Chemistry Class 12 NCERT Solutions: Chapter 6 General Principles and Processes of Isolation of Elements Part 1

Q: 1. Copper can be extracted by hydrometallurgy but not zinc. Explain.

Answer

The reduction potentials of zinc and iron are lower than that of copper. In hydrometallurgy, zinc and iron can be used to displace copper from their solution.

$$Fe_{(s)} + Cu^{2+}_{(aq)} \rightarrow Fe^{2+}_{(aq)} + Cu_{(s)}$$

But to displace zinc, more reactive metals i.e.. , metals having lower reduction potentials than zinc such as $Mg, Ca, K,$ etc. are required. But all these metals react with water with the evolution of H_2 gas.

$$2K_{(s)} + 2H_2O_{(l)} \rightarrow 2KOH_{(aq)} + H_{2(g)}$$

As a result, these metals cannot be used in hydrometallurgy to extract zinc.

Hence, copper can be extracted by hydrometallurgy but not zinc.

Q: 2. What is the role of depressant in froth floatation process?

Answer

In the froth floatation process, the role of the depressants is to separate two sulphide ores by selectively preventing one ore from forming froth. For example, to separate two sulphide ores (ZnS and Pbs) , $NaCN$ is used as a depressant which selectively allows PbS to come with froth, but prevents ZnS from coming to froth. This happens because $NaCN$ reacts with ZnS to form $Na_2\left[Zn(CN)_4\right]$.

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

Q: 3. Why is the extraction of copper from pyrites more difficult than that from its oxide ore through reduction?

Answer:

The Gibbs free energy of formation $\left(\Delta_f G\right)$ of Cu_2S is less than that of H_2S and CS_2 .

Therefore, H_2 and $_c$ cannot reduce Cu_2S to Cu .

On the other hand, the Gibbs free energy of formation of Cu_2O is greater than that of CO . Hence, C can reduce Cu_2O to Cu .

$$C_{(s)} + Cu_2O_{(s)} \rightarrow 2Cu_{(s)} + CO_{(g)}$$

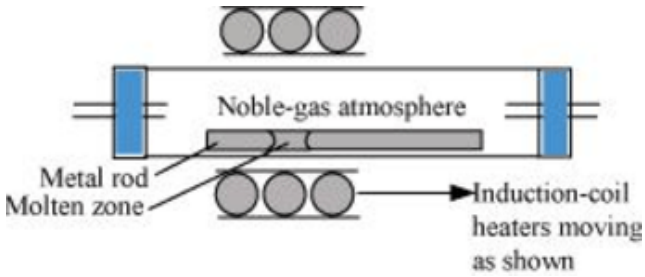
Hence, the extraction of copper from its pyrite ore is difficult than from its oxide ore through reduction.

Q: 4. Explain: (i) Zone refining (ii) Column chromatography

Answer:

