

## General Principles of Extraction of Metals

### JEE (Main) Exercises

#### Single Correct Answer Type

- Froth floatation process is used for the:  
(a) Oxide ores (b) Sulphide ores  
(c) Chloride ores (d) All of these
- In the froth floatation process, for the beneficiation of ores, the ore particles float because:  
(a) They are light  
(b) Their surface is not easily wetted by water  
(c) They bear electrostatic charge  
(d) They are insoluble
- Zone refining is a method to obtain:  
(a) Very high temperature (b) Ultrapure Al  
(c) Ultrapure metals (d) Ultrapure oxides
- Cassiterite is an ore of:  
(a) Mn (b) Ni  
(c) Sb (d) Sn
- Cryolite is:  
(a)  $\text{Na}_3\text{AlF}_6$  and is used in the electrolysis of alumina for decreasing electrical conductivity  
(b)  $\text{Na}_3\text{AlF}_6$  and is used in the electrolysis of alumina for lowering the melting point of alumina  
(c)  $\text{Na}_3\text{AlF}_6$  and is used in the electrolytic purification of alumina  
(d)  $\text{Na}_3\text{AlF}_6$  and is used in the electrolysis of alumina
- The process of converting hydrated alumina into anhydrous alumina is called:  
(a) Roasting (b) Smelting  
(c) Dressing (d) Calcination
- Pyrolusite is a/an:  
(a) Oxide ore (b) Sulphide ore  
(c) Carbide ore (d) Not an ore
- Composition of azurite mineral is:  
(a)  $\text{CuCO}_3 \cdot \text{CuO}$  (b)  $\text{Cu}(\text{HCO}_3)_2 \cdot \text{Cu}(\text{OH})_2$   
(c)  $2\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$  (d)  $\text{CuCO}_3 \cdot 2\text{Cu}(\text{OH})_2$
- Which of the following metal is not manufactured by electrolysis?  
(a) Na (b) Mg  
(c) Al (d) Fe
- Poling process is used:  
(a) For the removal of  $\text{Cu}_2\text{O}$  from Cu  
(b) For the removal of  $\text{Al}_2\text{O}_3$  from Al  
(c) For the removal of  $\text{Fe}_2\text{O}_3$  from Fe  
(d) All of these
- The pyrometallurgical operations involve the use of:  
(a) High temperature (b) Sulphide ores  
(c) Electrolysis (d) Complexation
- Aluminium is extracted by the electrolysis of:  
(a) Bauxite  
(b) Alumina  
(c) Alumina mixed with molten cryolite  
(d) Molten cryolite

13. Which of the following ores is best concentrated by froth floatation process?  
 (a) Malachite (b) Cassiterite  
 (c) Galena (d) Magnetite
14. The function of flux during the smelting of the ore is:  
 (a) To make the ore porous  
 (b) To remove gangue  
 (c) To facilitate reduction (d) To facilitate oxidation
15. Complex formation method is used for the extraction of:  
 (a) Zn (b) Ag  
 (c) Hg (d) Cu
16. Heating of pyrites in presence of air to remove sulphur is called:  
 (a) Roasting (b) Calcination  
 (c) Smelting (d) Fluxing
17. The acidic refractory material is:  
 (a) CaO (b)  $P_2O_5$   
 (c)  $SiO_2$  (d) MgO
18. The incorrect statement is:  
 (a) Calamine and siderite are carbonates  
 (b) Argentite and cuprite are oxides  
 (c) Zinc blende and iron pyrites are sulphides  
 (d) Malachite and azurite are ores of copper
19. Composition of malachite mineral is:  
 (a)  $CuCO_3 \cdot CuO$  (b)  $Cu(HCO_3)_2 \cdot Cu(OH)_2$   
 (c)  $2CuCO_3 \cdot Cu(OH)_2$  (d)  $CuCO_3 \cdot Cu(OH)_2$
20. Select the correct statement:  
 (a) Calcination and roasting take place in reverberatory furnace and small roasting takes place in small blast furnace  
 (b) Calcination and roasting take place only in small blast furnace  
 (c) Calcination and roasting take place only in reverberatory furnace  
 (d) All are correct
21. Bauxite is extracted by:  
 (a) Hall's process (b) Baeyer's process  
 (c) Serpek's process (d) All of these
22. Tin is extracted from its ore, cassiterite, by:  
 (a) Electrolytic reduction  
 (b) Carbon-monoxide reduction  
 (c) Carbon reduction  
 (d) The aluminothermic process
23. Tin is not refined by:  
 (a) Liquation (b) Zone refining  
 (c) Poling (d) Any of these
24. Matte contains:  
 (a)  $Cu_2S$ , FeS, and silica  
 (b)  $Cu_2S$ , FeO, and silica  
 (c)  $Cu_2S$ , CuO, and silica  
 (d)  $Cu_2S$ ,  $Cu_2O$ , and silica
25. The ore that is concentrated by froth floatation process is:  
 (a) Cinnabar (b) Bauxite  
 (c) Malachite (d) Zincite
26. Hydro-metallurgical process of extraction of metals is based on:  
 (a) Complex formation (b) Hydrolysis  
 (c) Dehydration (d) Dehydrogenation
27. In aluminothermic process, aluminium is used as:  
 (a) Oxidizing agent (b) Reducing agent  
 (c) Dehydrating agent  
 (d) Complex formation agent
28. Which of the following metals are found in native state?  
 Ag, Pt, C, Si, N, O, Mg, Na, Pb.  
 (a) Ag, Pt, C, N, O (b) Ag, Pt, Mg  
 (c) Ag, Pt, Pb, Mg (d) Ag, Pt
29. Most abundant metal in earth crust is:  
 (a) Al (b) O  
 (c) Fe (d) Si
30.  $CaS_2 + \frac{3}{2}O_2 \longrightarrow CaS_2O_3$   
 What is the difference in average oxidation number of sulphur in product and in reactant in the above given reaction?  
 (a) 1 (b) 2  
 (c) 3 (d) 4
31. Ellingham diagram represents:  
 (a) Change of  $\Delta G$  with temperature  
 (b) Change of  $\Delta H$  with temperature  
 (c) Change of  $\Delta G$  with pressure  
 (d) Change of  $(\Delta G - T\Delta S)$  with temperature
32. To carry out a reduction process, select a temperature so as to make:  
 (a)  $\Delta G$  negative (b)  $\Delta G$  positive  
 (c)  $\Delta H$  negative (d)  $\Delta H$  positive



33. Self-reduction of the sulphide ore takes place during:  
 (a) Roasting (b) Smelting  
 (c) Calcination (d) Cupellation
34. Corundum is ..... mineral of Al:  
 (a) Silicate (b) Oxide  
 (c) Double salt (d) Sulphate
35. Purest form of iron is:  
 (a) Cast iron (b) Wrought iron  
 (c) Pig iron (d) None of these
36. Cementite is:  
 (a) Predominant content of cement  
 (b) A mineral of calcium  
 (c) A carbide of iron in steel  
 (d) None of these
37. Iron obtained from blast furnace is:  
 (a) Wrought iron (b) Cast iron  
 (c) Pig iron (d) Steel
38. In the extraction of nickel by Mond's process, the metal is obtained by:  
 (a) Electrochemical reduction  
 (b) Thermal decomposition  
 (c) Chemical reduction by aluminium  
 (d) Reduction by carbon
39. Iron obtained from reduction zone of the blast furnace is:  
 (a) Wrought iron (b) Cast iron  
 (c) Spongy iron (d) Steel
40. Refining of silver is done by:  
 (a) Liquation (b) Poling  
 (c) Cupellation (d) Van Arkel method
41. Bessemerization is carried out for  
 I: Fe, II: Cu, III: Al, IV: silver  
 (a) I, II (b) II, III  
 (c) III, IV (d) I, III
42. Calcination is the process of heating the ore:  
 (a) In inert gas  
 (b) In the presence of air  
 (c) In the absence of air or limited supply of air  
 (d) In the presence of CaO and MgO
43.  $\text{Ag}_2\text{S} + \text{NaCN} + \text{Zn} \longrightarrow \text{Ag}$   
 This method of extraction of Ag by complex formation and then its displacement is called:  
 (a) Parke's method  
 (b) Mac Arthur-Forest method  
 (c) Serpek method  
 (d) Hall's method
44. The slag obtained during the extraction of copper from copper pyrites is composed of:  
 (a)  $\text{Cu}_2\text{S}$  (b)  $\text{CuSiO}_3$   
 (c)  $\text{FeSiO}_3$  (d)  $\text{SiO}_2$
45. In zone-refining method, the molten zone:  
 (a) Consists of impurities only  
 (b) Contains more impurity than the original metal  
 (c) Contains the purified metal only  
 (d) Moves to either side
46. Out of  $\text{Cu}_2\text{S}$ ,  $\text{HgS}$ , and  $\text{ZnS}$ , roasting is used to convert the minerals into metal in case of:  
 (a)  $\text{Cu}_2\text{S}$ ,  $\text{ZnS}$  (b)  $\text{HgS}$ ,  $\text{ZnS}$   
 (c)  $\text{Cu}_2\text{S}$  (d)  $\text{HgS}$
47. During smelting, an additional substance is added which combines with impurities to form a fusible mass. The additional substance is called:  
 (a) Flux (b) Slag  
 (c) Gangue (d) Ore
48. The process of isolation of metals by dissolving the ore in a suitable chemical reagent followed by precipitation of the metal by a more electropositive metal is called:  
 (a) Electrometallurgy (b) Hydrometallurgy  
 (c) Electro-refining (d) Zone-refining
49. Smelting involves reduction of metal oxide with:  
 (a) Carbon (b) Self-reduction  
 (c) Magnesium (d) Aluminium
50. Zone-refining has been employed for preparing ultra-pure samples of:  
 (a) Cu (b) Zn  
 (c) Ge (d) Ag
51. In the aluminothermite process, aluminium acts as:  
 (a) An oxidizing agent (b) A flux  
 (c) A reducing agent (d) A solder
52. In which of the following minerals, is aluminium not present?  
 (a) Cryolite (b) Mica  
 (c) Feldspar (d) Fluorspar
53. Which of the following metals is obtained by leaching the ore with dilute cyanide solution?  
 (a) Silver (b) Titanium  
 (c) Vanadium (d) Zinc
54. Which method of purification is represented by the equations:  

$$\text{Ti (Impure)} + 2\text{I}_2 \xrightarrow{500\text{ K}} \text{TiI}_4 \xrightarrow{1675\text{ K}} \text{Ti (Pure)} + 2\text{I}_2$$
  
