



## d-Block Elements

### JEE (Main) Exercises

#### Single Correct Answer Type

- A transition element containing only one electron in 4s-orbital is:  
(a)  ${}_{21}\text{Sc}$  (b)  ${}_{23}\text{Mn}$   
(c)  ${}_{26}\text{Fe}$  (d)  ${}_{29}\text{Cu}$
- The magnetic moment of a transition metal of 3d-series is  $6.92 \mu_B$ . Its electronic configuration will be:  
(a)  $(3d)^4(4s)^2$  (b)  $(3d)^5(4s)^1$   
(c)  $(3d)^{10}$  (d)  $(3d)^5(4s)^0$
- Which of the following electronic configuration will be associated with the lowest magnetic moment?  
(a)  $d^2$  (b)  $d^3$   
(c)  $d^4$  (d)  $d^9$
- Find the species/elemental atom has minimum number of unpaired electrons:  
(a)  $\text{Kr}^+$  (b)  $\text{Mn}^{2+}$   
(c)  $\text{Fe}^{3+}$  (d)  $\text{O}^+$
- In which of the following pairs do the two species resemble each other most closely in chemical properties?  
(a)  ${}^1_1\text{H}$  and  ${}^2_1\text{H}$  (b)  ${}^{16}_8\text{O}$  and  ${}^{16}_8\text{O}^{2-}$   
(c)  ${}^{24}_{12}\text{Mg}$  and  ${}^{24}_{12}\text{Mg}^{2+}$  (d)  ${}^{14}_7\text{N}$  and  ${}^{14}_7\text{N}^{3-}$
- Which forms interstitial compounds?  
(a) Fe (b) Co  
(c) Ni (d) All
- The highest magnetic moment is shown by the transition metal with the configuration:  
(a)  $3d^2$  (b)  $3d^6$   
(c)  $3d^7$  (d)  $3d^9$
- Arrange the following ions in order of their magnetic moment:  
(i)  $\text{V}^{4+}$  (ii)  $\text{Mn}^{4+}$   
(iii)  $\text{Fe}^{3+}$  (iv)  $\text{Ni}^{2+}$   
(Atomic number of V = 23, Mn = 25, Fe = 26, Ni = 28)  
(a) (ii) > (iii) > (i) > (iv) (b) (iii) > (ii) > (iv) > (i)  
(c) (i) > (iv) > (iii) > (ii) (d) (iv) > (iii) > (i) > (ii)
- Which of the ions will give colorless aqueous solution?  
(a)  $\text{Ni}^{2+}$  (b)  $\text{Fe}^{2+}$   
(c)  $\text{Cu}^{2+}$  (d)  $\text{Cu}^+$
- Which of the following form an alloy?  
(a) Zn + Pb (b) Fe + Hg  
(c) Pt + Hg (d) Fe + C
- In which of the following pairs are both the ion colored in aqueous solution?  
(a)  $\text{Sc}^{3+}$ ,  $\text{Co}^{2+}$  (b)  $\text{Ni}^{2+}$ ,  $\text{Cu}^+$   
(c)  $\text{Ni}^{2+}$ ,  $\text{Ti}^{3+}$  (d)  $\text{Sc}^{3+}$ ,  $\text{Ti}^{3+}$
- The electronic configuration of four elements are:  
(i)  $[\text{Xe}] 6s^1$  (ii)  $[\text{Xe}] 4f^{14}, 5d^1 6s^2$   
(iii)  $[\text{Ar}] 4s^2 4p^3$  (iv)  $[\text{Ar}] 3d^7, 4s^2$   
Which one of the following statements about these elements is not correct?  
(a) (i) is a strong reducing agent

- (b) (ii) is a  $d$ -block element  
 (c) (iii) has high electron affinity  
 (d) (iv) shows variable oxidation states
13. Among the following transition elements, pick out the element/elements with highest second ionization energy:  
 (i) V (At. no. = 23) (ii) Cr (At. no. = 24)  
 (iii) Mn (At. no. = 25) (iv) Cu (At. no. = 29)  
 (v) Zn (At. no. = 30)  
 (a) (i) and (iii) (b) (ii) and (v)  
 (c) Only (iii) (d) Only (iv)
14. Lanthanoids contraction is caused due to:  
 (a) The same effective nuclear charge from Ce to Lu  
 (b) The imperfect shielding on outer electrons by  $4f$  electrons from the nuclear charge  
 (c) The appreciable shielding on outer electrons by  $4f$ -electrons from the nuclear charge  
 (d) The appreciable shielding on outer electrons by  $5d$ -electrons from the nuclear charge
15. Which of the following has the maximum number of unpaired electrons?  
 (a)  $Mg^{2+}$  (b)  $Ti^{3+}$   
 (c)  $V^{3+}$  (d)  $Fe^{2+}$
16. Which of the following halides is least stable and has doubtful existence?  
 (a)  $Cl_4$  (b)  $GeI_4$   
 (c)  $SnI_4$  (d)  $PbI_4$
17. 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
18.  $K_2[HgI_4]$  detects the ion/group:  
 (a)  $NH_2^-$  (b) NO  
 (c)  $NH_4^+$  (d)  $AlCl_3$
19. Which of the following belongs to the actinoids series of elements?  
 (a) Y (b) Ta  
 (c) U (d) Y
20. Which oxides will not give metal on heating?  
 (a) HgO (b) ZnO  
 (c)  $Ag_2O$  (d) All of these
21. Most common oxidation state of lanthanoids is:  
 (a) +2 (b) +3  
 (c) +4 (d) +5
22. The purest form of Fe is:  
 (a) Stainless steel (b) Steel  
 (c) Cast iron (d) Wrought iron
23. For Ni and Pt different I.P. in  $\text{kJ mol}^{-1}$  are given below:
- |    | $(IP)_1 + (IP)_2$ | $(IP)_3 + (IP)_4$ |
|----|-------------------|-------------------|
| Ni | 2.49              | 8.80              |
| Pt | 2.60              | 6.70              |
- Hence:  
 (a) Nickel(II) compounds tend to be thermodynamically more stable than platinum(II)  
 (b) Platinum(IV) compounds tend to be more stable than nickel(IV)  
 (c) Both are correct  
 (d) None is correct
24. An acidic solution contains  $Cu^{2+}$ ,  $Pb^{2+}$ , and  $Zn^{2+}$ . If hydrogen sulphide gas is passed through this solution, the precipitate will contain:  
 (a)  $CuS$  and  $ZnS$  (b)  $PbS$  and  $ZnS$   
 (c)  $CuS$  and  $PbS$  (d)  $CuS$ ,  $PbS$ , and  $ZnS$
25.  $Ti^{2+}$  is purple while  $Ti^{4+}$  is colorless, because:  
 (a) There is no crystal field effect in  $Ti^{4+}$   
 (b)  $Ti^{4+}$  has  $3d^2$  configuration  
 (c)  $Ti^{4+}$  has  $3d^0$  configuration  
 (d)  $Ti^{4+}$  is a very small cation when compared to  $Ti^{2+}$ , and hence does not absorb any radiation
26. In dilute alkaline solution  $MnO_4^-$  changes to:  
 (a)  $MnO_4^{2-}$  (b)  $MnO_2$   
 (c)  $Mn_2O_3$  (d)  $MnO$
27. Pyrolusite in  $MnO_2$  is used to prepare  $KMnO_4$ . Steps are:  

