

**EXERCISE-01****CHECK YOUR GRASP****SELECT THE CORRECT ALTERNATIVE (ONLY ONE CORRECT ANSWER)**

1. For a catalyst which condition is not essential :  
(A) Variable valency (B) High ionisation energy  
(C) Empty orbitals (D) Free valency on the surface
2. Which element is having lowest melting and boiling point :  
(A) Ti (B) Cu (C) Zn (D) Mn
3. Density of which of the following element is highest :  
(A) Pt (B) Hg (C) Mn (D) Cu
4. The adsorption of hydrogen by platinum black is called :  
(A) hydrogenation (B) Reduction (C) Occlusion (D) Hydration
5. To which of the following series the transition element from  $Z = 39$  to  $Z = 48$  belong :  
(A) 3d series (B) 4d series (C) 5d series (D) 6d series
6. Permanent magnets are generally made of alloys of :  
(A) Co (B) Zn (C) Mn (D) Pb
7. The reaction of  $O_2$  and CO with haemoglobin gives :  
(A) Only oxygen-haeme complex  
(B) Only CO-haeme complex  
(C) Both but oxygen-haeme-complex is more stable  
(D) Both but CO-haeme-complex is more stable
8. Which of the following statement is not correct :  
(A) Fe, Ni, Co form interstitial compound  
(B)  $CuSO_4 + Ca(OH)_2$  is called Bordeaux mixture  
(C) Verdigris is basic copper acetate  $[Cu(COOCH_3)_2Cu(OH)_2]$   
(D) 24 carat gold is an alloy of Au and Cu
9. Chromium forms most stable compound in the following oxidation state :  
(A) Cr (I) (B) Cr (II) (C) Cr (III) (D) Cr (iv)
10. Not more than one oxidation state is show by :  
(A) Mn (B) Cr (C) Fe (D) Sc
11. Which pair of ions is colourless :  
(A)  $Mn^{+3}$ ,  $CO^{+3}$  (B)  $Fe^{+3}$ ,  $Cr^{+3}$  (C)  $Zn^{2+}$ ,  $Sc^{3+}$  (D)  $Ti^{2+}$ ,  $Cu^{2+}$
12. Which of the following set of metals can form alloy :  
(A) Cu – Au (B) Li–Na (C) Fe–Hg (D) All
13. Which of the following is ferromagnetic :  
(A) Cu, Ag, Au (B) Fe, Co, Ni (C) Zn, Cd, Hg (D) Ca, Sr, Ba
14. The number of moles of acidified  $KMnO_4$  required to convert sulphite ion into sulphate ion is :  
(A)  $2/5$  (B)  $3/5$  (C)  $4/5$  (D) 1

15.  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \xrightleftharpoons{\text{Fe} + \text{Mo}} 2\text{NH}_3(\text{g})$ ; Haber's process, Mo is used as :  
 (A) A catalyst (B) A catalytic promoter  
 (C) An oxidising agent (D) As a catalytic poison
16.  $\text{Cr}_2\text{O}_7^{2-} \xrightleftharpoons[\text{Y}]{\text{X}} 2\text{CrO}_4^{2-}$ , X and Y are respectively :  
 (A)  $\text{X} = \text{OH}^-$ ,  $\text{Y} = \text{H}^+$  (B)  $\text{X} = \text{H}^+$ ,  $\text{Y} = \text{OH}^-$   
 (C)  $\text{X} = \text{OH}^-$ ,  $\text{Y} = \text{H}_2\text{O}_2$  (D)  $\text{X} = \text{H}_2\text{O}_2$ ,  $\text{Y} = \text{OH}^-$
17. The magnetism of  $\text{Ni}^{2+}$  ion is :  
 (A)  $\frac{eh}{4\pi m}$  (B)  $\sqrt{6} \left( \frac{eh}{4\pi m} \right)$   
 (C)  $\sqrt{8} \left( \frac{eh}{4\pi m} \right)$  (D)  $\sqrt{10} \left( \frac{eh}{4\pi m} \right)$
18. During estimation of oxalic acid Vs  $\text{KMnO}_4$ , self indicator is :  
 (A)  $\text{KMnO}_4$  (B) Oxalic acid (C)  $\text{K}_2\text{SO}_4$  (D)  $\text{MnSO}_4$
19. Bayer's reagent used to detect olifinic double bond is :  
 (A) Acidified  $\text{KMnO}_4$  (B) Aqueous  $\text{KMnO}_4$   
 (C) 1% alkaline  $\text{KMnO}_4$  solution (D)  $\text{KMnO}_4$  in benzene
20.  $\text{Cu} + \text{conc. HNO}_3 \xrightarrow{\text{(hot)}} \text{Cu}(\text{NO}_3)_2 + \text{X}$  (oxide of nitrogen); then X is :  
 (A)  $\text{N}_2\text{O}$  (B)  $\text{NO}_2$  (C) NO (D)  $\text{N}_2\text{O}_3$
21. The higher oxidation states of transition elements are found to be the combination with A and B, which are:  
 (A) F, O (B) O, N (C) O, Cl (D) F, Cl
22. Manganese steel is used for making railways because :  
 (A) It is hard with high percentage of Mn  
 (B) It is soft with high percentage of Mn  
 (C) It is hard with small concentration of manganese with the impurities  
 (D) It is soft with small concentration of manganese with impurities.
23. 'Bordeaux mixture' is used as a fungicide. It is a mixture of :  
 (A)  $\text{CaSO}_4 + \text{Cu}(\text{OH})_2$  (B)  $\text{CuSO}_4 + \text{Ca}(\text{OH})_2$   
 (C)  $\text{CuSO}_4 + \text{CaO}$  (D)  $\text{CuO} + \text{CaO}$
24. 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  $\text{HCl}$  (aq)  
 (D) reaction of metallic iron with  $\text{HCl}$  (aq)

25. 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)  $\text{IO}_4^-$
26. Copper becomes green when exposed to moist air for longer period.  
 (A) Because of the formation of a layer of cupric oxide on the surface of copper  
 (B) Because of the formation of a layer of basic carbonate of copper on the surface of copper  
 (C) Because of the formation of a layer of cupric hydroxide on the surface of copper.  
 (D) (A) and (C) both
27.  $\text{CuFeS}_2 + \text{O}_2 \text{ (excess)} \xrightarrow{\Delta} \text{X(s)} + \text{Y(s)}$  (Unbalanced Equation) :  
 Which is correct choice for (X) and (Y) ?  
 (A) (X) liberates iodine from soluble iodides like KI  
 (B) (Y) on heating liberates  $\text{SO}_3$  only  
 (C) (X) forms bluish white ppt. with sodium hydroxide which redissolves in excess of sodium hydroxide.  
 (D) (Y) on reaction with potassium ferricyanide gives brown ppt.
28.  $\text{FeCl}_3 \cdot 6\text{H}_2\text{O} + \text{C}(\text{CH}_3)_2 (\text{CH}_3\text{O})_2 \rightarrow \text{Products}$   
 Reaction products are  
 (A)  $\text{FeCl}_3$ ,  $\text{CH}_3\text{OH}$  and  $\text{CH}_3\text{COCH}_3$  (B)  $(\text{CH}_3\text{O})_3\text{Fe}$ ,  $\text{HCl}$  and  $\text{H}_2\text{O}$   
 (C)  $\text{FeCl}_2$ ,  $\text{HCl}$  and  $\text{CH}_3\text{COCH}_3$  (D)  $\text{Fe}(\text{OH})_3$ ,  $\text{FeCl}_3$  and  $\text{CH}_3\text{COCH}_3$
29. Which of the following statements is incorrect ?  
 (A) Transition element exhibit higher enthalpies of atomization as they have stronger interatomic interaction  
 (B)  $\text{IE}_2$  of  ${}_{23}\text{V} < {}_{24}\text{Cr} > {}_{25}\text{Mn}$  and  ${}_{28}\text{Ni} < {}_{29}\text{Cu} > {}_{30}\text{Zn}$   
 (C) Ni (II) compounds are more stable than pt(II) where as pt(IV) compounds are more stable than Ni (IV)  
 (D) The elements which gives the greatest number of oxidation states does not occur in or near the middle of the series
30. Stability of  $\text{Cu}^+$  and  $\text{Ag}^+$  halide complexes are in order :  
 (A)  $\text{I} > \text{Br} > \text{Cl} > \text{F}$  (B)  $\text{F} > \text{Cl} > \text{Br} > \text{I}$  (C)  $\text{Cl} > \text{F} > \text{I} > \text{Br}$  (D)  $\text{Br} > \text{I} > \text{Cl} > \text{F}$
31. 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.  $\text{HgI}_2$  in II and a yellow ppt. of  $\text{PbI}_2$  in III  
 (B) A white ppt. of  $\text{CuI}$  in I, an orange 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
32.  $\text{CuSO}_4$  can be estimated volumetrically :  
 (A) by reaction with KI followed by reaction with  $\text{Na}_2\text{S}_2\text{O}_3$   
 (B) by reaction with  $\text{BaCl}_2$   
 (C) by reaction with  $\text{K}_4[\text{Fe}(\text{CN})_6]$   
 (D) none is correct