 (a) Cupellation (b) Poling  
 (c) Van Arkel (d) Zone refining



55. Which of the following beneficiation processes is used for the mineral,  $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ ?  
 (a) Froth floatation (b) Leaching  
 (c) Liquefaction (d) Magnetic separation
56. Malachite is an ore of:  
 (a) Iron (b) Zinc  
 (c) Copper (d) Mercury
57. Heating of pyrites to remove sulphur is called:  
 (a) Smelting (b) Calcination  
 (c) Liquefaction (d) Roasting
58. In the metallurgy of which of the following, is cupellation process used?  
 (a) Copper (b) Silver  
 (c) Iron (d) Aluminium
59. The methods chiefly used for the extraction of lead and tin from their ores are, respectively:  
 (a) Self-reduction and carbon reduction  
 (b) Self-reduction and electrolytic reduction  
 (c) Carbon reduction and self-reduction  
 (d) Cyanide process and carbon reduction
60. Vapor phase refining of nickel is carried out using:  
 (a)  $\text{I}_2$  (b)  $\text{Cl}_2$   
 (c)  $\text{HCl}$  (d)  $\text{CO}$
61. Complexes formed in the following methods are:  
 (I) Mond's process for purification of nickel  
 (II) Removal of lead poisoning from the body  
 (III) Cyanide process for extraction of silver  
 (IV) Froth floatation process for separation of  $\text{ZnS}$  from galena ore by using depressant
- | I                            | II                              | III                             | IV                              |
|------------------------------|---------------------------------|---------------------------------|---------------------------------|
| (a) $\text{Ni}(\text{CO})_4$ | $[\text{Pb}(\text{EDTA})]^{2-}$ | $[\text{Ag}(\text{CN})_2]^-$    | $[\text{Zn}(\text{CN})_2]$      |
| (b) $\text{Ni}(\text{CO})_4$ | $[\text{Pb}(\text{EDTA})]^{2-}$ | $[\text{Ag}(\text{CN})_2]^-$    | $[\text{Zn}(\text{CN})_4]^{2-}$ |
| (c) $\text{Ni}(\text{CO})_6$ | $[\text{Pb}(\text{EDTA})]^{4-}$ | $[\text{Ag}(\text{CN})_2]^-$    | $[\text{Zn}(\text{CN})_6]^{4-}$ |
| (d) $\text{Ni}(\text{CO})_4$ | $[\text{Pb}(\text{EDTA})]^{2-}$ | $[\text{Ag}(\text{CN})_4]^{3-}$ | $[\text{Zn}(\text{CN})_4]^{2-}$ |
62. Silver is obtained from  $\text{Na}[\text{Ag}(\text{CN})_2]$  by reaction with:  
 (a) Fe (b) Na  
 (c) Zn (d) Au
63. Which of the following reactions taking place in the blast furnace during extraction of iron is endothermic?  
 (a)  $\text{CaCO}_3 \longrightarrow \text{CaO} + \text{CO}_2$   
 (b)  $2\text{C} + \text{O}_2 \longrightarrow 2\text{CO}$   
 (c)  $\text{C} + \text{O}_2 \longrightarrow \text{CO}_2$   
 (d)  $\text{Fe}_2\text{O}_3 + 3\text{CO} \longrightarrow 2\text{Fe} + 3\text{CO}_2$
64. Cassiterite ore consists of magnetic impurity named as:  
 (a) Chromite (b) Wolframite  
 (c) Magnetite (d) Limonite
65.  $A + 3\text{O}_2 \longrightarrow 2\text{ZnO} + 2\text{SO}_2$   
 Find the formula of A  
 (a)  $\text{ZnCO}_3$  (b)  $\text{ZnS}$   
 (c)  $\text{ZnSO}_4$  (d)  $\text{ZnCO}_3 \cdot 3\text{Zn}(\text{OH})_2$
66. Which of the following term is not related to Al-extraction?  
 (a) Serpek's process (b) Hall-Heroult process  
 (c) Thermite process (d) Hoop's process
67. Which of the following is not the ore of Fe?  
 (a) Siderite (b) Limonite  
 (c) Magnetite (d) Anthracite
68. Gold is extracted by hydrometallurgical process based on its property:  
 (a) Of being electropositive  
 (b) To form complexes which are water soluble  
 (c) Of being less reactive  
 (d) To form salts which are water soluble

### JEE (Advanced) Exercises

#### Single Correct Answer Type

- Van Arkel method of purification of metals involves converting the metal to a:  
 (a) Volatile enough stable compound  
 (b) Volatile unstable compound  
 (c) Non-volatile stable compound  
 (d) None of these
- When an aqueous solution of sodium chloride is electrolyzed using platinum electrodes, the ions discharged at the electrodes are:  
 (a) Sodium and hydrogen (b) Sodium and chloride  
 (c) Hydrogen and chloride  
 (d) Hydroxyl and chloride
- Native silver metal forms a water soluble complex with a dilute aqueous solution of  $\text{NaCN}$  in the presence of:  
 (a) Nitrogen (b) Oxygen  
 (c) Carbon dioxide (d) Argon
- Extraction of zinc from zinc blende is achieved by:  
 (a) Electrolytic reduction  
 (b) Roasting followed by reduction with carbon  
 (c) Roasting followed by reduction with another metal  
 (d) Roasting followed by self-reduction



5. The metal oxide which cannot be reduced to metal by carbon is:
  - (a) ZnO
  - (b) Fe<sub>2</sub>O<sub>3</sub>
  - (c) PbO
  - (d) Al<sub>2</sub>O<sub>3</sub>
6. The actual reducing agent of haematite in blast furnace is:
  - (a) C
  - (b) CO
  - (c) Al
  - (d) CO<sub>2</sub>
7. In the cyanide process for extraction of gold and silver from ores, the cyanide solution acts as a:
  - (a) Reducing agent to reduce the gold and silver compounds present in the ores into the metallic states
  - (b) Leaching agent to bring the gold and silver into solution as cyanide complexes and thus separate these metals from the ores
  - (c) Leaching agent to dissolve all the other constituents of the ores leaving the gold and silver as metals
  - (d) Leaching agent to bring the ores into solution
8. During the process of electrorefining of Cu, some metals present as impurity settle as anode mud. These are:
  - (a) Sn and Ag
  - (b) Pb and Zn
  - (c) Ag and Au
  - (d) Fe and Ni
9. Electrolytic reduction process is used for the extraction of:
  - (a) Alkali metals
  - (b) Alkaline earth metals
  - (c) Aluminium
  - (d) All of these
10. Choose the correct code regarding roasting process:
  - (I) It is the process of heating ore in air to obtain the oxide
  - (II) It is an exothermic process
  - (III) It is used for hydrated oxide and oxysalt ore
  - (IV) It is used after the concentration of ore
  - (a) I, II, and III
  - (b) I, II, and IV
  - (c) I, III, and IV
  - (d) I, II, III, and IV
11. The ignition mixture in "alumino thermite" process consists of a mixture of:
  - (a) Magnesium powder and BaO<sub>2</sub> or KClO<sub>3</sub>
  - (b) Magnesium powder, aluminium, and BaO<sub>2</sub>/KClO<sub>3</sub>
  - (c) Magnesium and aluminium powder
  - (d) Magnesium and aluminium oxides
12. Metal sulphides occur mainly in rocks and metal halides in lakes and seas because:
  - (a) Metal sulphides are soluble in water while metal chlorides are insoluble in water
  - (b) Metal sulphides are insoluble in water while metal chlorides are soluble in water
  - (c) Metal sulphide and metal chlorides both are soluble
  - (d) Metal sulphides and metal chlorides both are insoluble
13. From which of the following reaction is blister copper obtained?
  - (a)  $\text{Cu}_2\text{S} + \text{FeO} \longrightarrow 2\text{Cu} + \text{FeO}$
  - (b)  $\text{Cu}_2\text{S} + \text{FeS} \longrightarrow 2\text{Cu} + \text{FeS}_2$
  - (c)  $\text{Cu}_2\text{S} + 2\text{Cu}_2\text{O} \longrightarrow 6\text{Cu} + \text{SO}_2$
  - (d)  $\text{Cu}^{2+} + \text{Fe} \longrightarrow \text{Fe}^{2+} + \text{Cu}$
14. During the extraction of copper from chalcopyrites, iron is removed as:
  - (a) Fe<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>
  - (b) Fe<sub>2</sub>O<sub>3</sub>
  - (c) Fe<sub>2</sub>(SiO<sub>3</sub>)<sub>3</sub>
  - (d) FeSiO<sub>3</sub>
15. Blister copper is:
  - (a) Electrolytically refined copper
  - (b) A mixture of impure copper and silver
  - (c) Copper containing 2% impurity
  - (d) Present in the anode mud in an electrolytic process
16. In the electrolytic refining of silver, the anode mud obtained contains:
  - (a) Zn, Ag, and Au
  - (b) Zn, Cu, Ag, and Au
  - (c) Au
  - (d) Cu, Ag, and Au
17.  $\Delta G^\circ$  vs  $T$  plot in Ellingham diagram slopes downward for the reaction:
  - (a)  $\text{Mg} + 1/2 \text{O}_2 \longrightarrow \text{MgO}$
  - (b)  $2\text{Ag} + 1/2 \text{O}_2 \longrightarrow \text{Ag}_2\text{O}$
  - (c)  $\text{C} + 1/2 \text{O}_2 \longrightarrow \text{CO}$
  - (d)  $\text{CO} + 1/2 \text{O}_2 \longrightarrow \text{CO}_2$
18. Self-reduction of CuS to Cu can be carried out in:
  - (a) Bessemer converter
  - (b) Blast furnace
  - (c) Both (a) and (b)
  - (d) None of these
19. When alloy of silver and lead is rich in silver:
  - (a) Cupellation process is used
  - (b) Parke's method is used
  - (c) Bett's method is used
  - (d) Any of these methods can be used
20. Phosphorus separates, in the extraction of iron, as:
  - (a) Slag, Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>
  - (b) Volatile P<sub>2</sub>O<sub>5</sub>
  - (c) Slag, Mg<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>
  - (d) Ca<sub>3</sub>P<sub>2</sub>
21. In the metallurgy of iron, when CaCO<sub>3</sub> is added to the blast furnace, calcium ion appears as:
  - (a) CaO
  - (b) Metallic Ca
  - (c) Gangue
  - (d) Slag



