filtrate & a brown residue
- Q 11. Ammonium dichromate is used in some fireworks. The green coloured powder blown in the air is
[IIT JEE 1997S]
(A) CrO_3 (B) Cr_2O_3
(C) Cr (D) $\text{CrO}(\text{O}_2)$
- Q 12. KMnO_4 is the oxo salt of
(A) MnO_2 (B) Mn_2O_7
(C) MnO (D) Mn_2O_3
- Q 13. Traces of KMnO_4 in conc. H_2SO_4 may change to
(A) Mn_2O_7 (B) MnO_3^+
(C) MnO_2 (D) MnO_4^{2-}
- Q 14. KMnO_4 is added to KOH , which of the following colour is observed?
[AIIMS 2018]
(A) Pale Pink (B) Brown
(C) Black (D) Green
- Q 15. On addition of KMnO_4 to conc. H_2SO_4 , a green oily compound is obtained, which is highly explosive in nature. Identify the compound from the following.
[NCERT Exemplar]
(A) Mn_2O_7 (B) MnO_2
(C) MnSO_4 (D) Mn_2O_3
- 6. Reaction of KMnO_4**
- Q 1. K_2MnO_4 is unstable in solution and the green solution obtained into purple colouration. Correct statements regarding the above changes are
(A) It is a disproportionation reaction
(B) It produces KMnO_4
(C) Overall solution becomes alkaline
(C) it produces black ppt. of hydrated MnO_2
- Q 2. MnO_4^{2-} (1 mole) in neutral aqueous medium Undergo disproportionation to [AIIMS 2003]
(A) $2/3$ mole of MnO_4^- and $1/3$ mole of MnO_2
(B) $1/3$ mole of MnO_4^- and $2/3$ mole of MnO_2
(C) $1/3$ mole of Mn_2O_7 and $2/3$ mole of MnO_2
(D) $2/3$ mole of Mn_2O_7 and $1/3$ mole of MnO_2
- Q 3. When MnO_2 is heated with KOH , a coloured compound is formed, the product & its colour is
[IIT JEE 2003S]
(A) K_2MnO_4 , Purple Green (B) KMnO_4 , Purple
(C) Mn_2O_3 , Brown (D) Mn_3O_4 , Black
- Q 4. Which of the following statement is/are correct?
(A) MnO_2 (pyrolustite) is fused with KOH and KNO_3 to give a green solid
(B) The green solid is dissolved in water and Cl_2 is passed in it, to form purple colour compound
(C) The green solid is dissolved in water and O_3 is passed in it, to form purple colour compound
(D) MnCl_2 is heated with $(\text{NH}_4)_2\text{S}_2\text{O}_8$ in acid Medium
- Q 5. Why HCl is not used to make the medium acidic in oxidation reaction of KMnO_4 in acidic medium?
[NCERT Exemplar]
(A) Both HCl & KMnO_4 acts as oxidising agent
(B) KMnO_4 oxidises HCl into Cl_2 which is also an oxidising agent
(C) KMnO_4 is a weaker oxidising agent than HCl
(D) KMnO_4 acts as reducing agent in the presence of HCl
- Q 6. F_2 can be formed by the reaction of K_2MnF_6 with
[AIIMS 2005]
(A) SbF_5 (B) MnF_3
(C) KSbF_6 (D) MnF_4
- Q 7. Highest oxidation state of Mn in fluoride is +4 whereas highest oxidation state of Mn in its oxide is +7 because [NCERT Exemplar]
(A) fluorine is more electronegative than oxygen
(B) fluorine does not possess d orbitals

