Chapter - 6

Metals

Minerals

- ✓ Naturally occurring metals or compounds are called minerals.
- ✓ Minerals include metallic compounds and non metallic compounds.

Example

Clay ($Al_2O_3.2SiO_2.2H_2O$), **Cryolite** (Na_3AlF_6), **Bauxite** ($Al_2O_3.2H_2O$) are the minerals of **Aluminium**

Ore

- ✓ Any mineral from which a metal can be extracted easily and economically is called an ore of that metal.

Metal	Ore	Chemical formula
Aluminium (Al)	Bauxite	$Al_2O_3.2H_2O$
Iron (Fe)	Haematite	Fe_2O_3
	Magnetite	Fe_3O_4
Copper (Cu)	Copper pyrites	$CuFeS_2$
	Copper glance	Cu_2S
	Cuprite	Cu_2O
Zinc (Zn)	Zinc blende	ZnS
	Calamine	$ZnCO_3$
Tin (Sn)	Cassiterite (Tinstone)	SnO_2

Question : What are the qualities of a mineral which is used to extract a metal?

Answer :

i. Abundance ii. Ease of extraction

iii. High metal content iv. Low production cost

Metallurgy

- ✓ The process of extraction of metal from ores involves three major stages. Such processes are generally referred to as metallurgy.
- ✓ There are three important stages in metallurgy.

A. Concentration of ores

B. Extraction of metal from concentrated ore

C. Refining of metal

A. Concentration of ores

- ✓ Concentration of ores is the process of increasing the metal content of the ore by removing impurities(gangue) mixed with the ore.
- ✓ Depending on the nature of the ore and the impurity, different methods adopted for the concentration of ores are
  1. Levigation (Hydraulic washing)
  2. Froth flotation
  3. Magnetic seperation
  4. Leaching

1. Levigation or Hydraulic washing

- ✓ This method is employed when the density of the ore is more than that of the gangue.
- ✓ The powdered ore is washed in a stream of water. The less dense gangue, which floats, is filtered out. The more dense ore remains at the bottom.
- ✓ Oxide ores can be concentrated by this method.

2. Froth Floatation

- ✓ The froth floatation process is used when the ore is less dense than the gangue.
- ✓ The powdered ore is added to a mixture of water and pine oil and is stirred in a strong current of air.
- ✓ The ore particles stick to the froth formed, and float. It is removed and then the ore is separated and dried.
- ✓ Sulphide ores are concentrated by this method.

3. Magnetic separation

- ✓ If either the ore or the impurity has magnetic nature, concentration is done by magnetic seperation.
- ✓ When the powdered ore is passed through a magnetic roller, either the ore or the impurities having magnetic property is separated.

Example 1

Magnetite (Fe_3O_4) the ore of iron (Fe) has **magnetic properties**, but the **gangue** is **non magnetic**.

Example 2

Tinstone (SnO_2), the ore of tin is **non magnetic**, but **iron tungstate**, the gangue present in it is **magnetic**.

4. Leaching

- ✓ The powdered ore is mixed with a suitable solvent. The ore dissolvesin it or undergoes a chemical reaction to become a solution.
- ✓ The gangue remains insoluble in it. It is then filtered out.

Example 1 : Bauxite, the ore of aluminium, is concentrated by leaching

Example 2 : The ores of gold (Au) and Silver (Ag) are leached with a dilute solution of sodium cyanide (NaCN) or potassium cyanide (KCN) in the presence of air.

Properties of ore	Properties of the impurities	Method of concentration
High density (Eg : Oxide ores)	Low density	Levigation
Low density (Eg : Sulphide ores)	High density	Froth floatation

Magnetic in nature (Eg : Magnetite)	Non – magnetic in nature	Magnetic separation
Non magnetic in nature (Eg : Tinstone)	Magnetic in nature (Iron tungstate)	Magnetic separation
The ore that get dissolved in the solution (Eg : Bauxite)	Impurity is insoluble in the solution	Leaching

Question : Write suitable method of concentration for the ores given below

a. Tinstone b. Bauxite c. Zinc blende

Answer :

a. Tinstone (SnO_2) – Magnetic separation

b. Bauxite ($Al_2O_3.2H_2O$) – Leaching

c. Zinc blende (ZnS – Sulphide ore) – Froth floatation

B. Extraction of metal from concentrated ore

- ✓ The metals potassium, sodium, calcium, magnesium and aluminum are highly reactive and form stable compounds.
- ✓ Zinc, iron, tin and lead are metals with comparatively moderate reactivity and form stable compounds.
- ✓ Less reactive metals like copper, mercury, silver and gold form less stable compounds. They occur more or less in the free state in nature.
- ✓ Mercury can be easily separated from its ores by controlled heating.
- ✓ Metals with comparatively moderate reactivity like Zn, Fe, Sn, Pb, are generally found as oxides, sulphides or carbonates.

