

**THE D AND F BLOCK ELEMENTS**

**Single Correct Answer Type**

- The metal extracted by cyanide process is  
 a) Silver                      b) Copper                      c) Iron                      d) Sodium
- The magnetic moment  $\mu$ , of transition metals is related to the number of unpaired electrons  $n$  as  
 a)  $\mu = n(n + 2)^2$               b)  $\mu = n^2(n + 2)$               c)  $\mu = \frac{n}{(n + 2)}$               d)  $\mu = \sqrt{n(n + 2)}$
- Granulated Zn is obtained by:  
 a) Suddenly cooling molten Zn  
 b) Adding molten Zn to water  
 c) Heating Zn 100 to 150°C  
 d) Dropping molten Zn drop by drop
- Metallic silver may be obtained from AgCl by  
 a) Heating it in the current of H<sub>2</sub>                      b) Fusing it with sand  
 c) Treating with carbon monoxide                      d) Fusing it with Na<sub>2</sub>CO<sub>3</sub>
- Transition metals show paramagnetism due to  
 a) High lattice energy                      b) Characteristics configuration  
 c) Variable oxidation states                      d) Unpaired electrons
- Heating mixture of Cu<sub>2</sub>O and Cu<sub>2</sub>S will give  
 a) Cu<sub>2</sub>SO<sub>3</sub>                      b) CuO + CuS                      c) Cu + SO<sub>3</sub>                      d) Cu + SO<sub>2</sub>
- Native silver metal forms a water soluble complex with a dilute aqueous solution of NaCN in presence of:  
 a) Nitrogen                      b) Oxygen                      c) CO<sub>2</sub>                      d) Ar
- Which metal makes steel suitable for cutting purposes by maintaining the cutting edge of the blade?  
 a) Mn                      b) Al                      c) W                      d) C
- Ferrous sulphate on heating gives:  
 a) SO<sub>3</sub>                      b) SO<sub>2</sub>                      c) Fe<sub>2</sub>O<sub>3</sub>                      d) All of these
- Which is formed when iron reacts with carbon?  
 a) FeC<sub>2</sub>                      b) Fe<sub>3</sub>C                      c) FeC<sub>3</sub>                      d) Fe<sub>2</sub>C
- Gold is extracted by hydrometallurgical process, based on its property  
 a) Of being electropositive                      b) Of being less reactive  
 c) To form complexes which are water soluble                      d) To form salts which are water soluble
- The reaction of K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> with NaCl and conc H<sub>2</sub>SO<sub>4</sub> gives  
 a) CrO<sub>2</sub>Cl<sub>2</sub>                      b) Cr<sub>2</sub>O<sub>3</sub>                      c) CrCl<sub>3</sub>                      d) CrOCl<sub>2</sub>
- Refining of impure copper with zinc impurity is to be done by electrolysis using electrodes as  

<b>Cathode</b>	<b>Anode</b>		
a) Pure copper	Pure zinc	b) Pure zinc	Pure copper
c) Pure copper	Impure copper	d) Pure zinc	Impure zinc
- Iron sheets are galvanized mainly to:  
 a) Harden the surface  
 b) Increase lustre  
 c) Prevent action of water  
 d) Prevent action of oxygen and water

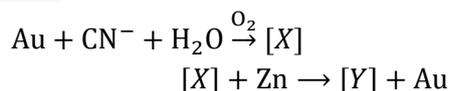


15. Pig iron:  
 a) Contains carbon and other impurities  
 b) Is pure form of iron  
 c) Is same as wrought iron  
 d) Is same as steel
16. Which of the following is amphoteric oxide?  
 a)  $\text{SO}_2$                       b)  $\text{B}_2\text{O}_3$                       c)  $\text{ZnO}$                       d)  $\text{Na}_2\text{O}$
17. Which forms interstitial compounds?  
 a) Fe                      b) Ni                      c) Co                      d) All of these
18. The meniscus of mercury in a glass tube is:  
 a) Convex upwards              b) Concave                      c) Plane                      d) Convex inwards
19.  $\text{CuCl}$  absorbs  
 a)  $\text{CO}_2$                       b)  $\text{SO}_2$                       c)  $\text{H}_2\text{SO}_4$                       d)  $\text{CO}$
20. Which of the following is a ferrous alloy?  
 a) Invar                      b) Solder                      c) Magnalium                      d) Type metal
21.  $\text{Cl}_2 + \text{HgO} \rightarrow ?$   
 a)  $\text{Cl}_2\text{O} + \text{HgCl}$               b)  $\text{Cl}_2\text{O} + \text{HgCl}_2$               c)  $\text{ClO} + \text{HgCl}$               d)  $\text{ClO} + \text{HgCl}_2$
22. Carbon in wrought iron is present as  
 a) Silicon carbide                      b) Iron carbide  
 c) Graphite                      d) Partly iron carbide and partly as graphite
23. Railway wagon axles are made by heating rods of iron embedded in charcoal powder. The process is known as  
 a) Case hardening              b) Tempering                      c) Sheradizing                      d) Annealing
24. Silver nitrate solution gives a red precipitate with:  
 a) Sodium iodide              b) Potassium chloride              c) Calcium nitrate              d) Sodium chromate
25. Impurities of Cu and Ag from gold are removed by  
 a) Boiling impure gold with dil.  $\text{H}_2\text{SO}_4$               b) Boiling impure gold with conc.  $\text{H}_2\text{SO}_4$   
 c) Electrolytically              d) Both (b) and (c)
26. Essential constituent of an amalgam is:  
 a) Fe                      b) An alkali metal                      c) Silver                      d) Mercury
27. Which of the following compounds volatiles on heating?  
 a)  $\text{FeCl}_3$                       b)  $\text{HgCl}_2$                       c)  $\text{CaCl}_2$                       d)  $\text{MgCl}_2$
28. Which of the following is most stable?  
 a)  $\text{V}^{3+}$                       b)  $\text{Ti}^{3+}$                       c)  $\text{Mn}^{3+}$                       d)  $\text{Cr}^{3+}$
29. Which one of the following transition metal ions is diamagnetic?  
 a)  $\text{Co}^{2+}$                       b)  $\text{Ni}^{2+}$                       c)  $\text{Cu}^{2+}$                       d)  $\text{Zn}^{2+}$
30. Which sets are the transition elements?  
 a) Ti, Zr, Hf                      b) V, Nb, Ta                      c) Rh, Rb, Pd                      d) All of these
31. Incorrect statement is  
 a) Atomic radii of Zr and Hf are same because of lanthanide contraction  
 b) Zn and Hg do not show variable valency  
 c) Across the lanthanides series, the basicity of lanthanide hydroxides decreases  
 d) Protactinium is transuranic element
32. Which of the following has got incompletely filled  $f$ -subshell?  
 a) Gadolinium                      b) Lutetium                      c) Lawrencium                      d) Tantalum
33. Volatile metals Zn, Cd and Hg are purified by:  
 a) Liquation                      b) Distillation                      c) Cupellation                      d) Electrolysis

