Chapter - 6

GENERAL PRINCIPLES AND PROCESSES OF ISOLATION OF ELEMENTS

VSA QUESTIONS (1 - MARK QUESTIONS)

1. Name three metals which occur in native state in nature.

[**Ans. :** Au, Ag and Pt]

2. What are collectors in froth flotation process? Give one example.

[**Ex. :** Pine oil]

*3. Give the names and formulae of three ores which are concentrated by froth floatation process.

[**Ans. :** Galena (PbS), zinc blend (zns) cinnabar (HgS)]

4. Among Fe, Cu, Al and Pb, which metal (s) can not be obtained by smelting.

[**Ans. :** Al]

5. What is the thermodynamic criteria for the feasibility of a reaction?

[**Ans. :** ΔG should be –ve or log K = + ve]

8. Why can't aluminium be reduced by carbon?

[**Hint :** Al is stronger reducing agent than carbon]

9. Name the most important form of iron. Mention its one use.

[**Ans. :** Cast iron is used for making gutter pipes, castings, railway sleepers, toys etc.]

10. Name the impurities present in bauxite ore.

[**Ans. :** SiO_2, Fe_2O_3 and TiO_2]

11. What is the composition of copper matte?

[**Hint :** Cu_2S and FeS]

12. Which from of copper is called blister copper?

13. What are froth stabilizers? Give two examples.

    [**Ex. :** Cresol and aniline].

14. A sample of galena is contaminated with zinc blend. Name one chemical which can be used to concentrate galena selectively by froth floatation method. [**Ans. :** NaCN]

15. What are the constituents of German silver?

    [**Ans. :** Cu = 25-30%, Zn = 25-30%, Ni = 40-50%]

16. Why is froth floatation process selected for concentration of the sulphide ore?

    [**Ans. :** Sulphide ore particles are wetted by oil (Pine oil) and gangue particles by water]

17. Write the reaction involved in the extraction of copper from low grade ores.

    [**Ans. :** First step is leaching of ore with acid or bacteria then
    Cu^{2+} (aq) + H_2 (g) $\rightarrow$ Cu(s) + $2H^+$ (g)]

18. Although aluminium is above hydrogen in the electrochemical series, it is stable in air and water. Why?

19. Which method of purification is represented by the following reaction

    $$Ti(s) + 2I_2, (g) \xrightarrow{523K} Ti\ I_4(g) \xrightarrow{1700K} Ti(s) + 2I_2(g)$$

20. Zinc is used but not copper for the recovery of metallic silver from the complex $[Ag(CN)_2]^-$, although electrode potentials of both zinc and copper are less than that of Ag. Explain why?

    [**Hint :** Zinc reacts at faster rate as compared with copper, further zinc is cheaper than copper].

21. Write the composition of motlen mixture which is electrolysed to extract aluminium.

SA (I) QUESTIONS (2 - MARK QUESTIONS)

*22. What is hydrometallurgy? Give one example where it is used for metal extraction.

[**Ans. :** Leaching followed by reduction is called hydrometallurgy. It is used in extraction and copper

*23. Name the process for the benefaction/concentration of (i) an ore having lighter impurities (ii) sulphide ore.

24. Mention the role of cryolite in the extraction of aluminium.

25. Mention the role of following :

(a) SiO_2 in the metallurgy of Cu.

(b) $CaCO_3$ in the metallurgy of Fe.

(c) CO in the metallergy of iron

(d) I_2 in the purification of zirconium.

26. Extraction of copper directly from sulphide ore is less favourable than from its oxide through reduction. Explain.

[**Ans. :** $2Cu\ S(s) + C(s) \rightarrow CS_2\ (l) + 2Cu(s)$

$CuO(s) + C(s) \rightarrow CO\ (g) + Cu(s)$

ΔG value is more –ve in second case as compared with first case]

27. The graphite electrodes in the extraction of 'alluminium' by Hall-Heroult process need to be changed frequently. Why?

