

METALLURGY

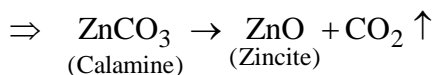
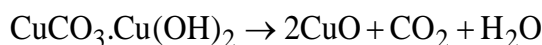
1. The correct statement(s) related to processes involved in the extraction of metals is(are) [JEE(Advanced) 2023]
- (A) Roasting of Malachite produces Cuprite.
(B) Calcination of Calamine produces Zincite.
(C) Copper pyrites is heated with silica in a reverberatory furnace to remove iron.
(D) Impure silver is treated with aqueous KCN in the presence of oxygen followed by reduction with zinc metal.
2. The electrochemical extraction of aluminum from bauxite ore involves. [JEE(Advanced) 2022]
- (A) the reaction of Al_2O_3 with coke (C) at a temperature $> 2500^\circ\text{C}$.
(B) the neutralization of aluminate solution by passing CO_2 gas to precipitate hydrated alumina ($\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$).
(C) the dissolution of Al_2O_3 in hot aqueous NaOH.
(D) the electrolysis of Al_2O_3 mixed with Na_3AlF_6 to give Al and CO_2 .
3. The treatment of galena with HNO_3 produces a gas that is [JEE(Advanced) 2022]
- (A) paramagnetic (B) bent in geometry
(C) an acidic oxide (D) colorless
4. The correct option(s) related to the extraction of iron from its ore in the blast furnace operating in the temperature range 900 – 1500 K is(are) [JEE(Advanced) 2022]
- (A) Limestone is used to remove silicate impurity.
(B) Pig iron obtained from blast furnace contains about 4% carbon.
(C) Coke (C) converts CO_2 to CO.
(D) Exhaust gases consist of NO_2 and CO.
5. The correct statement(s) related to the metal extraction processes is(are) [JEE(Advanced) 2021]
- (A) A mixture of PbS and PbO undergoes self-reduction to produce Pb and SO_2 .
(B) In the extraction process of copper from copper pyrites, silica is added to produce copper silicate.
(C) Partial oxidation of sulphide ore of copper by roasting, followed by self-reduction produces blister copper.
(D) In cyanide process, zinc powder is utilized to precipitate gold from $\text{Na}[\text{Au}(\text{CN})_2]$.
6. Which among the following statement(s) is(are) true for the extraction of aluminium from bauxite? [JEE(Advanced) 2020]
- (A) Hydrated Al_2O_3 precipitates, when CO_2 is bubbled through a solution of sodium aluminate.
(B) Addition of Na_3AlF_6 lowers the melting point of alumina.
(C) CO_2 is evolved at the anode during electrolysis.
(D) The cathode is a steel vessel with a lining of carbon.

7. Calamine, malachite, magnetite and cryolite, respectively are [JEE(Advanced) 2019]
 (A) ZnSO_4 , CuCO_3 , Fe_2O_3 , AlF_3 (B) ZnCO_3 , $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$, Fe_3O_4 , Na_3AlF_6
 (C) ZnSO_4 , $\text{Cu}(\text{OH})_2$, Fe_3O_4 , Na_3AlF_6 (D) ZnCO_3 , CuCO_3 , Fe_2O_3 , Na_3AlF_6
8. The cyanide process of gold extraction involves leaching out gold from its ore with CN^- in the presence of **Q** in water to form **R**. Subsequently, **R** is treated with **T** to obtain Au and **Z**. Choose the correct option(s). [JEE(Advanced) 2019]
 (A) **T** is Zn (B) **R** is $[\text{Au}(\text{CN})_4]^-$
 (C) **Z** is $[\text{Zn}(\text{CN})_4]^{2-}$ (D) **Q** is O_2
9. Galena (an ore) is partially oxidized by passing air through it at high temperature. After some time, the passage of air is stopped, but the heating is continued in a closed furnace such that the contents undergo self-reduction. The weight (in kg) of Pb produced per kg of O_2 consumed is _____. [JEE(Advanced) 2018]
 (Atomic weights in g mol^{-1} : O = 16, S = 32, Pb = 207)
10. Extraction of copper from copper pyrite (CuFeS_2) involves [JEE(Advanced) 2016]
 (A) crushing followed by concentration of the ore by froth-flotation
 (B) removal of iron as slag
 (C) self-reduction step to produce 'blister copper' following evolution of SO_2
 (D) refining of 'blister copper' by carbon reduction
11. Copper is purified by electrolytic refining of blister copper. The correct statement(s) about this process is (are) [JEE(Advanced) 2015]
 (A) Impure Cu strip is used as cathode
 (B) Acidified aqueous CuSO_4 is used as electrolyte
 (C) Pure Cu deposits at cathode
 (D) Impurities settle as anode-mud
12. Match the anionic species given in Column-I that are present in the ore(s) given in Column-II [JEE(Advanced) 2015]
- | Column - I | Column - II |
|---------------|---------------|
| (A) Carbonate | (P) Siderite |
| (B) Sulphide | (Q) Malachite |
| (C) Hydroxide | (R) Bauxite |
| (D) Oxide | (S) Calamine |
| | (T) Argentite |
13. Upon heating with Cu_2S , the reagent(s) that give copper metal is/are [JEE(Advanced) 2014]
 (A) CuFeS_2 (B) CuO (C) Cu_2O (D) CuSO_4