$$MnO_2 \xrightarrow{I} MnO_4^{2-} \xrightarrow{II} MnO_4^-$$
  
 I and II are:  
 (a) Fused with  $KOH$ /air, electrolytic oxidation  
 (b) Fused with  $KOH$ /air, electrolytic reduction  
 (c) Fused with conc.  $HNO_3$ /air, electrolytic reduction  
 (d) All are correct
28. Maximum magnetic moment is shown by:  
 (a)  $d^6$  (b)  $d^6$   
 (c)  $d^7$  (d)  $d^8$
29. Magnetic moments of Cr ( $Z = 24$ ),  $Mn^+$  ( $Z = 25$ ), and  $Fe^{2+}$  ( $Z = 26$ ), are  $x$ ,  $y$ ,  $z$ . They are in order:  
 (a)  $x < y < z$  (b)  $x = y < z$   
 (c)  $z < x = y$  (d)  $x = y = z$



30. Maximum oxidation state is shown by:  
 (a) Os (b) Mn  
 (c) Cr (d) Co
31. Following elements do not show the properties characteristic of *d*-block elements:  
 (a) Cu, Ag, Au (b) Zn, Hg, Cd  
 (c) Sc, Ti, V (d) Fe, Co, Ni
32. AgCl and NaCl are colorless. NaBr and NaI are also colorless but AgBr and AgI are colored. This is due to:  
 (a)  $\text{Ag}^+$  polarizes  $\text{Br}^-$  and  $\text{I}^-$   
 (b)  $\text{Ag}^+$  has unpaired *d*-orbital  
 (c)  $\text{Ag}^+$  depolarizes  $\text{Br}^-$  and  $\text{I}^-$   
 (d) None is correct
33. In 3*d* transition series, if nuclear charge increases, the screening effect:  
 (a) Increases (b) Decreases  
 (c) First decreases and then increases  
 (d) First increases and then decreases
34. Least paramagnetic property is shown by:  
 (a) Fe (b) Mn  
 (c) Ni (d) Cu
35. Which shows maximum magnetic moment among the bivalent ions of the first transition series?  
 (a)  $\text{Fe}^{2+}$  (b)  $\text{Co}^{2+}$   
 (c)  $\text{Ni}^{2+}$  (d)  $\text{Mn}^{2+}$
36. Which of the following compounds is amphoteric?  
 (a)  $\text{Cr}(\text{OH})_2$  (b)  $\text{Fe}(\text{OH})_2$   
 (c)  $\text{Cr}(\text{OH})_3$  (d)  $\text{Fe}(\text{OH})_3$
37.  $(\text{NH}_4)_2 \text{Cr}_2\text{O}_7$  on heating gives a gas which is also given by:  
 (a) Heating  $\text{NH}_4\text{NO}_2$  (b) Heating  $\text{NH}_4\text{NO}_3$   
 (c)  $\text{Mg}_3\text{N}_2 + \text{H}_2\text{O}$  (d)  $\text{Na} + \text{H}_2\text{O}_2$
38. The pair of compounds having metals in their highest oxidation state is:  
 (a)  $\text{MnO}_2$ ,  $\text{FeCl}_3$  (b)  $[\text{MnO}_4]^-$ ,  $\text{CrO}_2\text{Cl}_2$   
 (c)  $[\text{Fe}(\text{CN})_6]^{3-}$ ,  $[\text{Co}(\text{CN})_3]$   
 (d)  $[\text{NiCl}_4]^{2-}$ ,  $[\text{CoCl}_4]^-$
39. The compound having tetrahedral geometry is:  
 (a)  $[\text{Ni}(\text{CN})_4]^{2-}$  (b)  $[\text{Pd}(\text{CN})_4]^{2-}$   
 (c)  $[\text{PdCl}_4]^{2-}$  (d)  $[\text{NiCl}_4]^{2-}$
40.  $\text{CrO}_3$  dissolves in aqueous NaOH to give:  
 (a)  $\text{CrO}_4^{2-}$  (b)  $\text{Cr}(\text{OH})_3$   
 (c)  $\text{Cr}_2\text{O}_7^{2-}$  (d)  $\text{Cr}(\text{OH})_2$
41. The electronic configuration of gadolinium (At. no. = 64) is:  
 (a)  $[\text{Xe}] 4f^8, 5d^0, 6s^2$  (b)  $[\text{Xe}] 4f^7, 5d^1, 6s^2$   
 (c)  $[\text{Xe}] 4f^3, 5d^5, 6s^2$  (d)  $[\text{Xe}] 4f^6, 5d^2, 6s^2$
42. Which of the following compounds is expected to be colored?  
 (a)  $\text{Ag}_2\text{SO}_4$  (b)  $\text{CuF}_2$   
 (c)  $\text{MgF}_2$  (d)  $\text{CuCl}$
43. Ammonium dichromate is used in fire works. The green colored powder blow in the air is:  
 (a)  $\text{CrO}_3$  (b)  $\text{Cr}_2\text{O}_3$   
 (c) Cr (d)  $\text{CrO}(\text{O}_2)$
44. In acidic medium, one mole of  $\text{MnO}_4^-$  accepts how many moles of electrons in a redox process?  
 (a) 1 (b) 3  
 (c) 5 (d) 6
45. The correct formula for permanganic acid is:  
 (a)  $\text{HMnO}_4$  (b)  $\text{HMnO}_5$   
 (c)  $\text{H}_2\text{MnO}_4$  (d)  $\text{MnO}_2$
46. On heating ammonium dichromate, the gas evolved is:  
 (a) Oxygen (b) Ammonia  
 (c) Nitrous oxide (d) Nitrogen
47. Arrange the following in order of their increasing thermal conductivity.  
 (a) Al, Ag, Cu (b) Cu, Ag, Al  
 (c) Ag, Cu, Al (d) Al, Cu, Ag
48. Which one of the following forms a colorless solution in aqueous medium?  
 (a)  $\text{Cr}^{3+}$  (b)  $\text{Ti}^{3+}$   
 (c)  $\text{Sc}^{3+}$  (d)  $\text{V}^{3+}$
49.  $\text{KMnO}_4$  acts as an oxidizing agent in:  
 (a) Acidic medium only  
 (b) Neutral and acidic media  
 (c) Neutral and alkaline media  
 (d) Neutral, acidic, and alkaline media
50. The transition metals are mostly:  
 (a) Diamagnetic (b) Paramagnetic  
 (c) Neither diamagnetic nor paramagnetic  
 (d) Both diamagnetic and paramagnetic
51. Titanium shows magnetic moment of 1.73 BM; then find out its oxidation state:  
 (a) +1 (b) +4  
 (c) +3 (d) +2