There are two stages for the production of metal from concentrated ore.

1. Conversion of concentrated ore to oxide

2. Reduction of oxide ore

1. Conversion of concentrated ore to oxide

Two methods are commonly used for this.

a. Calcination
b. Roasting

a. Calcination

- ✓ Calcination refers to heating the concentrated ore in limited quantities or absence of air at a temperature below the melting point.
- ✓ Metal carbonates or hydroxides are converted to their oxides by a process called calcination.

Examples

$$CaCO_3(s) + Heat \rightarrow CaO\ (s) + CO_2(g)$$

$$ZnCO_3(s) + Heat \rightarrow ZnO\ (s) + CO_2(g)$$

b. Roasting

- ✓ Roasting refers to heating the concentrated ore at a temperature below the melting point in the presence of air.
- ✓ Sulphide ores can be easily converted into their oxides by this method.

Examples

$$2ZnS(s) + 3O_2(g) + Heat \rightarrow 2ZnO\ (s) + 2SO_2(g)$$

$$2PbS(s) + 3O_2(g) + Heat \rightarrow 2PbO(s) + 2SO_2(g)$$

2. Reduction of oxide ore

- ✓ The process of extraction of metal from the oxide is reduction.
- ✓ The metal part of the ores is in the form of positive ions, and hence it can be extracted by a reduction process.
- ✓ Suitable reducing agents can be used for this purpose.
- ✓ Reducing agents such as coke and carbon monoxide are used to extract moderately reactive metals such as iron, zinc and tin from their oxide ores.
- ✓ Electricity is used as the reducing agent to extract highly reactive metals like sodium, potassium and calcium from their ores.

Method of separating metals from ores	Metals
Electrolysis	Sodium (Na), Potassium (K), Calcium (Ca), Aluminium (Al)
Reduction using coke	Zinc (Zn)
Heating in controlled ways	Mercury (Hg)

Question: The order of reactivity of some metals is given. Al > Zn > Fe > Au

a. Which metal forms the most stable compound?

b. Which metal is produced by electrolysis?

c. Which metal can displace zinc from compounds of zinc? Why?

d. Which metal is found in the free state in nature?

e. Which metal is produced by reduction using carbon?

Answer:

a. Al (Aluminium)

b. Al (Aluminium)

c. Al. Beacuae Al is more reactive than Zn.

d. Au

e. Zn

C. Refining of metals

- ✓ The metal extracted from concentrated ore may contain other elements or their compounds as impurities. Refining of metals is the process of removal of these impurities to produce pure metal.

Depending on the nature of metals and the impurities present in them, different methods are used for the refining of metals. Some of them are

a. Liquation b. Distilation c. Electrolytic refining

a. Liquation

- ✓ This method is used for the refining of metals with low meltig points.
- ✓ When metals with low melting point contain impurities with high melting point, the metal is heated on the inclined surface of the furnace. The pure metal separates from the impurities, melts, flows down and it is collected. This is known as liquation.

Example : Metals such as **tin (Sn)** and **lead (Pb)** having low melting point can be purified by this method.

b. Distilation

- ✓ This method is used for the refining of metals with low meltig points.
- ✓ When the metal containing impurities is heated under suitable conditions, only the pure metal vapourises. When this vapour condenses, pure metal is obtained.

Example : Metals like zinc (Zn), cadmium (Cd) and mercury (Hg) can be purified using this method.

c. Electrolytic refining

- ✓ Electrolytic refining is the process of refining a metal by the electrolysis of a solution of the salt of the metal.
- ✓ In this process an impure metal is used as the anode and a thin piece of pure metal is used as the cathode.
- ✓ When electric current is passed, the pure metal alone is separated from the anode and deposited at the cathode.
- ✓ Chemical reaction taking place

At Anode

$M \rightarrow M^{n+} + ne^-$

At Cathode

$M^{n+} + ne^- \rightarrow M$

Here $M =$ Metal, $n =$ Nnumber of electrons

Extraction of iron

- ✓ Iron is industrially prepared mainly from haematite.
- ✓ Iron is produced in steel towers, known as blast furnaces, which are 25 to 30 meters high.
- ✓ Method of concentration – Levigation, Roasting
- ✓ The concentrated ore mixed with limestone ($CaCO_3$) and coke (C) is fed from the top of the furnace via cup & cone arrangement. This mixture is called **charge**.