- (C) Fluorine stabilises lower oxidation state
(D) in covalent compounds, fluorine can form single bond only while oxygen can form double bond
- Q 8. When the chromite ore is heated with Na_2CO_3 powder in the presence of air
(A) one gaseous product is formed
(B) one product is water insoluble which is dark brown in colour
(C) one product is water soluble which is red in colour
(D) One product is water soluble is yellow in colour
- Q 9. Choose incorrect options from the following statements
(A) O_2 is evolved during the hydrolysis of XeF_2 , XeF_4 & XeF_6
(B) $\text{K}_2\text{Cr}_2\text{O}_7$ is not a deliquescent substance
(C) O_2 is evolved on heating of KMnO_4
(D) $\text{K}_2\text{Cr}_2\text{O}_7$ reacts with cold conc. H_2SO_4 to produce a blue colour compound
- Q 10. The E^0 values for the couple $\text{Cr}^{3+}/\text{Cr}^{2+}$ is -0.41 V and for $\text{Mn}^{3+}/\text{Mn}^{2+}$ is $+1.51$ V. Those values suggest that
(A) Cr^{2+} is the reductant while Mn^{3+} oxidant
(B) Cr^{3+} is less stable than Mn^{2+}
(C) Mn^{3+} is less stable than Mn^{2+}
(D) Cr^{2+} acts as oxidizer and Mn^{3+} as reducer
- Q 11. The action of heat on KMnO_4 produces
(A) K_2MnO_4 (B) MnO_2
(C) K_2MnO_3 (D) Mn
- Q 12. MnO_4^- is of intense pink colour, though Mn is in +7 oxidation state. It is due to [AIIMS 2010]
(A) oxygen gives colour to it
(B) Charge transfer when Mn gives its electron to oxygen
(C) Charge transfer when oxygen gives its electron to Mn making it Mn(+VI)
(D) Presence of unpaired electrons
- Q 13. The colour of KMnO_4 is due to [JEE Main 2016]
(A) $L \rightarrow M$ charge transfer transition
(B) $\sigma \rightarrow \sigma^*$ transition
(C) $M \rightarrow L$ charge transfer transition
(D) d – d transition
- Q 14. The colourless species is [AIIMS 2003]
(A) VCl_3 (B) VO_4
(C) Na_3VO_4 (D) $[\text{V}(\text{H}_2\text{O})_6]\text{SO}_4 \cdot \text{H}_2\text{O}$
- Q 15. Assertion (A) : $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ is coloured while $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$ is colourless
Reason (R) : d–d transition is not possible in $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$ because there is no d orbital electron present in Sc^{3+} while for Ti^{3+} having d^1 configuration [AIIMS 2016]
(A) Both A & R are true and R is the correct explanation of A
(B) Both A & R are true but R is not correct explanation of A
(C) A is true but R is false
(D) Both A & R are false
- Q 16. Assertion (A) : The purple colour of KMnO_4 is due to the charge transfer transition.
Reason (R) : The intense colour in most of the transition metal complex is due to d – d transition [AIIMS 2014]
(A) Both A & R are true and R is the correct explanation of A
(B) Both A & R are true but R is not correct explanation of A
(C) A is true but R is false
(D) Both A & R are false
- Q 17. Assertion (A) : Change in colour of acidic solution of Potassium dichromate solution by breath is used to test drunk drivers,
Reason (R) : Change in colour is due to the complexation of alcohol with Potassium dichromate. [AIIMS 2006]
(A) Both A & R are true and R is the correct explanation of A
(B) Both A & R are true but R is not correct explanation of A
(C) A is true but R is false
(D) Both A & R are false
- Q 18. Predict which of the following will be coloured in aqueous solution? Ti^{3+} , V^{2+} , Cu^+ , Sc^{3+} , Mn^{2+} , Fe^{3+} & Co^{2+} . Give reason for each. [NCERT]

