5. **What is collodion?**
   AnsCellulose-nitrate used to make ultra-filters.

CHAPTER-6 :General Principles and Processes of isolation of elements

LEVEL -1 QUESTION

1. **What is a slag?**
   Ans: Flux + Impurity = Slag

2. **State the role of silica in the metallurgy of copper.**
   Ans: Act as acidic flux

3. **Write the principle involved in zone refining.**

Ans. Impurities are more soluble in melt than in the solid state.

4. **What is the thermodynamics consideration of selecting a reducing agent in metallurgy?**
   Ans:ΔG should be negative.

5. **Why froth floatation process is used for concentration sulphide ores**
   Ans: It is based on the preferential wetting of the ore particles by oil and the gangue particles by water.

6. **What is depressant and give one example?**
   Ans: They are used to separate 2 sulphide ores in froth floatation process. Ex: NaCN acts as depressant to separate PbS from ZnS.

7. **Explain the following terms:**
   (i) Liquation
   (ii) Electrolytic refining
   Ans (i) It is used for low melting metals. Ex: Sn
   (ii) Anode: impure metal, Cathode: pure metallic strip; Electrolyte: metallic salt solution; by passing electric current pure metals gets deposited on the cathode.

8. **Define leaching. How is this process used in the benefaction of silver and gold ores?**
Ans Ore is treated with suitable reagent to form soluble complex not the impurities. In extraction of gold and silver NaCN forms soluble complex with respective metals. By displacement reaction using Zn silver and gold can be separated out.

9. **Distinguish the following:**
   i) **Roasting and calcination**
   ii) **Electrolytic reduction and chemical reduction**

Ans(i) Roasting: heating the ore in presence of air.
Calcination: heating the ore in absence of air.
(ii) Electrolytic reduction: reduction in the presence of electric current.
Chemical reduction: reduction with the help of reductant.

10. **Explain the following:**
(i) Van Arkel method
(ii) Hydraulic washing

Ans (i) Metal is converted in volatile compound which can be decomposed at high temperature to give pure metal. For example:

$$Zr + 2I_2 \xrightarrow{870K} ZrI_4 \xrightarrow{2075K} Zr + 2I_2$$

(ii) it is based on the difference of densities of ore particles and impurities.

LEVEL-2 QUESTIONS

1. **Name the method used for the refining of Nickel metal**

Ans: Mond's Process

2. (a) Which solution is used for leaching of silver metal in the presence of air in the metallurgy of silver?
(b) Out of C and CO, which is a better reducing agent at a lower temperature range in the blast furnace to extract iron from the oxide ore.

Ans: (a) Sodium cyanide(NaCN)
(b) CO is a better reducing agent at the lower temperature because it does not decompose into carbon and oxygen rather gets dioxidized to carbon dioxide, and reduce the metal oxide to metal.

3. **Explain the following:**
i) NaCN acts as a depressant in preventing ZnS from forming froth.

ii) Role of cryolite in the metallurgy of aluminium

Ans: i) NaCN combines with ZnS to form a complex sodiumtetracyanozincate(II) on the surface of ZnS and thus prevents it from forming the froth.

$$ZnS + 4NaCN \rightarrow Na_2[Zn(CN)_4] + Na_2S$$

ii) the role of cryolite is two fold:

- It lowers the melting point of the mixture to about 1250 K
- It increases the electrical conductivity of the mixture.

4. **The value ΔG° for formation of Cr_2O_3 is -540 kJ/mol and that of Al_2O_3 is -827 kJ/mol. Is the reduction of Cr_2O_3 possible with Al?**

   Ans Yes, as DG is more negative.

5. **Name the chief ore of tin. Write its formula.**

   AnsCassiterite- SnO_2

LEVEL-3 QUESTIONS

1. **Why is it advantageous to roast a sulphide ore to oxide before reduction?**

Ans. Oxides can be more easily reduced to the respective metals using carbon or hydrogen as reducing agent. On the other hand sulphides cannot be reduced by carbon or hydrogen because Δr G for such reactions is positive and hence these reactions are not feasible.