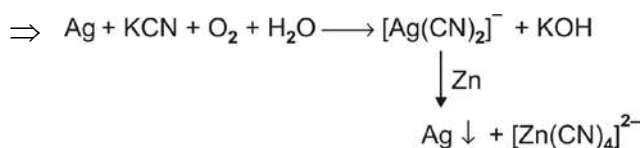
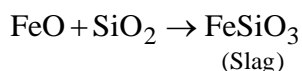
SOLUTIONS

1. **Ans. (B, C, D)**

Sol. \Rightarrow Under roasting condition, the malachite will be converted into

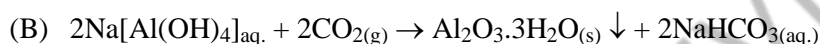


\Rightarrow Copper pyrites is heated in a reverberatory furnace after mixing with silica. In the furnace, iron oxide 'slag of' as iron silicate and copper is produced in the form of copper matte.

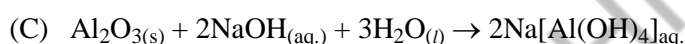


2. **Ans. (B, C, D)**

Sol. (A) Electrochemical extraction of Aluminum from bauxite done below 2500°C



The sodium aluminate present in solution is neutralised by passing CO₂ gas and hydrated Al₂O₃ is precipitated.



Concentration of bauxite is carried out by heating the powdered ore with hot concentrated solution of NaOH.

(D) In metallurgy of aluminum, Al₂O₃ is mixed with Na₃AlF₆

3. **Ans. (A, D)**



NO \Rightarrow Neutral oxide, Paramagnetic, Linear geometry, Colourless gas

4. **Ans. (A, B, C)**

Sol. (A) $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$ (in the temperature range 900 – 1500 K)

(B) In fusion zone molten iron becomes heavy by absorbing elemental impurities and produces Pig iron. (in the temperature range 900 – 1500 K)



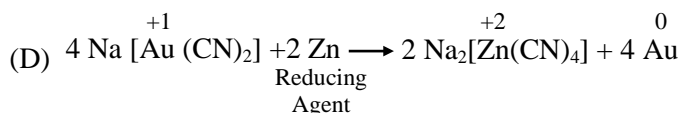
(D) Exhaust gases does not contain NO₂.

5. **Ans. (A, C, D)**

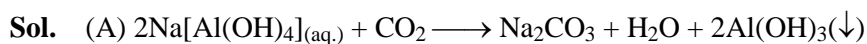
Sol. (A) $\text{PbS} + 2\text{PbO} \rightarrow 3\text{Pb} + \text{SO}_2$ (self reduction)

(B) Silica is added to remove impurity of Fe in the form of slag FeSiO₃

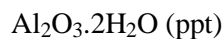
(C) CuFeS₂ ore is partially oxidized first by roasting and then self reduction of Cu takes place to produce blister copper.



