Metallurgy

Exercise

Q. 1. Write names.

a. Alloy of sodium with mercury.
b. Molecular formula of the common ore of aluminum.
c. The oxide that forms salt and water by reacting with both acid and base.
d. The device used for grinding an ore.
e. The nonmetal having electrical conductivity.
f. The reagent that dissolves noble metals.

Answer : (a) Sodium amalgam, commonly denoted Na(Hg), is an alloy of mercury and sodium.

(b) Bauxite. The molecular formula is $Al_2O_3.H_2O$

(c) Amphoteric oxides

Eg. Al_2O_3 is an example of an amphoteric oxide

(d) Ball mill, is often used for grinding an ore and getting enough size reduction.

(e) Graphite is the only non-metal element that is a good conductor of electricity

(f) Aqua Regia, 1:3 mixture of concentrated nitric and hydrochloric acids can dissolve noble metals such as gold, palladium, and platinum.

Q. 2. Make pairs of substances and their properties

Substance	Property
a. Potassium bromide	1. Combustible
b. Gold	2. Soluble in water
c. Sulphur	3. No chemical reaction
d. Neon	4. High ductility.

Answer :

Substance	Property	Explanation
a. Potassium bromide	2. Soluble in water	Potassium bromide compound can readily soluble in water due to the presence of alkali metal potassium.
b. Gold	4. High ductility.	Gold is one of the most ductile elements.
c. Sulphur	1. Combustible	Sulphur is a highly combustible element.
d. Neon	3. No chemical reaction	Neon is an inert gas and usually has no chemical reaction.

Q. 3. Identify the pairs of metals and their ores from the following.

Group A	Group B
a. Bauxite	i. Mercury
b. Cassiterite	ii. Aluminum
c. Cinnabar	iii. Tin

Answer :

Group A	Group B	Explanation
a. Bauxite	ii. Aluminum	Bauxite consists mostly of the aluminum minerals
b. Cassiterite	iii. Tin	Cassiterite is a tin oxide mineral, SnO_2.
c. Cinnabar	i. Mercury	Cinnabar is essentially found in all mineral extraction localities that yield mercury.

Q. 4. Explain the terms.

a. Metallurgy
b. Ores
c. Minerals
d. Gangue

Answer : (a) The process of extraction of the metals in pure form from their ores is termed as metallurgy.

(b) The minerals or deposits from which the metals can be extracted are called ores.

(c) The naturally occurring compounds of metals along with their impurities is termed as minerals.

(d) Ores contain metal compounds with some of the impurities such as sand and rocky materials and these impurities are called gangue.

Q. 5. A. Write scientific reason.

Lemon or tamarind is used for cleaning copper vessels turned greenish.

Answer : Copper reacts with moist carbon dioxide in the air to form copper carbonate. The citric acid present in the lemon or tamarind neutralizes the basis copper carbonate and dissolves the layer. That is why tarnished copper vessels are cleaned with lemon or tamarind juice to give the surface of the copper vessel its characteristic shiny appearance.

Q. 5. B. Write scientific reason.

Generally, the ionic compounds have high melting points.

Answer : Ionic compounds are formed from strong electrostatic interactions between ions, which result in higher melting points and electrical conductivity compared to covalent compounds.

Q. 5. C. Write scientific reason.

Sodium is always kept in kerosene.

Answer : Sodium is a very reactive metal. It is kept in kerosene to prevent it from coming in contact with oxygen and moisture. If this happens, it will react with the moisture present in air and form sodium hydroxide. This is a strongly exothermic reaction, and a lot of heat is generated.

Q. 5. D. Write scientific reason.

Pine oil is used in froth flotation.

Answer : Pine oil is used in froth flotation process because it does not have an affinity towards water (because of the hydrophobic chemicals as its constituents) and it attracts impurities which can be washed away.

Q. 5. E. Write scientific reason.

Anodes need to be replaced from time to time during the electrolysis of alumina.

Answer : This is because over time the graphite anode gets degraded and loses its ability to act as an electrode. Also, more impurities will stick to the electrode.

Q. 6. When a copper coin is dipped in silver nitrate solution, a glitter appears on the coin after some time. Why does this happen? Write the chemical equation.

