NCERT IN TEXT QUESTIONS

6.1. Which of the ores mentioned can be concentrated by magnetic separation method?
Ans: Ores Which are magnetic in nature can be separated from non-magnetic gangue particles by magnetic separation method. For ex: ores of iron such as haemetite (Fe_2O_3), magnetite (Fe_3O_4), siderite ($FeCO_3$) and iron pyrites (FeS_2) being magnetic can be separated from non-magnetic silica and other impurities by magnetic separation method.

6.2. What is the significance of leaching in the extraction of aluminium?
Ans: Aluminium contains silica (SiO_2), iron oxide (Fe_2O_3) and titanium oxide (TiO_4) as impurities. These impurities can be removed by the process of leaching. During leaching, the powdered bauxite ore is heated with a concentrated (45%) solution of NaOH at 473-523 K, where alumina dissolves as sodium meta-aluminate and silica as sodium silicate leaving Fe_2O_3, TiO_2 and other impurities behind:

$$Al_2O_3(s) + 2NaOH(aq) + 3H_2O(l) \xrightarrow{473-523K} 2\,Na\,[Al(OH)_4]\,(aq)$$

Sodium meta-aluminate

$$SiO_2\,(l) + 2NaOH\,(aq) \xrightarrow{473-523K} Na_2SiO_3\,(aq) + H_2O\,(l)$$

Sodium silicate

The impurities are filtered off and solution of sodium meta-aluminate is neutralised by passing CO_2 when hydrated alumina separates out while sodium silicate remains in solution. The hydrated aluminathus obtained is filtered, dried and heated to give back pure alumina.

$$Al_2O_3 \cdot xH_2O\,(s) \xrightarrow{1473K} Al_2O_3\,(s) + xH_2O\,(g)$$

Thus, by leaching, pure alumina can be obtained from bauxite ore.

6.3.

The reaction, $Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2\ Cr$ ($\Delta G^{\Theta} = -421$ kJ) is thermodynamically feasible as is apparent from the Gibbs energy value. Why does it not take place at room temperature?

Ans: This is explained on the basis of K_{eq}, the equilibrium constant. In the given redox reaction, all reactants and products are solids at room temperature, so, there is no equilibrium between the reactants and products and hence the reactions does not occur at RT. At high temperature, Cr melts and values of TAS increases. As a result, the value of

$\Delta_r G^{\Theta}$ becomes more negative and hence the reaction proceeds rapidly.

6.4. Is it true that under certain conditions, Mg can reduce Al203 and Al can reduce MgO? What are those conditions?
Ans:

Below 1966 K, $\Delta_f G°$ curve for the formation of SiO_2 lies above the $\Delta_f G°$ curve for the formation of MgO, therefore, at temperatures below 1966 K, Mg can reduce SiO_2 to metallic silicon.

$$SiO_2 + 2Mg \xrightarrow{1966K} 2MgO + Si;$$

$\Delta_r G° =$ negative

Above 1966 K, $\Delta_f G°$ curve for the formation of SiO_2 lies below the corresponding curve for the formation of MgO. Therefore, above 1966 K, silicon can reduce MgO to Mg.

$$Si + 2\,MgO \xrightarrow{>1966K} SiO_2 + Mg$$

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