

UNIT- 6
PRINCIPLES AND PROCESSES OF EXTRACTION OF METALS.

I. ONE MARK QUESTIONS:

1. Name an important ore of Aluminium .
Ans: Bauxite
2. Give the composition of copper pyrites.
A: CuFeS_2
3. What is meant by concentration of ores?
A: The process of removal of earthy impurities from the ore.
4. Name the electrolyte used in the extraction of aluminium.
A: Molten $\text{Al}_2\text{O}_3 + \text{Cryolite} + \text{CaF}_2$
5. Sulphide ores are roasted before reduction. Why?
A: To convert sulphides to oxides so that reduction is easy.
6. What are the products formed when calcium carbonate is calcined?
A: $\text{CaO} + \text{CO}_2$
7. Give the composition of copper matte.
A: $\text{Cu}_2\text{S} + \text{FeS}$
8. How is FeO removed during the extraction of copper?
A: It is removed as iron silicate FeSiO_3 using SiO_2 .
9. What do you mean by blister copper?
A: The solidified copper obtained has blistered appearance due to the evolution of SO_2 and so it is called blister copper.
10. During froth floatation process, name the component that comes along with the froth.
A: Ore
11. Why do we add collectors during froth floatation?
A: To enhance non-wettability of ore particles by water.
12. Haematite ore particles are heavier than gangue. Suggest a suitable method for its concentration.
A: Gravity separation
13. What is the importance of roasting and calcination.
A: This is done to get the metal in its oxide form so that reduction can be done easily.
14. Give an example of a metal that can be extracted by electrolytic method.
A: Aluminium (Or Sodium, magnesium)

15. In the extraction of aluminium carbon anodes are replaced regularly. Why?
 A: Because the carbon gets worn out as the oxygen liberated reacts with it to form CO_2 .

II. TWO MARK QUESTIONS

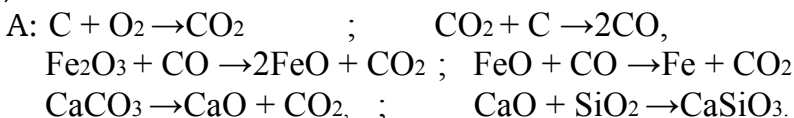
1. What is the role of (i) lime stone in iron extraction and (ii) cryolite in aluminium extraction.?

A: (i) Removes silica impurity as slag calcium silicate
 (ii) Cryolite increases conductivity and reduces melting point of Al_2O_3 .

2. Give the chemical reactions involved in

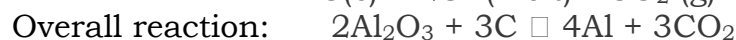
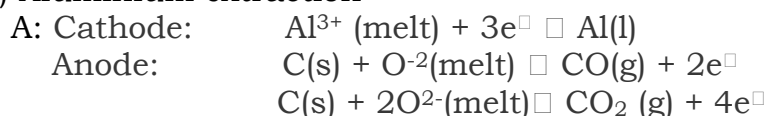
(a) Iron extraction

2 marks



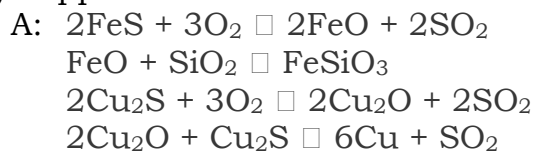
(b) Aluminium extraction

2 marks



(c) Copper extraction

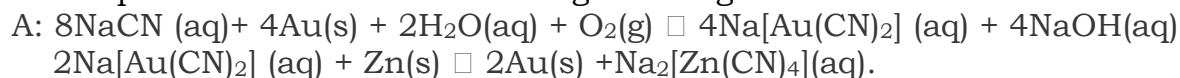
2 marks



3. How is zinc obtained from ZnO ?

A: ZnO is heated with coke at 1673K. Zinc and carbon monoxide are formed.
 $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$

4. Give equations for the extraction of gold using NaCN .



5. Give the principles involved in (i) zone refining (ii) liquation

A: (i) Zone refining: The impurities are more soluble in the melt than in the solid state of the metal.

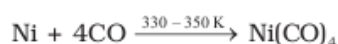
(ii) Liquation: melting point of metals is lower than the impurities.

6. What are the requirements for the compound to be purified by vapour phase refining?

A: (i) The metal should form a volatile compound with an available reagent,
 (ii) The volatile compound should be easily decomposable.

7. How do you refine nickel by Mond's process?

A: In this process, nickel is heated in a stream of carbon monoxide forming a volatile complex, nickel tetracarbonyl:



The carbonyl is subjected to higher temperature so that it is decomposed giving the pure metal:



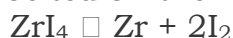
8. How do you remove oxygen and nitrogen impurities from Zirconium.

A: By van Arkel method:

The crude metal is heated in an evacuated vessel with iodine. The metal iodide volatilises



The metal iodide is decomposed on a tungsten filament. The pure metal is thus deposited on the filament.