Answer : When Copper is dipped in silver nitrate solution, copper nitrate and silver metal are formed. A shining white deposit of silver metal is formed on the copper coin, which makes it glitter for some time.

eq:

$$2AgNO_3(ag) + Cu(s) \rightarrow Cu(NO_3)_2(ag) + 2Ag(s)$$

Q. 7. The electronic configuration of metal 'A' is 2,8,1 and that of metal 'B' is 2,8,8,2. Which of the two metals is more reactive? Write their reaction with dilute hydrochloric acid.

Answer : From the configuration,

Metal A is Sodium or Na-2,8,1

Metal B is Calcium or Ca-2,8,8,1

Metal A i.e Sodium is more reactive than Calcium. Sodium metal reactive than calcium and it even reacts when kept open in the air.

Reaction With dil.HCl:

Sodium reacts vigorously with dilute hydrochloric acid to form sodium chlorides and hydrogen.

$$2Na_{(a)} + 2HCl_{(aq)} \rightarrow 2NaCl_{(aq)} + H_{2(g)}$$

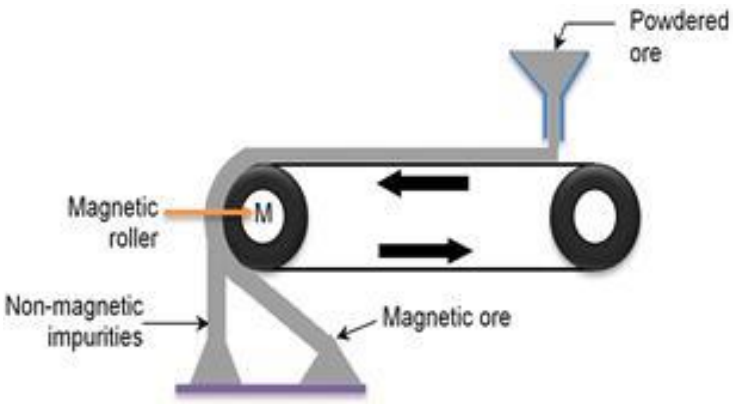
Calcium reacts less vigorously to form calcium chloride and hydrogen gas.

$$Ca + 2HCl \rightarrow CaCl_2 + H_2$$

Q. 8. A. Draw a neat labelled diagram.

Magnetic separation method.

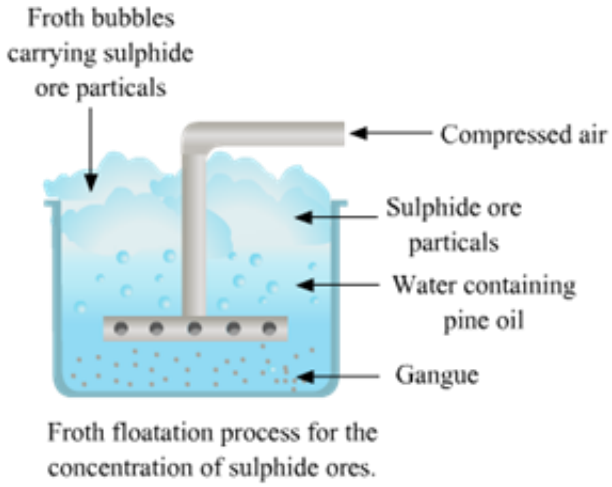
Answer :



Q. 8. B. Draw a neat labelled diagram.

Froth floatation method.

Answer :

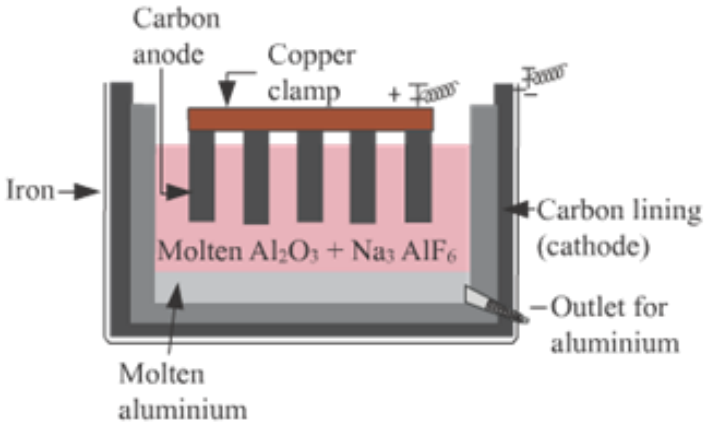


Froth floatation process for the concentration of sulphide ores.