33.  $\text{Cl}_2$  gas is obtained by various reactions but not by :
- (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)  $\text{KCl} + \text{F}_2 \xrightarrow{\Delta}$
34. Maximum magnetic moment is shown by :
- (A)  $d^5$  (B)  $d^6$  (C)  $d^7$  (D)  $d^8$
35. A jeweller is selling 22-carat gold articles with 95% purity, it is approximately :
- (A) exact (B) 3.5% higher (C) 3.5% lower (D) 5% lower
36. The basic character of the transition metal monoxides follows the order :
- (Atomic no. Ti = 22, V = 23, Cr = 24, Fe = 26)
- (A)  $\text{TiO} > \text{FeO} > \text{VO} > \text{CrO}$  (B)  $\text{TiO} > \text{VO} > \text{CrO} > \text{FeO}$
- (C)  $\text{VO} > \text{CrO} > \text{TiO} > \text{FeO}$  (D)  $\text{CrO} > \text{VO} > \text{FeO} > \text{TiO}$
37. AgCl on fusion with sodium carbonate, gives :
- (A)  $\text{Ag}_2\text{CO}_3$  (B)  $\text{Ag}_2\text{O}$  (C) Ag (D)  $\text{Ag}_2\text{C}_2$
38. Which of the following reactions is used to estimate copper volumetrically ?
- (A)  $2\text{Cu}^{2+} + 4\text{CN}^- \longrightarrow \text{Cu}_2(\text{CN})_2 + (\text{CN})_2$
- (B)  $\text{Cu}^{2+} + 4\text{NH}_3 \longrightarrow [\text{Cu}(\text{NH}_3)_4]^{2+}$
- (C)  $2\text{Cu}^{2+} + 2\text{CNS}^- + \text{SO}_2 + 2\text{H}_2\text{O} \longrightarrow \text{Cu}_2(\text{CNS})_2 + \text{H}_2\text{SO}_4 + 2\text{H}^+$
- (D)  $2\text{Cu}^{2+} + 4\text{I}^- \longrightarrow \text{Cu}_2\text{I}_2 + \text{I}_2$
39. Atomic size of gold is almost the same as that of silver. It is due to :
- (A) the same crystal structure of silver and gold
- (B) almost the same electropositive character of the two metals
- (C) transition metals contraction in a series
- (D) the effect of lanthanide contraction
40. Which of the following compounds is most sensitive of light ?
- (A) AgCl (B) AgCN (C) AgI (D) AgBr

CHECK YOUR GRASP					ANSWER KEY						EXERCISE-1				
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	B	C	A	C	B	A	D	D	C	D	C	A	B	A	B
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	A	C	D	C	B	A	A	B	B	A	B	A	A	A	A
Que.	31	32	33	34	35	36	37	38	39	40					
Ans.	B	A	B	A	B	B	C	D	D	D					

**EXERCISE-02****BRAIN TEASERS****SELECT THE CORRECT ALTERNATIVES (ONE OR MORE THEN ONE CORRECT ANSWERS)**

1. An inorganic salt is lemon yellow in colour. It becomes orange in colour like methyl orange when it is acidic and again becomes yellow when it is alkaline. The inorganic salt will be :  
(A) Copper nitrate (B) Ferric chloride  
(C) Potassium chromate (D) Potassium ferri cyanide
2. Magnetic moment  $\sqrt{35}$  is true for which of the following pair :  
(A)  $\text{Co}^{+2}$ ,  $\text{Fe}^{+2}$  (B)  $\text{Fe}^{+3}$ ,  $\text{Mn}^{+2}$  (C)  $\text{Co}^{+3}$ ,  $\text{Cr}^{+2}$  (D)  $\text{Fe}^{+2}$ ,  $\text{Mn}^{+2}$
3.  $\text{Fe}^{+3}$  is more stable than  $\text{Fe}^{+2}$ , the reason is/are :  
(A) 1<sup>st</sup> and 2<sup>nd</sup> I.P. difference is less than 11.0 eV  
(B) Core of  $\text{Fe}^{+3}$  is more stable  
(C) 2<sup>nd</sup> and 3<sup>rd</sup> IP difference is less than 11.0 eV  
(D) IP of  $\text{Fe}^{+3}$  is high
4. Addition of non-metals like B and C to the interstitial sites of a transition metal results the metal :  
(A) of more ductability (B) of less ductability  
(C) Less malleable (D) of more hardness
5. The metal(s) which does/do not form amalgam is/are :  
(A) Fe (B) Pt (C) Zn (D) Ag
6. Correct statement(s) is/are :  
(A) An acidified solution of  $\text{K}_2\text{Cr}_2\text{O}_7$  liberates iodine from KI  
(B)  $\text{K}_2\text{Cr}_2\text{O}_7$  is used as a standard solution for estimation of  $\text{Fe}^{2+}$  ions  
(C) In acidic medium,  $N = M/6$  for  $\text{K}_2\text{Cr}_2\text{O}_7$   
(D)  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$  on heating decomposes to yield  $\text{Cr}_2\text{O}_3$  through an endothermic reaction
7. The highest oxidation state shown by transition element is :  
(A) + 7 by Mn (B) + 8 by Os (C) + 8 by Ru (D) + 7 by Fe
8. A compound of mercury used in cosmetics, in Ayurvedic and Yunani medicines and known as Vermilion is :  
(A)  $\text{HgCl}_2$  (B)  $\text{HgS}$  (C)  $\text{Hg}_2\text{Cl}_2$  (D)  $\text{HgI}$
9. Acidified chromic acid +  $\text{H}_2\text{O}_2 \longrightarrow \text{X} + \text{Y}$ , X and Y are :  
(Blue colour)  
(A)  $\text{CrO}_5$  and  $\text{H}_2\text{O}$  (B)  $\text{Cr}_2\text{O}_3$  and  $\text{H}_2\text{O}$   
(C)  $\text{CrO}_2$  and  $\text{H}_2\text{O}$  (D)  $\text{CrO}$  and  $\text{H}_2\text{O}$
10.  $\uparrow \text{Y(g)} \xleftarrow{\text{KI}} \text{CuSO}_4 \xrightarrow{\text{dil H}_2\text{SO}_4} \text{X(Blue colour)}$ , X and Y are :  
(A)  $\text{X} = \text{I}_2$ ,  $\text{Y} = [\text{Cu}(\text{H}_2\text{O})_4]^{2+}$  (B)  $\text{X} = [\text{Cu}(\text{H}_2\text{O})_4]^{2+}$ ,  $\text{Y} = \text{I}_2$   
(C)  $\text{X} = [\text{Cu}(\text{H}_2\text{O})_4]^+$ ,  $\text{Y} = \text{I}_2$  (D)  $\text{X} = [\text{Cu}(\text{H}_2\text{O})_5]^{2+}$ ,  $\text{Y} = \text{I}_2$
11.  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$  (Ammonium dichromate) is used in fire works. The green coloured powder blown in air is :  
(A)  $\text{Cr}_2\text{O}_3$  (B)  $\text{CrO}_2$  (C)  $\text{Cr}_2\text{O}_4$  (D)  $\text{CrO}_3$

12. Iron becomes passive by.....due to formation of..... :

- (A) dil. HCl, Fe<sub>2</sub>O<sub>3</sub> (B) Aqua-regia, Fe<sub>3</sub>O<sub>4</sub>  
 (C) conc. H<sub>2</sub>SO<sub>4</sub>, Fe<sub>3</sub>O<sub>4</sub> (D) conc. HCl, Fe<sub>3</sub>O<sub>4</sub>



13.  $\begin{array}{l} \xrightarrow{+ ye^- \text{ (Acidic medium)}} \text{Mn}^{+2} \\ \xrightarrow{+ ze^- \text{ (Natural medium)}} \text{MnO}_2 \end{array}$  x, y and z are respectively :

- (A) 1, 2, 3 (B) 1, 5, 3 (C) 1, 3, 5 (D) 5, 3, 1

14. In the equation :  $\text{M} + 8 \text{CN}^- + 2\text{H}_2\text{O} + \text{O}_2 \longrightarrow 4[\text{M}(\text{CN})_2]^- + 4\text{OH}^-$ , metal M is :

- (A) Ag (B) Au (C) Cu (D) Hg

15. Amongst CuF<sub>2</sub>, CuCl<sub>2</sub> and CuBr<sub>2</sub> :

- (A) Only CuF<sub>2</sub> is ionic  
 (B) Both CuCl<sub>2</sub> and CuBr<sub>2</sub> are covalent  
 (C) CuF<sub>2</sub> and CuCl<sub>2</sub> are ionic but CuBr<sub>2</sub> is covalent  
 (D) CuF<sub>2</sub>, CuCl<sub>2</sub> as well as CuBr<sub>2</sub> are ionic