22. The method not used for the extraction of Al is:  
 (a) Van Arkel (b) Serpek's  
 (c) Baeyer (d) Hall-Heroult
23. Four metals and their methods of refinement are given  
 (i) Ni, Cu, Zr, Ga  
 (ii) Electrolysis, Van Arkel process, zone refining, Mond's process  
 Choose the right method for each:  
 (a) Ni: Electrolysis, Cu: Van Arkel process, Zr: Zone refining, Ga: Mond's process  
 (b) Ni: Mond's process, Cu: Electrolysis, Zr: Van Arkel process, Ga: Zone refining  
 (c) Ni: Mond's process, Cu: Van Arkel process, Zr: Zone refining, Ga: Electrolysis  
 (d) Ni: Electrolysis, Cu: Zone refining, Zr: Van Arkel process, Ga: Mond's process
24. Extraction of aluminium from aluminium oxide ( $\text{Al}_2\text{O}_3$ ) is best done by:  
 (a) Electrolytic reduction of  $\text{Al}_2\text{O}_3$   
 (b) Reduction of  $\text{Al}_2\text{O}_3$  with carbon  
 (c) Reduction of  $\text{Al}_2\text{O}_3$  with sodium  
 (d) Reduction of  $\text{Al}_2\text{O}_3$  with CO
25. Chemical leaching is useful in the concentration of:  
 (a) Copper pyrites (b) Bauxite  
 (c) Galena (d) Cassiterite
26. Which one of the following is not a method of concentration of metals?  
 (a) Gravity separation  
 (b) Froth floatation process  
 (c) Electromagnetic separation  
 (d) Smelting
27.  $\text{Ag}_2\text{S} + \text{NaCN} \longrightarrow (A)$ ,  $(A) + \text{Zn} \longrightarrow (B)$   
 (B) is a metal. Hence, (A) and (B) are:  
 (a)  $\text{Na}_2[\text{Zn}(\text{CN})_4]$ , Zn (b)  $\text{Na}[\text{Ag}(\text{CN})_2]$ , Ag  
 (c)  $\text{Na}_2[\text{Ag}(\text{CN})_4]$ , Ag (d)  $\text{Na}_3[\text{Ag}(\text{CN})_4]$ , Ag
28. Which of the following does not contain Mg?  
 (a) Magnetite (b) Magnesite  
 (c) Epsom (d) Carnallite
29. Annealing of steel is the process of heating steel:  
 (a) To a bright red hot and then cooling it slowly  
 (b) To a bright red hot and then cooling it suddenly  
 (c) To a temperature much below redness and cooling it slowly  
 (d) None of the above
30. Which of the following process is not a physical process of separation?  
 (a) Levigation (b) Magnetic separation  
 (c) Leaching (d) Froth floatation
31. The process of concentrating Au and Ag ores is based upon their solubility in:  
 (a)  $\text{NH}_3$  (b)  $\text{HNO}_3$   
 (c)  $\text{HCl}$  (d)  $\text{KCN}$
32. Which of the following metal is sometimes found native in nature?  
 (a) Aluminium (b) Copper  
 (c) Iron (d) Magnesium
33. In the Parke's process of Ag-extraction, Zn is removed from (Zn-Ag) alloy by using  
 (a) Cupellation (b) Electrolytic refining  
 (c) Distillation (d) Fractional crystallization
34. In the extraction of copper from its sulphide ore, the metal is formed by reduction of  $\text{Cu}_2\text{O}$  with:  
 (a)  $\text{FeS}$  (b) CO  
 (c)  $\text{Cu}_2\text{S}$  (d)  $\text{SO}_2$
35. In the process of extraction of gold,  

$$\text{Roasted gold ore} + \text{CN}^- + \text{H}_2\text{O} \xrightarrow{\text{O}_2} [\text{X}] + \text{OH}^-$$

$$[\text{X}] + \text{Zn} \longrightarrow [\text{Y}] + \text{Au}$$
 (a)  $\text{X} = [\text{Au}(\text{CN})_2]^-$ ,  $\text{Y} = [\text{Zn}(\text{CN})_4]^{2-}$   
 (b)  $\text{X} = [\text{Au}(\text{CN})_4]^{2-}$ ,  $\text{Y} = [\text{Zn}(\text{CN})_4]^{2-}$   
 (c)  $\text{X} = [\text{Au}(\text{CN})_2]^-$ ,  $\text{Y} = [\text{Zn}(\text{CN})_6]^{4-}$   
 (d)  $\text{X} = [\text{Au}(\text{CN})_4]^-$ ,  $\text{Y} = [\text{Zn}(\text{CN})_4]^{2-}$
36. Carbon cannot be used to produce magnesium by chemical reduction of  $\text{MgO}$  because:  
 (a) Carbon is not a powerful reducing agent  
 (b) Magnesium reacts with carbon to form carbides  
 (c) Carbon does not react with magnesium  
 (d) Carbon is a non-metal
37. The ore having two different metal atoms is:  
 (a) Hematite (b) Galena  
 (c) Magnetite (d) Copper pyrites
38. Which of the following statement is correct regarding Cu-extraction?  
 (a) In the smelting step, carbon reduction takes place  
 (b) During roasting,  $\text{Cu}_2\text{S}$  remains almost unaffected  
 (c) In Bessemer converter, only self-reduction occurs, not slag formation  
 (d) Blister formed in the blister Cu is due to dissolved  $\text{CO}_2$



39. Which of the following process is not involved in the extraction of Fe?
- (a) Gravity separation (b) Leaching  
(c) Roasting (d) Carbon reduction
40. Carbon reduction process is not commercially applicable for which of the following set of oxides to extract the respective metal?
- (I) ZnO (II) Fe<sub>2</sub>O<sub>3</sub>  
(III) Al<sub>2</sub>O<sub>3</sub> (IV) SnO<sub>2</sub>  
(V) MgO  
(a) ZnO, Fe<sub>2</sub>O<sub>3</sub>, SnO<sub>2</sub> (b) ZnO, SnO<sub>2</sub>, MgO  
(c) MgO, Al<sub>2</sub>O<sub>3</sub> (d) MgO, SnO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>
41. Which of the following metal can be reduced by carbon reduction as well as self-reduction?
- (a) Fe (b) Al  
(c) Pb (d) None of these
42. Which of the following metal is leached by cyanide process?
- (a) Ag (b) Na  
(c) Al (d) Cu
43. Which one of the following ore is not concentrated by froth floatation process?
- (a) Copper pyrites (b) Cinnabar  
(c) Pyrolusite (d) Zinc blende
44. Sulphide ores of metals are usually concentrated by froth floatation process. Which one of the following sulphide ores offers an exception and is concentrated by chemical leaching?
- (a) Galena (b) Copper pyrite  
(c) Sphalerite (d) Argentite
45. Among the metals Cr, Fe, Mn, Ti, Ba, and Mg, the one that cannot be obtained by reduction of its metal oxide by aluminium is:
- (a) Cr (b) Fe  
(c) Mn (d) Ba
46. Which of the following factors is of no significance for roasting sulphide ores to the oxides and not subjecting the sulphide ores to carbon reduction directly?
- (a) CO<sub>2</sub> is more volatile than CS<sub>2</sub>  
(b) Metal sulphides are thermodynamically more stable than CS<sub>2</sub>  
(c) CO<sub>2</sub> is thermodynamically more stable than CS<sub>2</sub>  
(d) Metal sulphides are less stable than the corresponding oxides
47. The method not used in metallurgy to refine the impure metal is:
- (a) Mond's process (b) Van-Arkel process  
(c) Liquation (d) All are used
48. Chalcogens are:
- (a) Hydrocarbons (b) Ore forming elements  
(c) Oxide forming elements  
(d) Those having ability to catenate
49. The oxidation state of Cu and Fe in Chalcopyrite is, respectively:
- (a) +2, +2 (b) +1, +2  
(c) +1, +3 (d) +2, +1
50. Extraction of zinc from zinc blende is achieved by:
- (a) Electrolytic reduction  
(b) Roasting followed by reduction with carbon  
(c) Roasting followed by reduction with another metal  
(d) Roasting followed by self-reduction
51. Copper can be extracted by hydrometallurgy but not zinc because:
- (a) Copper is comparatively less active metal as its reduction potential is high. It can be displaced from solutions of Cu<sup>2+</sup> ion by more active metals  
(b) Zn displaced from solution of Zn<sup>2+</sup> ion, a more reactive metal than it, but then readily react with water forming their corresponding ions and evolve hydrogen gas  
(c) Both (a) and (b) are correct  
(d) Copper can never be extracted by hydrometallurgy
52. Consider the following reactions at 1000°C:
- (i)  $\text{Zn}_{(s)} + \frac{1}{2} \text{O}_{2(g)} \longrightarrow \text{ZnO}_{(s)}$   
 $\Delta G^\circ = -360 \text{ kJ mol}^{-1}$
- (ii)  $\text{C}_{(s)} + \frac{1}{2} \text{O}_{2(g)} \longrightarrow \text{CO}_{(g)}$   
 $\Delta G^\circ = -460 \text{ kJ mol}^{-1}$
- Choose the correct statement at 1000°C:
- (a) Zinc can be oxidized by CO  
(b) Zinc oxide can be reduced by C  
(c) Both statements (i) and (ii) are true  
(d) Both statements (i) and (ii) are false
53. Formation of Ni(CO)<sub>4</sub> and subsequently its decomposition into Ni and CO (recycled) make the basis of Mond's process:
- $$\text{Ni} + 4\text{CO} \xrightarrow{T_1} \text{Ni(CO)}_4 \xrightarrow{T_2} \text{Ni} + 4\text{CO}$$
- T<sub>1</sub> and T<sub>2</sub> are:
- (a) 100°C, 50°C (b) 50°C, 100°C  
(c) 50°C, 230°C (d) 230°C, 50°C