Haematite + Limestone + Coke = Charge

- ✓ The coke combines with the oxygen in the air and carbon dioxide is formed. This is an exothermic reaction.

$$C + O_2 \rightarrow CO_2 + \text{Heat}$$

- ✓ Coke reacts with carbon dioxide to produce carbon monoxide. This is an endothermic reaction

$$CO_2 + C + \text{Heat} \rightarrow 2CO$$

- ✓ The reduction of haematite into iron is done mainly by carbon monoxide (CO).

Reducing agent = Carbon monoxide (CO)

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

- ✓ Even though the iron ore fed into the furnace, it may contain acidic impurities such as sand (silica $- SiO_2$) that cannot be removed in the first stages of concentration methods.

- ✓ For this, a substance known as flux is added during the metallurgical stage.
- ✓ The flux combines with gangue to form molten slag.

$$\textbf{Flux} + \textbf{Gangue} = \textbf{Slag}$$

- ✓ As the impurities are acidic in nature, a basic substance is used as the flux.
- ✓ When heated at high temperature, the limestone ($CaCO_3$) decomposes to calcium oxide (Quick lime – CaO).

$$CaCO_3(s) + Heat \rightarrow CaO + CO_2$$

- ✓ **Calcium oxide** produced in this reaction acts as **flux**.
- ✓ Calcium oxide (CaO) reacts with sand (SiO_2) to form calcium silicate (**slag**) which melts easily.

$$CaO\ (s) + SiO_2(s) \rightarrow CaSiO_3\ (l)$$

Flux **Gangue** **Slag**

$CaSiO_3 =$ Calcium silicate

- ✓ Since the molten slag is less dense, it floats on the molten iron.
- ✓ The slag is used in the production of cement and in the construction of roads.
- ✓ The molten iron obtained from the blast furnace contains **4% carbon** and small amounts of other impurities such as manganese, silicon, phosphorus and sulphur. This is called **pig iron**.
- ✓ If the percentage of impurity in it is reduced, the iron obtained can be **cast as desired**. It is called **cast iron**. It contains **more than 2% carbon**.
- ✓ **Wrought iron** is a relatively **pure form of iron**, containing **0.02% - 0.05% carbon** and small amounts of phosphorus, silicon, manganese, sulphur etc.

Steel

- ✓ The pig iron obtained from the blast furnace is not suitable either for hammering into various shapes or for drawing into wires. The steel obtained from this is used for various industrial purposes.
- ✓ Steel is iron containing 0.05% to 1.5% carbon.
- ✓ There are different types of carbon steels depending on the amount of carbon. They are

i. Mild steel ii. Medium steel iii. High carbon steel

Carbbon steel	Amount of carbon (%)	Features
Mild steel	0.05 - 0.2	Easy to draw into wires and hammer into plates. Strong and hard. Used for making agricultural tools.
Medium steel	0.2 - 0.6	High hardness. Used for the construction of railway tracks, handrails, rafters etc.
High carbon steel	0.6 - 1.5	Very high elasticity and hardness. Used for the manufacture of surgical instruments, springs, knives, drills etc.

Alloy steel

- ✓ Alloys are mixtures of two or more metals.
- ✓ Nonmetals like carbon, nitrogen and phosphorus are also used for the production of alloys.
- ✓ Alloy steels are made by adding other metals to steel. Their properties are different from those of steel.

Alloy steels	Constituent elements	Properties and uses
Stainless steel	Fe, Cr, Ni, C	Resists corrosion. Manufacture of household appliances and blades.
Manganese steel	Fe, Mn, C	High hardness. Used for the manufacture of drills, safes, plates and railway tracks.
Silicon steel	Fe, Si, C	Also known as electrical steel. As it reduces electric loss, it is used in the core of electromagnetic instruments like motors, generators, transformers etc.