52. The colorless species is:  
 (a)  $\text{VCl}_3$  (b)  $\text{VOSO}_4$   
 (c)  $\text{Na}_3\text{VO}_4$  (d)  $[\text{V}(\text{H}_2\text{O})_6\text{SO}_4] \cdot \text{H}_2\text{O}$
53.  $\text{MnO}_4^{2-}$  (1 mole) in neutral aqueous medium disproportionate to:  
 (a)  $\frac{2}{3}$  mole of  $\text{MnO}_4^-$  and  $\frac{1}{3}$  mole of  $\text{MnO}_2$   
 (b)  $\frac{1}{3}$  mole of  $\text{MnO}_4^-$  and  $\frac{2}{3}$  mole of  $\text{MnO}_2$   
 (c)  $\frac{1}{3}$  mole of  $\text{Mn}_2\text{O}_7$  and  $\frac{1}{3}$  mole of  $\text{MnO}_2$   
 (d)  $\frac{2}{3}$  mole of  $\text{Mn}_2\text{O}_7$  and  $\frac{1}{3}$  mole of  $\text{MnO}_2$
54. Lanthanoids contraction is observed in:  
 (a) Hf (b) At  
 (c) Xe (d) Ac
55. Lanthanoids are:  
 (a) 14 elements in the sixth period (atomic number 90 to 103) that are filling 4f-sublevel  
 (b) 14 elements in the seventh period (atomic number 90 to 103) that are filling 5f-subshell  
 (c) 14 elements in the sixth period (atomic number 58 to 71) that are filling the 4f-subshell  
 (d) 14 elements in the seventh period (atomic number 58 to 71) that are filling the 4f-subshell
56. For delocalization of 1 mole of  $\text{KMnO}_4$ , the moles of  $\text{H}_2\text{O}_2$  required is:  
 (a)  $\frac{1}{2}$  (b)  $\frac{3}{2}$   
 (c)  $\frac{5}{2}$  (d)  $\frac{7}{2}$
57. Among the following pairs of ions, the lower oxidation state in aqueous solution is more stable than the other, in:  
 (a)  $\text{Ti}^+$ ,  $\text{Ti}^{3+}$  (b)  $\text{Fe}^+$ ,  $\text{Fe}^{3+}$   
 (c)  $\text{Cr}^{2+}$ ,  $\text{Cr}^{3+}$  (d)  $\text{V}^{2+}$ ,  $\text{VO}^{2+}$
4. One element (A) is having four valence shell electron. Which of following values will be maximum.  
 (a) EA of A (b)  $\text{IE}_4 - \text{IE}_3$   
 (c)  $\text{IE}_5 - \text{IE}_3$  (d)  $\text{IE}_2 - \text{IE}_1$
5. The maximum oxidation state of osmium is:  
 (a) +6 (b) +7  
 (c) +8 (d) +5
6. Which of the following elements involves gradual filling of 5f-level?  
 (a) Lanthanoids (b) Actinoids  
 (c) Transition metals (d) Coinage metals
7. Which chromium compound is widely used in tanning of leather?  
 (a)  $\text{Cr}_2\text{O}_3$  (b)  $\text{CrO}_2\text{Cl}_2$   
 (c)  $\text{CrCl}_3$   
 (d)  $\text{K}_2\text{SO}_4 \cdot \text{Cr}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$   
 Chrome alum  $\text{K}_2\text{SO}_4 \cdot \text{Cr}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$  is widely used in tanning of leather.
8.  $\text{K}_2\text{Cr}_2\text{O}_7$  reacts with  $\text{NH}_4\text{Cl}$  in the presence of  $\text{H}_2\text{SO}_4$ . The product formed is:  
 (a) Chromyl chlorate with green vapor  
 (b) Chromous chloride with white vapor  
 (c) Chromous chloride with blue vapor  
 (d) Chromyl chloride with deep red color
9. The "Spin-only" magnetic moment [in units of Bohr magneton, ( $\mu_B$ )] of  $\text{Ni}^{2+}$  in aqueous solution would be (At. no. Ni = 28):  
 (a) 0 (b) 1.73  
 (c) 2.84 (d) 4.90
10. Which of the following compounds is not colored?  
 (a)  $\text{Na}_2\text{CuCl}_4$  (b)  $\text{Na}_2\text{CdCl}_4$   
 (c)  $\text{K}_4[\text{Fe}(\text{CN})_6]$  (d)  $\text{K}_3[\text{Fe}(\text{CN})_6]$
11. When KI (excess) is added to:  
 (i)  $\text{CuSO}_4$  (ii)  $\text{HgCl}_2$  (iii)  $\text{Pb}(\text{NO}_3)_2$   
 (a) A white ppt. of  $\text{CuI}$  in (i), an orange ppt. of  $\text{HgI}_2$  in (ii), and a yellow ppt. of  $\text{PbI}_2$  in (iii)  
 (b) A white ppt. of  $\text{Cu}_2\text{I}_2$  in (i), a red ppt. dissolving to  $\text{HgI}_4^{2-}$  in (ii), and a yellow ppt. of  $\text{PbI}_2$  in (iii)  
 (c) A white ppt. of  $\text{CuI}$ ,  $\text{HgI}_2$ , and  $\text{PbI}_2$  in each case  
 (d) None is correct
12. Due to lanthanoids contraction:  
 (a) Fe, Co, Ni have equal size  
 (b) Zr and Hf have equal size  
 (c) All f-block ions have equal size  
 (d) All isoelectronic ions have equal size

### JEE (Advanced) Exercises

#### Single Correct Answer Type

1. The oxidation states of Mn in  $\text{K}_2\text{MnO}_4$  and  $\text{KMnO}_4$  respectively are:  
 (a) +6, +7 (b) +6, +6  
 (c) +7, +7 (d) +7, +6
2. The basic character of the transition metal monoxides follows the order:  
 (a)  $\text{CrO} > \text{VO} > \text{FeO} > \text{TiO}$   
 (b)  $\text{TiO} > \text{FeO} > \text{VO} > \text{CrO}$   
 (c)  $\text{TiO} > \text{VO} > \text{CrO} > \text{FeO}$   
 (d)  $\text{VO} > \text{CrO} > \text{TiO} > \text{FeO}$
3. Which is not a transition element?  
 (a) Cu (b) Ac  
 (c) Zn (d) Pd



13. Silver ornaments turn black in atmosphere:  
 (a)  $O_2$  (b)  $N_2$   
 (c)  $Cl_2$  (d)  $H_2S$
14. What are the species  $A$  and  $B$  in the following:  