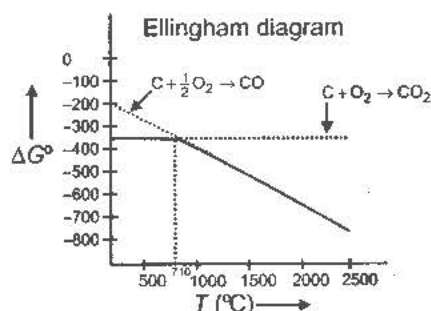


54. Oxides of the various metals are converted into metal by heating but not in:
- (a)  $\text{Ag}_2\text{O}$  (b)  $\text{CuO}$   
(c)  $\text{HgO}$  (d) All of these
55. When  $\text{FeCr}_2\text{O}_4$  (chromite) is reduced with Al:
- (a) Cr and  $\text{Fe}_2\text{O}_3$  are formed  
(b) Fe and  $\text{Cr}_2\text{O}_3$  are formed  
(c) Fe and Cr (ferrochrome) are formed  
(d)  $\text{FeCrO}_4$  is formed
56. Boron can be obtained by various methods but not by:
- (a) Pyrolysis of  $\text{BBr}_3$  (Van Arkel)  
(b) Reducing  $\text{BCl}_3$  with  $\text{H}_2$   
(c) Electrolysis of fused  $\text{BCl}_3$   
(d) Oxidation of  $\text{B}_2\text{O}_3$
57. Which of the following statement is correct?
- (a) Roasting is unnecessarily done for Fe-extraction because there is no sulphide ore  
(b) In the smelting step of Cu-extraction, reduction of the ore takes place  
(c) Ores may not be mineral  
(d) Sphalerite is the ore of zinc
58. Consider the following metallurgical processes:
1. Heating impure metal with CO and distilling the resulting volatile carbonyl (b.pt.  $43^\circ\text{C}$ ) and finally decomposing at  $150^\circ\text{C}$  to  $230^\circ\text{C}$  to get the pure metal
  2. Heating the sulphide ore in air until a part is converted to oxide and then further heating in the absence of air to let the oxide react with unchanged sulphide
  3. Electrolyzing the molten electrolyte containing  $\text{CaCl}_2$  to obtain the metal
- The processes used for obtaining sodium, nickel, and copper are, respectively,
- (a) 1, 2, and 3 (b) 2, 3, and 1  
(c) 3, 1, and 2 (d) 2, 1, and 3
59. Consider the following statements:  
Roasting is carried out to
1. Convert sulphide to oxide and sulphate
  2. Remove water of hydration
  3. Melt the ore
  4. Remove arsenic and sulphur impurities
- Of these statements:
- (a) 1, 2, and 3 are correct  
(b) 1 and 4 are correct  
(c) 1, 2, and 4 are correct  
(d) 2, 3, and 4 are correct
60. The element which could be extracted by electrolytic reduction of its oxide dissolved in a high temperature melt is:
- (a) Sodium (b) Magnesium  
(c) Fluorine (d) Aluminium
61. In which of the following isolations is no reducing agent required?
- (a) Iron from haematite  
(b) Tin from tin oxide  
(c) Mercury from cinnabar  
(d) Zinc from zinc blende
62. The following are the extraction process of silver but not:
- (a) As a side product in electrolytic refining of copper  
(b) Parke's process in which Zn is used to extract silver by solvent extraction from molten lead  
(c) By reaction of silver sulphide with KCN and then reaction of soluble complex with Zn  
(d) By heating  $\text{Na}[\text{Ag}(\text{CN})_2]$
63. Reduction of a metal oxide by excess carbon at high temperature is a method for the commercial preparation of some metals. This method can be successfully applied in the case of:
- (a)  $\text{BeO}$  and  $\text{Al}_2\text{O}_3$  (b)  $\text{ZnO}$  and  $\text{Fe}_2\text{O}_3$   
(c)  $\text{CaO}$  and  $\text{Cr}_2\text{O}_3$  (d)  $\text{BaO}$  and  $\text{U}_3\text{O}_8$
64. The salt which is least likely to be found in minerals is:
- (a) Chloride (b) Sulphate  
(c) Sulphide (d) Nitrate
65. Which of the following statement is correct?
- (a) Froth floatation method can only be used for sulphide ore  
(b) Tin stone consists of wolframite as non-magnetic impurity  
(c) In cyanide process for the extraction of silver, Zn is used as leaching agent  
(d) Bessemerization process is used in the extraction of copper from copper pyrite
66. A solution containing  $1 \text{ mol L}^{-1}$  each of  $\text{Cu}(\text{NO}_3)_2$ ,  $\text{AgNO}_3$ ,  $\text{Hg}_2(\text{NO}_3)_2$ , and  $\text{Mg}(\text{NO}_3)_2$  is electrolyzed using inert electrodes; with increasing potential difference applied across the electrodes, the sequence of deposition of metals on the cathode will be:
- $$\left( E^\circ_{\text{Ag}^+/\text{Ag}} = 0.80 \text{ V}, E^\circ_{\text{Hg}_2^{2+}/\text{Hg}} = 0.79 \text{ V}, E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}, E^\circ_{\text{Mg}^{2+}/\text{Mg}} = -2.37 \text{ V} \right)$$



- (a) Ag, Hg, Cu, Mg      (b) Mg, Ag, Cu, Hg  
(c) Ag, Hg, Cu      (d) Cu, Hg, Ag
67. Thermite reduction is not used for commercial extraction of the respective metal from which of the following oxides?
- (a)  $\text{Mn}_3\text{O}_4$       (b)  $\text{TiO}_2$   
(c)  $\text{Fe}_2\text{O}_3$       (d)  $\text{Cr}_2\text{O}_3$

68.



Which of the following is incorrect on the basis of the above Ellingham diagram for carbon?

- (a) Up to  $710^\circ\text{C}$ , the reaction of formation of  $\text{CO}_2$  is energetically more favorable, but above  $710^\circ\text{C}$ , the formation of  $\text{CO}$  is preferred
- (b) In principle, carbon can be used to reduce any metal oxide at a sufficiently high temperature
- (c)  $\Delta S(\text{C}_{(\text{s})} + \frac{1}{2} \text{O}_{2(\text{g})} \longrightarrow \text{CO}_{(\text{g})}) < \Delta S(\text{C}_{(\text{s})} + \text{O}_{2(\text{g})} \longrightarrow \text{CO}_{2(\text{g})})$
- (d) Carbon reduces many oxides at elevated temperature because  $\Delta G^\circ$  vs temperature line has a negative slope

### Multiple Correct Answers Type

1.  $\text{Ca}_3(\text{PO}_4)_2$  is:
- (a) Thomas slag  
(b) Formed in manufacturing of steel iron  
(c) Used in manufacture of phosphorus fertilizer  
(d) Used as a refractory material
2. Which of the following ores is/are oxide ore(s)?
- (a) Cassiterite      (b) Bauxite  
(c) Cryolite      (d) Haematite
3. Select the correct statement(s):
- (a) Gravity separation method is used in concentration of oxide ore and carbonate ore
- (b) Magnetic separation method is used for separation of non-magnetic rutile and magnetic impurity of chlorapatite
- (c)  $\text{Fe}_3\text{O}_4$  is magnetic and impurities non-magnetic  
(d)  $\text{MnO}_2$  is non-magnetic and impurities magnetic
4. Auto-reduction process is used for the extraction of:
- (a) Cu      (b) Hg  
(c) Pb      (d) Al
5. Which of following reaction is not an example of thermite reaction?
- (a)  $\text{Cr}_2\text{O}_3 + 2\text{Al} \longrightarrow \text{Al}_2\text{O}_3 + 2\text{Cr}$   
(b)  $3\text{Mn}_3\text{O}_4 + 8\text{Al} \longrightarrow 4\text{Al}_2\text{O}_3 + 9\text{Mn}$   
(c)  $2\text{HgO} + \text{HgS} \longrightarrow 3\text{Hg} + \text{SO}_2$   
(d)  $2\text{Cu}_2\text{S} + 3\text{O}_2 \longrightarrow 2\text{Cu}_2\text{O} + 2\text{SO}_2$
6. Which represent incorrect matching of metals with their ores?
- | Mg            | Na        | Cu       | Al        |
|---------------|-----------|----------|-----------|
| (a) Chloride  | chloride  | sulphide | silicate  |
| (b) Carbonate | chloride  | sulphide | oxide     |
| (c) Carbonate | carbonate | oxide    | phosphate |
| (d) Oxide     | chloride  | sulphide | oxide     |
7. Which of the following reactions represent correct method?
- (a)  $\text{NaCl}_{(\text{molten})} \longrightarrow \text{Na}^+ + \text{Cl}^-$  : Down cell  
(b)  $\text{Ni}(\text{CO})_4 \longrightarrow \text{Ni} + 4\text{CO}$  : Mond process  
(c)  $\text{Ag}_2\text{CO}_3 \longrightarrow 2\text{Ag} + \text{CO}_2 + \frac{1}{2} \text{O}_2$   
: Van Arkel method  
(d)  $\text{ZrI}_4 \longrightarrow \text{Zr} + 2\text{I}_2$  : Van Arkel method
8. For the pyrometallurgical method used for the extraction of copper from sulphide ore, which statement(s) is/are correct?
- (a) Pyrometallurgy is a dry method  
(b) It involves concentration by leaching the sulphide ore with dil.  $\text{H}_2\text{SO}_4$   
(c) It involves concentration of the sulphide ore by froth floatation process  
(d) It involves concentration by leaching for every ore
9. Blister copper is:
- (a) Impure copper  
(b) Obtained in self-reduction process during bassemmerization  
(c) Obtained in carbon reduction process during bassemmerization  
(d) None is correct