16. A metal M which is not affected by strong acids like conc. HNO<sub>3</sub>, conc. H<sub>2</sub>SO<sub>4</sub> and conc. solution of alkalis like NaOH, KOH forms MCl<sub>3</sub> which finds use for toning in photography. The metal M is :

- (A) Ag (B) Hg (C) Au (D) Cu

17.  $\text{CuSO}_4(\text{aq.}) + 4\text{NH}_3 \longrightarrow \text{X}$ , then X is :

- (A)  $[\text{Cu}(\text{NH}_3)_4]^{2+}$  (B) Paramagnetic  
 (C) Coloured (D) Of a magnetic moment of 1.73 BM

18. Number of moles of SnCl<sub>2</sub> required for the reduction of K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> into Cr<sub>2</sub>O<sub>3</sub> is (in acidic medium) :

- (A) 3 (B) 2 (C) 1 (D) 1/3

19. Acidified KMnO<sub>4</sub> can be decolourised by :

- (A) SO<sub>2</sub> (B) H<sub>2</sub>O<sub>2</sub> (C) FeSO<sub>4</sub> (D) FeCl<sub>3</sub>

20. The Ziegler-Natta catalyst used for polymerisation of ethene and styrene is TiCl<sub>4</sub> + (C<sub>2</sub>H<sub>5</sub>)<sub>3</sub>Al, the catalysing species (active species) involved in the polymerisation is :

- (A) TiCl<sub>4</sub> (B) TiCl<sub>3</sub> (C) TiCl<sub>2</sub> (D) TiCl

21. Which of the following reaction is possible at anode?

- (A)  $2\text{Cr}^{3+} + 7\text{H}_2\text{O} \longrightarrow \text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+$  (B)  $\text{F}_2 \longrightarrow 2\text{F}^-$   
 (C)  $\frac{1}{2}\text{O}_2 + 2\text{H}^+ \longrightarrow \text{H}_2\text{O}$  (D) None of these

22. Colourless solution of the following four salts are placed separately in four different test tubes and a strip of copper is dipped in each one of these. Which solution will turn blue?

- (A) KNO<sub>3</sub> (B) AgNO<sub>3</sub> (C) Zn(NO<sub>3</sub>)<sub>2</sub> (D) ZnSO<sub>4</sub>

23. Cuprous chloride is obtained from cupric chloride :

- (A) By heating cupric chloride with chlorine  
 (B) By the electrolysis of cupric chloride containing HCl  
 (C) By heating cupric chloride with conc. HCl and copper turnings  
 (D) By passing H<sub>2</sub> over CuCl<sub>2</sub>

24. When excess of sodium thiosulphate is added to dil.  $\text{AgNO}_3$  solution a soluble compound X is formed. However, when dil.  $\text{Na}_2\text{S}_2\text{O}_3$  solution is added to conc.  $\text{AgNO}_3$  solution a white ppt. turning yellow and finally black ppt. of Y is obtained. Which is correct pair. :

(A) X is  $\text{Ag}_2\text{S}$  and Y is  $\text{Na}_3[\text{Ag}(\text{S}_2\text{O}_3)_2]$   
 (B) X is  $\text{Na}_3[\text{Ag}(\text{S}_2\text{O}_3)_2]$  and Y is  $\text{Ag}_2\text{S}$   
 (C) X is  $\text{Ag}_2\text{S}_2\text{O}_3$  and Y is  $\text{Ag}_2\text{S}$   
 (D) X is  $\text{Ag}_2\text{S}_2\text{O}_3$  and Y is  $\text{Na}_3[\text{Ag}(\text{S}_2\text{O}_3)_2]$

25. Carat is a measure of :

(A) Impure gold (B) Purity of gold  
 (C) Pure gold (D) None of these

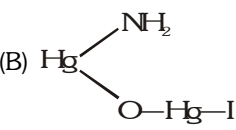
26. Fulminating gold is :

(A)  $\text{CuFeS}_2$  (B)  $\text{FeS}_2$   
 (C)  $\text{Au}(\text{NH}_2) = \text{NH}$  or  $\text{AuN}_2\text{H}_3$  (D)  $\text{AuCl}_3$

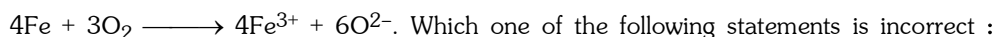
27. In the reaction  $\text{HgCl}_2 + 4\text{KI} \longrightarrow \text{A} + 2\text{KCl}$ , A is :

(A)  $\text{HgI}_2$  (B)  $\text{K}_2\text{HgI}_3$  (C)  $\text{K}_2\text{HgI}_4$  (D)  $\text{KHgI}_3$

28. Iodide of Millon's base is :

(A)  $\text{K}_2[\text{HgI}_4]$  (B)   
 (C)  $[\text{Hg}_2\text{O}.\text{NH}_2\text{OH}].\text{H}_2\text{O}$  (D)  $\text{Hg}(\text{NH}_2)\text{I} + \text{Hg}$

29. The following reaction describes the rusting of iron,



(A) This is an example of a redox reaction  
 (B) Metallic iron is reduced to  $\text{Fe}^{2+}$   
 (C)  $\text{Fe}^{3+}$  is an oxidising agent  
 (D) Metallic iron is a reducing agent

30. Which of the following chemical reaction(s) is (are) involved in the developing of photographic plate ?

(A)  $\text{C}_6\text{H}_4(\text{OH})_2 + 2\text{AgBr} \longrightarrow 2\text{Ag} + \text{C}_6\text{H}_4\text{O}_2 + 2\text{HBr}$   
 (B)  $\text{AgBr} + 2\text{Na}_2\text{S}_2\text{O}_3 \longrightarrow \text{Na}_3[\text{AgS}_2\text{O}_3] + \text{NaBr}$   
 (C)  $\text{AgBr} + 2\text{NH}_3(\text{aq}) \longrightarrow [\text{Ag}(\text{NH}_3)_2] \text{Br}$   
 (D)  $2\text{AgBr} + \text{Na}_2\text{S}_2\text{O}_3 \longrightarrow \text{Ag}_2\text{S}_2\text{O}_3 + 2\text{NaBr}$

31. Which of the following statement(s) is (are) not correct with reference to ferrous and ferric ions

(A)  $\text{Fe}^{3+}$  gives brown colour with potassium ferricyanide  
 (B)  $\text{Fe}^{2+}$  gives blue ppt with potassium ferricyanide  
 (C)  $\text{Fe}^{3+}$  gives red colour with potassium sulphocyanide  
 (D)  $\text{Fe}^{2+}$  gives brown colour with potassium sulphocyanide

32.  $\text{KMnO}_4$  on treatment with conc.  $\text{H}_2\text{SO}_4$  forms a compound (X) which decomposes explosively on heating forming (Y). The (X) and (Y) are respectively :
- (A)  $\text{Mn}_2\text{O}_7$ ,  $\text{MnO}_2$  (B)  $\text{Mn}_2\text{O}$ ,  $\text{Mn}_2\text{O}_3$  (C)  $\text{MnSO}_4$ ,  $\text{Mn}_2\text{O}_3$  (D)  $\text{Mn}_2\text{O}_3$ ,  $\text{MnO}_2$
33. The hydrated cupric chloride is strongly heated. Which of the following statement(s) is (are) correct for this :
- (A) It is reduced to  $\text{Cu}_2\text{Cl}_2$  (B) Cupric oxide is formed along with  $\text{Cu}_2\text{Cl}_2$   
 (C) Only  $\text{Cl}_2$  is liberated (D)  $\text{Cl}_2$  and  $\text{HCl}$  both are liberated
34. Select the incorrect statement(s) :
- (A) In  $\text{K}_2\text{MnO}_4$  and  $\text{CrO}_2\text{Cl}_2$ , The central transition metals/ions have the same oxidation state.  
 (B) Both sodium and potassium dichromate can be used as primary standard in volumetric estimations.  
 (C) Potassium dichromate on strong heating evolves oxygen gas and forms green powder.  
 (D) Potassium permanganate on heating with solid  $\text{KOH}$  evolves oxygen gas and forms a black powder.
35. Cuprous chloride can not be prepared :
- (A) by passing  $\text{SO}_2$  through the solution containing  $\text{CuSO}_4$  and  $\text{NaCl}$   
 (B) by heating excess of copper with conc.  $\text{HCl}$  in presence of a little  $\text{KClO}_3$   
 (C) by boiling copper sulphate solution with excess of copper turnings in presence of hydrochloric acid  
 (D) by dissolving cupric oxide or copper carbonate in conc.  $\text{HCl}$
36. Which of the following ion is not coloured ?
- (A)  $\text{Ni}(\text{DMG})_2$  (B)  $[\text{Co}(\text{SCN})_4]^{2-}$  (C)  $[\text{Fe}(\text{H}_2\text{O})_5\text{SCN}]^{2+}$  (D)  $[\text{Al}(\text{OH})_4]^-$
37. The total spin and paramagnetism (B.M.) of ferrocyanide ion are respectively :
- (A)  $0, 2\sqrt{6}$  (B)  $5/2, \sqrt{35}$  (C)  $2, \sqrt{24}$  (D)  $1, 2\sqrt{2}$
38. Which is not correct about  $\text{FeO}_{0.94}$  ?
- (A) It is non-stoichiometric compound  
 (B) Some of  $\text{Fe}^{2+}$  ions get replaced by as many two third  $\text{Fe}^{3+}$  ions  
 (C) It is metal excess solid  
 (D) It is metal deficient solid.
39. The transition metal used in X-rays tube is :
- (A) Mo (B) Ta (C) Tc (D) Pm
40. The reagent used in the gravimetric analysis of  $\text{Co}^{2+}$  ion is :
- (A) DMG (B)  $\alpha$ -nitro- $\beta$ -naphthol (C)  $\beta$ -nitro- $\alpha$ -naphthol (D)  $\text{K}_4[\text{Fe}(\text{CN})_6]$

