6.10. What is meant by the term “chromatography”?
Ans: Chromatography is a technique used for separation, purification, identification and characterization of the components of a mixture whether coloured or colourless. The term chromatography was originally derived from the Greek word ‘chroma’ meaning colour and 'graphy for writing because the method was first used for the separation of coloured substances (plant pigments) into individual components.

6.11. What criterion is followed for the selection of the stationary phase in chromatography?
Ans: The stationary phase is selected in such a way that the impurities are more strongly adsorbed or are more soluble in the stationary phase than component to be purified. Thus, when the column is extracted, the impurities will be retained by the stationary phase while the pure component is easily eluted.

6.12. Describe a method for refining nickel.
Ans: When impure nickel is heated in presence of CO at 330-350 K, it forms volatile nickel tetracarbonyl leaving behind the impurities. The nickel tetracarbonyl thus obtained is then heated to higher temperature (450-470K), then it undergoes thermal decomposition to give pure nickel.

$$\underset{\text{Zinc blende}}{2\,ZnS} + 3O_2 \xrightarrow{\Delta} \underset{\text{Zinc oxide}}{2\,ZnO} + 2SO_2$$

$$ZnO + C \xrightarrow{1673\ K} Zn + CO$$

$$\underset{\text{(impure)}}{Ni} + 4CO \xrightarrow{330\text{-}350\ K} \underset{\text{Nickel tetracarbonyl}}{Ni(CO)_4}$$

6.13. How can you separate alumina from silica in a bauxite ore associated with silica? Give equations, if any.
Ans: Pure alumina can be separated from silica in bauxite by Baeyer’s process. The bauxite ore associated with silica is heated with a concentrated solution of NaOH at 473-523 K and 35-36 bar pressure. Under these conditions, alumina dissolves as sodium meta-aluminate and silica as sodium silicate leaving behind the impurities.

$$Ni(CO)_4 \xrightarrow{450\text{-}470\ K} \underset{\text{Nickel}}{Ni} + 4CO$$

$$\underset{\text{Alumina}}{Al_2O_3\,(s)} + 2NaOH\,(aq) + 3H_2O\,(l) \longrightarrow$$

$$2Na[Al(OH)_4]\,(aq)$$
Sodium meta-aluminate

$$\underset{\text{Silica}}{SiO_2\,(s)} + 2NaOH\,(aq) \xrightarrow{473\text{–}523\ K}$$

$$Ni_2SiO_3\,(aq) + H_2O\,(l)$$
Sodium silicate

$$2Na\,[Al(OH)_4]\,(aq) + CO_2\,(g) \longrightarrow$$

$$\underset{\text{Hydrated alumina}}{Al_2O_3 \cdot xH_2O\,(s)} + 2NaHCO_3\,(aq)$$

The hydrated alumina thus precipitated is filtered, dried and heated to give back pure Al_2O_3.

$$\underset{\text{Hydrated alumina}}{Al_2O_3 \cdot xH_2O\,(s)} \xrightarrow{1473\ K} \underset{\text{Pure alumina}}{Al_2O_3\,(s)} + xH_2O$$

6.14. Giving examples, differentiate between 'roasting' and 'calcination'.
Ans: Calcination is a process of converting carbonates and hydroxide ores of metals to their respective oxides by heating them, strongly below their melting points either in absence or limited supply of air.

$$Fe_2O_3 \cdot 3H_2O \xrightarrow{\Delta} Fe_2O_3 + 3H_2O$$

$$CaCO_3 \cdot MgCO_3 \xrightarrow{\Delta} CaO + MgO + 2CO_2$$

$$CuCO_3 \cdot Cu(OH)_2 \xrightarrow{\Delta} 2CuO + H_2O + CO_2$$

$$ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2$$

6.15. I low is 'cast iron' different from 'pig iron '?
Ans: The iron obtained from blast furnace is called pig iron. It contains about 4% carbon and many other impurities in smaller amount (eg., S, P, Si and Mn). Cast iron is made by melting pig iron with scrap iron and coke using hot air blast. It has slightly lower carbon content (about 3%) and is extremely hard and brittle.

6.16. Differentiate between "minerals" and "ores'.
Ans: Minerals: The natural substances in which the metals or their compounds occur in the earth is called minerais.
Ores: The minerals from which the metals can be coaveniently and economically extracted are called ores.
Note : All ores are minerals but all minerals are not ores.

6.17. Why copper matte is put in silica lined converter?
Ans: Copper matte consists of Cu_2S along with some unchanged FeS. When a blast of hot air is passed through molten matte placed in silica lined converter, FeS present in matte is oxidised to FeO which combines with silica (SiO_2) to form $FeSiO_3$ slag.

$$2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2$$

$$FeO + \underset{\text{Silica}}{SiO_2} \longrightarrow \underset{\text{Slag}}{FeSiO_3}$$

When whole of iron has been removed as slag, some of the Cu_2S undergoes oxidation to form Cu_2O which then reacts with more Cu_2S to form copper metal.

$$2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$$
$$2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$$

Thus, copper matte is heated in silica lined converter to remove FeS present in matte as $FeSiO_3$ slag.

6.18. What is the role of cryolite in the metallurgy of aluminium?
Ans:
(a) It lowers the fusion (melting) point of the bath from 2323 K to about 1140 K.
(b) It makes alumina a good conductor of electricity.

6.19. How is leaching carried out in case of low grade copper ores?
Ans. Leaching in case of low grade copper ores is carried out with acids in presence of air. In this process, copper is oxidised to Cu^{2+} ions which pass into the solution.

$$(a)\quad \frac{4}{3}Cr(s) + \frac{3}{2}O_2(g) \longrightarrow \frac{2}{3}Cr_2O_3(s);$$
$$\Delta G_f^\circ = -540 \text{ kJ mol}^{-1}$$

$$(b)\quad \frac{4}{3}Al(s) + \frac{3}{2}O_2(g) \longrightarrow \frac{2}{3}Al_2O_3(s);$$
$$\Delta G_f^\circ = -827 \text{ kJ mol}^{-1}$$

********** END **********