34. Maximum oxidation state is presented by:  
 a)  $\text{CrO}_2\text{Cl}_2$  and  $\text{MnO}_4^-$       b)  $\text{MnO}_2$       c)  $[\text{Fe}(\text{CN})_6]^{3-}$  and  $[\text{Co}(\text{CND})\text{MnO}$
35. Substance which do not react with cold water but react with steam are:  
 a) C, Ca,  $\text{SO}_2$       b) Fe, Al,  $\text{Cl}_2$       c)  $\text{CO}_2$ , Na, Mg      d) C, Fe, Mg
36. Least paramagnetic property is shown by  
 a) Fe      b) Mn      c) Ni      d) Cu
37. Most abundant transition element is:  
 a) Fe      b) Sc      c) Os      d) None of these
38. Thermite is a mixture of iron oxide and:  
 a) Zn powder      b) K metal      c) Na-Hg      d) Al powder
39.  $\text{ZnSO}_4$  on heating to  $800^\circ\text{C}$  gives:  
 a)  $\text{ZnO} + \text{SO}_2 + \text{O}_2$       b)  $\text{Zn} + \text{SO}_2$       c)  $\text{ZnS} + \text{O}_2$       d)  $\text{Zn} + \text{SO}_2 + \text{O}_2$
40. In chromite ore, the oxidation number of iron and chromium are respectively.  
 a) +3,+2      b) +3,+6      c) +2,+6      d) +2,+3
41. A solution when diluted with  $\text{H}_2\text{O}$  and boiled gives a white ppt. On addition of excess  $\text{NH}_4\text{Cl}/\text{NH}_4\text{OH}$ , the volume of precipitate decreases due to dissolution leaving behind a white gelatinous precipitate. The precipitate which dissolves in  $\text{NH}_4\text{OH}/\text{NH}_4\text{Cl}$  is:  
 a)  $\text{Zn}(\text{OH})_2$       b)  $\text{Al}(\text{OH})_3$       c)  $\text{Mg}(\text{OH})_2$       d)  $\text{Ca}(\text{OH})_2$
42. The outer electronic configuration of Gd (At. No 64) is  
 a)  $4f^3 5d^5 6s^2$       b)  $4f^8 5d^0 6s^2$       c)  $4f^4 5d^4 6s^2$       d)  $4f^7 5d^1 6s^2$
43. When steam is passed over heated iron, one of the products is:  
 a) FeO      b)  $\text{Fe}_2\text{O}_3$       c)  $\text{Fe}_3\text{O}_4$       d)  $\text{FeSO}_4$
44. The radius of  $\text{La}^{3+}$  (Atomic number of La = 57) is  $1.06 \text{ \AA}$ . Which one of the following given values will be closest to the radius of  $\text{Lu}^{3+}$ ?  
 (Atomic number of Lu=71)  
 a)  $1.60 \text{ \AA}$       b)  $1.40 \text{ \AA}$       c)  $1.06 \text{ \AA}$       d)  $0.85 \text{ \AA}$
45. Steel resistant to acid is:  
 a) Carbon steel      b) Molybdenum steel      c) Stainless steel      d) Nickel steel
46.  $\text{H}_2\text{S}$  is passed in aqueous solution of ..... to give a white precipitate of ZnS.  
 a)  $\text{ZnCl}_2$       b)  $\text{Zn}(\text{NO}_3)_2$       c)  $(\text{CH}_3\text{COO})_2\text{Zn}$       d) None of these
47. Mond process is used in the extraction of:  
 a) Co      b) Ni      c) Mo      d) Zn
48. Blue vitriol is:  
 a)  $\text{CuSO}_4 \cdot 7\text{H}_2\text{O}$       b)  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$       c)  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$       d)  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
49. Iron is obtained on large scale from haematite( $\text{Fe}_2\text{O}_3$ ):  
 a) By reduction  
 b) By oxidation  
 c) By reduction followed by oxidation  
 d) By oxidation followed by reduction
50. Acidified solution of chromic acid on treatment with hydrogen peroxide yields  
 a)  $\text{CrO}_5 + \text{H}_2\text{O}$       b)  $\text{H}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{O} + \text{O}_2$   
 c)  $\text{Cr}_2\text{O}_3 + \text{H}_2\text{O} + \text{O}_2$       d)  $\text{CrO}_3 + \text{H}_2\text{O} + \text{O}_2$
51. For which one of the following ions, the colour is not due to a  $d - d$  transition?  
 a)  $\text{CrO}_4^{2-}$       b)  $\text{Cu}(\text{NH}_3)_4^{2+}$       c)  $\text{Ti}(\text{H}_2\text{O})_6^{3+}$       d)  $\text{CoF}_6^{3-}$
52. Various methods have been employed for protecting iron from rusting. Which of the following is incorrect?  
 a) Zinc plating is more permanent than chrome plating



- b) Zinc protects iron but gets corroded itself  
 c) Tin plating is cheap but unreliable  
 d) None of the above
53. Which compound cannot be prepared?  
 a)  $\text{Zn}(\text{OH})_2$                       b)  $\text{Cd}(\text{OH})_2$                       c)  $\text{Hg}(\text{OH})_2$                       d)  $\text{HgCl}_2$
54. Which of the following is called white vitriol?  
 a)  $\text{ZnCl}_2$                       b)  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$                       c)  $\text{Al}_2(\text{SO}_4)_3$                       d)  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$
55. Transition metal used for making joins in jewellery is  
 a) Zn                      b) Cu                      c) Ag                      d) Cd
56. Which metal is used in making cathode containers of dry cell?  
 a) Zn                      b) Bi                      c) Cr                      d) Fe
57. The electronic configuration of actinoids can to be assigned with degree of certainty because of  
 a) Overlapping of inner orbitals  
 b) Free movement of electrons over all the orbitals  
 c) Small energy difference between  $5f$  and  $6d$  levels  
 d) None of the above
58. The most stable ion is:  
 a)  $\text{Mn}^{2+}$                       b)  $\text{Sc}^{4+}$                       c)  $\text{Fe}^{2+}$                       d)  $\text{Mn}^{3+}$
59. The metal used for making armoured steel for tanks and domestic safes is:  
 a) Manganese                      b) Aluminium                      c) Lead                      d) Chromium
60. In the chemical reaction;  
 $\text{Ag}_2\text{O} + \text{H}_2\text{O} + 2e^- \rightarrow 2\text{Ag} + 2\text{OH}^-$   
 a) Water is oxidised                      b) Electrons are reduced                      c) Silver is oxidised                      d) Silver is reduced
61. Heteropoly acids are formed by:  
 a) Be                      b) Fe                      c) Mo                      d) Cr
62. In the manufacture of iron from an iron oxide ore, limestone is added because it acts as:  
 a) An oxidizing agent                      b) A reducing agent                      c) A flux                      d) A precipitating agent
63. Which of the following represents ammonium molybdate?  
 a)  $(\text{NH}_4)_2\text{MoO}_4$                       b)  $(\text{NH}_4)\text{MoO}_2$                       c)  $(\text{NH}_4)_2\text{MoO}_3$                       d)  $\text{NH}_4 \cdot 12\text{MoO}_3$
64. The variety of iron having highest melting point is:  
 a) Pig iron                      b) Cast iron                      c) Wrought iron                      d) Steel
65. Which of the following elements is present as the impurity to the maximum extent in the pig iron?  
 a) Phosphorus                      b) Manganese                      c) Carbon                      d) Silicon
66. Nessler's reagent is:  
 a)  $\text{KHgI}_4$                       b)  $\text{K}_2\text{HgI}_4$                       c)  $\text{K}_2\text{HgI}_4 + \text{NaOH}$                       d)  $\text{KHgI}_4 + \text{NaOH}$
67. Transition metal with low oxidation number will act as  
 a) An oxidizing agent                      b) A base                      c) An acid                      d) None of these
68.  $\text{AuCl}_3$  when heated in air gives:  
 a) Gold oxide                      b) Gold perchlorate                      c) Gold nitride                      d) AuCl
69. When dil.  $\text{H}_2\text{SO}_4$  is added to aqueous solution of potassium chromate, yellow colour of solution turns to orange colour. It indicates  
 a) Chromate ions are reduced.  
 b) Chromate ions are oxidised.  
 c) Mono centric complex is converted into dicentric complex.  
 d) Oxygen gets removed from chromate ions.
70. During the extraction of gold the following reactions take place



X and Y are respectively

- a)  $[\text{Au}(\text{CN})_2]^-$  and  $[\text{Zn}(\text{CN})_6]^{4-}$                       b)  $[\text{Au}(\text{CN})_4]^{2-}$  and  $[\text{Zn}(\text{CN})_4]^{2-}$   
 c)  $[\text{Au}(\text{CN})_4]^{3-}$  and  $[\text{Zn}(\text{CN})_4]^{2-}$                       d)  $[\text{Au}(\text{CN})_2]^-$  and  $[\text{Zn}(\text{CN})_4]^{2-}$