BRAIN TEASERS					ANSWER KEY						EXERCISE-2				
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	C	B	B, C	B,C,D	A,B	A,B,C	B,C	B	B	B	A	B	B	B	A,B
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	C	A,B,C,D	A	A,B,C	B	A	B	C	B	B	C	C	B	B	A,B
Que.	31	32	33	34	35	36	37	38	39	40					
Ans.	D	A	A,B,D	B,D	D	D	C	C	A	B					



**EXERCISE-03****MISCELLANEOUS TYPE QUESTIONS****TRUE / FALSE**

1.  $\text{Fe}_3\text{O}_4$  is mixed oxide of  $\text{FeO}$  and  $\text{Fe}_2\text{O}_3$ .
2. Acidic potassium permanganate is used in organic chemistry under the name Baeyer's reagent.
3. Cast iron has the maximum percentage of carbon.
4. No rusting takes place in absence of moisture.
5. Silver is found in nature both in native and combined state.
6. Copper dissolves in hydrochloric acid.

**FILL IN THE BLANKS**

1. ....ion show maximum paramagnetic character among the bivalent ions of first transition on series.
2. The salts ..... and ..... are isostructural ( $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ ,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ,  $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ ,  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ )
3. Which one of the following  $\text{CuCl}_2$ ,  $\text{CaCl}_2$  or  $\text{CdCl}_2$  is paramagnetic in character .....
4. The chromate ion in acidic medium changes to .....
5. Among the ion,  $\text{Sc}^{3+}$ ,  $\text{V}^{3+}$  and  $\text{Cr}^{3+}$ , the ion that gives colourless compound is.....

**MATCH THE COLUMN**

1.

Column-I (Metals)	
(A)	Zn
(B)	Cu
(C)	Ag
(D)	Pt

Column-II (Ores)	
(p)	Cyanide process
(q)	hydrometallurgical process
(r)	roasting
(s)	brass.

2.

Column-I (Alloys)	
(A)	TiCl <sub>4</sub>
(B)	PdCl <sub>2</sub>
(C)	Pt/PtO
(D)	Cu

Column-II (Constituents)	
(p)	Adams catalyst in reduction
(q)	In preparation of (CH <sub>3</sub> ) <sub>2</sub> SiCl <sub>2</sub>
(r)	Used as the Natta catalyst in polythene production
(s)	Wake process for converting C <sub>2</sub> H <sub>4</sub> to CH <sub>3</sub> CHO

**ASSERTION & REASON QUESTIONS**

These questions contains, Statement-I (assertion) and Statement-II (reason).

- (A) Statement-I is True, Statement-II is True ; Statement-II is a correct explanation for Statement-I  
 (B) Statement-I is True, Statement-II is True ; Statement-II is NOT a correct explanation for Statement-I  
 (C) Statement-I is True, Statement-II is False.  
 (D) Statement-I is False, Statement-II is True.

1. **Statement-I** : General formula of transition element is  $(n-1)d^{1-10} ns^{1-2}$   
**Because**  
**Statement-II** : Transition element have 10 electrons in  $(n-1)d$  orbitals.

2. **Statement-I** : 1<sup>st</sup> ionisation potential of mercury is greater than cadmium.  
**Because**  
**Statement-II** : Hg has stable electronic configuration (5d<sup>10</sup> 6s<sup>2</sup>).
3. **Statement-I** : Cu<sup>+</sup> is more stable than Cu<sup>+2</sup>.  
**Because**  
**Statement-II** :  $\Delta IP$  is greater than 16 eV
4. **Statement-I** : AgI is coloured while AgF is colourless.  
**Because**  
**Statement-II** : Unpaired electron is present in AgI
5. **Statement-I** : Change in colour of acidic solution of potassium dichromate by breath is used to test drunk drivers.  
**Because**  
**Statement-II** : Change in colour is due to the complexation of alcohol with potassium dichromate.
6. **Statement-I** : K<sub>2</sub>CrO<sub>4</sub> has yellow colour due to charge transfer.  
**Because**  
**Statement-II** : CrO<sub>4</sub><sup>2-</sup> ion is tetrahedral in shape.
7. **Statement-I** : CrO<sub>3</sub> reacts with HCl to form chromyl chloride gas.  
**Because**  
**Statement-II** : Chromyl chloride (CrO<sub>2</sub>Cl<sub>2</sub>) has tetrahedral shape.
8. **Statement-I** : Zinc does not show characteristic properties of transition metals.  
**Because**  
**Statement-II** : In zinc outermost shell is completely filled
9. **Statement-I** : Equivalent mass of KMnO<sub>4</sub> is equal to one-third of its molecular mass when it acts as an oxidising agent in an alkaline medium.  
**Because**  
**Statement-II** : Oxidation number of Mn is +7 in KMnO<sub>4</sub>

### COMPREHENSION BASED QUESTIONS

#### Comprehension # 1

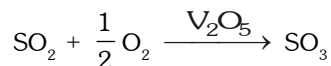
Hg shows two oxidation states (I) and (II) in its compounds. Chemistry of Hg(I) is interesting as Hg<sup>+</sup> does not exist. It has been proved on the basis of magnetic moment determination and equilibrium studies on Hg(I) and Hg(II) salts. It is interesting to note that Hg(I) salts are diamagnetic, yet Hg<sup>+</sup> contains unpaired electron. In solutions Hg<sub>2</sub><sup>2+</sup> disproportionates as :  $Hg_2^{2+} \rightleftharpoons Hg_{(l)} + Hg^{2+}$ , but equilibrium constant is very low. But when anions like S<sup>2-</sup> are added the formation of insoluble HgS promotes the disproportionation. The same reason is used to explain non-existence of some mercurous salts.

1. The equilibrium established when HgCl<sub>2</sub> is shaken with excess of Hg is :  
 (A)  $Hg^{2+} + Hg \rightleftharpoons 2Hg^+$  (B)  $Hg^{2+} + Hg_{(l)} \rightleftharpoons Hg_2^{2+}$   
 (C)  $Hg + 2Hg^{2+} \rightleftharpoons Hg_2^{2+} + 2Hg^+$  (D) No equilibrium is established
2. In an experiment when placed in weak magnetic field, calomel was slightly repelled by the magnetic field. This experimental observation suggests that :  
 (A) Hg<sup>+</sup> ion has no unpaired electron  
 (B) Mercurous ion has formula Hg<sub>2</sub><sup>2+</sup> instead of Hg<sup>+</sup>  
 (C) This experimental observation is not correct and actually mercurous salts are paramagnetic due to 6s unpaired electron  
 (D) Sometimes mercurous ion may exist as Hg<sub>2</sub><sup>2+</sup>
3. Which is well known compound :  
 (A) Hg<sub>2</sub>S (B) Hg<sub>2</sub>O (C) Hg<sub>2</sub>Cl<sub>2</sub> (D) All of the above

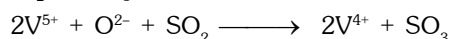
4.  $\text{Hg}_2\text{Cl}_2$  on treatment with alkali gives red solid which is :  
 (A)  $\text{Hg}_2\text{O}$  (B)  $\text{HgO}$  (C)  $\text{Hg}_2(\text{OH})_2$  (D)  $\text{Hg}(\text{OH})_2$

### Comprehension # 2

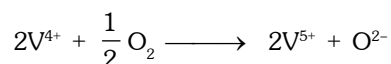
Transition metal and their compounds are used as catalysts in industry and in biological system. For example, in the Contact process, vanadium compounds in the +5 state ( $\text{V}_2\text{O}_5$  or  $\text{VO}_3^-$ ) are used to oxidise  $\text{SO}_2$  to  $\text{SO}_3$ :



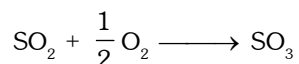
It is thought that the actual oxidation process takes place in two stages. In the first step,  $\text{V}^{5+}$  in the presence of oxide ions converts  $\text{SO}_2$  to  $\text{SO}_3$ . At the same time,  $\text{V}^{5+}$  is reduced to  $\text{V}^{4+}$ .