10. Froth floatation process used for the concentration of sulphide ore:
- Is based on the difference in wettability of different minerals
  - Uses sodium ethyl xanthate,  $C_2H_5OCS_2Na$ , as collector
  - Uses NaCN as depressant in the mixture of ZnS and PbS when ZnS forms soluble complex and PbS forms froth
  - Uses pine oil as frothing agent
11. Mg can be obtained:
- By heating  $MgCl_2$  (anhydrous) with Na in the atmosphere of coal gas
  - By electrolysis of fused carnallite
  - By electrolysis of aqueous solution of carnallite
  - None of the above
12. NaCl and  $CaCl_2$  are also added to fused  $MgCl_2$  in the electrolysis of  $MgCl_2$ . Select the incorrect statement(s) for this solution:
- Melting point is decreased and conductivity is increased
  - Melting point is increased and conductivity is decreased
  - Melting point and conductivity both are decreased
  - Melting point and conductivity both are increased
13.  $SnO_2$  is reduced to metallic Sn on smelting oxide with anthracite and lime. In this, the function of lime is:
- It acts as a flux
  - It removes acidic impurities as slag
  - It removes basic impurities as slag
  - It acts as a slag
14. Poling process:
- Reduces  $SnO_2$  to Sn
  - Oxidizes impurities like iron; removes as scum
  - Uses green poles
  - Uses brown poles
15. Refining of tin can be done by:
- Cupellation
  - Liquation
  - Poling
  - Electrorefining
16. Which is the correct process-mineral matching in metallurgical extraction?
- |                   |      |
|-------------------|------|
| (a) Leaching      | : Ag |
| (b) Zone-refining | : Sn |
| (c) Liquation     | : Sn |
| (d) Van Arkel     | : Zr |
17. Tempering of steel:
- Is heating the steel to appropriate temperature and then cooling it slowly
  - Increases mechanical strength
  - Changes ratio of iron in steel
  - Decreases mechanical strength
18. Of the following reduction processes:
- $Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO$
  - $ZnO + C \longrightarrow Zn + CO$
  - $Cu_2O + C \longrightarrow 2Cu + CO$
  - $PbO + C \longrightarrow Pb + CO$
- correct process is/are:
- (i)
  - (ii)
  - (iii)
  - (iv)
19. Reaction(s) involved in thermite process is/are:
- $3Mn_3O_4 + 8Al \longrightarrow 9Mn + 4Al_2O_3$
  - $Cr_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Cr$
  - $2Fe + Al_2O_3 \longrightarrow 2Al + Fe_2O_3$
  - $B_2O_3 + 2Al \longrightarrow 2B + Al_2O_3$
20. Which of the following compounds are not called Thomas slag?
- Calcium silicate
  - Calcium phosphate
  - Barium phosphate
  - Strontium silicate
21. Out of the following metals, that can be obtained by electrolysis of the aqueous solution of their salts is/are:
- Ag
  - Au
  - Cu
  - Mg
22. Mond's process is not used for:
- Ni
  - Al
  - Fe
  - Cu
23. The metal(s) which cannot be obtained by electrolysis of aqueous solution of their salts is/are:
- Ag
  - Mg
  - Cu
  - Al
24. The anodic mud obtained during electrorefining of Cu contains:
- Ag
  - Fe
  - Au
  - Zn
25. In Fe-extraction, the roasting is carried out because:
- All FeO are to be converted to  $Fe_2O_3$
  - The formation of  $FeSiO_3$  slag is prevented



- (c)  $\text{Fe}_2\text{O}_3$  does not react with  $\text{SiO}_2$  to form slag  
 (d) The formation of slag ( $\text{CaSiO}_3$ ) is enhanced
26. Brine solution on electrolysis will give:  
 (a)  $\text{NaOH}$  (b)  $\text{O}_2$   
 (c)  $\text{Cl}_2$  (d)  $\text{H}_2$
27. The extraction of metals from oxide ores involve(s):  
 (a) Reduction with carbon  
 (b) Reduction with aluminium  
 (c) Electrolytic reduction  
 (d) Reduction with  $\text{CO}$
28. Select the correct statement(s):  
 (a) When temperature is raised, a point will be reached where the graph crosses the  $\Delta G = 0$  line. Below this temperature, the free energy of formation of the oxide is negative, so the oxide is stable  
 (b) When temperature is raised, a point will be reached where the graph crosses the  $\Delta G = 0$  line. Above this temperature, the free energy of formation of the oxide is positive, and the oxide becomes unstable, and should decompose into the metal and dioxygen  
 (c) Theoretically, all oxides can be decomposed to give the metal and dioxygen if a sufficiently high temperature can be attained  
 (d) Theoretically, all oxides cannot be decomposed to give the metal and dioxygen if a sufficiently high temperature can be attained
29. Metals which can be extracted by smelting process is/are:  
 (a)  $\text{Sn}$  (b)  $\text{Cu}$   
 (c)  $\text{Zn}$  (d)  $\text{Al}$
30. Which of the following steps is/are involved in roasting?  
 (a) Remove water of hydration  
 (b) Remove arsenic and sulphur impurities  
 (c) Convert sulphide to oxide and sulphate  
 (d) None of these
31. Which of the following ores is/are sulphide ore(s)?  
 (a) Galena (b) Cinnabar  
 (c) Tinstone (d) Copper pyrites
32. In the commercial extraction of iron, roasting is adopted because:  
 (a) It removes impurities of  $\text{S}$ ,  $\text{As}$ , and  $\text{Sb}$  in the form of their elemental vapor.  
 (b) It prevents slag formation by  $\text{Fe}_2\text{O}_3$ .  
 (c) It prevents slag formation by  $\text{FeO}$ .  
 (d) Limonite is converted into its anhydrous form.
33. Select the correct statement(s):  
 (a) In hydrometallurgy,  $\text{Zn}$  is used as oxidizing agent in the purification of  $\text{Ag}$  from  $[\text{Ag}(\text{CN})_2]^\ominus$   
 (b) When pine oil or eucalyptus oil is added into the water, it lowers down the surface tension by which froth is formed  
 (c) Sodium ethyl xanthate is used as collector  
 (d) Basic copper carbonate or  $\text{PbSO}_4$  is concentrated by froth floatation method by using an activator
34. Select the correct statement(s) for calcination:  
 (a) Carbonate ore is converted in oxide ore  
 (b) Hydrated oxide ore is converted into its oxide ore  
 (c) Oxidizable volatile impurities are removed by calcination process  
 (d) Only calcination occurs for carbonate or oxide ore.
35.  $\text{H}_2$  is not widely used as the reducing agent in metallurgical process because:  
 (a) Many metals react with  $\text{H}_2$  at elevated temperature forming hydrides  
 (b) There is a risk of explosion from  $\text{H}_2$  and  $\text{O}_2$  present in the air  
 (c)  $\Delta G^\circ/T$  line for  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$  has positive slope, and runs parallel to many metal oxide lines so, reducing power of  $\text{H}_2$  does not increase with temperature  
 (d)  $\Delta G^\circ/T$  line for  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$  has positive slope, and runs parallel to many metal oxide lines, so reducing power of  $\text{H}_2$  increase with temperature
36. Which is/are correct statement(s)?  
 (a) Cassiterite, chromite, and pitchblende are concentrated by hydraulic washing (tabling)  
 (b) Pure  $\text{Al}_2\text{O}_3$  is obtained from the bauxite ore by leaching in the Baeyer's process  
 (c) Sulphide ore is concentrated by calcination method  
 (d) Roasting can convert sulphide into oxide or sulphate and part of sulphide may also act as a reducing agent
37. Which is/are the correct method-metal matching for refining of crude metals?  
 (a) Distillation: zinc and mercury  
 (b) Liquation: tin  
 (c) Van Arkel: zirconium  
 (d) Mond process: lead
38. Select the correct reduction process:  
 (a)  $2[\text{Ag}(\text{CN})_2] + \text{Zn} \longrightarrow [\text{Zn}(\text{CN})_4]^{2-} + 2\text{Ag}$   
 (b)  $\text{CuO} + \text{H}_2 \longrightarrow \text{Cu} + \text{H}_2\text{O}$   
 (c)  $\text{Al}_2\text{O}_3 + 3\text{Zn} \longrightarrow 2\text{Al} + 3\text{ZnO}$   
 (d)  $\text{MgO} + \text{C} \xrightarrow{\text{high temp.}} \text{Mg} + \text{CO}$



39. Select the incorrect meaning of softening of lead:

- (a) Melting pure lead at high temperature
- (b) Removal of impurities, except silver, present in commercial lead
- (c) Formation of lead alloy
- (d) Formation of 100% pure lead

40. Softened lead is not desilverized by:

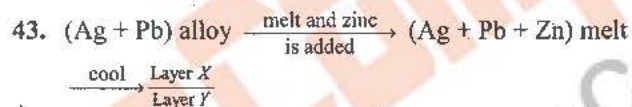
- (a) Parke's method
- (b) Roasting method
- (c) Calcination
- (d) Electrolysis

41. Select the correct statement(s):

- (a) When the lead-silver alloy is rich in silver, lead is removed by the cupellation process
- (b) When the lead-silver alloy is rich in lead, silver is removed by Parke's or Pattinson's process
- (c) Zinc forms an alloy with lead, from which lead is separated
- (d) Zinc forms an alloy with silver, from which zinc is separated by distillation

42. In the leaching of  $\text{Ag}_2\text{S}$  with  $\text{NaCN}$ , a stream of air is also passed. It is because of:

- (a) Reversible nature of reaction between  $\text{Ag}_2\text{S}$  and  $\text{NaCN}$
- (b) Oxidized  $\text{Na}_2\text{S}$  formed into  $\text{Na}_2\text{SO}_4$
- (c) Irreversible nature of reaction between  $\text{Ag}_2\text{S}$  and  $\text{NaCN}$
- (d) None of the above



Select the correct statement(s) based on above scheme:

- (a) Layer X contains zinc and silver
- (b) Layer Y contains lead and silver but amount of silver in this layer is smaller than in the layer X.
- (c) X and Y are immiscible layers
- (d) X and Y are miscible layers

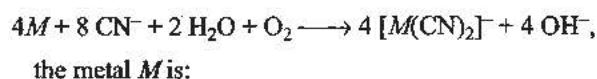
44. Which mineral has/have been named correctly?

- (a) Bauxite :  $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$
- (b) Corundum :  $\text{Al}_2\text{O}_3$
- (c) Cryolite :  $3\text{NaF} \cdot \text{AlF}_3$
- (d) Galena :  $\text{HgS}$

45. Chemical leaching is not useful in the concentration of:

- (a) Copper pyrites
- (b) Bauxite
- (c) Galena
- (d) Cassiterite

46. In the equation,



- (a) Copper
- (b) Silver
- (c) Gold
- (d) Zinc

47. Which of the following statements are correct regarding metallurgy of iron?

- (a) Coke reduces  $\text{FeO}$  to  $\text{Fe}$  above  $710^\circ\text{C}$
- (b)  $\text{CO}$  reduces  $\text{Fe}_2\text{O}_3$  to  $\text{FeO}$  below  $710^\circ\text{C}$
- (c) Coke reduces  $\text{Fe}_2\text{O}_3$  to  $\text{FeO}$  below  $710^\circ\text{C}$
- (d)  $\text{CO}$  reduces  $\text{Fe}_2\text{O}_3$  to  $\text{FeO}$  above  $710^\circ\text{C}$

48. The major role of fluorspar which is added in small amount in the electrolytic reduction of  $\text{Al}_2\text{O}_3$  dissolved in fused cryolite is:

- (a) As a catalyst
- (b) To make the fused mixture very conducting
- (c) To lower the fusion temperature of the melt
- (d) To decrease the rate of oxidation of carbon at the anode

49. Select the correct statements for Ellingham diagram:

- (a) Any metal will reduce the oxide of other metals which lie above it in the Ellingham diagram
- (b) According to Ellingham diagram, Al will not reduce  $\text{MgO}$  at temperature below  $1350^\circ\text{C}$
- (c) According to Ellingham diagram, Al will reduce  $\text{MgO}$  at temperature below  $1350^\circ\text{C}$
- (d) Any metal will not reduce the oxide of other metals which lie above it in the Ellingham diagram