$$CrO_3 + H_2O \xrightarrow{OH^-} A \xrightarrow{OH^-} B$$
  
 (a)  $H_2CrO_4$ ,  $H_2Cr_2O_7$  (b)  $H_2Cr_2O_7$ ,  $Cr_2O_3$   
 (c)  $CrO_4^{2-}$ ,  $Cr_2O_7^{2-}$  (d)  $H_2Cr_2O_7$ ,  $CrO_4^{2-}$
15. In August 2003, IUPAC approved the name of the element of atomic number 110. Name of the elements is:  
 (a) Darmstadtium (b) Mountanium  
 (c) Rhenium (d) Bhorium
16. Which one of the following characteristics of the transition metals is associated with their catalytic activity?  
 (a) Color of hydrated ions  
 (b) Variable oxidation states  
 (c) Diamagnetic behavior  
 (d) Paramagnetic behavior
17. Which of the following factor may be regarded as the main cause of lanthanoids contraction?  
 (a) Poor shielding of one of the 4  $f$ -electrons by another in the subshell.  
 (b) Effective shielding of one of the 4  $f$ -electrons by another in the subshell.  
 (c) Poorer shielding of 5  $d$ -electrons by 4  $f$ -electrons.  
 (d) Greater shielding of 5  $d$ -electrons by 4  $f$ -electrons.
18. An extremely hot copper wire reacts with steam to produce:  
 (a)  $Cu_2O$  (b)  $CuO$   
 (c)  $Cu_2O_2$  (d)  $CuO$
19. Spin only magnetic moment of the compound  $Hg[Co(SCN)_4]$  is:  
 (a)  $\sqrt{3}$  (b)  $\sqrt{15}$   
 (c)  $\sqrt{24}$  (d)  $\sqrt{8}$
20. Consider a titration of potassium dichromate solution with acidified Mohr's salt solution using diphenylamine as indicator. The number of moles of Mohr's salt required per mole of dichromate is:  
 (a) 3 (b) 4  
 (c) 5 (d) 6
21.  $FeCr_2O_4 + Na_2CO_3 + O_2 \xrightarrow{\text{Fusion}} [X] \xrightarrow{H_2O} [Y] \xrightarrow{H_2O_2} [Z]$   
 Which of the following statements is true for the compounds  $[X]$ ,  $[Y]$ , and  $[Z]$ ?  
 (a) In all three compounds, the chromium is in +6 oxidation state  
 (b)  $[Z]$  is a deep blue-violet colored compound which decomposes rapidly in aqueous solution into  $Cr^{3+}$  and dioxygen  
 (c) Saturated solution of  $[Y]$  given bright orange compound, chromic anhydride, with concentrated  $H_2SO_4$   
 (d) All of these
22. The number of moles of  $KMnO_4$  that will be needed to react with one mole of sulphite in an acidic solution is:  
 (a) 2/5 (b) 3/5  
 (c) 4/5 (d) 1
23. Which of the following metals will not form an amalgam?  
 (a) Gold (b) Silver  
 (c) Zinc (d) Iron
24. The equivalent weight of  $K_2Cr_2O_7$  in acid medium is equal to:  
 (a) Molecular weight (b) 1/2 Molecular weight  
 (c) 1/6 Molecular weight (d) 1/5 Molecular weight
25. Number of electrons transfer in each case when  $KMnO_4$  acts as an oxidizing agent to give  $MnO_2$ ,  $Mn^{2+}$ ,  $Mn(OH)_3$ , and  $MnO_4^{2-}$  are respectively:  
 (a) 3, 5, 4, and 1 (b) 4, 3, 1, and 5  
 (c) 1, 3, 4, and 5 (d) 5, 4, 3, and 1
26. The atomic numbers of V, Cr, Mn, and Fe are respectively 23, 24, 25, and 26. Which one of these may be expected to have the highest second ionization enthalpy?  
 (a) Cr (b) Mn  
 (c) Fe (d) V
27. In the reaction,  

$$(NH_4)_2 Cr_2O_7 \xrightarrow{\Delta} N_2 + H_2O + Cr_2O_3$$
  
 The coefficient of  $H_2O$  is:  
 (a) 1 (b) 2  
 (c) 3 (d) 4
28. Lanthanoids contraction is due to increase in:  
 (a) Shielding by 4  $f$ -electrons  
 (b) Atomic number  
 (c) Effective nuclear charge  
 (d) Size of 4  $f$ -orbital
29. A certain metal will liberate hydrogen from dilute acids. It will react with water to form hydrogen only



- when the metal is heated and the water is in the form of steam. The metal is probably:
- (a) Iron (b) Potassium  
(c) Copper (d) Mercury
30. The product of oxidation of  $\text{I}^-$  with  $\text{MnO}_4^-$  in alkaline medium is:
- (a)  $\text{IO}_3^-$  (b)  $\text{I}_2$   
(c)  $\text{IO}^-$  (d)  $\text{IO}_4^-$
31. The non-metallic cation is present in:
- (a)  $\text{CrO}_2\text{Cl}_2$  (b)  $\text{VOCl}$   
(c)  $\text{NH}_4\text{Cl}$  (d)  $\text{PCl}_3$
32. The compound of vanadium has magnetic moment of 1.73 BM. The vanadium chloride has the formula:
- (a)  $\text{VCl}_2$  (b)  $\text{VCl}_3$   
(c)  $\text{VCl}_4$  (d)  $\text{VCl}_5$
33. Which of the following species will be the strongest Lewis acid?
- (a)  $\text{Fe}^0$  (b)  $\text{Fe}^{3+}$   
(c)  $\text{Fe}^{2+}$  (d)  $\text{Fe}^{1+}$
34.  $\text{Cr}_2\text{O}_7^{2-} \xrightarrow{\text{H}^+} \text{Cr}^{3+}$ . Eq. wt. of  $\text{Cr}_2\text{O}_7^{2-}$  is:
- (a) mol. wt./6 (b) mol. wt./3  
(c) mol. wt./4 (d) mol. wt./1
35. More number of oxidation states are exhibited by the actinoids than by the lanthanoids. The main reason for this is:
- (a) Greater metallic character of the lanthanoids than that of the corresponding actinoids.  
(b) More active nature of the actinoids  
(c) More energy difference between 5f and 6d-orbitals than that between 4f and 5d-orbitals  
(d) Lesser energy difference between 5f and 6d-orbitals than that between 4f and 5d-orbitals
36. The reduction potential values of M, N and O are +2.46, -1.13 and -3.13 V respectively. Which of the following order is correct regarding their reducing property?
- (a)  $O > N > M$  (b)  $O > M > N$   
(c)  $M > N > O$  (d)  $M > O > N$
37. Which of the following compounds will not give positive chromyl chloride test?
- (a)  $\text{CuCl}_2$  (b)  $\text{HgCl}_2$   
(c)  $\text{ZnCl}_2$  (d)  $\text{C}_6\text{H}_5\text{NH}_3\text{Cl}^+$
38. The equivalent weight of  $\text{KMnO}_4$  (formula weight: M) when it is used as an oxidant in neutral medium is:
- (a) M. (b)  $M/2$   
(c)  $M/3$  (d)  $M/5$
39. Hemoglobin and chlorophyll contain respectively:
- (a) Fe, Co (b) Fe, Mn  
(c) Mg, Fe (d) Fe, Mg
40. In  $\text{Cr}_2\text{O}_7^{2-}$  every Cr is linked to:
- (a) Two O-atoms (b) Three O-atoms  
(c) Four O-atoms (d) Five O-atoms
41. Fe is made passive by:
- (a) Dil.  $\text{H}_2\text{SO}_4$  (b) Dil.  $\text{HCl}$   
(c) Aqua regia (d) Conc.  $\text{H}_2\text{SO}_4$
42.  $\text{FeCr}_2\text{O}_4$  (chromite) is converted to Cr by following steps:
- Chromite  $\xrightarrow{\text{I}}$   $\text{Na}_2\text{CrO}_4$   $\xrightarrow{\text{II}}$   $\text{Cr}_2\text{O}_3$   $\xrightarrow{\text{III}}$  Cr
- I, II, and III are:
- | I   | II                             | III          |
|---|--------------------------------|--------------|
| (a) $\text{Na}_2\text{CO}_3/\text{air}, \Delta$ | C                              | C            |
| (b) $\text{Na}_2\text{CO}_3/\text{air}, \Delta$ | C, $\Delta$                    | Al, $\Delta$ |
| (c) $\text{NaOH}/\text{air}, \Delta$            | C, $\Delta$                    | Mg, $\Delta$ |
| (d) conc. $\text{H}_2\text{SO}_4, \Delta$       | $\text{NH}_4\text{Cl}, \Delta$ | C, $\Delta$  |
43. When  $\text{H}_2\text{O}_2$  is added to an acidified solution of  $\text{K}_2\text{Cr}_2\text{O}_7$ :
- (a) Solution turns green due to formation of  $\text{Cr}_2\text{O}_3$   
(b) Solution turns yellow due to formation of  $\text{K}_2\text{CrO}_4$   
(c) A deep blue-violet colored compound  $\text{CrO}(\text{O}_2)_2$  is formed  
(d) Solution gives green ppt. of  $\text{Cr}(\text{OH})_3$
44. Four successive members of the first row transition elements are listed below with their atomic numbers. Which one of them is expected to have the highest third ionization enthalpy?
- (a) Vanadium ( $Z = 23$ ) (b) Manganese ( $Z = 25$ )  
(c) Chromium ( $Z = 24$ ) (d) Iron ( $Z = 26$ )
45. Select incorrect statement(s):
- (a) Ionization energies of 5d-elements are greater than those of 3d and 4d-elements  
(b) Cu(I) is diamagnetic while Cu(II) is paramagnetic  
(c)  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  is colored while  $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$  is colorless  
(d) Transition elements cannot form complexes
46. Increasing basic properties of  $\text{TiO}_2$ ,  $\text{ZrO}_2$ , and  $\text{HfO}_2$  are in order:
- (a)  $\text{TiO}_2 < \text{ZrO}_2 < \text{HfO}_2$  (b)  $\text{HfO}_2 < \text{ZrO}_2 < \text{TiO}_2$   
(c)  $\text{HfO}_2 < \text{TiO}_2 < \text{ZrO}_2$  (d)  $\text{ZrO}_2 < \text{TiO}_2 < \text{HfO}_2$