In the second step,  $\text{V}^{5+}$  is regenerated from  $\text{V}^{4+}$  by oxygen :



The overall process is, of course, the sum of these two steps:



- Transition metals and their compounds catalyse reactions because :  
 (A) They have completely filled s-subshell  
 (B) They have a comparable size due to poor shielding of d-subshell  
 (C) They introduce an entirely new reaction mechanism with a lower activation energy  
 (D) They have variable oxidation states differ by two units
- During the course of the reaction :  
 (A) Catalyst undergoes changes in oxidation state  
 (B) Catalyst increases the rate constant  
 (C) Catalyst is regenerated in its original form when the reactants form the products  
 (D) All are correct.
- Catalytic activity of transition metals depends on :  
 (A) Their ability to exist in different oxidation states  
 (B) The size of the metal atoms  
 (C) The number of empty atomic orbitals available  
 (D) None of these
- Which of the following ion involved in the above process will show paramagnetism?  
 (A)  $\text{V}^{5+}$  (B)  $\text{V}^{4+}$  (C)  $\text{O}^{2-}$  (D)  $\text{VO}_3^-$

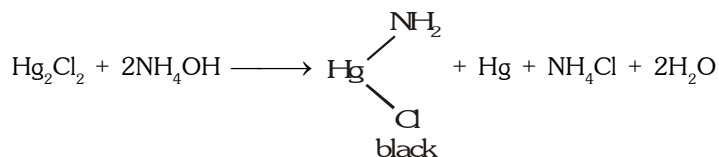
MISCELLANEOUS TYPE QUESTION	ANSWER KEY	EXERCISE -3
<ul style="list-style-type: none"> <li><b>True / False</b>            1. T    2. F    3. F    4. T    5. T    6. F</li> <li><b>Fill in the Blanks</b>            1. <math>\text{Mn}^{+2}</math>    2. <math>\text{FeSO}_4 \cdot 7\text{H}_2\text{O}</math>, <math>\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}</math>    3. <math>\text{CuCl}_2</math>    4. <math>\text{Cr}_2\text{O}_7^{-2}</math>    5. <math>\text{Sc}^{+3}</math></li> <li><b>Match the Column</b>            1. (A) <math>\rightarrow</math> r,s; (B) <math>\rightarrow</math> r,s ; (C) <math>\rightarrow</math> p,q ; (D) <math>\rightarrow</math> p    2. (A) <math>\rightarrow</math> r ; (B) <math>\rightarrow</math> s ; (C) <math>\rightarrow</math> p ; (D) <math>\rightarrow</math> q</li> <li><b>Assertion - Reason Questions</b>            1.C    2.B    3.D    4. C    5. C    6.B    7.B    8.C    8.B</li> <li><b>Comprehension Based Questions</b>            Comprehension #1 : 1. B    2. B    3. C    4. B            Comprehension #2 : 1. C    2. D    3. A    4. B</li> </ul>		

**EXERCISE-04 [A]****CONCEPTUAL SUBJECTIVE EXERCISE**

---

1. What happens when excess of ammonia is added to  $\text{CuSO}_4$  solution ?
  2. Why does  $\text{AgCl}$  dissolve in ammonia solution ?
  3. Why is that orange solution of  $\text{K}_2\text{Cr}_2\text{O}_7$  turns yellow on adding  $\text{NaOH}$  to it ?
  4. Name one ore of manganese and chromium.
  5. The electronic configuration of  $\text{Co}^{2+}$  and  $\text{Cu}^{2+}$  is  $d^7$  and  $d^9$  respectively, which of these ions is expected to be more paramagnetic ?
  6. Write the highest oxidation state shown by element with atomic number 23
  7. One unpaired electron in atom contributes a magnetic moment of 1.1 BM. Calculate the magnetic moment of Cr (At. No. 24)
  8. Why first ionisation energy of Cu is higher than that of sodium ?
  9. Which is more stable  $\text{Fe}^{2+}$  or  $\text{Fe}^{3+}$  and why ?
  10. Why is  $\text{KMnO}_4$  kept in dark bottles ?
  11. What is Baeyer's reagent ?
  12. Account for the following that enthalpies of atomisation of transition elements are quite high.
  13. Which d-block element is not normally considered as transition elements ?
  14. Transition metals are weak reducing agents. Why?
  15. Zinc but not copper is used for the recovery of silver from the complex  $[\text{Ag}(\text{CN})_2]$ . Why?
  16. Explain : Blue colour of  $\text{CuSO}_4$  solution is discharged slowly when an iron rod is dipped into it.
  17. Explain : Green solution of potassium manganate (VI)  $\text{K}_2\text{MnO}_4$  turns purple and a brown solid is precipitated when  $\text{CO}_2$  is bubbled into the solution.
  18. Explain : When  $\text{Mn}(\text{OH})_2$  is made by adding an alkali to a solution containing  $\text{Mn}^{2+}$  ions, the ppt quickly darkens, and eventually goes black.
  19. Explain : A deep blue colour is produced when  $\text{Fe}^{2+}$  reacts with  $\text{K}_3[\text{Fe}(\text{CN})_6]$
  20. Explain : The colour of mercurous chloride changes from white to black when treated with ammonia solution.
-

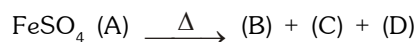
1.  $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$
2. Complex formation  $[\text{Ag}(\text{NH}_3)_2]\text{Cl}$
4. Pyrolusite =  $\text{MnO}_2$   
Chromite =  $\text{FeO} \cdot \text{Cr}_2\text{O}_3$   
 $\text{Fe}(\text{CrO}_2)_2$   
 $\text{FeCr}_2\text{O}_4$
5.  $\text{Co}^{+2}$  = more paramagnetic  
 $d^7 = n = 3$                        $\text{Cu}^{+2} = d^9 = n = 1$
6. + 5
7.  $\text{Cr} = 3d^5 4s^1$   
 $n = 6$   
 $\mu = 6.6$
8. Small size and maximum zeff of Cu than Na
9.  $\text{Fe}^{+3} > \text{Fe}^{+2}$   
 $3d^5$                        $3d^6$   
Half filled              Incomplete
10.  $\text{KMnO}_4$  is photosensitive.
12. Strong metallic bond strength.
13. IIB or 12 or volatile metal (Zn, Cd, Hg)
14. Due to high heat of sublimation, high ionisation energy and low  $E_{\text{R.P.}}^0$ .
15. Zinc is cheaper as well as strong reducing agent than Cu and replaces Ag from complex.
16. Iron is above copper in electrochemical series.
17.  $\text{CO}_2$  in aqueous solution gives bicarbonate and is acidic.  
 $\text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{CO}_3 \rightleftharpoons \text{H}^+ + \text{HCO}_3^-$   
(purple by oxidation) and  $\text{MnO}_2$  (brown solid, by reduction)
18. The black colour is due to the manganese (VI) oxide  $\text{MnO}_2$ . It is made by the  $\text{Mn}(\text{OH})_2$  being oxidized by oxygen in air
19.  $\text{Fe}^{\text{II}}\text{SO}_4 + \text{K}_3[\text{Fe}^{\text{III}}(\text{CN})_6] \longrightarrow \text{KFe}^{\text{II}}[\text{Fe}^{\text{III}}(\text{CN})_6]$   
Turn bull's blue (deep blue colour)
20.  $\text{Hg}_2\text{Cl}_2$  absorbs  $\text{NH}_3$  to form a mixture of mercury and mercuric qminochloride, black substance.