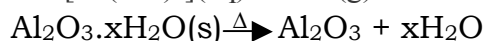
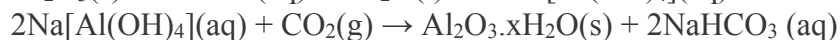
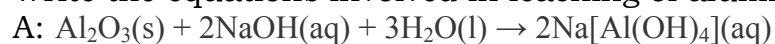
III. THREE MARK QUESTIONS:

1. Explain the concentration of bauxite ore.

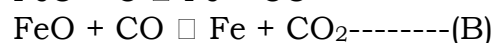
A: Bauxite ore is concentrated by leaching. The steps involved are

- Bauxite is concentrated by digesting the powdered ore in a concentrated solution of sodium hydroxide at 473-573 K and 35 bar pressure. Al_2O_3 is leached as sodium aluminate.
- Aluminate solution is neutralised by passing CO_2 . Hydrated Al_2O_3 is precipitated by seeding.
- Hydrated Al_2O_3 is filtered, dried and heated to get pure Al_2O_3 .

2. Write the equations involved in leaching of alumina.



3. Two reactions are given below, which of these two happen at a temperature above 1073K. Justify.

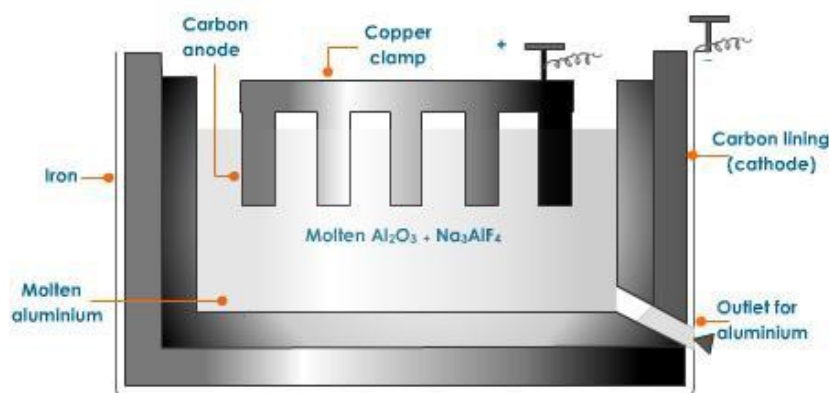


A: $\text{FeO} + \text{C} \rightleftharpoons \text{Fe} + \text{CO}$ happens at a temperature above 1073K.

In the Ellingham diagram we can see that the C,CO line goes below while CO,CO₂ goes above FeO line at temperature above 1073K. So, C is the reducing agent.

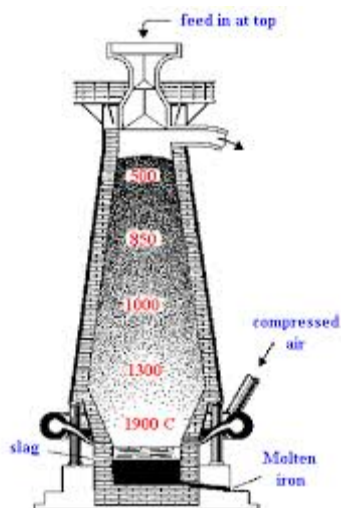
4. How do you extract aluminium from bauxite ore?

A: Diagram.



Aluminium is extracted from bauxite ore by Hall-Heroult process. *the electrolyte is purified $Al_2O_3 + Na_3AlF_6 + CaF_2$. $Na_3AlF_6 + CaF_2$ lowers the melting point of the mix and brings conductivity.* The fused matrix is electrolysed. Steel cathode and graphite anode are used. The overall reaction may be taken as:
 $2Al_2O_3 + 3C \rightarrow 4Al + 3CO_2$

5. How do you extract iron from roasted haematite ore. Explain with diagram.
 A: Diagram



Iron extraction is carried out in blast furnace and different reactions takes place at different temperatures. Ore, limestone and coke are fed into the furnace. Hot air is blown from the bottom. Coke is burnt to give high temperature. At the top of the furnace at lower temperature iron oxide is reduced to iron by carbon monoxide and at high temperatue at the botton iron oxide is reduced by carbon. Calcium carbonate forms CaO which removes silica as calcium silicate.

6. Name the methods used in the refining of
 (a) tin (b) copper (c) germanium (d) Titanium
 A: (a) tin- liquation
 (b) copper- electrolytic refining
 (c) germanium-zone refining
 (d) Titanium-van Arkel refining Or vapour phase refining
7. Explain van Arkel method of refining of zirconium.

A: The crude metal is heated in an evacuated vessel with iodine. The metal iodide volatilises



The metal iodide is decomposed on a tungsten filament. The pure metal is thus deposited on the filament.



8. Explain magnetic separation method of concentration of ore.

A: Principle: This is based on differences in magnetic properties of the ore and the gangue. The powdered ore is carried on a conveyer belt which passes over a magnetic roller. Magnetic substances stick to the roller while non magnetic

substances fall and form a heap. Once the roller moves the magnetic substances come out of the influence of the magnetic roller and fall off forming a separate heap.

9. Give the principle of froth floatation process. How can we separate ZnS and PbS present in an ore using froth floatation process?

A: Principle: This is based on the differences in the wetting properties of ore and gangue.

ZnS and PbS present in the ore can be separated by using depressants like NaCN. It selectively prevents ZnS from coming to the froth but allow PbS to come with the froth.