71. The impurity of sulphur makes the iron:  
 a) Fibrous                      b) Red short                      c) Cold short                      d) Malleable
72. On the extraction of iron, the slag produced is  
 a) CO                      b)  $\text{FeSiO}_3$                       c)  $\text{MgSiO}_3$                       d)  $\text{CaSiO}_3$
73. The number of incomplete orbitals in inner transition elements is:  
 a) 3                      b) 4                      c) 2                      d) 1
74. Which of the following is not a member of 3d-transition series?  
 a) Fe                      b) Co                      c) Au                      d) Cu
75. The process used in obtaining metallic silver from argentite is:  
 a) Fused mixture of  $\text{Ag}_2\text{S}$  and KCl is electrolysed  
 b)  $\text{Ag}_2\text{S}$  is reduced with CO  
 c)  $\text{Ag}_2\text{S}$  is roasted to  $\text{Ag}_2\text{O}$  which is reduced with C  
 d) Treating with NaCN solution followed by metal displacement with zinc
76. Effective magnetic moment of  $\text{Sc}^{3+}$  ion is  
 a) 1.73                      b) 0                      c) 5.92                      d) 2.83
77. In the electrolytic purification of copper some gold is found in the:  
 a) Cathode                      b) Cathode mud                      c) Anode mud                      d) None of these
78. As percentage of carbon increase in iron, its hardness:  
 a) Decreases                      b) Increases                      c) Remains same                      d) None of these
79. The spin only magnetic moment of  $\text{Mn}^{4+}$  ion is nearly  
 a) 3 BM                      b) 6 BM                      c) 4 BM                      d) 5 BM
80. Chrome green is  
 a) Chromium nitrate                      b) Chromium sulphate                      c) Chromium oxide                      d) Chromium chloride
81. Silver amalgam is used in:  
 a) Silvering of mirror                      b) Filling of teeth                      c) Both (a) and (b)                      d) None of these
82. In which metal's metallurgical process carbon is used for reduction of metal oxides?  
 a) Na                      b) Ag                      c) Fe                      d) Hg
83. 5f-level is successively filled up in:  
 a) Lanthanoids                      b) Actinoids                      c) Rare gases                      d) Transition elements
84. Of the ions  $\text{Zn}^{2+}$ ,  $\text{Ni}^{2+}$  and  $\text{Cr}^{3+}$ , (atomic number of Zn=30, Ni=28, Cr=24)  
 a) All three are coloured  
 b) All three are colourless  
 c) Only  $\text{Zn}^{2+}$  is colourless and  $\text{Ni}^{2+}$  and  $\text{Cr}^{3+}$  are coloured  
 d) Only  $\text{Ni}^{2+}$  is coloured and  $\text{Zn}^{2+}$  and  $\text{Cr}^{3+}$  are colourless
85. Calomel is:  
 a)  $\text{Hg}_2\text{Cl}_2$  and Hg                      b)  $\text{HgCl}_2$                       c) Hg +  $\text{HgCl}_2$                       d)  $\text{Hg}_2\text{Cl}_2$
86. Anhydrous  $\text{CuCl}_2$  and  $\text{CuBr}_2$  exist as:  
 a) Monomer                      b) Dimer                      c) Trimer                      d) polymer
87. In haemoglobin the iron shows oxidation state :  
 a) +2                      b) +3                      c) +1                      d) +4
88. Which group of metals is known as Pt-metals?  
 a) Fe, Co, Ni                      b) Ag, Au, Cu                      c) Zn, Cd, Hg                      d) Ru, Rh, Pd



89.  $\text{Cu}^{2+}$  ions would be reduced to cuprous ion if their solutions are mixed with an aqueous:  
 a) KI solution                      b) KCl solution                      c)  $\text{K}_2\text{CO}_3$  solution                      d)  $\text{K}_2\text{SO}_4$  solution
90. The reaction between copper and hot concentrated sulphuric acid produces:  
 a)  $\text{SO}_2$                       b)  $\text{SO}_3$                       c)  $\text{H}_2$                       d)  $\text{Cu}^+$  ions
91. Which metal is purified by Pattinson's process?  
 a) Ag                      b) Au                      c) Fe                      d) Sb
92. Which ion in aqueous medium has orange colour?  
 a)  $\text{Cr}_2\text{O}_7^{2-}$                       b)  $\text{Cr}^{3+}$                       c)  $\text{MnO}_4^-$                       d)  $\text{MnO}_4^{2-}$
93. Ferric sulphate on heating gives:  
 a)  $\text{SO}_2$  and  $\text{SO}_3$                       b)  $\text{SO}_2$  only                      c)  $\text{SO}_3$  only                      d) S only
94. Chromium is used in making:  
 a) Bronze                      b) Brass                      c) Stainless steel                      d) Electrodes
95.  $\text{KMnO}_4$  (acidic/alkaline) is not decolourized by  
 a) Mohr salt                      b) Oxalic acid                      c) Benzene                      d) Propene
96. Zinc reacts with very dilute nitric acid to produce:  
 a) NO                      b)  $\text{NH}_4\text{NO}_3$                       c)  $\text{NO}_2$                       d)  $\text{H}_2$
97. What effect is noticed on shaking dilute sulphuric acid with a small quantity of anhydrous copper sulphate?  
 a) The white solid dissolves to form a colourless solution  
 b) The white solid dissolves to form a green solution  
 c) The white solid turns blue but does not dissolve  
 d) The white solid dissolves to form a blue solution
98. The number of ions formed on dissolving one molecule of  $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$  is:  
 a) 4                      b) 5                      c) 3                      d) 6
99. Larger number of oxidation states are exhibited by the actinoides than those by the lanthanoides, the main reason being  
 a)  $4f$ - orbitals more diffused than the  $5f$ -orbitals  
 b) Lesser energy difference between  $5f$  and  $6d$  than between  $4f$  and  $5d$ -orbitals  
 c) More energy difference between  $5f$  and  $6d$  than between  $4f$  and  $5d$ -orbitals.  
 d) More reactive nature of the actinoides than the lanthanoides
100. Invar steel, which is very little affected by temperature changes, contains 36%:  
 a) Co                      b) Ni                      c) Cu                      d) Al
101. 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  $\text{H}_2$  over  $\text{CuCl}_2$
102. Near the top of a blast furnace employed for the extraction of iron the metal oxides are reduced to spongy iron by:  
 a) Carbon                      b) CO                      c)  $\text{CO}_2$                       d) Limestone
103. Standard reduction potential of most of the transition elements is generally:  
 a) Negative                      b) Positive                      c) Zero                      d) None of these
104. An example of double salt is:  
 a) Bleaching powder                      b)  $\text{K}_4[\text{Fe}(\text{CN})_6]$                       c) Hypo                      d) Potash alum
105. The mineral from which copper is manufactured is:  
 a) Galena                      b) Pyrite                      c) Malachite                      d) Chalcopyrite