**EXERCISE-04 [B]****BRAIN STORMING SUBJECTIVE EXERCISE**

1. What happens when silver sulphide is shaken with NaCN solution ?
2. Give the formula of the complex used in electroplating of object by silver.
3. What is the coordination entity formed when excess of aqueous KCN is added to an aqueous solution of copper sulphate? Why is it that no precipitate of copper sulphide is obtained when  $\text{H}_2\text{S}(\text{g})$  is passed through this solution?
4. Why are the compounds of transition metal generally coloured ?
5. Why HCl not used to acidify a  $\text{KMnO}_4$  solutions in volumetric estimations of  $\text{Fe}^{2+}$  or  $\text{C}_2\text{O}_4^{2-}$  ?
6. Why is  $\text{K}_2\text{Cr}_2\text{O}_7$  generally preferred over  $\text{Na}_2\text{Cr}_2\text{O}_7$  in volumetric analysis although both are oxidising agents ?
7.  $\text{K}_2\text{PtCl}_6$  is well known compound whereas corresponding Ni compound is not known .  
Explain
8. Complete the following :  
$$\text{TiCl}_4 + \text{H}_2\text{O} \rightarrow$$
9. What is the percentage of gold in 22 carat gold ?
10. Why do the transition metals exhibit higher enthalpies of atomisation ?
11. (a) Of the ions  $\text{Ag}^+$ ,  $\text{Co}^{2+}$ ,  $\text{Ti}^{4+}$ , which one will be coloured in aqueous solutions.  
[Atomic no : Ag = 47, Co = 27, Ti = 22]  
(b) If each one of the above ionic species is in turn kept in a magnetic field, how will it respond and why ?
12. Write balanced equations for the reaction between  $\text{K}_2\text{Cr}_2\text{O}_7$  and acidified solution :  
(i) Ferrous sulphate  
(ii) KI solution.
13. Describe the preparation of potassium permanganate. How does the acidified permanganate solution re-acts with  
(a) iron (II) ions  
(b)  $\text{SO}_2$   
(c) oxalic acid ?  
Write the ionic equation for the reactions.
14. What happens when aqueous ammonia reacts with :  
(a) Silver chloride                      (b) Mercury (I) chloride                      (c) Mercury (II) chloride ?
15. What are the equivalent weights of oxalic acid and potassium permanganate in their titration in acidic medium? (K=39, Mn=55)
16. Complete the following chemical equations :  
(i)  $\text{MnO}_2 + \text{KOH} + \text{O}_2 \xrightarrow{\text{Heat}}$   
(ii)  $\text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{S} + \text{H}^+ \longrightarrow$   
(iii)  $\text{I}^- + 2\text{MnO}_4^- + \text{H}_2\text{O} \longrightarrow \text{MnO}_2 + 2\text{OH}^- + \text{IO}_3^{-1}$
17. When  $\text{H}_2\text{S}$  is passed into  $\text{FeCl}_3$  solution yellow colour of  $\text{FeCl}_3$  changes to light green ? Explain.

18. Identify (A) to (F) in the following:



(C) and (D) are gases, (B) is red-brown solid, (C) can be oxidised to (D). (C) also turns  $\text{Cr}_2\text{O}_7^{2-}/\text{H}^+$  solution green. (B) dissolves in HCl forming deep yellow solution (E). (E) gives blue colour (F) with  $\text{K}_4[\text{Fe}(\text{CN})_6]$ . (D) dissolves in  $\text{H}_2\text{O}$  forming a well known mineral acid called "king of acids".

19. 2.78 g of  $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$  is treated with excess of  $\text{BaCl}_2$  then 2.33 g of white precipitate are obtained. Calculate the value of x. (Ba = 137, S = 32, Fe = 56, H = 1, O = 16).

20. Suggest a series of reactions, using common chemicals, by which each of the following synthesis can be performed:

(a)  $\text{Fe}(\text{OH})_3$  from FeS

(b)  $\text{BaCrO}_4$  from  $\text{BaCO}_3$  and  $\text{K}_2\text{Cr}_2\text{O}_7$

(c)  $\text{CrCl}_3$  from  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$

(d)  $\text{MnCO}_3$  from  $\text{MnO}_2$

21. A white amorphous powder (A) on heating yields a colourless, non combustible gas (B) and a solid (C). The later compound assumes a yellow colour on heating and changes to white on cooling. (C) dissolves in dilute acid and the resulting solution gives a white ppt. on adding  $\text{K}_4[\text{Fe}(\text{CN})_6]$  solution. (A) dissolves in dilute HCl with evolution of gas, which is identical in all respect to (B). The gas (B) turns lime water milky, but the milkiness disappears with the continuous passage of gas. The solution of (A) as obtained above gives a white precipitate (D) on the addition of excess  $\text{NH}_4\text{OH}$  and passing  $\text{H}_2\text{S}$ . Another portion of the solution initially gives a white precipitate (E) on the addition of NaOH solution, but dissolves on further addition of the base. Identify (A) to (E).

22. A compound (A) is greenish crystalline salt which gave the following results:

(i) Addition of  $\text{BaCl}_2$  solution to solution of (A) results in the formation of a white ppt. (B), which is insoluble in dil. HCl.

(ii) On heating (A), water vapours and two oxides of sulphur, (C) and (D) are liberated leaving a red brown residue (E).

(iii) (E) dissolves in warm conc. HCl to give a yellow solution (F).

(iv) With  $\text{H}_2\text{S}$ , the solution (F) yields a pale yellow ppt. (G), which when filtered, leaves a greenish filtrate (H).

(v) Solution (F) on treatment with thiocyanate ions gives blood red coloured compound (I).

Identify the substances from (A) to (I)

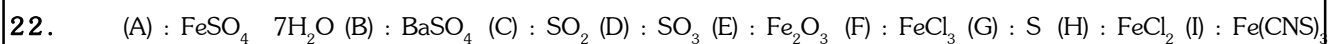
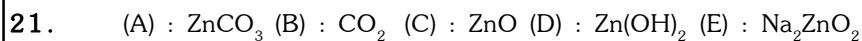
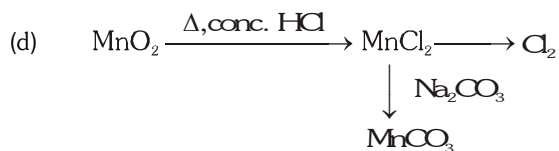
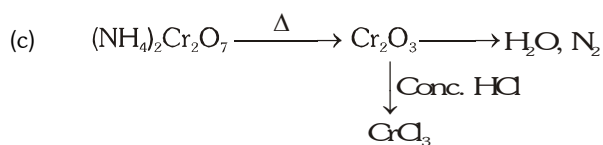
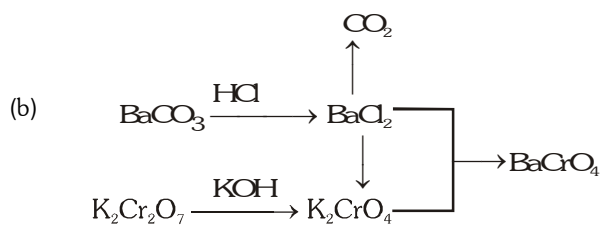
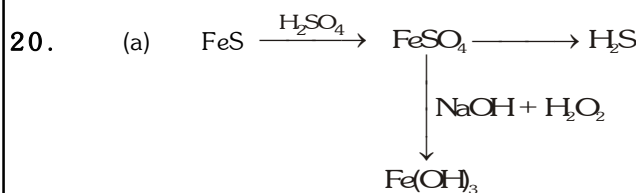
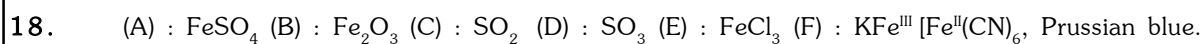
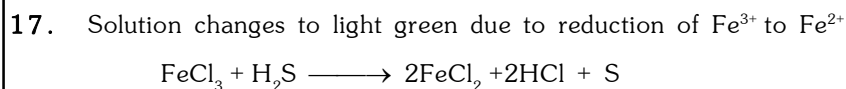
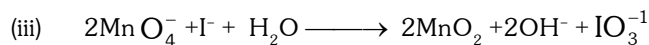
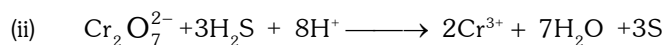
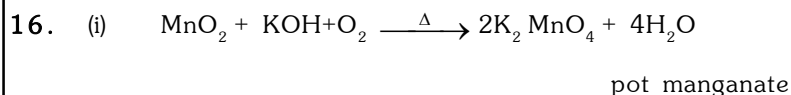
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1.  $\text{Ag}_2\text{S} + 4\text{NaCN} \rightarrow 2\text{Na}[\text{Ag}(\text{CN})_2] + \text{Na}_2\text{S}$
2.  $\text{Na}[\text{Ag}(\text{CN})_2]$
3.  $\text{CuSO}_4 + \text{KCN} \rightarrow \text{Cu}(\text{CN})_2$   
 $2\text{Cu}(\text{CN})_2 \rightarrow 2\text{CuCN} + \text{NC-CN}$  (Cyanogen)  
 $\text{CuCN} + \text{KCN} \rightarrow \text{K}_3[\text{Cu}(\text{CN})_4]$   
 $\text{K}_3[\text{Cu}(\text{CN})_4] \rightarrow 3\text{K}^+ + [\text{Cu}(\text{CN})_4]^{-3} \xrightarrow{\text{H}_2\text{S}} \text{no ppt}$
4. Due to presence of unpaired electron and d-d transition
5.  $\text{KMnO}_4$  oxidizes  $\text{HCl}$  to  $\text{Cl}_2$
6.  $\text{Na}_2\text{Cr}_2\text{O}_7$  is deliquescent in nature
7.  $\text{Pt}^{+4}$  is thermo dynamically more stable than  $\text{Ni}^{+4}$ .
8.  $\text{TiCl}_4 + \text{H}_2\text{O} \longrightarrow \text{Ti}(\text{OH})_4 + 4\text{HCl}$
10. Due to strong metallic bond strength
11. (a)  $\text{Ag}^+ = 5\text{d}^{10} \quad n = 0$   
 $\text{Ti}^{+4} = 3\text{s}^2 3\text{p}^6 \quad n = 0$   
 $\text{Co}^{+2} = [\text{Ar}] 3\text{d}^7 \quad n = 3$   
 (b)  $\text{Co}^{+2}$  attracted by a magnetic field due to presence of unpaired electron.
12. (i)  $\text{Cr}_2\text{O}_7^{-2} + 6\text{Fe}^{+2} + 14\text{H}^+ \longrightarrow 2\text{Cr}^{+3} + 6\text{Fe}^{+3} + 7\text{H}_2\text{O}$   
 (ii)  $\text{Cr}_2\text{O}_7^{-2} + 6\text{I}^- + 14\text{H}^+ \longrightarrow 2\text{Cr}^{+3} + 3\text{I}_2 + 7\text{H}_2\text{O}$
13. (a)  $2\text{MnO}_4^- + 16\text{H}^+ + 10\text{Fe}^{+2} \longrightarrow 2\text{Mn}^{+2} + 8\text{H}_2\text{O} + 10\text{Fe}^{+3}$   
 (b)  $2\text{MnO}_4^- + 5\text{SO}_2 + 2\text{H}_2\text{O} \longrightarrow 5\text{SO}_4^{-2} + 2\text{Mn}^{+2} + 4\text{H}^+$   
 (c)  $2\text{MnO}_4^- + 16\text{H}^+ + 5\text{C}_2\text{O}_4^{-2} \longrightarrow 2\text{Mn}^{+2} + 8\text{H}_2\text{O} + 10\text{CO}_2$
14. (a)  $\text{AgCl} + 2\text{NH}_4\text{OH} \longrightarrow [\text{Ag}(\text{NH}_3)_2] + 2\text{H}_2\text{O}$   
 (b)  $\text{Hg}_2\text{Cl}_2 + \text{NH}_3 \longrightarrow \text{Hg} + \text{HgNH}_2\text{Cl} + \text{NH}_4\text{Cl}$   
 (c)  $\text{HgCl}_2 + 2\text{NH}_3 \xrightarrow{\text{aq.}} \text{Hg}(\text{NH}_2)\text{Cl} + \text{NH}_4\text{Cl}$   
 Mercury aminochloride
15. In acidic medium