7. Lanthanoids

- Q 1. Lanthanoid are [CBSE PMT 2004]
 (A) 14 elements in the sixth period (At. No. 90 to 103) that are filling 4f sub level
 (B) 14 elements in the seventh period (At. No. 90 to 103) that are filling 5f sub level
 (C) 14 elements in the sixth period (At. No. 58 to 71) that are filling 4f sub level
 (D) 14 elements in the seventh period (At. No. 90 to 103) that are filling 4f sub level
- Q 2. Lanthanoid from series is
 (A) La to Lu (B) Th to Lr
 (C) Ce to Lu (D) Ac to Lr
- Q 3. General electronic configuration of lanthanide is
 (A) $(n-2)f^{1-14} (n-1)s^2p^6d^{0-1} ns^2$
 (B) $(n-2)f^{0-14} (n-1)s^2p^6d^{0-1} ns^2$
 (C) $(n-2)f^{0-14} (n-1)s^2p^6d^{10} ns^2$
 (D) None of these
- Q 4. The electronic configuration of Eu (Atomic no. 63), Gd (Atomic No. 64) & Tb (Atomic no. 65) [NEET 2016, phase II]
 (A) $[Xe]4f^65d^16s^2$, $[Xe]4f^75d^16s^2$ & $[Xe]4f^96s^2$
 (B) $[Xe]4f^65d^16s^2$, $[Xe]4f^75d^16s^2$ & $[Xe]4f^85d^16s^2$
 (C) $[Xe]4f^76s^2$, $[Xe]4f^75d^16s^2$ & $[Xe]4f^96s^2$
 (D) $[Xe]4f^76s^2$, $[Xe]4f^86s^2$ & $[Xe]4f^85d^16s^2$
- Q 5. In which of the following lanthanides, electronic configuration has d^1 configuration?
 (A) ${}_{58}\text{Ce}$ (B) ${}_{64}\text{Gd}$
 (C) ${}_{71}\text{Lu}$ (D) All of these
- Q 6. In context of the lanthanoids, which of the following statement is not correct? [AIEEE 2011]
 (A) There is a gradual decrease in the radii of the members with increasing atomic number in series
 (B) All the members exhibit +3 oxidation state
 (C) Because of similar properties the separation of lanthanoids is not easy
 (D) Availability of 4f electrons result in the formation of compound in +4 oxidation state for all the members of the series
- Q 7. Choose the Incorrect statement among the following [AIIMS 2016]
 (A) The Chemistry of different lanthanoids is very similar
 (B) 4f & 5f orbitals are equally shielded
 (C) d block elements shows irregular and erratic chemical properties among themselves
 (D) La & Lu have partially filled d orbitals and no other partially filled orbitals
- Q 8. Lanthanide, for which only +2 & +3 oxidation states are common is [AIIMS 2003]
 (A) La (B) Nd
 (C) Ce (D) Eu
- Q 9. Most common oxidation state of Ce (Cerium) are [AIEEE 2002]
 (A) +2, +3 (B) +2, +4
 (C) +3, +4 (D) +3, +5
- Q 10. Gadolinium belongs to 4f series. Its atomic number is 64. Which of the following is the correct electronic configuration of Gadolinium? [CBSE PMT 2015]
 (A) $[Xe]4f^86s^2$ (B) $[Xe]4f^96s^1$
 (C) $[Xe]4f^75d^16s^2$ (D) $[Xe]4f^65d^26s^2$
- Q 11. Tb^{4+} (atomic no. 65) is stable because it has
 (A) noble gas configuration
 (B) half filled electronic configuration of f orbital
 (C) half filled electronic configuration of d orbital
 (D) full filled electronic configuration of f orbital
- Q 12. Cerium ($Z = 58$) is an important member of the lanthanoids. Which of the following statements about Cerium is incorrect? [AIEEE 2004]
 (A) The +4 oxidation state of cerium is not known in solution
 (B) The +3 oxidation state of Cerium is more stable than the +4 oxidation state
 (C) the common oxidation state of cerium is +3 and +4
 (D) Cerium (IV) acts as an oxidising agent
- Q 13. On moving from Ce^{3+} to Lu^{3+} , the cation having maximum number of unpaired electrons is
 (A) Ce^{3+} (B) Lu^{3+}
 (C) Eu^{3+} (D) Gd^{3+}
- Q 14. Which of the following lanthanoid ion is diamagnetic? [NEET 2013]
 (A) Ce^{2+} (B) Sm^{2+}
 (C) Eu^{2+} (D) Yb^{2+}
- Q 15. Which of the following is not paramagnetic?
 (A) Yb^{2+} (At. No. 70) (B) Ce^{4+} (At. No. 71)
 (C) Lu^{3+} (At. No. 71) (D) All of these
- Q 16. The correct order of ionic radii of Y^{3+} (39), La^{3+} (57), Eu^{3+} (63) & Lu^{3+} (71) is [CBSE PMT 2003]
 (A) $\text{Y}^{3+} > \text{La}^{3+} > \text{Eu}^{3+} > \text{Lu}^{3+}$
 (B) $\text{Y}^{3+} > \text{Lu}^{3+} > \text{Eu}^{3+} > \text{La}^{3+}$