106. An aqueous solution of  $\text{FeSO}_4$ ,  $\text{Al}_2(\text{SO}_4)_3$  and chrome alum is heated with excess of  $\text{Na}_2\text{O}_2$  and filtered. The materials obtained are:
- A colourless filtrate and a green residue
  - A yellow filtrate and a green residue
  - A yellow filtrate and a brown residue
  - A green filtrate and a brown residue
107. Which of the following is coloured compound?
- $\text{CuF}_2$
  - $\text{CuI}$
  - $\text{NaCl}$
  - $\text{MgCl}_2$
108. Duraluminium is an alloy contains:
- $\text{Mg} + \text{Al}$
  - $\text{Mg} + \text{Cu} + \text{Al} + \text{Mn} + \text{Si}$
  - $\text{Mg} + \text{Cu}$
  - $\text{Cu} + \text{Al}$
109. The purest zinc is made by
- Electrolytic refining
  - Zone refining
  - The van- Arkel method
  - The Mond process
110. Which of the following compounds volatilises on heating?
- $\text{MgCl}_2$
  - $\text{HgCl}_2$
  - $\text{CaCl}_2$
  - $\text{FeCl}_3$
111. A developer used in photography is:
- A weak acid
  - A weak base
  - A mild reducing agent
  - An oxidizing agent
112. Which of the following transition metal ions will have definite value of magnetic moment?
- $\text{Sc}^{3+}$
  - $\text{Ti}^{3+}$
  - $\text{Cu}^{3+}$
  - $\text{Zn}^{2+}$
113. Among  $\text{Sc(III)}$ ,  $\text{Ti(IV)}$ ,  $\text{Pd(II)}$  and  $\text{Cu(II)}$  ions
- All are paramagnetic
  - All are diamagnetic
  - $\text{Sc(III)}$ ,  $\text{Ti(IV)}$  are paramagnetic and  $\text{Pd(II)}$ ,  $\text{Cu(II)}$  are diamagnetic
  - $\text{Sc(III)}$ ,  $\text{Ti(IV)}$  are diamagnetic and  $\text{Pd(II)}$ ,  $\text{Cu(II)}$  are paramagnetic
114. Which one of the following statements is false?
- During roasting, moisture is removed from the ore.
  - The ore is freed from almost all nonmetallic impurities.
  - Calcination of ore is carried out in the absence of any blast of air.
  - The concentrated zinc blend is subjected to calcination during its extraction by pyrometallurgy.
115. It is always advisable not to cover egg yolk or mustard with silver cutlery because:
- Silver reacts with water of egg yolk to form  $\text{AgOH}$
  - Silver reacts with sulphur of egg yolk forming black  $\text{Ag}_2\text{S}$
  - Silver reacts with egg yolk forming  $\text{Ag}_2\text{SO}_4$  which is a poisonous substance
  - Silver attracts UV light of the atmosphere, thereby spoiling the food
116. Transition metal ions show colour because
- They absorb light
  - They emit light
  - They are paramagnetic
  - They exhibit  $d-d$  transition
117. Gold exhibits the variable oxidation states of:
- +2, +3
  - +1, +3
  - +2, +4
  - +1, +2
118. A yellow ppt. is formed when  $\text{H}_2\text{S}$  is passed through an acidified solution of:
- $\text{Co}^{2+}$  ions
  - $\text{Cd}^{2+}$  ions
  - $\text{Cu}^{2+}$  ions
  - $\text{Ni}^{2+}$  ions
119. Among the following pair of ions, the lower oxidation state in aqueous solution is more stable in
- $\text{V}^{2+}$ ,  $\text{VO}^{2+}$
  - $\text{Cr}^{2+}$ ,  $\text{Cr}^{3+}$
  - $\text{Ti}^+$ ,  $\text{Ti}^{3+}$
  - $\text{Cu}^+$ ,  $\text{Cu}^{2+}$
120. Group 11 or IB elements are commonly known as:



- a) Coinage metals  
 b) Transition metals  
 c) Typical elements  
 d) Representative elements
121. The temperature of blast furnace to produce iron from its ore  $\text{Fe}_2\text{O}_3$  varies from  $500^\circ\text{C}$  at the top of the furnace to about  $1900^\circ\text{C}$  at the bottom of the furnace. The reaction between the ore  $\text{Fe}_2\text{O}_3$  and  $\text{CO}$  at the lowest temperature ( $\sim 500^\circ\text{C}$ ) is:  
 a)  $3\text{Fe}_2\text{O}_3 + \text{CO} \rightarrow 2\text{Fe}_3\text{O}_4 + \text{CO}_2$   
 b)  $\text{Fe}_2\text{O}_3 + \text{CO} \rightarrow 2\text{FeO} + \text{CO}_2$   
 c)  $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$   
 d)  $\text{Fe}_2\text{O}_3 + \text{CO} \rightarrow 2\text{Fe} + \text{CO}_2 + \frac{1}{2}\text{O}_2$
122. The equilibrium  $\text{Cr}_2\text{O}_7^{2-} + 2e \rightleftharpoons 2\text{CrO}_4^{2-}$ :  
 a) Exists in acidic medium  
 b) Exists in basic medium  
 c) Exists in neutral medium  
 d) Does not exist
123. Pudding process is used in the manufacture of:  
 a) Steel                                      b) Cast iron                                      c) Wrought iron                                      d) Pig iron
124. The metal that does not displace hydrogen from an acid is:  
 a) Hg                                      b) Zn                                      c) Al                                      d) Ca
125. During the extraction of copper, the impurity ( $\text{FeS}$ ) is removed as slag by mixing the contaminated copper ore with silica and coke. The molecular formula of slag is  
 a)  $\text{FeSiO}_3$                                       b)  $\text{Fe}_2\text{O}_3$                                       c)  $\text{FeSi}$  (solid)                                      d)  $\text{FeSi}$  (vapour)
126. Yellow mercury (II) oxide is obtained when  
 a) Hg is heated in excess of air at  $623\text{ K}$                                       b)  $\text{HgCl}_2$  is treated with  $\text{NaOH}$  solution  
 c)  $\text{HgS}$  is roasted in air                                      d)  $\text{Hg}(\text{NO}_3)_2$  is heated in presence of Hg
127. A scarlet red precipitate is obtained on treating mercuric chloride solution with:  
 a)  $\text{H}_2\text{S}$                                       b)  $\text{KI}$                                       c)  $\text{NaOH}$                                       d)  $\text{NH}_4\text{OH}$
128. Transition elements exhibits variable valencies because they release electrons from the following orbits  
 a)  $ns$                                       b)  $ns$  and  $np$                                       c)  $(n - 1)d$  and  $ns$                                       d)  $(n - 1)d$
129. The formula of sodium nitroprusside is:  
 a)  $\text{Na}_4[\text{Fe}(\text{CN})_5\text{NOS}]$                                       b)  $\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]$                                       c)  $\text{NaFe}[\text{Fe}(\text{CN})_6]$                                       d)  $\text{Na}_2[\text{Fe}(\text{CN})_6\text{NO}_2]$
130. Excess of  $\text{KI}$  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?  
 a)  $\text{Cu}_2\text{I}_2$  formed                                      b)  $\text{CuI}_2$  is formed  
 c)  $\text{Na}_2\text{S}_2\text{O}_3$  is oxidized                                      d) Evolved  $\text{I}_2$  is reduced
131. In the extraction of Fe from  $\text{Fe}_2\text{O}_3$ , the reducing agent used is  
 a) C                                      b) Al                                      c) Electrolytic reduction                                      d) Cu
132. Which transition metal is used for the reduction of steam to hydrogen?  
 a) Mg                                      b) Fe                                      c) Sc                                      d) Pt

**: ANSWER KEY :**

1)	a	2)	d	3)	b	4)	d	5)	d	6)	d	7)	b	8)	c
9)	d	10)	b	11)	b	12)	a	13)	c	14)	d	15)	a	16)	c
17)	d	18)	a	19)	d	20)	a	21)	b	22)	d	23)	a	24)	d
25)	d	26)	d	27)	b	28)	d	29)	d	30)	d	31)	d	32)	a
33)	a	34)	a	35)	d	36)	d	37)	a	38)	d	39)	a	40)	d
41)	a	42)	d	43)	c	44)	d	45)	b	46)	c	47)	b	48)	c
49)	b	50)	a	51)	a	52)	b	53)	c	54)	d	55)	d	56)	a
57)	c	58)	a	59)	a	60)	a	61)	c	62)	c	63)	a	64)	c
65)	c	66)	c	67)	a	68)	d	69)	c	70)	d	71)	b	72)	d
73)	a	74)	c	75)	d	76)	b	77)	c	78)	b	79)	c	80)	c
81)	c	82)	c	83)	b	84)	c	85)	d	86)	d	87)	b	88)	d
89)	a	90)	a	91)	a	92)	a	93)	c	94)	c	95)	c	96)	b
97)	d	98)	b	99)	b	100)	b	101)	c	102)	b	103)	a	104)	d
105)	d	106)	c	107)	a	108)	b	109)	b	110)	b	111)	c	112)	b
113)	d	114)	b	115)	b	116)	d	117)	b	118)	b	119)	c	120)	a
121)	c	122)	b	123)	c	124)	a	125)	a	126)	b	127)	b	128)	c
129)	b	130)	b	131)	a	132)	b								