$$\text{Equivalent weight of oxalic acid} = \frac{90}{2} = 45$$



$$\text{Equivalent weight of KMnO}_4 = \frac{158}{5} = 31.6$$



**EXERCISE-05 [A]****PREVIOUS YEARS QUESTIONS**

- The radius of  $\text{La}^{3+}$  is  $1.06\text{\AA}$ , which of the following given values will be closest to the radius of  $\text{Lu}^{3+}$  (At no. of Lu = 71, La = 57)- [AIEEE-2003]
  - $1.6\text{\AA}$
  - $1.4\text{\AA}$
  - $1.06\text{\AA}$
  - $0.85\text{\AA}$
- What would happen when a solution of potassium chromate is treated with an excess of dilute nitric acid - [AIEEE-2003]
  - $\text{Cr}^{3+}$  and  $\text{Cr}_2\text{O}_7^{2-}$  are formed
  - $\text{Cr}_2\text{O}_7^{2-}$  and  $\text{H}_2\text{O}$  are formed
  - $\text{Cr}_2\text{O}_7^{2-}$  is reduced to +3 state of Cr
  - $\text{Cr}_2\text{O}_7^{2-}$  is oxidised to +7 state of Cr
- Cerium (Z = 58) is an important member of the lanthanoids. Which of the following statements about cerium is incorrect - [AIEEE-2004]
  - Cerium (IV) acts as an oxidising agent
  - The +3 oxidation state of cerium is more stable than the +4 oxidation state
  - The +4 oxidation state of cerium is not known in solutions
  - The common oxidation states of cerium are +3 and +4
- Excess of KI reacts with  $\text{CuSO}_4$  solution and then  $\text{Na}_2\text{S}_2\text{O}_3$  solution is added to it. Which of the statements is incorrect for this reaction : [AIEEE-2004]
  - Evolved  $\text{I}_2$  is reduced
  - $\text{CuI}_2$  is formed
  - $\text{Na}_2\text{S}_2\text{O}_3$  is oxidised
  - $\text{Cu}_2\text{I}_2$  is formed
- Calomel on reaction with  $\text{NH}_4\text{OH}$  gives [AIEEE-2004]
  - $\text{HgNH}_2\text{Cl}$
  - $\text{NH}_2\text{-Hg-Hg-Cl}$
  - $\text{Hg}_2\text{O}$
  - $\text{HgO}$
- The lanthanoid contraction is responsible for the fact that - [AIEEE-2005]
  - Zr and Y have about the same radius
  - Zr and Nb have similar oxidation state
  - Zr and Hf have about the same radius
  - Zr and Zn have similar oxidation state
- Lanthanoid contraction is caused due to [AIEEE-2006]
  - the same effective nuclear charge from Ce to Lu
  - the imperfect shielding on outer electrons by 4f electrons from the nuclear charge
  - the appreciable shielding on outer electrons by 4f electrons from the nuclear charge
  - the appreciable shielding on outer electrons by 5d electrons from the nuclear charge
- Identify the incorrect statement among the following- [AIEEE-2007]
  - d-block elements show irregular and erratic chemical properties among themselves
  - La and Lu have partially filled d-orbitals and no other partially filled orbitals
  - The chemistry of various lanthanoids is very similar
  - 4f and 5f-orbitals are equally shielded
- The actinoids exhibit more number of oxidation states in general than the lanthanoids. This is because - [AIEEE-2007]
  - The 5f-orbitals are more buried than the 4f-orbitals
  - There is a similarity between 4f and 5f in their angular part of the wave function
  - The actinoids are more reactive than the lanthanoids
  - The 5f-orbitals extend further from the nucleus than the 4f-orbitals
- Larger number of oxidation states are exhibited by the actinides than those by the lanthanides, the main reason being [AIEEE-2008]
  - 4f orbitals more diffused than the 5f orbitals
  - lesser energy difference between 5f and 6d than between 4f and 5d orbitals
  - more energy difference between 5f and 6d than between 4f and 5d orbitals
  - more reactive nature of the actinides than the lanthanides

11. In context with the transition elements, which of the following statements is incorrect ? [AIEEE-2009]  
 (1) In the highest oxidation states of the first five transition elements (Sc to Mn), all the 4s and 3d electrons are used for bonding.  
 (2) Once the  $d^5$  configuration is exceeded, the tendency to involve all the 3d electrons in bonding decreases.  
 (3) In addition to the normal oxidation states, the zero oxidation state is also shown by these elements in complexes.  
 (4) In the highest oxidation states, the transition metal show basic character and form cationic complexes.
12. Knowing that the chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state, which of the following statements is incorrect ? [AIEEE-2009]  
 (1) Ln(III) compounds are generally colourless  
 (2) Ln(III) hydroxides are mainly basic in character  
 (3) Because of the large size of the Ln(III) ions the bonding in its compounds is predominantly ionic in character  
 (4) The ionic sizes of Ln(III) decrease in general with increasing atomic number
13. In context of the lanthanoids, which of the following statements is not correct ? [AIEEE-2011]  
 (1) Because of similar properties the separation of lanthanoids is not easy  
 (2) Availability of 4f electrons results in the formation of compounds in +4 state for all the members of the series  
 (3) There is a gradual decrease in the radii of the members with increasing atomic number in the series  
 (4) All the members exhibit +3 oxidation state
14. Iron exhibits +2 and +3 oxidation states. Which of the following statements about iron is **incorrect** ? [AIEEE-2012]  
 (1) Ferrous compounds are more easily hydrolysed than the corresponding ferric compounds.  
 (2) Ferrous oxide is more basic in nature than the ferric oxide.  
 (3) Ferrous compounds are relatively more ionic than the corresponding ferric compounds.  
 (4) Ferrous compounds are less volatile than the corresponding ferric compounds.
15. Which of the following arrangements does not represent the correct order of the property stated against it ? [JEE MAINS-2013]  
 (1)  $V^{2+} < Cr^{2+} < Mn^{2+} < Fe^{2+}$  : paramagnetic behaviour  
 (2)  $Ni^{2+} < Co^{2+} < Fe^{2+} < Mn^{2+}$  : ionic size  
 (3)  $Co^{3+} < Fe^{3+} < Cr^{3+} < Sc^{3+}$  : stability in aqueous solution  
 (4)  $Sc < Ti < Cr < Mn$  : number of oxidation states
16. Four successive members of the first row transition elements are listed below with atomic numbers. Which one of them is expected to have the highest  $E_{M^{3+}/M^{2+}}^0$  value ? [JEE MAINS-2013]  
 (1) Cr(Z = 24) (2) Mn(Z = 25)  
 (3) Fe (Z = 26) (4) Co(Z = 27)
17. Experimentally it was found that a metal oxide has formula  $M_{0.98}O$ . Metal M, is present as  $M^{2+}$  and  $M^{3+}$  in its oxide. Fraction of the metal which exists as  $M^{3+}$  would be :- [JEE MAINS-2013]  
 (1) 7.01% (2) 4.08%  
 (3) 6.05% (4) 5.08