50. The extraction of metals from sulphide ore involves:

- (a) Reduction with carbon
- (b) Froth floatation
- (c) Reduction with Al
- (d) Electrolytic reduction

51. Find the correct match:

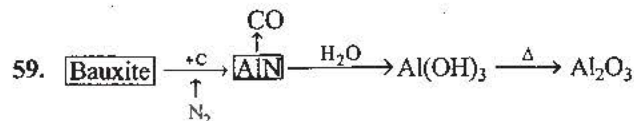
Column-I	Column-II
(a) Azurite	$\text{CuCO}_3 \cdot 2\text{Cu}(\text{OH})_2$
(b) Malachite	$\text{Cu}(\text{OH})_2 \cdot \text{CuCO}_3$
(c) Anglesite	$\text{PbSO}_4$
(d) Chalcocite	$\text{Cu}_2\text{S}$

52. Which of the following statements are correct?

- (a) The process of producing a hard coating of iron nitride on the surface of steel is called nitriding
- (b) The process of producing a thin coating of iron carbide on the surface of mild steel is called case-hardening



- (c) Quenched steel is produced by heating steel to redness and allowing it to cool slowly
- (d) Stainless steel is produced by heating wrought iron in molten chromium
53. Carbon can be used to reduce a number of oxides and other compounds, and because of the low cost and availability of coke, this method is widely used, but the disadvantages are that:
- High temperature is needed, which is expensive
  - Many metals combine with carbon to form carbides
  - Low temperature is needed, which is expensive
  - Many metal combine with carbon and do not form carbides
54. Select the correct statement(s):
- Based on reactivity series, occurrence of certain elements takes place in native state
  - Due to the basic nature of oxides of alkaline earth elements, they combine with atmospheric acidic oxides giving salts
  - Based on reactivity series, occurrence of certain elements takes place in atomic state
  - None is correct
55. The reduction of an oxide by aluminium is not called:
- Ellingham process
  - Goldschmidt's aluminothermite process
  - Kroll's process
  - Van Arkel process
56. Which of the following steps are involved in hydrometallurgical process?
- $\text{Cu}_2\text{S} + 2\text{Cu}_2\text{O} \longrightarrow 6\text{Cu} + \text{SO}_2$
  - $\text{CuFeS}_2 + 2\text{H}_2\text{SO}_4 \longrightarrow \text{CuSO}_4 + \text{FeSO}_4 + 2\text{H}_2\text{S}$
  - $\text{Ag}_2\text{S} + 2\text{NaCN} \longrightarrow [\text{Ag}(\text{CN})_2]^- + \text{Na}_2\text{S}$
  - $\text{CuCO}_3 + \text{H}_2\text{SO}_4 \longrightarrow \text{CuSO}_4 + \text{H}_2\text{O} + \text{CO}_2$
57. Which are not sulphate ore of Mg?
- Dolomite
  - Carnallite
  - Magnesite
  - Kieserite
58. In the Baeyer's process, which of the following statements are incorrect?
- $\text{Al}_2\text{O}_3$  goes into solution as soluble  $\text{Al}(\text{OH})_4^-$  while other basic oxides as  $\text{TiO}_2$  and  $\text{Fe}_2\text{O}_3$  remain insoluble.
  - $\text{Al}_2\text{O}_3$  changes to  $\text{AlN}$  which in turn is decomposed by  $\text{H}_2\text{O}$
  - $\text{Al}_2\text{O}_3$  changes to  $\text{Al}_2(\text{CO}_3)_3$  which changes to  $\text{AlCl}_3$
  - $\text{Al}_2\text{O}_3$  changes to  $\text{Al}_2(\text{SO}_4)_3$  which changes to  $\text{Al}_2\text{S}_3$



This flow-sheet is not for:

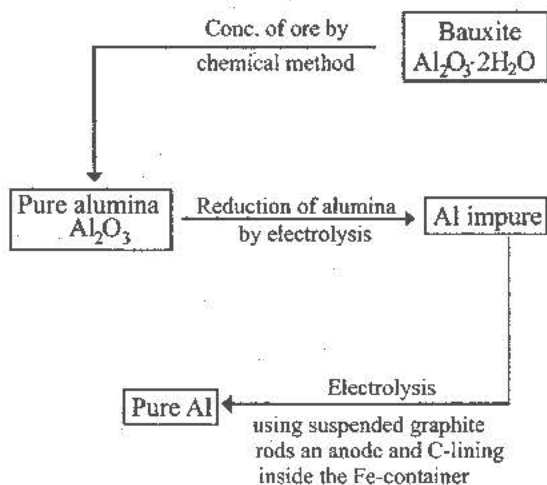
- Baeyer's process
  - Serpek's process
  - Hall's process
  - Kroll's process
60. Silver containing lead as an impurity is not purified by:
- Poling
  - Cupellation
  - Levigation
  - Distillation
61. Which of the following oxides cannot be reduced to metal by carbon?
- $\text{ZnO}$
  - $\text{Al}_2\text{O}_3$
  - $\text{CuO}$
  - $\text{CaO}$
62. Select the correct statements for Ellingham diagram:
- The slope of the curves of the formation of metal oxide is +ve because  $\Delta G^\circ$  becomes less negative or increases with the rise in temperature
  - Each curve is a straight line except when some change takes place in phase ( $s \rightarrow l$  or  $l \rightarrow g$ )
  - Each curve is not a straight line except when some change takes place in phase ( $s \rightarrow l$  or  $l \rightarrow g$ )
  - The slope of the curves of the formation of metal oxide is -ve because  $\Delta G^\circ$  becomes less negative or increases with the rise in temperature
63. Which of the following metal oxides are reduced by self-reduction method?
- $\text{Cu}_2\text{O}$
  - $\text{PbO}$
  - $\text{HgO}$
  - $\text{CaO}$
64. Which of the following pair consists of ore of the same metal?
- Magnesite, cerussite
  - Chalcocite, copper pyrites
  - Bauxite, corundum
  - Anglesite, cerussite
65. Which of the following statement(s) is/are correct?
- The chemical processes in the production of steel from haematite ore involve reduction followed by oxidation
  - In Hall-Heroult process, the electrolyte used is a molten mixture of alumina and cryolite or fluorspar
  - Lead is extracted from its chief ore galena by both carbon reduction as well as self-reduction
  - Haematite, cassiterite, and argentite are oxide ores



## Comprehension Type

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

Extraction of aluminium can be understood by:



Electrolytic reduction of  $\text{Al}_2\text{O}_3$ :

Electrolyte :  $(\text{Al}_2\text{O}_3 + \text{Cryolite} + \text{CaF}_2)$

Cathode : Carbon inside the Fe-container

Anode : Graphite rods

- The purpose of adding cryolite is:
  - To decrease the electrical conductivity of pure aluminium
  - To lower the melting point of  $\text{Al}_2\text{O}_3$
  - To remove the impurities as slag
  - To increase the Al percentage in the yield
- Coke powder is spread over the molten electrolyte to:
  - Prevent the heat radiation from the surface
  - Prevent the corrosion of graphite anode
  - Prevent the oxidation of molten aluminium by air
  - Both (a) and (b)
- The function of fluorspar ( $\text{CaF}_2$ ) is:
  - To increase the melting point of electrolyte
  - To increase electrolytic conductivity power
  - To remove the impurities as slag
  - All of these
- The molten electrolytes contain  $\text{Na}^+$ ,  $\text{Al}^{3+}$ , and  $\text{Ca}^{2+}$  but only Al gets deposited at cathode because:
  - Standard reduction potential of Al is more than that of Na and Ca
  - Standard oxidation potential of Al is more than that of Na and Ca

(c) Discharge potential of  $\text{Al}^{3+}$  is higher than  $\text{Na}^+$  and  $\text{Ca}^{2+}$

(d) Graphite reacts only with  $\text{Al}^{3+}$  and not with  $\text{Na}^+$  and  $\text{Ca}^{2+}$

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

Roasting is a process in which the ore (mostly sulphide) is heated strongly in the presence of excess of air. The heating should be done at a temperature below the melting point of the ore.

5. Select the correct statement:

(a) Roasting also removes easily oxidizable volatile impurities like arsenic as  $\text{As}_2\text{O}_3$ , antimony as  $\text{Sb}_2\text{O}_3$ , and sulphur as  $\text{SO}_2$

(b) The release of  $\text{SO}_2$  (in roasting process) has been a serious air pollution problem

(c) In roasting process, if temperature is fairly low (about  $500^\circ\text{C}$ ) and the concentration of  $\text{SO}_2$  in the gaseous environment is more, sulphate may be produced, that is stable, and high temperature is needed to decompose it

(d) All are correct

6.  $2\text{PbS} + 3\text{O}_2 \xrightarrow{\quad} \text{A} + 2\text{SO}_2$

The name of A is:

- Litharge
- Galena
- Sesquioxide
- None of these

7. Sometimes roasting may not bring about complete oxidation:



Find out A:

- $\text{Cu}_2\text{O}$
- $\text{CuO}$
- $\text{Cu}_2\text{S}$
- $\text{CuS}$

## Comprehension-3: (Q. 8 to Q. 11)

Lead obtained from galena ore ( $\text{PbS}$ ) by air reduction or carbon reduction process contains base metal (Cu, Bi, Sn, As) as impurities; it is due to the presence of these impurities that lead becomes hard and brittle.