## : HINTS AND SOLUTIONS :

- 1 (a)  
Silver metal is extracted by cyanide process.  

$$\text{Ag}_2\text{S} + 4\text{NaCN} \rightleftharpoons 2\text{Na}[\text{Ag}(\text{CN})_2] + \text{Na}_2\text{S}$$
 Argentite sodium argentocyanide  

$$2\text{Na}[\text{Ag}(\text{CN})_2] + \text{Zn} \rightarrow \text{Na}_2[\text{Zn}(\text{CN})_4] + 2\text{Ag} \downarrow$$
 Sodium tetracyano ppt.  
 Zincate (II)
- 2 (d)  
Magnetic moment of transition metal is  

$$\mu = \sqrt{n(n+2)}$$
- 3 (b)  
It is a process to get Zn granules.
- 4 (d)  
On fusing AgCl with Na<sub>2</sub>CO<sub>3</sub>, metallic silver is obtained.  

$$2\text{AgCl} + \text{Na}_2\text{CO}_3 \xrightarrow{\text{Fuse}} 2\text{Ag} \downarrow + 2\text{NaCl} + \text{CO}_2 + \frac{1}{2}\text{O}_2$$
 metallic silver
- 6 (d)  
Following reaction takes place during bessemerisation  

$$2\text{Cu}_2\text{O} + \text{Cu}_2\text{S} \rightarrow 6\text{Cu} + \text{SO}_2$$
- 7 (b)  

$$4\text{Ag} + 8\text{NaCN} + 2\text{H}_2\text{O} + \text{O}_2 \rightarrow 4\text{Na}[\text{Ag}(\text{CN})_2] + 4\text{NaOH}$$
- 8 (c)  
Tungsten steel contains 14–20% W, 3–8% Cr; used for high speed tools as well as for cutting purposes and maintain the cutting edge of the blade.
- 9 (d)  

$$2\text{FeSO}_4 \xrightarrow{\Delta} \text{Fe}_2\text{O}_3 + \text{SO}_2 + \text{SO}_3.$$
- 10 (b)  
Iron carbide or Fe<sub>3</sub>C.
- 11 (b)  
Hydrometallurgy is the process of dissolving the metal or its ore by the action of a suitable chemical reagent followed by recovery of the metal either by electrolysis or by the use of a suitable precipitating agent.  

$$4\text{Au} + 8\text{KCN} + 2\text{H}_2\text{O} + \text{O}_2 \rightarrow 4\text{K}[\text{Au}(\text{CN})_2] + 4\text{KOH}$$
 air  

$$2\text{K}[\text{Au}(\text{CN})_2] + \text{Zn} \rightarrow 2\text{Au} + \text{K}_2[\text{Zn}(\text{CN})_4]$$
- 12 (a)  

$$\text{NaCl} + \text{H}_2\text{SO}_4 + \text{K}_2\text{Cr}_2\text{O}_7 \rightarrow \text{CrO}_2\text{Cl}_2 + \text{K}_2\text{SO}_4 + \text{Na}_2\text{SO}_4$$
 chromyl chloride
- 13 (c)  
Pure copper as a cathode and impure copper as anode is used in refining of impure copper.
- 14 (d)  
The process is called galvanisation and it protects iron from corrosion against the action of water and O<sub>2</sub>.

- 15 (a)  
In Bessemer's converter impurities of C, Mn, Si, P in pig iron are oxidized to produce steel.
- 16 (c)  
It reacts with alkalies and acids both.
- 17 (d)  
The transition metals form a large number of interstitial compounds in which small atoms like hydrogen, carbon, boron and nitrogen occupy interstitial sites in their lattices
- 18 (a)  
It is a fact.
- 19 (d)  
 $\text{CuCl} + \text{CO} \rightarrow \text{CuClCO}$
- 20 (a)  
Invar is Ni-Fe alloy used in clock pendulum.
- 21 (b)  
 $2\text{Cl}_2 + \text{HgO} \rightarrow \text{Cl}_2\text{O} + \text{HgCl}_2$   
mercuric oxide                      mercuric chloride
- 22 (d)  
In wrought iron, carbon is present as  $\text{Fe}_3\text{C}$  (cementite) *ie*, iron carbide and graphite
- 23 (a)  
The process of hardening the surface of wrought iron by depositing a surface layer of steel on it is called case-hardening. It is done by heating wrought iron in contact with potassium ferricyanide Alternatively, case hardening can also be done by heating wrought iron with charcoal and then plunging it in a suitable oil
- 24 (d)  
 $\text{Na}_2\text{CrO}_4 + 2\text{AgNO}_3 \rightarrow \text{Ag}_2\text{CrO}_4 + 2\text{NaNO}_3$
- 25 (d)  
Impurities of Cu and Ag from gold are removed by boiling impure gold with conc.  $\text{H}_2\text{SO}_4$  and also by electrolytic method.  
 $\text{Cu} + 2\text{H}_2\text{SO}_4 \xrightarrow{\text{Heat}} \text{CuSO}_4 + \text{SO}_2 + 2\text{H}_2\text{O}$   
 $2\text{Ag} + 2\text{H}_2\text{SO}_4 \xrightarrow{\text{Heat}} \text{Ag}_2\text{SO}_4 + \text{SO}_2 + 2\text{H}_2\text{O}$   
This method is called parting. Conc.  $\text{HNO}_3$  can also be used for this purpose.
- 26 (d)  
Hg-alloys with other metals are called amalgams.
- 27 (b)  
 $\text{HgCl}_2$  is easily volatile. It is insoluble in water and soluble in acids
- 28 (d)  
 $\text{Mn}^{2+}$ ,  $\text{V}^{4+}$ ,  $\text{Ti}^{4+}$  and  $\text{Cr}^{3+}$  are stable oxidation state of respective elements.
- 29 (d)  
 $\text{Zn}^{2+}$  ions have all paired electrons so, it is diamagnetic .
- 30 (d)  
All are transition elements.
- 32 (a)  
Gadolinium ( $Z=64$ )  $[\text{Xe}] 4f^7, 5d^1, 6s^2$   
Lutetium( $Z=71$ ) $[\text{Xe}] 4f^{14}, 5d^1, 6s^2$   
Lawrencium( $Z=103$ ) $[\text{Rn}] 5f^{14}, 6d^1, 7s^2$   
Tantalum( $Z=73$ )  $[\text{Xe}]4f^{14}, 5d^3, 6s^2$



Hence, gadolinium has got incompletely filled  $f$ -subshell.

33

(a)

The b.p. of Zn, Cd, Hg are 1193, 1040, 1129.7K, comparatively lower values, and are called volatile metals. These are therefore, purified by distillation.

34

(a)

Mn in  $\text{MnO}_4^-$  has +7 and Cr in  $\text{CrO}_2\text{Cl}_2$  has +6 oxidation state, the highest for Mn and Cr respectively.

35

(d)

C, Fe, Mg react with hot water to give  $\text{H}_2$ .

36

(d)

The element having unpaired electron is paramagnetic. More the number of unpaired electrons, more will be paramagnetic character.