- (C) $Y^{3+} < La^{3+} < Eu^{3+} < Lu^{3+}$
 (D) $Y^{3+} < Lu^{3+} < Eu^{3+} < La^{3+}$
- Q 17. Arrange Ce^{3+} , La^{3+} , Pm^{3+} & Yb^{3+} in increasing order of their ionic radii [AIEEE 2002]
 (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) $Pm^{3+} < La^{3+} < Ce^{3+} < Yb^{3+}$
- Q 18. Choose the correct order of ionic radius from the given options (where atomic numbers of Ce, Pr, Eu & Dy are 58, 59, 63 & 66 respectively)
 (A) $Ce^{3+} > Pr^{3+} > Dy^{3+} > Eu^{3+}$
 (B) $Pr^{3+} > Dy^{3+} > Eu^{3+} > Ce^{3+}$
 (C) $Dy^{3+} > Eu^{3+} > Ce^{3+} > Pr^{3+}$
 (D) $Ce^{3+} > Pr^{3+} > Eu^{3+} > Dy^{3+}$
- Q 19. A reduction in size of atomic size with increase in atomic number is a characteristic of elements of [AIEEE 2003]
 (A) d block (B) f block
 (C) Radioactive series (D) High atomic masses
- Q 20. The radius of La^{3+} (Atomic No. 57) is 1.06 \AA . Which one of the following given values will be the closest to the radius of Lu^{3+} (Atomic No 71) [AIEEE 2003]
 (A) 1.40 \AA (B) 1.06 \AA
 (C) 0.85 \AA (D) 1.60 \AA
- 8. Compounds of Lanthanoids**
- Q 1. Which of the following statements related to lanthanons is incorrect? [NEET 2016, phase I]
 (A) Europium shows + 2 oxidation state
 (B) The Basicity decreases as the ionic radius decreases from Pr to Lu
 (C) All the lanthanons are much more reactive than Aluminium
 (D) $Ce(+4)$ solution are widely used as oxidising agent in volumetric analysis
- Q 2. Identify the correct statement among the following. [AIEEE 2007]
 (A) 4f & 5f orbitals are equally shielded
 (B) d block elements show irregular and erratic chemical properties among themselves
 (C) La & Lu have partially filled d orbitals and no other partially filled orbitals
 (D) The chemistry of various lanthanoids is very similar
- Q 3. Which of the following cations has the strongest tendency towards complex formation?
 (A) Sm^{3+} (B) Lu^{3+}
 (C) Gd^{3+} (D) Yb^{3+}
- Q 4. Which of the following ions will exhibit colour in aqueous solution? [CBSE PMT 2010]
 (A) La^{3+} (Z = 57) (B) Ti^{3+} (Z = 22)
 (C) Lu^{3+} (Z = 71) (D) Sc^{3+} (Z = 21)
- Q 5. Colour of La^{2+} is due to
 (A) d – d transition (B) f – f transition
 (C) charge transfer (D) None of these
- Q 6. The colour of Nd^{3+} (At. No. 60) will be similar to
 (A) Ho^{3+} (At. No. 67) (B) Gd^{3+} (At. No. 64)
 (C) Er^{3+} (At. No. 68) (D) Yb^{2+} (At. No. 70)
- Q 7. Ce reacts with O_2 to form
 (A) Ce_2O_3 (B) CeO
 (C) CeO_2 (D) CeO_3
- Q 8. Which of the following statements is not correct? [CBSE PMT 2001]
 (A) $La(OH)_3$ is less basic than $Li(OH)_3$
 (B) In lanthanide series, ionic radius of Ln^{3+} ion decreases
 (C) La is actually an element of transition series rather than of lanthanides
 (D) Atomic radius of Zr & Hf are the same because of lanthanide contraction
- Q 9. Ln Metal reacts with H_2O to produce generally
 (A) $Ln(OH)_3$ (B) $Ln(OH)_2$
 (C) $Ln(OH)_4$ (D) None of these
- Q 10. Knowing the chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state, which of the following statement is incorrect? [AIEEE 2009]
 (A) The ionic size of Ln(III) decreases in general with increase in atomic number
 (B) Ln(III) compounds are generally colourless
 (C) Ln(III) hydroxide are mainly basic in nature
 (D) Because of large size of Ln(III) ions the bonding in its compounds is predominantly ionic in character
- Q 11. Which of the following elements has maximum composition in Misch Metal, which is used in gas lighters?