6. Ans. (A, B, C, D)

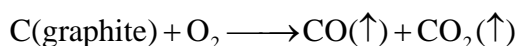
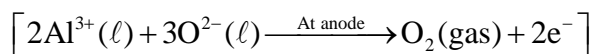


or



(B) Function of Na_3AlF_6 is to lower the melting point of electrolyte.

(C) During electrolysis of Al_2O_3 , the reactions at anode are :



(D) The steel vessel with a lining of carbon acts as cathode.

7. Ans. (B)

Sol. Ore

Formula

Calamine

ZnCO_3

Malachite

$\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$

Magnetite

Fe_3O_4

Cryolite

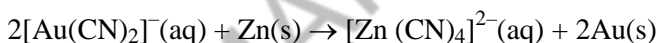
Na_3AlF_6

So correct answer is option(2)

8. Ans. (A, C, D)



(Q)

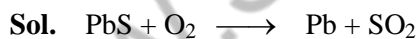


(R)

(T)

(Z)

9. Ans. (6.47)



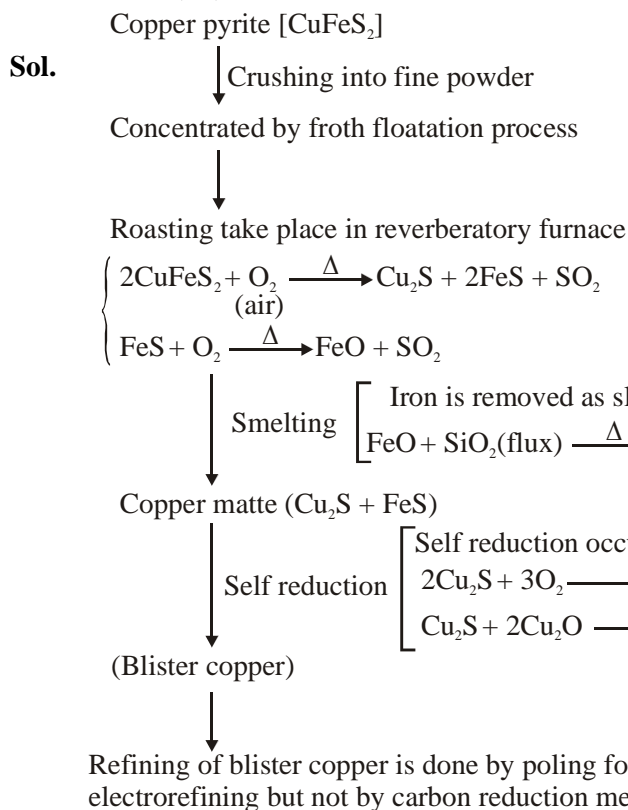
$$\frac{1000}{32} \text{ mol} \quad \frac{1000}{32} \times 207 \text{ gm}$$

mol of Pb = mol of O_2

$$= \frac{1000}{32} \text{ mol}$$

$$\therefore \text{mass of Pb} = \frac{1000}{32} \times 207 \text{ g} = \frac{207}{32} \text{ kg} = 6.47 \text{ kg}$$

10. Ans. (A, B, C)



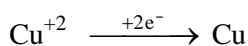
11. Ans. (B, C, D)

Sol. (A) Impure Cu strip is used as cathode : **INCORRECT**

Impure Cu strip is used as anode

(B) Aq. solution of (CuSO₄ + H₂SO₄) is used as electrolyte : **CORRECT**

(C) Pure Cu deposits at cathode : **CORRECT**



At cathode

(D) Impurities settle as anode mud : **CORRECT**

In electrorefining impurities are either soluble in electrolyte solution or deposit below anode known as anode mud.

12. Ans. (A - P, Q, S ; B - T ; C - Q, R ; D - R)

Sol. (A) → P, Q, S, (B) → T, (C) → Q, R, (D) → R

Siderite : FeCO₃

Malachite : CuCO₃·Cu(OH)₂

Bauxite : Al₂O₃·2H₂O consisting of part of hydroxide of aluminium also and the general formula is



where 0 < x < 1

Calamine : ZnCO₃

Argentite : Ag₂S

13. Ans. (C)