Mn (25) =  $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$

∴ 5 unpaired electrons

Fe (26) =  $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^6$

∴ 4 unpaired electrons

Ni (28) =  $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^8$

∴ 2 unpaired electrons

Cu (29) =  $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}$

∴ 1 unpaired electrons

∴ Mn has maximum and Cu has least paramagnetic property.

37

(a)

The most abundant transition metal is Fe.

38

(d)

Thermite is  $\text{Fe}_2\text{O}_3 + \text{Al}$  used for welding.

40

(d)

Actual composition of chromite ore ( $\text{FeCr}_2\text{O}_4$ ) is  $\text{FeO} \cdot \text{Cr}_2\text{O}_3$ . In FeO, the oxidation state of Fe is +2 while in  $\text{Cr}_2\text{O}_3$ , the oxidation state of Cr is +3.

41

(a)

All these compounds are less soluble in water and only  $\text{Zn}(\text{OH})_2$  is soluble in  $\text{NH}_4\text{Cl} + \text{NH}_4\text{OH}$  due to formation of tetramine zinc (II) complex.

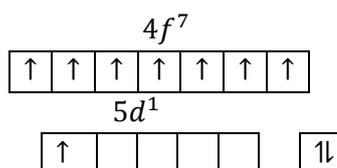
$\text{Zn}^{2+} + 4\text{NH}_4\text{OH} \rightarrow [\text{Zn}(\text{NH}_3)_4]^{2+} + 2\text{H}_2\text{O}$

42

(d)

Gd(64)

$[\text{Xe}]_{54}$



All the electrons of  $4f$ -orbital are unpaired, hence stable.

Thus, Gd(64) has EC as  $[\text{Xe}]_{54} 4f^7 5d^1 6s^2$

Instead of  $[\text{Xe}]_{54} 4f^8 6s^2$

43

(c)

$3\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$

44

(d)

Due to lanthanide contraction there occurs net decrease in size. Only one 0.85 Å is smaller one.

45

(b)

- Molybdenum steel is resistant to acid.
- 46 (c)  
ZnS (white), is precipitated in weak acidic medium ZnCl<sub>2</sub> (aq.) and Zn(NO<sub>3</sub>)<sub>2</sub> (aq.) give strongly acidic solution.
- 47 (b)  
Mond's process involves extraction of Ni.  

$$\text{Ni} + 4\text{CO} \xrightarrow{335\text{K}} \text{Ni}(\text{CO})_4 \text{ (Volatile);}$$

$$\text{Ni}(\text{CO})_4 \xrightarrow{450\text{K}} \text{Ni} + 4\text{CO}$$
- 48 (c)  
It is a trade name for CuSO<sub>4</sub> · 5H<sub>2</sub>O.
- 49 (b)  
Haematite (Fe<sub>2</sub>O<sub>3</sub>) having FeO is first oxidized to Fe<sub>2</sub>O<sub>3</sub> and then reduced to Fe by Co.
- 50 (a)  

$$\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{SO}_4 + 4\text{H}_2\text{O}_2 \rightarrow \text{K}_2\text{SO}_4 + 2\text{CrO}_5 + 5\text{H}_2\text{O}$$
- 51 (a)  
CrO<sub>4</sub><sup>2-</sup> has no unpaired *d* –electron.
- 52 (b)  
Zn does not show corrosion.
- 53 (c)  
Hg(OH)<sub>2</sub> does not exist.
- 54 (d)  
Zinc sulphate (ZnSO<sub>4</sub> · 7H<sub>2</sub>O) is called white vitriol. It when heated with barium sulphide, forms a white pigment lithopone
- 56 (a)  
Zn acts as cathode and carbon as anode in dry cells.
- 57 (c)  
There is very small difference in energies of 5*f*, 6*d* and 7*s* orbitals of actinoids, therefore their electronic configuration cannot assigned with a degree of certainty
- 58 (a)  
Due to 3*d*<sup>5</sup> configuration.
- 60 (d)  

$$\text{Ag}^+ + e \rightarrow \text{Ag}, \text{ i. e.}, \text{Ag}^+ \text{ is reduced.}$$
- 61 (c)  
A number of molybdic acids are known H<sub>2</sub>MoO<sub>4</sub>, H<sub>6</sub>Mo<sub>7</sub>O<sub>24</sub>.
- 62 (c)  
Haematite contains SiO<sub>2</sub> (acidic) non-fusible impurity and this basic flux CaCO<sub>3</sub> is used.  

$$\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2,$$

$$\text{CaO} + \text{SiO}_2 \rightarrow \underset{\text{Slag}}{\text{CaSiO}_3}$$
- 63 (a)  
The chemical formula for ammonium molybdate is (NH<sub>4</sub>)<sub>2</sub>MoO<sub>4</sub>.
- 64 (c)  
—do—
- 65 (c)  
Pig iron contains about 4% carbon. P, Mn and Si are in less percentage.
- 66 (c)  
It is a fact.



- 67 (a)  
Transition metal which have low oxidation number acts as reducing agent because of greater tendency to lose the electron. Moreover, they behave like a base
- 68 (d)  
$$\text{AuCl}_3 \xrightarrow{h\nu \text{ or } \Delta} \text{AuCl} + \text{Cl}_2$$
- 69 (c)  
Yellow colour of the potassium chromate changes to orange on acidification. It is due to the formation of dichromate ions
- $$\underset{\text{yellow}}{2\text{CrO}_4^{2-}} + 2\text{H}^+ \xrightleftharpoons[\text{alkali}]{\text{acid}} \underset{\text{orange}}{\text{Cr}_2\text{O}_7^{2-}} + 2\text{H}_2\text{O}$$
- 70 (d)  
$$4\text{Au} + 8\text{CN}^- + 2\text{H}_2\text{O} + \text{O}_2 \rightarrow 4[\text{Au}(\text{CN})_2]^- + 4\text{OH}^-$$
  
soluble  
$$2[\text{Au}(\text{CN})_2]^- + \text{Zn} \rightarrow 2\text{Au}(s) \downarrow + [\text{Zn}(\text{CN})_4]^{2-}$$
- 71 (b)  
Steel or iron containing excessive quantities of S is brittle while hot (hot or red short), whereas excessive quantities of phosphorus make it brittle white cold (cold short).
- 72 (d)  
In the iron silica is present as impurity, so for the removal of impurity of silica limestone is used.  
$$\text{CaCO}_3 \xrightarrow{\Delta} \text{CaO} + \text{CO}_2$$
  
$$\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$$
  
slag
- 73 (a)  
Inner transition elements or *f*-block elements have 3 incomplete shells, *i. e.*,  $(n-2)s^2p^6d^{10}f^{1-14}$ ,  $(n-1)s^2p^6$ ,  $ns^{1-2}$ .
- 74 (c)  
Au is a member of 5*d*-series. Fe, Co and Cu all are the members of 3*d*-series.
- 75 (d)  
$$\text{Ag}_2\text{S} + 4\text{NaCN} \rightarrow 2\text{Na}[\text{Ag}(\text{CN})_2] + \text{Na}_2\text{S}$$
  
$$2\text{Na}[\text{Ag}(\text{CN})_2] + \text{Zn} \rightarrow \text{Na}_2[\text{Zn}(\text{CN})_4] + 2\text{Ag}$$
- 76 (b)  
Magnetic moment depends upon number of unpaired electrons. In  $\text{Sc}^{3+}$ , there is no unpaired electron. So, its effective magnetic moment is zero.
- 77 (c)  
Anode mud left during electrolytic purification of Cu contains Au and Ag.
- 78 (b)  
It is a fact.
- 79 (c)  
The electronic configuration of Mn is  
 ${}_{25}\text{Mn} = [\text{Ar}] 3d^5 4s^2$   
 $\text{Mn}^{4+} = [\text{Ar}] 3d^3$   
Thus, three unpaired electrons are present.  
Spin only magnetic moment,  $\mu = \sqrt{n(n+2)}$   
 $n=3$

$$\begin{aligned}\mu &= \sqrt{3(3+2)} \\ &= \sqrt{15} = 3.87 \\ &\approx 4 \text{ BM}\end{aligned}$$

81

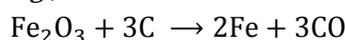
(c)

These are uses of Ag.