8. Parke's process is also called:

- Softening process
- Desilverisation method
- Cupellation
- None of these

9. Zn-Ag alloy formed in the upper layer of molten lead is skimmed off from the surface of the molten lead by perforated ladles. This alloy contains lead as impurity. This impurity of Pb is removed by:

- Distillation process
- Cupellation
- Liquation
- Bett's electrolysis



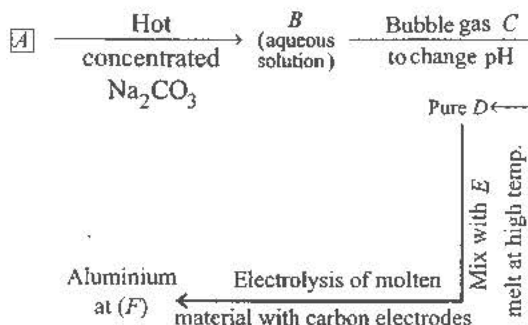
10. Ag can be obtained from purified Zn-Ag alloy by:

- (a) Distillation (b) Poling  
(c) Liquation (d) Reduction

11. Cupellation is used for purification of:

- (a) Pb (b) Ag  
(c) Zn (d) Fe

**Comprehension-4: (Q. 12 to Q. 16)**



12. Find out A:

- (a)  $\text{CuFeS}_2$  (b)  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$   
(c)  $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  (d)  $\text{Fe}_2\text{O}_3$

13. Find out B:

- (a)  $\text{Na}[\text{Al}(\text{OH})_4]$  (b)  $\text{NaOH}$   
(c)  $\text{H}_2\text{SO}_4$  (d)  $\text{Al}_2\text{O}_3$

14. Find out C:

- (a)  $\text{CO}_2$  (b)  $\text{SO}_2$   
(c)  $\text{SO}_3$  (d)  $\text{NO}_2$

15. Find out E:

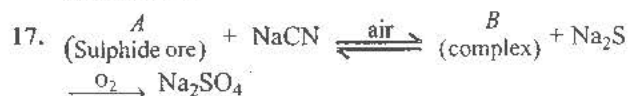
- (a)  $\text{Na}_3\text{GeF}_6$  (b)  $\text{Na}_3\text{AlF}_6$   
(c)  $\text{Al}_2\text{O}_3$  (d) None of these

16. Find out F:

- (a) Cathode (b) Anode  
(c) Electrolyte (d) None of these

**Comprehension-5: (Q. 17 and Q. 18)**

All minerals are not the ore but all ores are minerals. The extraction of a particular metal depends upon several factors and overall it has to be convenient and economical.



Then B is:

- (a) Ferromagnetic  
(b) Paramagnetic  
(c) Linear complex  
(d) Coordination number of central atom is 4

18. Which of the following statement is true?

- (a) Na-ethyl xanthate is used as frother exclusively  
(b) Levigation cannot be applied for sulphide in any condition  
(c) Froth floatation can be applied for non-sulphide ore also using suitable activator  
(d) Impurities like S and As are removed as elemental vapor in roasting

**Comprehension-6: (Q. 19 to Q. 21)**

Lead obtained from galena ore ( $\text{PbS}$ ) by air reduction or carbon reduction process contains base metal (Cu, Bi, As, Sn, Zn) as impurities.

19. The removal of the impurity of Ag from the commercial lead is called:

- (a) Desilverization of lead  
(b) Softening process  
(c) Bett's electrolysis  
(d) Cupellation

20. Which of the following electrolyte is used for electrolysis of Pb?

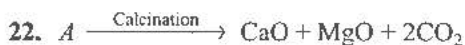
- (a)  $\text{PbSO}_4 + \text{H}_2\text{SO}_4$  (b)  $\text{PbCl}_2 + \text{HCl}$   
(c)  $\text{PbSiF}_6 + \text{H}_2\text{SiF}_6$  (d) None of these

21. Gelatin acts as addition agent in electrolysis of Pb; in the presence of gelatin, Pb becomes:

- (a) Hard and brittle (b) Soft and useless  
(c) Smooth and uniform (d) Only brittle

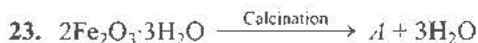
**Comprehension-7: (Q. 22 to Q. 24)**

Calcination is a process in which the ore is heated strongly in the absence of air to remove volatile impurities. It thermally decomposes the carbonate.



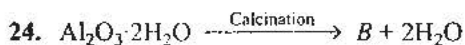
Find out A:

- (a)  $\text{CaCO}_3$  (b)  $\text{MgCO}_3$   
(c)  $\text{CaCO}_3 \cdot \text{MgCO}_3$  (d)  $\text{CaSO}_4 \cdot \text{MgCO}_3$



Find out A:

- (a)  $2\text{FeO}$  (b)  $2\text{Fe}_3\text{O}_4$   
(c)  $2\text{Fe}_2\text{O}_3$  (d)  $\text{FeO} \cdot \text{FeCO}_3$



The name of product B is:

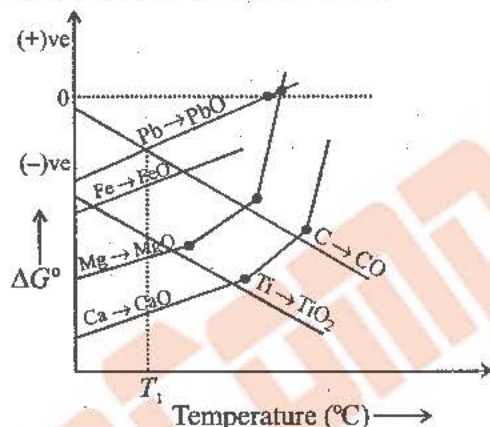
- (a) Corundum (b) Bauxite  
(c) Aluminum hydroxide (d) None of these



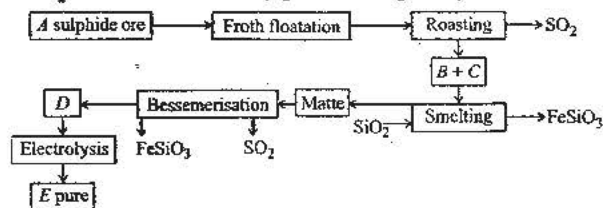
**Comprehension-8: (Q. 25 to Q. 27)**

Pb is a very important element of carbon family. It forms a number of compounds which are very useful in industries.

25. Which of the following electrolysis process is used for purification of Pb?  
 (a) Hall process (b) Parke's process  
 (c) Bett's electrolysis process  
 (d) None of these
26. The removal of impurity of Ag from the commercial lead is called:  
 (a) Softening process (b) Liquation  
 (c) Parke's process (d) Cupellation
27. The process of removal of base metals (Cu, Sn, Bi, As) from lead is called:  
 (a) Softening process (b) Liquation  
 (c) Parke's process (d) Cupellation

**Comprehension-9: (Q. 28 to Q. 30)**

28. Which in the above curve is wrongly presented?  
 (a)  $C \rightarrow CO_2$  (b)  $Ti \rightarrow TiO_2$   
 (c)  $Pb \rightarrow PbO$  (d)  $Mg \rightarrow MgO$
29. Which of the given metal oxides is having minimum thermal decomposition temperature?  
 (a) CaO (b) FeO  
 (c) PbO (d) MgO
30. Which of the following metal's oxide can be reduced by Fe as reducing agent at temperature  $T_1$ ?  
 (a) Pb (b) Ca  
 (c) Mg (d) None of these

**Comprehension-10: (Q. 31 to Q. 33)**

31. Find out A:

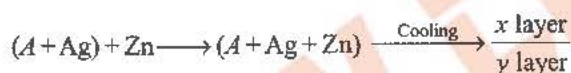
- (a)  $Cu_2S$  (b)  $CuFeS_2$   
 (c)  $FeS_2$  (d)  $Fe_3O_4$

32. Find out B and C:

- (a)  $FeS + FeO$  (b)  $Cu_2O + Cu_2S$   
 (c)  $Cu_2O + FeS$  (d)  $Cu_2S + FeO$

33. Find out D:

- (a) Pig iron (b) FeO  
 (c) Blister Cu (d) Wrought iron

**Comprehension-11: (Q. 34 to Q. 36)**

x layer-solid alloy y layer-molten metal

34. Molten metal is purified by:

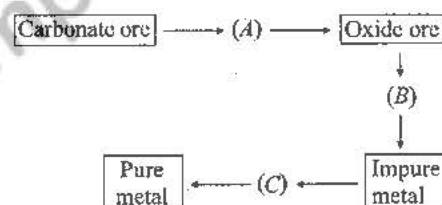
- (a) Hall-Heroult process (b) Hoop method  
 (c) Baeyer's process  
 (d) Bett's electrolysis process

35. Metal A is:

- (a) Cu (b) Sn  
 (c) Fe (d) Pb

36. Layer x contains:

- (a) Zn + Pb alloy (b) Zn + Ag alloy  
 (c) Only Ag (d) Only Pb

**Comprehension-12: (Q. 37 to Q. 39)**

37. A metal is in combined state as carbonate; find out process A:

- (a) Roasting (b) Calcination  
 (c) Smelting (d) Reduction

38. Find out process B:

- (a) Roasting (b) Reduction  
 (c) Van Arkel (d) Smelting

39. Find out process C:

- (a) Electrolysis (b) Reduction  
 (c) Smelting (d) Roasting

**Comprehension-13: (Q. 40 to Q. 44)**

Copper is extracted from copper pyrites. After roasting, the ore is mixed with silica and coke and then smelted

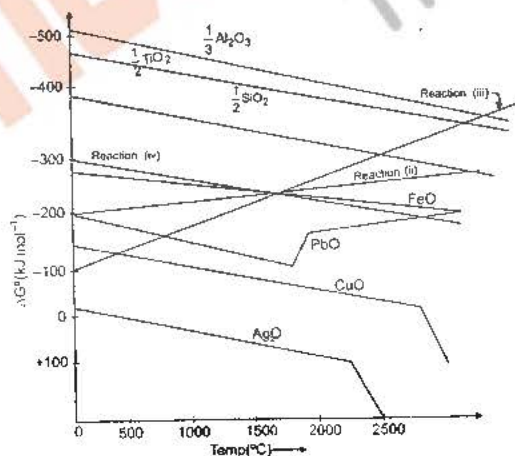


in a blast furnace. The matte obtained from the blast furnace is charged into a silica lined converter. Some silica is also added and a hot air blast is thrown into the mixture to obtain blister copper which is purified by electrorefining.