47. Which is called chromic anhydride?  
 (a) CrO (b) Cr<sub>2</sub>O<sub>3</sub>  
 (c) CrO<sub>3</sub> (d) CrO<sub>2</sub>
48. Philosopher's wool on treatment with cobalt nitrate produces:  
 (a) CoBaO<sub>2</sub> (b) CoZnO<sub>2</sub>  
 (c) CoSrO<sub>2</sub> (d) CoMgO<sub>2</sub>
49. Fulminating gold is:  
 (a) AuCl<sub>3</sub> (b) Au<sub>2</sub>S  
 (c) Au(NH<sub>2</sub>) = NH (d) H[Au(Cl)<sub>4</sub>]
50. Anhydrous ferric chloride is prepared by:  
 (a) Heating hydrated ferric chloride at a high temperature in a stream of air  
 (b) Heating metallic iron in a stream of dry chlorine gas  
 (c) Reaction of ferric oxide with HCl  
 (d) Reaction of metallic iron with HCl
51. When MnO<sub>2</sub> is fused with KOH and KClO<sub>3</sub>, a colored compound is formed, the product and its color is:  
 (a) K<sub>2</sub>MnO<sub>4</sub>, green (b) KMnO<sub>4</sub>, purple  
 (c) Mn<sub>2</sub>O<sub>3</sub>, brown (d) Mn<sub>3</sub>O<sub>4</sub>, black
52. Which pair of compounds is expected to show similar color in aqueous medium?  
 (a) FeCl<sub>3</sub> and CuCl<sub>2</sub> (b) VOCl<sub>2</sub> and CuCl<sub>2</sub>  
 (c) VOCl<sub>2</sub> and FeCl<sub>2</sub> (d) FeCl<sub>2</sub> and MnCl<sub>2</sub>
53. A solution of a metal ion when treated with KI gives a red precipitate which dissolves in excess KI to give a colorless solution. Moreover, the solution of metal ion on treatment with a solution of cobalt(II) thiocyanate gives rise to a deep blue crystalline precipitate. The metal ion is:  
 (a) Pb<sup>2+</sup> (b) Hg<sup>2+</sup>  
 (c) Cu<sup>2+</sup> (d) Co<sup>2+</sup>
54. In the standardization of Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> using K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> by iodometry, the equivalent weight of K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> is:  
 (a) (Molecular weight)/2 (b) (Molecular weight)/6  
 (c) (Molecular weight)/3 (d) Same as molecular weight
55. A red solid is insoluble in water. However, it becomes soluble if some KI is added to water. Heating the red solid in a test tube results in liberation of some violet colored fumes and droplets of a metal appear on the cooler parts of the test tube. The red solid is  
 (a) HgI<sub>2</sub> (b) HgO  
 (c) Pb<sub>3</sub>O<sub>4</sub> (d) (NH<sub>4</sub>)<sub>2</sub> Cr<sub>2</sub>O<sub>7</sub>
56. The value of 'spin only' magnetic moment for one of the following configurations is 2.84 BM. The correct one is:  
 (a) d<sup>4</sup> (in strong ligand field)  
 (b) d<sup>4</sup> (in weak ligand field)  
 (c) d<sup>3</sup> (in weak as well as strong fields)  
 (d) d<sup>6</sup> (in strong ligand field)
57. When MnO<sub>2</sub> is fused with KOH, a colored compound is formed. The product and its color is:  
 (a) K<sub>2</sub>MnO<sub>4</sub>, purple green  
 (b) KMnO<sub>4</sub>, purple  
 (c) Mn<sub>2</sub>O<sub>3</sub>, brown  
 (d) Mn<sub>2</sub>O<sub>4</sub>, black

### Multiple Correct Answers Type

1. d<sub>x<sup>2</sup>-y<sup>2</sup></sub> orbital is involved in which of the following hybridization:  
 (a) sp<sup>3</sup>d (TBP) (b) sp<sup>3</sup>d<sup>2</sup>  
 (c) sp<sup>3</sup>d<sup>3</sup> (d) None of these
2. Which of following is/are correctly matched?  
 (a) d-block element : electronic configuration is ns<sup>0-2</sup> (n-1)d<sup>1-10</sup>  
 (b) p-block element : electronic configuration is ns<sup>1-2</sup> np<sup>1-6</sup>  
 (c) s-block element : electronic configuration is ns<sup>1-2</sup>  
 (d) Ce : f-block's first member
3. Which is true statement about KMnO<sub>4</sub>?  
 (a) Its solution is unstable in acidic medium  
 (b) It has purple color  
 (c) MnO<sub>4</sub><sup>-</sup> changes to Mn<sup>2+</sup> in basic solution  
 (d) It is self-indicator in Fe<sup>2+</sup> or C<sub>2</sub>O<sub>4</sub><sup>2-</sup> titration
4. The ability of d-block elements to form complexes is due to:  
 (a) Small and highly charged ions  
 (b) Vacant low energy orbitals to accept lone pair of electrons from ligands  
 (c) Low polarizing power of cation  
 (d) None is correct
5. Out of [Fe(CN)<sub>6</sub>]<sup>4-</sup>, [Ni(CN)<sub>4</sub>]<sup>2-</sup>, and [Ni(CO)<sub>4</sub>]: select the incorrect statement(s):  
 (a) All have identical geometry  
 (b) All are paramagnetic  
 (c) All are diamagnetic