28. Write the chemical formulae of the following ores (a) Haematite (b) Magnetite (c) Limonite (d) Siderite.

[**Ans. :** (a) Fe_2O_3 (b) Fe_3O_4 (c) $Fe_2O_3.2H_2O$ (d) $FeCO_3$]

29. Give equations for the industrial extraction of zinc from calamine.

[**Ans. :** $ZnCO_3 \rightarrow ZnO + CO_2$ (Calcination) $ZnO + C \rightarrow Zn + CO$ (Reduction)]

30. Name the elements present in anode mud during refining of copper. Why does it contain such elements?

[**Ans. :** Au and Ag. They are not oxidised at anode. They are less electropositive than copper.]

31. Write the Chemical reactions taking place in different zones in the blast furnace for the extraction of iron from its ore.

32. How are impurities separated from bauxite ore to get pure alumina?

33. Why is the reduction of a metal oxide easier if metal formed is in liquid state at the temperature of reduction?

[**Hint :** Entropy is more positive when the metal is in liquid state as compared with solid state, so ΔG becomes more –ve]

34. What is pyrometallurgy? Explain with one example.

[**Ans. :** A process of reducing a metal oxide by heating with either coke or some other reducing agent *e.g.*, Al, Mg etc.

$$ZnO + C \xrightarrow{975\ k} Zn + CO]$$

35. Write the method to produce Copper matte from copper pyrites.

*38. Copper can be extracted by hydrometallurgy but not zinc. Explain why?

[**Hint :** $E^{\varnothing}_{Zn^{2+}/Zn}$ is – ve, $E^{\varnothing}_{Cu^{2+}/Cu}$ is + ve]

*39. Gibbs energies of formation $\Delta_f G$ of MgO(s) and CO(g) at 1273K and 2273 K are given below:

$\Delta_f G$ [MgO(s)] = –941 kJ mol^{-1} at 1273 K.

$\Delta_f G$ [CO(g)] = –439 kJ mol^{-1} at 1273 K.

$\Delta_f G$ [MgO(s)] = –314 kJ mol^{-1} at 2273 K.

$\Delta_f G$ [CO(g)] = –628 kJ mol^{-1} at 2273 K.

On the basis of above data, predict the temperature at which carbon can be used as a reducing agent for MgO(s).

[**Ans. :** For the reaction, MgO(s) + C(s) $\rightarrow$ Mg(s) + CO(g)

At 1273K, $\Delta_r G = \Delta_f G[CO(g)] - \Delta_f G[MgO(s)]$ = –439 – (–941) KJ mol^{-1} = 502 kJ mol^{-1}

At 2273 K, $\Delta_r G$ = –628 – (–314) kJ mol^{-1} = –314 kJ mol^{-1}

The temperature is 2273 K]

SA (II) TYPE QUESTIONS (3 - MARK QUESTIONS)

*40. State the principles of refining of metal by the following methods.

(a) Zone refining (b) Electrolytic refining (c) Vapour phase refining.

41. How is pure copper obtained from its principle ore? Write the chemical reactions occurring during the extraction.

42. Name the method of refining of the following metals –

(a) Hg (b) Sn (c) Cu (d) Ge (e) Ni (f) Zr

[**Ans. :** (a) Distillation, (b) Liquation; (c) Electrolytic refining (d) Zone refining; (e) Mond Process (f) Van Arkel Processl]

*44. The native silver forms a water soluble compound (B) with dilute aqueous solution of NaCN in the presence of a gas (A). The silver metal is obtained by the addition of a metal (C) to (B) and complex (D) is formed as a byproduct. Write the structures of (C) and (D) and identify (A) and (B) in the following sequence –

$Ag + NaCN + [A] + H_2O \rightarrow [B] + OH^- + Na^+$.

$[C] + [B] \rightarrow [D] + Ag$.

[**Ans. :** $[A] = O_2$

$[B] = Na\ [Ag(CN)_2]$

$[C] = Zn$

$[D] = Na_2\ [Zn\ (CN)_4]$].

45. In the cynamide extraction process of silver pon argentite ore, name the oxidising and reducing agents. Write the chemical equations of the reactions involved.