2. **Write the chemical reactions involved in the extraction of metallic silver from argentile.**

Ans.$Ag_2S + 4NaCN \rightarrow 2Na[Ag(CN)_2] + Na_2S$

$$4Na_2S + 5O_2 \rightarrow 2Na_2SO_4 + 4NaOH + 2S\downarrow$$

$$2\,Na[Ag(CN)_2] + Zn \rightarrow Na_2[Zn(CN)_4] + 2Ag\downarrow$$

Sod.tetracynozincate (II)

3. **Explain the role of**
   - **(i) Cryolite in the electrolytic reduction of alumina**
   - **(ii) Carbon monoxide in the purification of nickel.**

Ans. (i) Cryolite lowers the melting point of mixture. Or it act as electrolyte.
(ii)Carbon monoxide forms a volatile complex with nickel which on heating decomposes to give pure nickel.

4. **Describe how the following change are brought about:**
   (i) Pig iron into steel.
   (ii) Zinc oxide into metallic Zinc.
   (iii) Impure titanium into pure titanium.
   Ans. (i) Pig iron converted into steel by adding carbon and some other elements.
   (ii)Metallic zinc is obtained from zinc oxide by reduction by coke.

$$ZnO + C \longrightarrow Zn + CO$$

   (iii) Impure titanium is heated with iodine to form volatile complex TiI_4 which on further heating to higher temperature decomposes to give pure titanium.

5. **Describe the role of**
   (i) NaCN in the extraction of gold from gold ore.
   (ii) SiO_2 in the extraction of copper from copper matte.
   (iii) Iodine in refining of zirconium.
   Write chemical equations for the involved reactions.
   (i) Role of NaCN in the extraction of gold is to do the leaching of gold ore in the presence of the air from which gold is obtained later by replacement.

$$4Au(s) + SCN^-(aq) + 2H_2O + O_2(g) \rightarrow 4[Au(CN)_2]^- + 4OH^-$$

   (ii) SiO_2 is added in copper matte to convert the remaining FeS, FeO to slag.

$$FeO + SiO_2 \rightarrow FeSiO(slag)$$

   (iii) Iodine is heated with Zirconium to form a volatile compound which on further heating decompose to give pure zirconium as shown:

$$Zr + 2I_2 \longrightarrow ZrI_4$$

(Impure)

$$ZrI_4 \longrightarrow Zr + 2I_2$$

(Pure)

7. **State briefly the principles which serve as basis for the following operations in metallurgy.**
(i) Froth-floatation process (ii)Zone refining (iii) Refining by liquation
Ans: (i) Froth floatation process: This process is used for the concentration of sulphide ores. For example , ores of lead, zinc and copper, because of the fact that metallic sulphides are more wetted by certain oils(pine oil) and less by water. The finely crushed ore is put into a water containing a small quantity of oil (pine oil). The mixture is then agitated by passing a blast of air through it. The froth is formed which carries the ore particles along with it to the surface leaving the impurities behind. The froth scummed off. It is then dried for the recovery of the ore particle. In this way the oreis concentrated by froth floatation process.

(ii)**Zone Refining:** This method is based on the principle that the impurities are more soluble in the melt than in the solid state of the metal. A circular mobile heater is fixed at one end of a rod of impure metal. The molten zone moves along with the heater which is moved forward. As the heater moves forward, the pure metal crystallizes out the melt and the impurities pass on into the adjacent molten zone. The process is repeated several times and the heater is moved in the same direction. At one end, impurities get concentrated. This end is cut off. This method is very useful for producing semi-conductor and other metals of very high purity e.g., germanium, silicon ,boron, gallium and indium.

(iii) Refining by liquation: In this method a low melting metal like tin(Sn)can be made to flow on sloping surface. In this way it is separated from higher melting impurities.