- (d)  $[\text{Fe}(\text{CN})_6]^{4-}$  is diamagnetic but  $[\text{Ni}(\text{CN})_4]^{2-}$  and  $[\text{Ni}(\text{CO})_4]$  are paramagnetic
6. A transition element  $X$  has a configuration  $[\text{Ar}]3d^4$  in its +3 oxidation state. Its atomic number is not  
 (a) 25 (b) 26  
 (c) 22 (d) 19
7. Which one of the following ionic species will not impart color to an aqueous solution?  
 (a)  $\text{Ti}^{4+}$  (b)  $\text{Cu}^+$   
 (c)  $\text{Zn}^{2+}$  (d)  $\text{Cr}^{3+}$
8. Which out of the following halogen to 3d-series?  
 (a) Copper (b) Cobalt  
 (c) Gold (d) Silver
9. Transition elements have greater tendency to form complexes because:  
 (a) They have vacant  $d$ -orbitals  
 (b) They have large size  
 (c) They show variable oxidation state  
 (d) They have two electrons in their outermost shells.
10. The color of the transition metal ions is due to:  
 (a)  $d-d$  transition (b) Charge transfer  
 (c) Change in the geometry  
 (d) None of these
11. The transition metals which do not form amalgams are:  
 (a) Zn (b) Fe  
 (c) Cd (d) Pt
12. The elements which exist in the liquid state at room temperature are:  
 (a) Na (b) Br  
 (c) Hg (d) Ga
13. Which of the following statements are correct with reference to the ferrous and ferric ions?  
 (a)  $\text{Fe}^{3+}$  gives brown color with potassium ferricyanide  
 (b)  $\text{Fe}^{2+}$  gives blue precipitate with potassium ferri-cyanide  
 (c)  $\text{Fe}^{3+}$  gives red color with potassium thiocyanate  
 (d)  $\text{Fe}^{2+}$  gives brown color with ammonium thiocya-nate
14. Which of the following is false?  
 (a)  $\text{Cr}^{2+}$  (g) ion has greater magnetic moment compared to  $\text{Co}^{3+}$  (g)
- (b) The magnitude of ionization potential of iron an-ion (monoanion) would be equal to electron gain enthalpy of iron
- (c) Lanthanoids contraction is cause of lower I.P. of Pb than Sn
- (d) If successive ionization energy are 332, 738, 849, 4080, 4958 (in kJ/mol). Then this element can be of 15th group
15. Which of the following represents the correct order of the properties indicated?  
 (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)  $\text{Ni}^{2+} < \text{Co}^{2+} < \text{Fe}^{2+} < \text{Mn}^{2+}$  (unpaired electron)  
 (d)  $\text{Cr}^{3+} > \text{Cr}^{2+}$  (magnetic moment)
16. Which of the following represents the incorrect order of the properties indicated?  
 (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)  $\text{Ni}^{2+} < \text{Co}^{2+} < \text{Fe}^{2+} < \text{Mn}^{2+}$  (unpaired electron)  
 (d)  $\text{H}_3\text{AsO}_4 > \text{H}_3\text{PO}_4$  (acidic strength order)
17. For  $\text{CrO}_3$ , following is/are true statement:  
 (a) It is called chromic anhydride  
 (b) It is colorless due to  $3d^0$  configuration  
 (c) It is bright orange solid and color arises due to charge transfer  
 (d) It is toxic and corrosive
18. Coagulation of blood takes place by:  
 (a) Ferric alum (b) Potash alum  
 (c) Chrom alum (d) None of these
19. The correct statement for  $d$ -block element is:  
 (a) It shows magnetic property  
 (b) It has variable valency  
 (c) It has tendency of formation of colored ions  
 (d) It has complete  $d$ -orbitals
20. The aqueous solution of the salt will be colored in the case of:  
 (a)  $\text{Zn}(\text{NO}_3)_2$  (b)  $\text{LiNO}_3$   
 (c)  $\text{Co}(\text{NO}_3)_2$  (d)  $\text{CrCl}_3$
21. Complex forming tendency of an element depends upon:  
 (a) High charge (b) Small size of its cation  
 (c) Availability of vacant  $d$ -orbitals  
 (d) None of these
22. Potassium manganate ( $\text{K}_2\text{MnO}_4$ ) is formed when:  
 (a) Chlorine is passed through aqueous  $\text{KMnO}_4$  solution  
 (b) Manganese dioxide is fused with potassium hydroxide in air