82

(c)

Carbon is generally used for the reduction of oxides of moderately reactive metals like Fe, Zn, etc.  
*e.g.*,



**Note** Highly reactive metals like Na are produced by electrolytic reduction while less reactive metals like Ag and Hg are obtained by autoreduction.

83

(b)

4*f*-level is successively filled in lanthanoids and 5*f*-level is successively filled in actinoids.

84

(c)

Ni<sup>2+</sup> and Cr<sup>2+</sup> are coloured due to presence of unpaired electrons. But Zn<sup>2+</sup> is colourless because of absence of unpaired electrons

85

(d)

Calomel is the name for Hg<sub>2</sub>Cl<sub>2</sub>.

86

(d)

CuCl<sub>2</sub> and CuBr<sub>2</sub> exist as (CuCl<sub>2</sub>)<sub>x</sub> and (CuBr<sub>2</sub>)<sub>x</sub> polymeric bridge structure.

87

(b)

It is a fact.

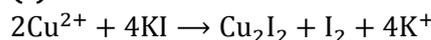
88

(d)

It is a fact.

89

(a)



90

(a)



91

(a)

Silver (Ag) metal is purified by Pattinson's process.

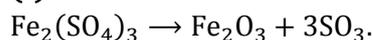
92

(a)

Cr<sub>2</sub>O<sub>7</sub><sup>2-</sup> has orange colour in *aq.* Medium.

93

(c)



94

(c)

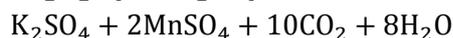
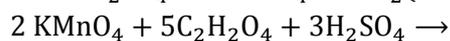
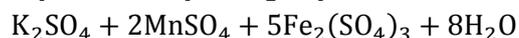
Stainless steel contains 11.5% Cr.

95

(c)

Aromatic compounds which have = or ≡ bond in the side chain decolourise acidic/ alkaline KMnO<sub>4</sub>. Benzene does not delcolourise the acidic/alkaline KMnO<sub>4</sub> due to the delocalization of π-electrons.

While propene decolourized the alkaline KMnO<sub>4</sub> due to the presence of = bond. Ferrous ammonium sulphate and oxalic acid decolourized the KMnO<sub>4</sub> in acidic medium.



96

(b)



- 97 **(d)**  
 $4\text{Zn} + 10\text{HNO}_3 \rightarrow 4\text{Zn}(\text{NO}_3)_2 + \text{NH}_4\text{NO}_3 + 3\text{H}_2\text{O}$   
 $\text{Cu}^{2+}(\text{aq.})$  is blue in colour.
- 98 **(b)**  
 $\text{Fe}^{2+}, 2\text{SO}_4^{2-}, 2\text{NH}_4^+$ .
- 99 **(b)**  
 Lanthanoids  $[\text{Xe}]4f^{1-14}5d^{0-1}6s^2$   
 Actinoides  $[\text{Rn}]5f^{1-14}6d^{0-1}7s^2$   
 Lanthanoides and actinoides use core  $d$  and  $f$ -orbitals also to show higher oxidation state. As actinoides have comparatively low energy difference between  $f$  and  $d$ -orbitals, show more oxidation states.
- 100 **(b)**  
 It contains 36% Ni.
- 101 **(c)**  
 $\text{CuCl}_2 + \text{Cu} \xrightarrow{\text{HCl}} \text{Cu}_2\text{Cl}_2$
- 102 **(b)**  
 It is a fact,  $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$ .
- 103 **(a)**  
 Except Cu, Hg, Ag, Pt and Au, where  $E_{\text{RP}}^\circ$  are + ve.
- 104 **(d)**  
 Bleaching powder is mixed salt,  $\text{K}_4\text{Fe}(\text{CN})_6$  is complex salt, hypo is normal salt.
- 105 **(d)**  
 Chalcopyrite is  $\text{CuFeS}_2$
- 106 **(c)**  
 $\text{Fe}(\text{OH})_3$  is formed as brown residue. Also colourless or light yellow solution will be left.
- 107 **(a)**  
 The  $d$ -block elements form coloured compounds. These compounds have ions with unpaired electron in  $d$ -subshell.  
 i) Na and Mg belong to  $s$ -block, so NaCl and  $\text{MgCl}_2$  are colourless compounds.  
 ii)  $\text{CuF}_2$   
 Oxidation state of Cu in  $\text{CuF}_2$  is +2  
 $\text{Cu}^{2+} = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^0, 3d^9$   

↑↓	↑↓	↑↓	↑↓	↑
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 $\therefore \text{CuF}_2$  in which Cu has one unpaired electron is coloured.  
 iii) CuI  
 Oxidation state of Cu in CuI = +1  
 $\text{Cu}^+ = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^0, 3d^{10}$   
 It has no unpaired electron. So, CuI is colourless.  
 $\therefore$  Only  $\text{CuF}_2$  is coloured among given choices.
- 108 **(b)**  
 A light hard aluminium alloy containing 4% Cu and small amounts of Mg, Mn and Si.
- 109 **(b)**  
 Purest zinc is made by zone refining method.
- 110 **(b)**  
 $\text{HgCl}_2$  compound is easily volatile. They are insoluble in water and soluble in acids.
- 111 **(c)**

A developer is a weak reducing agent, e. g. Ferrous oxalate; the parts affected by light on photographic plate are reduced to the maximum extent whereas part not affected by light remains unaffected.

112

(b)

Value of magnetic moment depends upon number of unpaired electrons. All except  $Ti^{3+} |3d^1|$  have either fully filled  $d$ -subshell (i. e.,  $Zn^{2+}$ ,  $Cu^+$ ) or empty  $d$ -subshell (ie,  $Sc^{3+}$ ). As such only  $Ti^{3+}$  has a net value of magnetic moment.

$$\begin{aligned} \text{Magnetic moment of } Ti^{3+} &= \sqrt{n(n+2)} \text{ BM} \\ &= \sqrt{1(1+2)} \text{ BM} \\ &= \sqrt{3} = 1.73 \text{ BM} \end{aligned}$$

113

(d)

$Sc^{3+} (3d^0)$ ,  $Ti^{4+} (3d^0)$  are diamagnetic due to absence of unpaired electrons. While  $Pd^{2+} (4d^8)$ ,  $Cu^{2+} (3d^9)$  contain two, and one unpaired electron respectively. Hence, these are paramagnetic

114

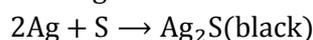
(b)

The nonmetallic impurities such as mica, earth particles etc associated with ore. These impurities are known as gangue.

115

(b)

Both mustard and egg yolk contain sulphur in form of compounds in large amount which reacts with Ag.



116

(d)

Only those transition metal ions which contain unpaired electrons, are coloured. Since colour appears when the unpaired  $d$ -electron absorb energy and gets excited to the higher energy  $d$ -orbital. Hence, the reason of appearance of colour is  $d-d$  transition.

117

(b)

It is a fact.

118

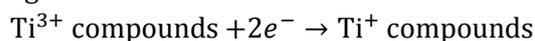
(b)

CdS is yellow solid.

119

(c)

$Ti^{3+}$  ions are more stable than  $Ti^{3+}$  and thus  $Ti^{3+}$  ions charge to  $Ti^+$  ions thereby acting as oxidizing agents



(less stable oxidizing agent) (More stable oxidising agent)

120

(a)

Cu, Ag and Au have been used in coins since ancient times.

121

(c)

At  $500^\circ C$   $Fe_2O_3$  is reduced by CO to Fe and  $CO_2$ .