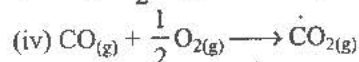
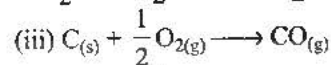
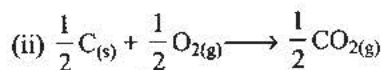
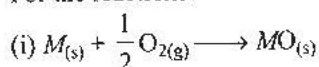
40. The chemical formula for copper pyrites is:  
 (a)  $\text{CuFeS}_2$  (b)  $\text{Cu}_2\text{S}$   
 (c)  $\text{Cu}_2\text{O}$  (d)  $\text{CuCO}_3 \cdot \text{Cu(OH)}_2$
41. During roasting, copper pyrites are ultimately converted into a mixture of:  
 (a)  $\text{FeS} + \text{Cu}_2\text{S}$  (b)  $\text{FeS} + \text{Cu}_2\text{O}$   
 (c)  $\text{FeO} + \text{Cu}_2\text{S}$   
 (d)  $\text{FeS} + \text{Cu}_2\text{S} + \text{FeO} + \text{Cu}_2\text{O}$
42. Coke is added during smelting:  
 (a) To reduce  $\text{FeO}$  to  $\text{Fe}$   
 (b) To reduce  $\text{Cu}_2\text{O}$  to  $\text{Cu}$   
 (c) To check the oxidation of  $\text{FeO}$  to  $\text{Fe}_2\text{O}_3$   
 (d) To check the oxidation of  $\text{Cu}_2\text{O}$  to  $\text{CuO}$
43. The chemical composition of the slag formed during smelting process is:  
 (a)  $\text{CuSiO}_3$  (b)  $\text{FeSiO}_3$   
 (c)  $\text{CaSiO}_3$  (d)  $\text{Cu}_2\text{O} \cdot \text{SiO}_2$
44. Matte is a mixture of:  
 (a)  $\text{Cu}_2\text{S} + \text{FeS}$  (small amount)  
 (b)  $\text{FeS} + \text{Cu}_2\text{S}$  (small amount)  
 (c)  $\text{Cu}_2\text{O} + \text{FeO}$  (small amount)  
 (d)  $\text{FeO} + \text{Cu}_2\text{O}$  (small amount)

#### Comprehension-14: (Q. 45 to Q. 47)

These equilibria can be discussed in terms of thermodynamic functions.



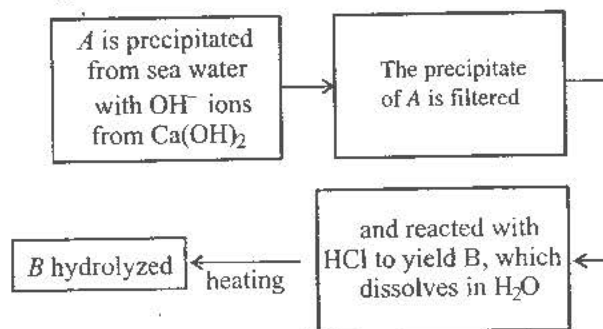
For the reactions:



The temperature dependence of  $\Delta G^\circ$  of reaction (i) to (iv) is shown in the given diagram. This is known as Ellingham diagram. With the help of Ellingham diagram, one can easily predict the most suitable reducing agent for the reduction of metal oxides.

45. A metal oxide  $MO_{(s)}$  can be reduced by carbon or carbon monoxide successfully when the line in Ellingham diagram for reaction (i):  
 (a) Lies above the line for one of the reactions (ii) to (iv)  
 (b) Intersects the line for one of the reactions (ii) to (iv)  
 (c) Lies below the line for one of the reactions (ii) to (iv)  
 (d) May lie above or below the line for one of the reactions (ii) to (iv) depending upon the temperature
46.  $\text{CuO}$  can be reduced to  $\text{Cu}$  conveniently by using  $\text{C}$  or  $\text{CO}$  at any temperature:  
 (a) Approximately equal to room temperature  
 (b) Above room temperature  
 (c) Below room temperature  
 (d) At all temperature
47.  $\text{Al}_2\text{O}_3$  can be reduced by carbon at a temperature of:  
 (a)  $30^\circ\text{C}$  (b)  $500^\circ\text{C}$   
 (c)  $2000^\circ\text{C}$  (d)  $> 2500^\circ\text{C}$

#### Comprehension-15: (Q. 48 to Q. 50)



48. Find out A:  
 (a)  $\text{Mg}$  cation (b)  $\text{MgCl}_2$   
 (c)  $\text{Mg(OH)}_2$  (d)  $\text{Ca}$  cation
49. The compound B is:  
 (a) Anhy.  $\text{MgCl}_2$  (b)  $\text{Mg(OH)}_2$   
 (c)  $\text{Ca(OH)}_2$  (d)  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$



50. When *B* is hydrolyzed, then which of the following compound is formed?

- (a) Anhy.  $\text{MgCl}_2$  (b)  $\text{MgO}$   
(c)  $\text{Mg(OH)}_2$  (d)  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$

**Comprehension-16: (Q. 51 to Q. 53)**

In many extraction processes, an oxide is added deliberately to combine with other impurities and form a stable molten phase immiscible with molten metal called a slag. The process is termed smelting.

51. The principle of slag formation is essentially the following:



Find out *X*.

- (a) Non-fusible (easily melted) slag  
(b) Fusible (easily melted) slag  
(c) Solid phase miscible with molten metal  
(d) Solid phase immiscible with molten metal
52. In the extraction of iron, which of the following flux is used for the formation of slag:
- (a)  $\text{MgCO}_3$  (b)  $\text{ZnCO}_3$   
(c)  $\text{SiO}_2$  (d)  $\text{CaCO}_3$
53.  $\text{FeO}$  is the impurity in the extraction of  $\text{Cu}$  from copper pyrite. Which of the following flux is used for the removal of impurity?
- (a)  $\text{CaO}$  (b)  $\text{MgO}$   
(c)  $\text{SiO}_2$  (d)  $\text{FeSiO}_3$

**Assertion-Reasoning Type**

1. **Statement-1:** Reduction of  $\text{Fe}_2\text{O}_3$  with  $\text{CO}$  is done below  $710^\circ\text{C}$ .

**Statement-2:**  $\Delta G$  is negative at this temperature; thus, process is spontaneous.

- (a) Statement-1 is true, statement-2 is true; statement -2 is a correct explanation for statement -1.  
(b) Statement-1 is true, statement-2 is true; statement -2 is NOT a correct explanation for statement -2.  
(c) Statement-1 is true, statement-2 is false.  
(d) Statement-1 is false, statement-2 is true.
2. **Statement-1:** Silver may be prepared by using silver coins; in this process, coins are treated with  $\text{HNO}_3$  and then treated with  $\text{HCl}$  to get  $\text{AgCl}$ , but directly coins are not treated with  $\text{HCl}$ .

**Statement-2:**  $\text{HCl}$  is not a good oxidizing agent.

(a) Statement-1 is true, statement-2 is true; statement-2 is a correct explanation for statement-1.

(b) Statement-1 is true, statement-2 is true; statement-2 is NOT a correct explanation for statement-1.

(c) Statement-1 is true, statement-2 is false

(d) Statement-1 is false, statement-2 is true

3. **Statement-1:** Graphite is used as anode but diamond is not.

**Statement-2:** There exist free electrons between two parallel sheets of graphite; hence, it helps in electron conduction.

(a) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(b) Statement-1 is true, statement-2 is true but statement-2 is NOT the correct explanation for statement-1

(c) Statement-1 is true, statement-2 is false.

(d) Statement-1 is false, statement-2 is true.

4. **Statement-1:** Copper and zinc are obtained by electrolysis of aqueous solution of their sulphates.

**Statement-2:** Elements that react with water are often extracted from fused melts of their ionic salts.

(a) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(b) Statement-1 is true, statement-2 is true but statement-2 is NOT the correct explanation for statement-1

(c) Statement-1 is true, statement-2 is false.

(d) Statement-1 is false, statement-2 is true.

**Matching Column Type**

1. Match the column:

**Column-I**

(Metal)

- (a) Hg  
(b) Ag  
(c) Ga  
(d) Pb

**Column-II**

(Purification method)

- (p) Zone refining method  
(q) Liquefaction  
(r)  $\text{CN}^-$  process  
(s) Distillation

2. Match the column:

**Column-I**

(a) Roasting

**Column-II**

(p) Process in which volatile impurities are removed



- (b) Calcination (q) Process in which hydrated water is removed  
 (c) Concentration (r) Magnetic impurities removed  
 (s) Sulphide ore converted into its oxide ore

3. Match the column:

Column-I	Column-II
(a) Flux	(p) $\text{SiO}_2$
(b) Slag	(q) $\text{CaO}$
(c) Acidic flux	(r) $\text{CaSiO}_3$
(d) Basic flux	(s) $\text{MgO}$
	(t) $\text{FeSiO}_3$

4. Match the column (for electrolytic refining of Cu):

Column-I	Column-II
(a) Anode	(p) Thin sheets of pure Cu
(b) Cathode	(q) An aqueous solution of copper sulphate containing $\text{H}_2\text{SO}_4$
(c) Electrolyte	(r) Ag, Au
(d) Anode mud	(s) Impure metal of Cu

5. Match Column-I with Column-II.

Column-I	Column-II
(a) Cyanide process	(p) Ultrapure Ge
(b) Floatation process	(q) Pine oil
(c) Electrolytic reduction	(r) Extraction of Al
(d) Zone refining	(s) Extraction of Au

6. Match the column:

Column-I	Column-II
(a) Van Arkel method	(p) Manufacture of caustic soda
(b) Cupellation	(q) Purification of titanium
(c) Poling	(r) Purification of copper
	(s) Refining of silver

7. Match the column:

Column - I	Column - II
(a) Vapor phase refining process	(p) Cu
(b) Thermite process	(q) Fe
(c) Self-reduction	(r) B
(d) Bessemerization	(s) Al
	(t) Ni

8. Match the column:

Column-I	Column-II
(a) Van Arkel method	(p) Manufacture of Mg
(b) Dow's sea-water process	(q) Purification of titanium

- (c) Cupellation (r) Manufacture of Na  
 (d) Poling (s) Purification of Cu  
 (t) Refining of silver

9. Match the column:

Column-I	Column-II
(a) Bauxite ore	(p) Roasting
(b) $\text{SnO}_2$ ore	(q) Calcination
(c) Native silver ore	(r) Leaching
(d) $\text{CuFeS}_2$ ore	(s) Electrolysis

10. Match the following:

Column-I	Column-II
(a) Slag formation	(p) Extraction of copper from copper pyrites
(b) Froth-floatation	(q) Extraction of iron from haematite
(c) Leaching	(r) Extraction of tin from cassiterite
(d) Roasting	(s) Extraction of lead from galena
	(t) Extraction of gold from its native ore

11. Match the column:

Column-I	Column-II
(a) Anglesite	(p) Sulphate ore
(b) Galena	(q) Sulphide ore
(c) Cerussite	(r) Ore of Pb
(d) Cinnabar	(s) Carbonate ore
	(t) Ore of Hg

12. Match the commercial extraction process listed in Column-I with metals listed in Column-II:

Column-I	Column-II
(a) Self-reduction	(p) Lead
(b) Carbon reduction	(q) Silver
(c) Complex formation and displacement by metal	(r) Copper
(d) Decomposition of iodide	(s) Boron

13. Match the column:

Column-I	Column-II
(a) Ni	(p) Van Arkel de boer process
(b) Zr	(q) Zone refining process
(c) Si	(r) Mond's process
(d) Fe	(s) Bessemerization
	(t) Reduction in blast furnace