Q. 8. C. Draw a neat labelled diagram.

Electrolytic reduction of alumina.

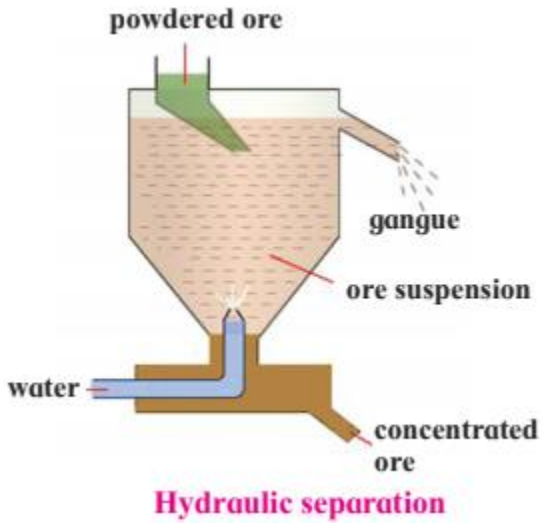
Answer :



Q. 8. D. Draw a neat labelled diagram.

Hydraulic separation method.

Answer :



Hydraulic separation

Q. 9. Write the chemical equation for the following events.

a. Aluminum came in contact with air.
b. Iron filings are dropped in an aqueous solution of copper sulfate.
c. A reaction was brought about between ferric oxide and aluminum.
d. Electrolysis of alumina is done.
e. Zinc oxide is dissolved in dilute hydrochloric acid.

Answer : (a) $4Al(s) + 3O_2(l) \rightarrow 2Al_2O_3(s)$

The surface of the aluminum metal is covered with a thin layer of oxide that helps

protect the metal from attack by air. So, normally, aluminum metal does not react with air. If the oxide layer is damaged, the aluminum metal is exposed to attack

(b) Iron is more electropositive than copper. It can displace Copper (Cu) from its salt Copper sulfate (CuSO4) and thus its colour changes from blue to green.

$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

(c) The reaction of Ferric oxide and aluminum produces aluminum oxide and iron. The chemical equation is:

$3Fe_3O_2 + 4Al \rightarrow 2Al_2O_3 + 6Fe$

(d) The electrode reactions are:

Anode reaction: $2O^{2-} \rightarrow O_2 + 4e^-$ (Oxidation)

Cathode reaction: $Al^{3+} \rightarrow$ Al (l)(Reduction)

(e) $ZnO(aq)+2HCl(aq) \rightarrow ZnCl_2(aq)+H_2O(l)$

Zinc chloride and water are produced in the reaction.

Q. 10. Complete the following statement using every given option.

During the extraction of aluminum……..
a. Ingredients and gangue in bauxite.
b. Use of leaching during the concentration of ore.
c. The chemical reaction of the transformation of bauxite into alumina by Hall's process.
d. Heating the aluminum ore with concentrated caustic soda.

Answer : (a) Silica, Ferric Oxide, and Titanium Oxide are the impurities or gangue in Bauxite

(b) By Hall's and Bayer's method, where finally the concentrated alumina can be obtained by the calcination process

(c) Halls Process:

$$Al_2O_3{\cdot}2H_2O\ (s) + Na_2CO_3(aq) \longrightarrow 2NaAlO_2(aq) + CO_2\uparrow + 2\ H_2O\ (l)$$

$$2NaAlO_2(aq) + 3H_2O + CO_2(g) \longrightarrow 2Al\ (OH)_3\downarrow + Na_2CO_3$$

$$2Al(OH)_3 \longrightarrow Al_2O_3 + 3H_2O$$

(final calcination method)

(d) Since aluminum oxide is amphoteric in nature, it reacts with NaOH to form water-soluble Sodium aluminate

$$Al_2O_3 \cdot 2H_2O\ (s) + 2\ NaOH\ (aq) \longrightarrow 2NaAlO_2\ (aq) + 3\ H_2O\ (l)$$

Q. 11. Divide the metals Cu, Zn, Ca, Mg, Fe, Na, Li into three groups, namely reactive metals, moderately reactive metals and less reactive metals.

Answer : Highly Reactive metals: Na, Li, Ca

Moderately Reactive Metals: Mg, Zn, Fe

Less Reactive Metals: Cu