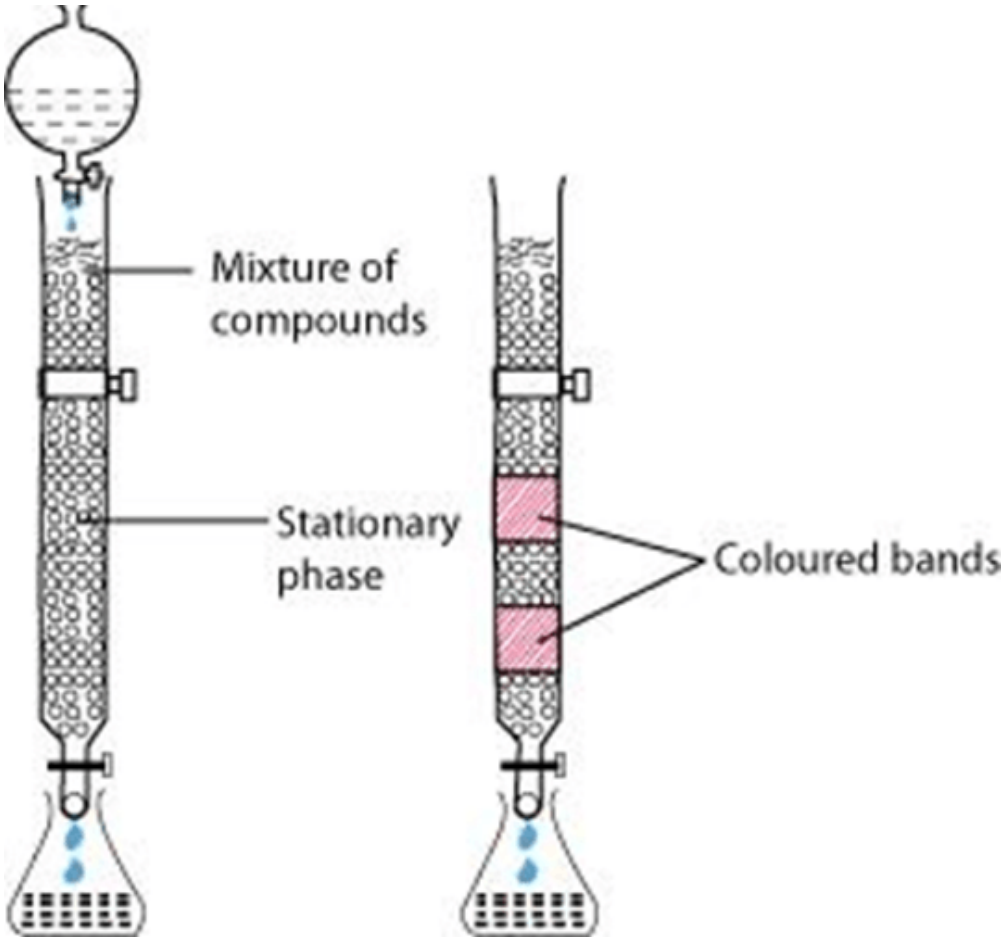
(i) Zone refining

This method is based on the principle that impurities are more soluble in the molten state of metal (the melt) than in the solid state. In the process of zone refining, a circular mobile heater is fixed at one end of a rod of impure metal. As the heater moves, the molten zone of the rod also moves with it. As a result, pure metal crystallizes out of the melt and the impurities pass onto the adjacent molten zone. This process is repeated several times, which leads to the segregation of impurities at one end of the rod. Then, the end with the impurities is cut off. Silicon, boron, gallium, indium etc. can be purified by this process.



(ii) Column chromatography:

Column chromatography is a technique used to separate different components of a mixture. It is a very useful technique used for the purification of elements available in minute quantities. It is also used to remove the impurities that are not very different in chemical properties from the element to be purified. Chromatography is based on the principle that different components of a mixture are differently adsorbed on an adsorbent. In chromatography, there are two phases: mobile phase and stationary phase. The stationary phase is immobile and immiscible. Al_2O_3 column is usually used as the stationary phase in column chromatography. The mobile phase may be a gas, liquid, or supercritical fluid in which the sample extract is dissolved. Then, the mobile phase is forced to move through the stationary phase. The component that is more strongly adsorbed on the column takes a longer time to travel through it than the component that is weakly adsorbed. The adsorbed components are then removed (eluted) using a suitable solvent (eluent) .



Q: 5. Out of $_{c}$ and CO , which is a better reducing agent at $673K$?

Answer:

At $673K$, the value of $\Delta G_{(CO,CO_2)}$ is less than that of $\Delta G_{(C,CO)}$. Therefore, CO can be reduced more easily to CO_2 than $_c$ to CO . Hence, CO is a better reducing agent than $_c$ at $673K$.

Q: 6. Name the common elements present in the anode mud in electrolytic refining of copper. Why are they so present?

Answer:

In electrolytic refining of copper, the common elements present in anode mud are selenium, tellurium, silver, gold, platinum, and antimony.

These elements are very less reactive and are not affected during the purification process. Hence, they settle down below the anode as anode mud.