- (c) Formaldehyde reacts with potassium  
(d) Potassium permanganate reacts with  $\text{H}_2\text{SO}_4$
23. What will be the correct representation of quantum numbers for the last electron entered into Ce?
- | $n$   | $l$ | $m$ | $s$            |
|-------|-----|-----|----------------|
| (a) 4 | 3   | -3  | $-\frac{1}{2}$ |
| (b) 4 | 3   | 0   | $-\frac{1}{2}$ |
| (c) 4 | 2   | -3  | $+\frac{1}{2}$ |
| (d) 4 | 3   | +2  | $-\frac{1}{2}$ |
24.  $\text{Cl}_2$  gas is obtained by various reactions select the reactions from the following(s):
- (a)  $\text{KMnO}_4 + \text{conc. HCl} \xrightarrow{\Delta}$   
(b)  $\text{KCl} + \text{K}_2\text{Cr}_2\text{O}_7 + \text{conc. H}_2\text{SO}_4 \xrightarrow{\Delta}$   
(c)  $\text{MnO}_2 + \text{conc. HCl} \xrightarrow{\Delta}$   
(d)  $\text{KCl} + \text{F}_2 \longrightarrow$
25. Which is/are true statement?
- (a) Ions of  $d$ -block elements are colored due to  $d-d$  transition  
(b) Ions of  $f$ -block elements are colored due to  $f-f$  transition  
(c)  $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$ ,  $[\text{Ti}(\text{H}_2\text{O})_6]^{4+}$  are colored complexes  
(d)  $\text{Cu}^+$  is colorless ion
26. In  $[\text{Fe}(\text{CN})_5(\text{NO})]^{2-}$ , Fe has +2 state. It cannot be decided by:
- (a) Magnetic measurement  
(b) Colligative property  
(c) Color  
(d) Hybridization
27. Which one of the following statements is/are correct?
- (a) Zinc dissolves in sodium hydroxide solution  
(b) Carbon monoxide reduces iron(III) oxide to iron  
(c) Mercury(II) iodide dissolves in excess of potassium iodide solution  
(d) Tin(IV) chloride is made by dissolving tin solution in concentrated hydrochloric acid
28. In  $\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]$ , sodium nitroprusside:
- (a) Oxidation state of Fe is +2  
(b) This has  $\text{NO}^+$  as ligand  
(c)  $d^8sp^3$ -hybridization  
(d) None of the above is correct
29. In the iodometric estimation in the laboratory which process is involved?
- (a)  $\text{Cr}_2\text{O}_7^{2-} + \text{H}^+ + \text{I}^- \longrightarrow 2\text{Cr}^{3+} + \text{I}_2$   
 $\text{I}_2 + \text{S}_2\text{O}_3^{2-} \longrightarrow \text{S}_4\text{O}_6^{2-} + \text{I}^-$   
(b)  $\text{MnO}_4^- + \text{H}^+ + \text{I}^- \longrightarrow \text{Mn}^{2+} + \text{I}_2$   
 $\text{I}_2 + \text{S}_2\text{O}_3^{2-} \longrightarrow \text{S}_4\text{O}_6^{2-} + \text{I}^-$   
(c)  $\text{MnO}_4^- + \text{OH}^- + \text{I}^- \longrightarrow \text{MnO}_2 + \text{I}_2$   
 $\text{I}_2 + \text{S}_2\text{O}_3^{2-} \longrightarrow \text{S}_4\text{O}_6^{2-} + \text{I}^-$   
(d)  $\text{Cr}_2\text{O}_7^{2-} + \text{OH}^- + \text{I}^- \longrightarrow 2\text{Cr}^{3+} + \text{I}_2$   
 $\text{I}_2 + \text{S}_2\text{O}_3^{2-} \longrightarrow \text{S}_4\text{O}_6^{2-} + \text{I}^-$
30.  $\text{K}_4[\text{Fe}(\text{CN})_6]$  is used in detecting:
- (a)  $\text{Cu}^{2+}$  ions  
(b)  $\text{Fe}^{2+}$  ions  
(c)  $\text{Fe}^{3+}$  ions  
(d)  $\text{Cu}^{2+}$  ions
31. Which of the following statements are correct when a mixture of  $\text{NaCl}$  and  $\text{K}_2\text{Cr}_2\text{O}_7$  is gently warmed with conc.  $\text{H}_2\text{SO}_4$ ?
- (a) A deep red vapor is evolved  
(b) The vapor when passed into  $\text{NaOH}$  solution gives yellow solution of  $\text{Na}_2\text{CrO}_4$   
(c) Chlorine gas is evolved  
(d) Chromyl chloride is formed
32. Pyrolusite is  $\text{MnO}_2$  used to prepare  $\text{KMnO}_4$ . Steps are:
- $$\text{MnO}_2 \xrightarrow{\text{I}} \text{MnO}_4^{2-} \xrightarrow{\text{II}} \text{MnO}_4^-$$
- Steps I and II are respectively:
- (a) Fuse with  $\text{KOH}$  / air, electrolytic oxidation  
(b) Fuse with  $\text{KOH}$  /  $\text{KNO}_3$ , electrolytic oxidation  
(c) Fuse with concentrated  $\text{HNO}_3$  / air, electrolytic reduction  
(d) Dissolve in  $\text{H}_2\text{O}$  oxidation.

### Comprehension Type

#### Comprehension-1: (Q.1 to Q.4)

The elements of the three transition series of the  $d$ -block are given below:

Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd
La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg

In any transition series, as we move from left to right, the  $d$ -orbitals are progressively filled and their properties vary accordingly.

1. Which element do you expect to have the smallest atomic radius?



- (a) Sc (b) Zn  
(c) La (d) Hg
2. Which element do you expect to have the highest melting point?  
(a) La (b) W  
(c) Os (d) Pt
3. Which element out of the following do you expect to have the lowest melting point?  
(a) Cr (b) Mn  
(c) Fe (d) Co
4. Which of the following is the correct order of second ionization energy?  
(a)  $V > Cr > Mn$  (b)  $V < Cr < Mn$   
(c)  $V < Cr > Mn$  (d)  $V > Cr < Mn$

### Comprehension-2: (Q. 5 to Q. 7)

Potassium permanganate is prepared from the mineral pyrolusite,  $MnO_2$ . Its crystals have deep purple color. It acts as an oxidizing agent in the neutral, alkaline as well as acidic medium. In acidic medium, it is used in volumetric analysis for the estimation of ferrous salts, oxalates, etc. The titrations are carried out in the presence of  $H_2SO_4$ . However, before using it as a titrant, it is first standardized with standard oxalic acid solution or Mohr salt solution. In one of the experiments on titration, 13.4 g of dry pure sodium oxalate (molar mass =  $134 \text{ g mol}^{-1}$ ) was dissolved in 100 mL of distilled water and then 100 mL of distilled water and then 100 mL of  $2M H_2SO_4$  were added. The solution was cooled to  $25.30^\circ C$ . Now to this solution,  $0.1M KMnO_4$  solution was added till a very faint pink color persisted.

5. When pyrolusite is fused with  $KOH$  and  $KClO_3$ , we get:  
(a)  $KMnO_4$  (b)  $K_2MnO_4$   
(c) Both  $KMnO_4$  and  $K_2MnO_4$   
(d) None of these
6. The purple color of  $KMnO_4$  is due to:  
(a) Incomplete  $d$ -subshell  
(b) Ionic nature of  $KMnO_4$   
(c) Charge transfer  
(d) Resonance in  $MnO_4^-$  ion
7. Mohr salt,  $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$ , is preferred over  $FeSO_4 \cdot 7H_2O$  for standardization of  $KMnO_4$  solution because:  
(a) Mohr salt is a double salt while ferrous sulphate is a single salt

- (b) Mohr salt is not hygroscopic but  $FeSO_4 \cdot 7H_2O$  is hygroscopic  
(c) Mohr salt contains only ferrous ions whereas ferrous sulphate contains some ferric ions  
(d) Mohr salt solution can be titrated even in the absence of  $H_2SO_4$

### Assertion-Reasoning Type

1. **Statement-1:** 'La' should be the  $f$ -block element according to Aufbau principle.

**Statement-2:** 57th electron exceptionally enters into the  $5d$ -orbital.

- (a) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.  
(b) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.  
(c) Statement-1 is true, statement-2 is false.  
(d) Statement-1 is false, statement-2 is true.

2. **Statement-1:** The compounds of copper in +1 state are colorless.

**Statement-2:** Due to  $3d^{10}$  electronic configuration of  $Cu^+$  ion no  $d-d$  transition takes place.

- (a) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.  
(b) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.  
(c) Statement-1 is true, statement-2 is false.  
(d) Statement-1 is false, statement-2 is true.

3. **Statement-1:** Mercurous compounds are diamagnetic.

**Statement-2:** Two  $Hg^+$  species which have  $6s^1$  configuration are bonded together using  $s$ -electrons.

- (a) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.  
(b) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.  
(c) Statement-1 is true, statement-2 is false.  
(d) Statement-1 is false, statement-2 is true.



### Matching Column Type

1. Match the column:

Column-I	Column-II
(a) Ni	(p) Elements having same number of unpaired electron in their dipositive in column-I.
(b) K	(q) At least 13 electrons are having magnetic quantum number 'zero'.
(c) Mn	(r) Atom is paramagnetic.
(d) Pd	(s) Element is not transition element
	(t) Element having pseudo inert gas configuration in its dipositive cation.

2. Match the column:

Column-I	Column-II
(a) $\text{Cr}^{3+}$	(p) Zero B.M.
(b) $\text{Cu}^+$	(q) 5.92 B.M.
(c) $\text{Mn}^{2+}$	(r) 3.87 B.M.
(d) $\text{Fe}^{2+}$	(s) 4.90 B.M.