- (A) La (B) Fe
(C) Ce (D) Other Metals
- Q 12. Which are constituents of Mischmetal?
[AIIMS 2010]
(A) La, Fe (B) La, Ce
(C) Fe, Ce (D) Ce, Cu
- Q 13. Which of the following compound of lanthanides are soluble in water
(A) Fluoride (B) Chloride
(C) Bromide (D) Iodide
- Q 14. Which lanthanide has maximum melting point?
(A) ${}_{70}\text{Yb}$ (B) ${}_{62}\text{Sm}$
(C) ${}_{71}\text{Lu}$ (D) ${}_{68}\text{Er}$
- Q 15. Among the lanthanides, the one obtained by synthetic method is [CBSE PMT 1994]
(A) Lu (B) Pm (C) Pr (D) Gd

9. Actinoids

- Q 1. Actinides [CBSE PMT 1994]
(A) are all synthetic elements
(B) Include element 104
(C) have any short lived isotopes
(D) have variable valency
- Q 2. Which of the following exhibit minimum number of oxidation state? [AIIMS 2018]
(A) Mn (B) Np
(C) Th (D) Cr
- Q 3. Which of the following is not an actinoid? [AIIMS 2014]
(A) Curium (Z = 96) (B) Californium (Z = 98)
(C) Uranium (Z = 92) (D) Terbium (Z = 65)
- Q 4. There are 14 elements in actinoid series. Which of the following elements does not belong to this series? [NCERT Exemplar]
(A) U (B) Np (C) Tm (D) Fm
- Q 5. Among the following, which actinide is not radioactive?
(A) Ac (B) Th
(C) Lr (D) None of these
- Q 6. The reason for greater range of oxidation states in actinoids is attributed to [AIEEE 2008, NEET 2017]

- (A) the radioactive nature of actinoids
(B) Actinoid contraction
(C) 5f, 6d & 7s level have comparable energy
(D) 4f & 5d levels being close in energy
- Q 7. In actinides, exceptions in electronic configuration is higher due to
(A) Small size of actinides
(B) Small energy difference between 5f, 6d & 7f orbitals
(C) Radioactive nature of actinides
(D) Low stability of element
- Q 8. The electronic configuration of actinides can not be assigned with degree of certainty because of [AIIMS 2010]
(A) small energy difference between 5f & 6d orbitals
(B) overlapping of inner orbitals
(C) free movement of electrons all the orbitals
(D) all of the above
- Q 9. Which of the following is not a f block elements?
(A) No (B) Nd
(C) Nb (D) Np
- Q 10. The magnetic moment of Am^{5+} (At. No. 95) is
(A) $\sqrt{24}$ B.M. (B) $\sqrt{35}$ B.M.
(C) $\sqrt{15}$ B.M. (D) $\sqrt{3}$ B.M.
- Q 11. Actinoid contraction is more compared to lanthanoid contraction because
(A) 5f orbitals are more diffused as compared to 4f orbitals from nucleus
(B) 4f orbitals are more diffused as compared to 5f orbitals from nucleus
(C) shielding effect of electrons present in 4f and 5f orbitals is equal
(D) the azimuthal quantum numbers of 4f and 5f orbitals are the same
- Q 12. Which element has lower Ionisation energy?
(A) Lanthanides (B) Actinides
(C) Noble Gas (D) Halogen
- Q 13. Which of the following ion is colourless?
(A) Lr^{3+} (B) Th^{3+}
(C) U^{2+} (D) Np^{3+}
- Q 14. Actinides does not react with
(A) HCl (B) HBr
(C) HNO_3 (D) HI
- Q 15. Actinide is used in