PREVIOUS YEARS QUESTIONS							ANSWER KEY				EXERCISE -5 [A]						
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ans	4	2	3	2	1	3	2	4	4	2	4	1	2	1	1	4	2

**EXERCISE-05 [B]****PREVIOUS YEARS QUESTIONS**

1. Anhydrous ferric chloride is prepared by – [IIT 2002]  
(A) Heating hydrated ferric chloride at a high temperature in a steam of air  
(B) Heating metallic iron in a steam of dry chlorine gas  
(C) Reaction of ferric oxide with HCl  
(D) Reaction of metallic iron with HCl
2. When  $\text{MnO}_2$  is fused with KOH and  $\text{KNO}_3$ , a coloured compound is formed, the product and its colour is – [IIT 2003]  
(A)  $\text{K}_2\text{MnO}_4$ , green (B)  $\text{KMnO}_4$ , purple (C)  $\text{Mn}_2\text{O}_3$ , brown (D)  $\text{Mn}_3\text{O}_4$ , black
3.  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$  on heating gives a gas, which is also given by – [IIT- 2004]  
(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)  $\text{Na} + \text{H}_2\text{O}_2$
4. The pair of compounds having metals in their highest oxidation state is – [IIT-2004]  
(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)  $[\text{NiCl}_4]^{2-}$ ,  $[\text{CoCl}_4]^-$
5. The compound having tetrahedral geometry is – [IIT- 2004]  
(A)  $[\text{Ni}(\text{CN})_4]^{2-}$  (B)  $[\text{Pd}(\text{CN})_4]^{2-}$  (C)  $[\text{PdCl}_4]^{2-}$  (D)  $[\text{NiCl}_4]^{2-}$
6. Spin only magnetic moment of the compound  $\text{Hg}[\text{Co}(\text{SCN})_4]$  is – [IIT- 2004]  
(A)  $\sqrt{3}$  (B)  $\sqrt{15}$  (C)  $\sqrt{24}$  (D)  $\sqrt{8}$
7. Which pair of compounds is expected to show similar colour in aqueous medium? [IIT- 2004]  
(A)  $\text{FeCl}_3$  and  $\text{CuCl}_2$  (B)  $\text{VOCl}_2$  and  $\text{CuCl}_2$  (C)  $\text{VOCl}_2$  and  $\text{FeCl}_2$  (D)  $\text{FeCl}_2$  and  $\text{MnCl}_2$
8.  $\text{NiCl}_2$  in the presence of dimethyl glyoxime (DMG) gives a complex which precipitates in the presence of  $\text{NH}_4\text{OH}$ , giving a bright red colour. [IIT- 2004]  
(a) Draw its structure and show H-bonding  
(b) Give oxidation state of Ni and its hybridisation  
(c) Predict whether it is paramagnetic or diamagnetic.
9. A solution of a metal ion when treated with KI gives a red precipitate which dissolves in excess KI to give a colourless 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 – [IIT- 2005]  
(A)  $\text{Pb}^{2+}$  (B)  $\text{Hg}^{2+}$  (C)  $\text{Cu}^{2+}$  (D)  $\text{Co}^{2+}$
10. Write balanced chemical equation for developing a black and white photographic film. Also give reason why the solution of sodium thiosulphate on acidification turns milky white and give balance equation of this reaction – [IIT- 2005]
11.  $\text{Fe}^{3+} \xrightarrow{\text{SNC}^-(\text{excess})} \text{A} \xrightarrow{\text{F}^-(\text{excess})} \text{B}$  [IIT- 2005]  
Blood red Colourless  
Identify A and B.  
(i) Write IUPAC name of A and B.  
(ii) Find out spin only magnetic moment of B
12. 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 – [IIT- 2007]  
(A) 3 (B) 4 (C) 5 (D) 6

## 13. Match the column

[IIT- 2007]

Column-I		Column-II	
(A)	$\text{O}_2^- \longrightarrow \text{O}_2 + \text{O}_2^{2-}$	(p)	redox reaction
(B)	$\text{CrO}_4^{2-} + \text{H}^+ \longrightarrow$	(q)	one of the products has trigonal planar structure
(C)	$\text{MnO}_4^- + \text{NO}_2^- + \text{H}^+ \longrightarrow$	(r)	dimeric bridged tetrahedral metal ion
(D)	$\text{NO}_3^- + \text{H}_2\text{SO}_4 + \text{Fe}^{2+} \longrightarrow$	(s)	disproportionation

14. Upon treatment with ammonical  $\text{H}_2\text{S}$ , the metal ion that precipitates as a sulphide is - [IIT-2013]

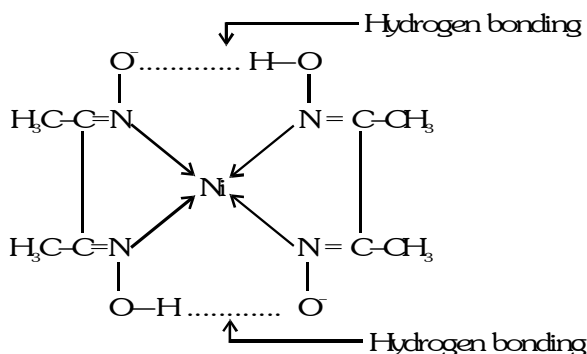
- (A) Fe(III) (B) Al(III)  
(C) Mg(II) (D) Zn (II)

## PREVIOUS YEARS QUESTIONS

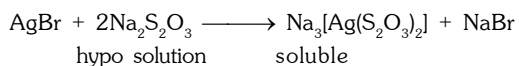
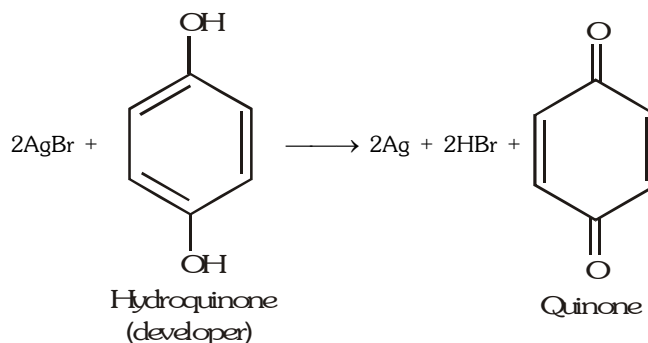
## ANSWER KEY

## EXERCISE -5 [B]

1. B 2. A 3. A 4. B 5. D 6. B 7. B  
8. (a) Structure of the complex is



- (b) The oxidation state of Ni in this compound is +2 and it shows  $\text{dsp}^2$  hybridisation.  
(c) Since the coordination number of Ni in this complex is 4. According to crystal field theory it is diamagnetic in nature  
9. (B)  
10. (i) The following reactions are used in developing the photographic film.



- (ii) Aqueous solution of sodium thiosulphate ( $\text{Na}_2\text{S}_2\text{O}_3$ ) on acidification gives milky white turbidity of colloidal sulphur.  $\text{Na}_2\text{S}_2\text{O}_3 + 2\text{H}^+_{(\text{aq})} \longrightarrow 2\text{Na}^+ + \text{H}_2\text{SO}_3 + \text{S}$  (colloidal sulphur)

11. (a) A :  $[\text{Fe}(\text{SCN})(\text{H}_2\text{O})_5]^{2+}$  (Pentaaquathiocyanatoferrate(III)ion)    B :  $[\text{FeF}_6]^{3-}$  (Hexafluoroferrate(III) ion)  
(b) 5.92 BM

12. D

13. (A)  $\rightarrow$  p,s ; (B)  $\rightarrow$  r ; (C)  $\rightarrow$  p,q ; (D)  $\rightarrow$  p

14. (D)