3. Match the column:

Column-I	Column-II
(a) Pt	(p) Used in X-ray tube
(b) Fe	(q) Do not form alloy with Hg
(c) Mo	(r) Element of VIII group
(d) Mn	(s) Native metal
	(t) highest unpaired $e^-$ in $d$ -orbital

4. Match column-I with column-II and select the correct answer using the codes given below the columns.

Column-I (Metal ion)	Column-II (Magnetic moment (BM))
(a) $\text{Cr}^{3+}$	(p) $\sqrt{35}$
(b) $\text{Fe}^{2+}$	(q) $\sqrt{30}$
(c) $\text{Ni}^{2+}$	(r) $\sqrt{24}$
(d) $\text{Mn}^{2+}$	(s) $\sqrt{15}$
	(t) $\sqrt{8}$

5. Match the column:

Column-I (Property)	Column-II (Transition elements)
(a) Highest oxidation state	(p) Cr
(b) Highest density	(q) Os
(c) Element with maximum unpaired electrons	(r) Tc

(d) Radioactive transition element (s) Ru

6. Match the following:

Column-I	Column-II
(a) $\text{K}_2\text{MnO}_4$	(p) Transition element in +6 oxidation state
(b) $\text{KMnO}_4$	(q) Paramagnetic
(c) $\text{K}_2\text{Cr}_2\text{O}_7$	(r) Manufactured from pyrolusite ore
(d) $\text{K}_2\text{CrO}_4$	(s) Manufactured from chromite ore

7. Match the column:

Column-I	Column-II
(a) $\text{CrO}_2\text{Cl}_2$	(p) $d^3s$ -hybridization
(b) $\text{CrO}_4^{2-}$	(q) Diamagnetic
(c) $\text{VO}_4^{3-}$	(r) Colorless
(d) $\text{MnO}_4^{2-}$	(s) Paramagnetic
	(t) Colorful due to charge transfer

8. Match the alloys (in Column-I) with the constituents metal (in Column-II).

Column-I	Column-II
(a) Gun metal	(p) Pb, Sn
(b) German silver	(q) Cu, Sn, Zn
(c) Brass	(r) Cu, Zn
(d) Solder	(s) Cu, Zn, Ni

9. Match the column:

Column-I	Column-II
(a) $\text{Cu}^{2+}$	(p) Form amphoteric oxide
(b) $\text{Zn}^{2+}$	(q) Diamagnetic and colorless compounds
(c) $\text{Cr}^{3+}$	(r) Form complex with $\text{NH}_3$
(d) $\text{Ag}^+$	(s) White oxide but on heating become yellow

10. Match column-I with column-II and select the correct answer using the codes given below the columns:

Column-I (Alloys)	Column-II (Constituents)
(a) Gun metal	(p) Lead + tin
(b) German silver	(q) Copper + tin + zinc
(c) Brass	(r) Copper + zinc
(d) Solder	(s) Copper + zinc + nickel

11. Match the compounds in column-I with their properties in column-II:

Column-I	Column-II
(a) $\text{K}_2\text{MnO}_4$	(p) Transition element in +6 state
(b) $\text{KMnO}_4$	(q) Oxidizing agent in acid medium



- (c)  $K_2Cr_2O_7$  (r) Manufactured from pyrolusite ore  
 (d)  $K_2CrO_4$  (s) Manufactured from chromite ore

12. Match the column:

**Column-I**

- (a) Baeyer's reagent  
 (b) Bordeaux mixture  
 (c) Nessler's reagent

**Column-II**

- (p)  $CuSO_4 + Ca(OH)_2$   
 (q) 1% alkaline  $KMnO_4$   
 (r) Detection of unsaturation in organic compounds  
 (s) Complex of mercury

13. Match the compounds of column I with oxidation state of column-II.

**Column-I**

- (a)  $[Cr(H_2O)_6]Cl_3$   
 (b)  $CrO_5$   
 (c)  $K_3CrO_8$

**Column-II**

- (p) 5  
 (q) 4  
 (r) 6  
 (s) 3

14. Match the reactions in Column-I with nature of the reactions/type of the products in Column-II.

**Column-I**

- (a)  $O_2^- \longrightarrow O_2 + O_2^{2-}$   
 (b)  $CrO_4^{2-} + H^+ \longrightarrow$   
 (c)  $MnO_4^- + NO_2^- + H^+ \longrightarrow$   
 (d)  $NO_3^- + H_2SO_4 + Fe^{2+} \longrightarrow$

**Column-II**

- (p) Redox reaction  
 (q) One of the products has trigonal planar structure  
 (r) Dimeric bridged tetrahedral metal ion  
 (s) Disproportionation

**Integer Answer Type**

- Calculate the  $Z_{eff}$  (approx.) for 4s-electron of Ni-atom according to Slater's rule.
- Calculate the value of  $Z_{eff}$  on 3d-electron of Sc.

**NCERT Exemplar Exercises**

**Single Correct Answer Type**

- Electronic configuration of a transition element X in +3 oxidation state is  $[Ar]3d^5$ . What is its atomic number?  
 (a) 25 (b) 26  
 (c) 27 (d) 24

2. The electronic configuration of Cu(II) is  $3d^9$  whereas that of Cu(I) is  $3d^{10}$ . Which of the following is correct?

- (a) Cu(II) is more stable  
 (b) Cu(II) is less stable  
 (c) Cu(I) and Cu(II) are equally stable  
 (d) Stability of Cu(I) and Cu(II) depends on nature of copper salts

3. Metallic radii of some transition elements are given below. Which of these elements will have highest density?

Element	Fe	Co	Ni	Cu
Metallic radii/pm	126	125	125	128
(a) Fe		(b) Ni		
(c) Co		(d) Cu		

4. Generally transition elements form colored salts due to the presence of unpaired electrons. Which of the following compounds will be colored in solid state?

- (a)  $Ag_2SO_4$  (b)  $CuF_2$   
 (c)  $ZnF_2$  (d)  $Cu_2Cl_2$

5. On addition of small amount of  $KMnO_4$  to concentrated  $H_2SO_4$ , a green oily compound is obtained which is highly explosive in nature. Identify the compound from the following.

- (a)  $Mn_2O_7$  (b)  $MnO_2$   
 (c)  $MnSO_4$  (d)  $Mn_2O_3$

6. The magnetic nature of elements depends on the presence of unpaired electrons. Identify the configuration of transition element, which shows highest magnetic moment.

- (a)  $3d^7$  (b)  $3d^5$   
 (c)  $3d^8$  (d)  $3d^2$

7. Which of the following reactions are disproportionation reactions?

- (a)  $2Cu^+ \rightarrow Cu^{2+} + Cu$   
 (b)  $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$   
 (c)  $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$   
 (d)  $2MnO_4^- + 3Mn^{2+} + 2H_2O \rightarrow 5MnO_2 + 4H^+$   
 (a) a, b (b) a, b, c  
 (c) b, c, d (d) a, d

8. When  $KMnO_4$  solution is added to oxalic acid solution, the decolorization is slow in the beginning but becomes instantaneous after some time because

- (a)  $CO_2$  is formed as the product  
 (b) Reaction is exothermic