- (A) in treatment of cancer
(B) As fuel in Nuclear Reactor
(C) Used in Glass, Silk & ceramic Industry
(D) All of these
- Q 16. Which of the following element is used in treatment of cancer?
(A) Uranium (B) Thorium
(C) Cerium (D) Plutonium
- Q 17. Which of the following characteristics is not the point of resemblance between lanthanoids & actinoids?
(A) Reducing Property
(B) +3 oxidation state
(C) Trends of ionic radii from M^{3+} ions
(D) Tendency towards complex formation
- Q 18. Which of the following properties is/are varying between lanthanoids and actinoids?
(A) Highest oxidation state
(B) Radioactive Nature
(C) Basicity of hydroxide
(D) All of these
- Q 19. **Assertion (A)** : Actinoids form relatively less stable complexes as compared to Lanthanoids.
Reason (R) : Actinoids can utilize their 5f orbitals along with 6d orbitals in bonding whereas lanthanoids do not use their 4f orbitals for bonding. [NCERT Exemplar]
(A) Both A & R are true and R is the correct explanation of A
(B) Both A & R are true but R is not correct explanation of A
(C) A is true but R is false
(D) Both A & R are false
- Q 20. Which of the following statement is true for f block elements?
(A) They can have electrons from f^0 to f^{14}
(B) Group number is 3 in the periodic table
(C) with the increase in number of f electrons, the radius decreases due to poor shielding effect of f electrons
(D) All of these
- Q 21. Compare the chemistry of lanthanoids & actinoids with reference to [NCERT]
(i) Electronic Configuration
(ii) Oxidation State
(iii) Atomic & Ionic Size
(iv) Chemical reactivity
- Q 22. The chemistry of actinoids is not so smooth as that of lanthanoids. Justify this statement by giving some examples from the oxidation state of these elements. [NCERT]

Answer Key

1. Elemental Properties of d block Elements

- (1). B (2). C (3). B
 (4). C (5). D (6). B
 (7). C (8). B (9). A
 (10). D (11). A (12). A
 (13). C (14). D

2. Elemental Properties of d block Elements

- (1). D (2). C (3). B
 (4). C (5). D (6). A
 (7). A (8). B (9). C
 (10). C (11). D (12). B
 (13). D (14). B (15). C
 (16). Due to increasing stability of lower oxidation state in which they are reduced.

3. Potentials & Stability of Metal ions

- (1). C (2). D (3). C
 (4). B
 (5). Due to irregular variation in sum of 1st & 2nd ionization energy and also in sublimation energy, which are relatively much less than for Mn & V
 (6). Much larger I.E. of Mn (d^5 to d^4) is mainly responsible for this.
 (7). D (8). B (9). A
 (10). A (11). D (12). C

4. Chemical Properties of d block Elements

- (1). D (2). A (3). B
 (4). D (5). D (6). B
 (7). D (8). B (9). A
 (10). D (11). A (12). A

5. $K_2Cr_2O_7$ & $KMnO_4$

- (1). A (2). D (3). C
 (4). C (5). D (6). A
 (7). B (8). B (9). A
 (10). C (11). B (12). B
 (13). B (14). D (15). A

6. Reaction of $KMnO_4$

- (1). A, B, C, D (2). A
 (3). A (4). A, B, C, D
 (5). B (6). A (7). D

- (8). A, B, D (9). A, D
 (10). A, C (11). A, B, C
 (12). C (13). A (14). C
 (15). A (16). B (17). C
 (18). Coloured ions will have unpaired electrons
 So Ti^{3+} , V^{2+} , Mn^{2+} , Fe^{3+} & Co^{2+} are coloured

7. Lanthanoids

- (1). C (2). C (3). D
 (4). C (5). A (6). D
 (7). B (8). D (9). C
 (10). C (11). B (12). A
 (13). D (14). D (15). D
 (16). D (17). A (18). D
 (19). B (20). C

8. Compounds of Lanthanoids

- (1). C (2). A (3). B
 (4). B (5). A (6). C
 (7). C (8). A (9). A
 (10). B (11). C (12). B
 (13). A (14). B (15). B

9. Actinoids

- (1). D (2). C (3). D
 (4). C (5). D (6). C
 (7). B (8). A (9). C
 (10). A (11). A (12). B
 (11). A (14). C (15). D
 (14). B (17). D (18). D
 (17). C (20). D

- (21). (i) More exception in Electronic Configuration of actinoids due to lower energy difference between 7S, 6d & 5f orbitals
 (ii) Oxidation State of actinoids are also variable
 (iii) Size of lanthanoids are known better because they are stable, actinoids are less stable & hence their properties are less known
 (iv) Chemical reactivity of actinoids are less known as they are radioactive
 (22). The chemistry of actinoids is not so smooth as that of lanthanoids because of variable oxidation state shown by actinoids due to lower energy difference between 7S, 6d & 5f orbitals.