122

(b)

$2e^- + Cr_2O_7^{2-} \rightleftharpoons 2CrO_4^{2-}$  exists in basic medium.

123

(c)

Wrought iron is obtained from pig iron by removing its impurities by puddling process in which cast iron is heated on the hearth of reverberatory furnace.

124

(a)

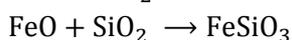
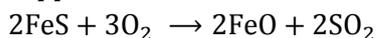
$E^\circ_{OP \text{ of H}} > E^\circ_{OP \text{ of Hg}}$

125

(a)



During the extraction of copper, the impurity (FeS) is removed as slag by mixing the contaminated copper ore with silica and coke.

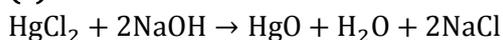


silica    ferrous silicate

(slag)

126

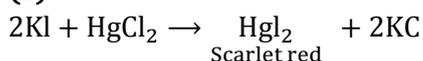
(b)



yellow

127

(b)



Scarlet red

128

(c)

Variable valency is due to the participation of electron from  $(n - 1)d$  and  $ns$  levels in bond formation

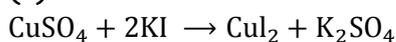
129

(b)

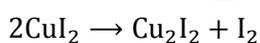
It is the desired chemical formula.

130

(b)



unstable

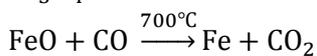
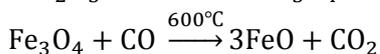
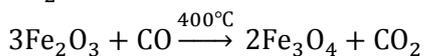
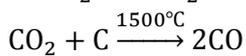
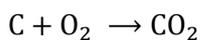


Thus,  $\text{CuI}_2$  is not formed.

131

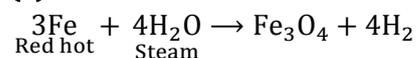
(a)

In the blast furnace, iron ore is reduced by coke and carbon monoxide at different temperatures.



132

(b)



**Assertion - Reasoning Type**

This section contain(s) 10 questions numbered 1 to 10. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

- a) Statement 1 is True, Statement 2 is True; Statement 2 is correct explanation for Statement 1
- b) Statement 1 is True, Statement 2 is True; Statement 2 is **not** correct explanation for Statement 1
- c) Statement 1 is True, Statement 2 is False
- d) Statement 1 is False, Statement 2 is True

- 1 **Statement 1:** The free gaseous Cr atom has six unpaired electrons.  
**Statement 2:** Half filled s- orbital has greater stability.
- 2 **Statement 1:** Magnetic moments values of actinides are lesser than the theoretically predicted values.  
**Statement 2:** Actinide elements are strongly paramagnetic.
- 3 **Statement 1:** Tungsten has the highest melting point  
**Statement 2:** Tungsten is a covalent compound
- 4 **Statement 1:** Oxalates and carbonates of lanthanides are almost insoluble in water  
**Statement 2:** Salts of lanthanides usually contains water of crystallisation
- 5 **Statement 1:**  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  on heating to  $250^\circ\text{C}$  loses all the five  $\text{H}_2\text{O}$  molecules and becomes anhydrous  
**Statement 2:** All the five  $\text{H}_2\text{O}$  molecules are coordinated to the central  $\text{Cu}^{2+}$  ion
- 6 **Statement 1:** Mercury vapour is shining silvery in appearance.  
**Statement 2:** Mercury is a metal with shining silvery appearance.
- 7 **Statement 1:** Chromium is hard but mercury is soft.  
**Statement 2:** Chromium is a 3d transition elements.
- 8 **Statement 1:** Mercury is liquid at room temperature  
**Statement 2:** In mercury, there is no unpaired *d*-electron and thus, metallic bonding is weakest
- 9 **Statement 1:** Europium(II) is more stable than cerium(II).  
**Statement 2:** Cerium salts are used as a catalyst in petroleum cracking.
- 10 **Statement 1:** Equivalent mass of  $\text{KMnO}_4$  is equal to one third of its molecular mass when it acts as an oxidising agent in an alkaline medium  
**Statement 2:** Oxidation number of Mn is +7 in  $\text{KMnO}_4$

**: ANSWER KEY :**

1)	c	2)	b	3)	c	4)	a	5)	c
6)	d	7)	b	8)	a	9)	b	10)	b

: HINTS AND SOLUTIONS :

- 1 (c)  
The free gaseous Cr atom has six unpaired electrons due to following electronic configuration  $(Ar)3d^5 4s^1$ . This is because half filled d-orbitals are more stable than incompletely filled  $d$ -orbitals. So, one electron jumps from  $4s^2$  to  $3d$  orbital.
- 2 (b)  
The magnetic moments are lesser than the theoretically predicted values. This is due to the fact that  $5f$  electrons of actinides are less effectively shielded which results in quenching of orbital contribution.
- 4 (a)  
The solubility of many salts of lanthanides follows the pattern of group II elements
- 5 (c)  

$$\text{CuSO}_4 \cdot 5\text{H}_2\text{O} \xrightarrow[\text{efflorescence}]{\text{Air}} \text{CuSO}_4 \cdot 3\text{H}_2\text{O} \xrightarrow{100^\circ\text{C}} \text{CuSO}_4 \cdot \text{H}_2\text{O} \xrightarrow{250^\circ\text{C}} \text{CuSO}_4$$
- One water molecular is hydrogen bonded to coordinated water molecules and  $\text{SO}_4^{2-}$  ion and remaining four are coordinated to the central  $\text{Cu}^{2+}$  ion
- 6 (d)  
Both assertion and reason are false. Mercury vapour are visible as no metallic bonding is possible in vapour state.
- 7 (b)  
Chromium has maximum number of unpaired  $d$ -electrons. While Hg does not have any unpaired  $d$ -electron.
- 8 (a)  
Statement II is the correct explanation of statement I
- 9 (b)  
 $\text{Eu}^{2+}[\text{Xe}]4f^7 5d^{10}$  (more stable)  
 $\text{Ce}^{2+}[\text{Xe}]4f^1 5d^1$
- 10 (b)  
In alkaline medium,  $\text{KMnO}_4$  is reduced to  $\text{MnO}_2$  which involves  $3e^-$   
Thus, its eq. wt =  $\frac{M}{3}$

**Matrix - Match Type**

This section contain(s) 1 question(s). Each question contains Statements given in 2 columns which have to be matched. Statements (A, B, C, D) in **columns I** have to be matched with Statements (p, q, r, s) in **columns II**.

1. Match List I with List II and select the correct answer using the codes given below the lists.

**Column-I**

- (A)  $\text{Cr}^{3+}$   
(B)  $\text{Fe}^{2+}$   
(C)  $\text{Ni}^{2+}$   
(D)  $\text{Mn}^{2+}$

**Column- II**

- (p)  $\sqrt{35}$   
(q)  $\sqrt{30}$   
(r)  $\sqrt{24}$   
(s)  $\sqrt{15}$   
(t)  $\sqrt{8}$

**CODES :**

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
a)	p	r	t	s
b)	q	r	t	p
c)	s	r	t	p
d)	s	t	r	p



: ANSWER KEY :

1)	c
----	---

## : HINTS AND SOLUTIONS :

1

(c)

$$\therefore \mu = \sqrt{n(n+2)}$$

$$\text{Cr}^{3+} (Z = 24): 3d^3 4s^0, \mu = \sqrt{3(3+2)} = \sqrt{15}$$

$$\text{Fe}^{2+} (Z = 26): 3d^6 4s^0, \mu = \sqrt{4(4+2)} = \sqrt{24}$$

$$\text{Ni}^{2+} (Z = 28): 3d^8 4s^0, \mu = \sqrt{2(2+2)} = \sqrt{8}$$

$$\text{Mn}^{2+} (Z = 25): 3d^5 4s^0, \mu = \sqrt{5(5+2)} = \sqrt{35}$$