Extraction of zinc

Sulphide ore of zinc	Zinc blende (ZnS)
Concentration method	Froth floatation
Process used in the conversion of ore into its oxide	Roasting
Carbonate ore of zinc	Calamine ($ZnCO_3$)
Process used in the conversion of ore into its oxide	Calcination

- ✓ Coke is mixed with the zinc oxide obtained after these processes.
- ✓ This mixture is put into a furnace similar to a blast furnace. At high temperature in the furnace, the coke reduces zinc oxide to zinc.

$$ZnO(s) + C(s) + Heat \rightarrow Zn\ (s) + CO(g)$$

- ✓ Brass is an important alloy containing zinc.

$$\mathbf{Zinc + Copper = Brass}$$

Extraction of copper

- ✓ Principal ores of copper are copper pyrites ($CuFeS_2$) and copper glance (Cu_2S).
- ✓ Concentration method = Froth floatation
- ✓ The ore contains basic impurities such as iron oxide even after concentration.
- ✓ Sand (SiO_2 – Flux) having acidic nature is added to the ore and heated to form cuprous sulphide (Cu_2S) of maximum purity. It is partially converted to cuprous oxide (Cu_2O) when heated under controlled flow of air.
- ✓ The cuprous oxide converts the remaining cuprous sulphide into copper.

$$2Cu_2O + Cu_2S \rightarrow 6\ Cu + SO_2$$

(No reducing agent is added here)

- ✓ The sulphur dioxide gas produced during the production of copper is released when the metal condenses. As a result blisters are formed and they appear as such on the surface of copper lumps. The copper lumps thus obtained are called **blister copper**.
- ✓ Brass and bronze are important alloys that contain copper.

Purification of Copper (Electrolytic refining of copper)

- ✓ A high quality copper is obtained through electrolytic refining.

Anode	Impure copper
Cathode	Pure copper
Electrolyte	Copper sulphate mixed with dilute H_2SO_4
Chemical equation of the reaction taking place at anode	$Cu \rightarrow Cu^{2+} + 2e^-$
Chemical equation of the reaction taking place at cathode	$Cu^{2+} + 2e^- \rightarrow Cu$

Extraction of aluminium

- ✓ Aluminium is produced by Hall-Heroult process. It has two stages.

1. Concentration of bauxite

2. Electrolysis of **alumina** (Aluminium oxide)

1. Concentration of bauxite

- ✓ Bauxite is concentrated through the leachng process.
- ✓ Impure bauxite is added to hot concentrated NaOH solution. The ore alone dissolves in it to form sodium aluminate ($NaAlO_2$) solution. Impurities are then filtered off.

$$Al_2O_3.2H_2O + 2\ NaOH \rightarrow 2\ NaAlO_2 + 3\ H_2O$$

- ✓ A little aluminium hydroxide ($Al(OH)_3$) is added to the solution of sodium aluminate and stirred vigorously. It is diluted by adding water. As a result, pure aluminium hydroxide separates out from the solution.

$$NaAlO_2 + 2\ H_2O \rightarrow Al(OH)_3 + NaOH$$

- ✓ If the aluminium hydroxide thus obtained is heated strongly, anhydrous alumina (Al_2O_3) is obtained.

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

2. Electrolysis of alumina (Aluminium oxide)

- ✓ The melting point (2017℃) of alumina is very high
- ✓ The alumina obtained by concentration of bauxite is mixed with molten cryolite (Na_3AlF_6) and subjected to electrolysis.
- ✓ Cryolite is added to alumina to reduce its melting point and increase its electrical conductivity.

Electrolyte	Mixture of molten cryolite and alumina
Equation of ionisation of alumina	$Al_2O_3 \rightarrow 2Al^{3+} + 3O^{2-}$
Ions in alumina	Al^{3+}, O^{2-}
Anode	Carbon rod
Cathode	Carbon lining
Equation of chemical reaction taking place at **anode**	$2O^{2-} \rightarrow O_2 + 4e^-$

	$C + O_2 \rightarrow CO_2$
Equation of chemical reaction taking place at **cathode**	$Al^{3+} + 3e^- \rightarrow Al$
Product formed at **anode**	Oxygen, Carbon dioxide
Product obtained at **cathode**	Aluminium

Question : In the electrolysis of alumina, the positively charged carbon rods are replaced periodically. What is the reason?

Answer : Oxygen released at the anode oxidises the carbon rod to oxides of carbon. As a result, the size of the anode rod decreases.

- ✓ **Duralumin** and **alnico** are important **alloys** which contain **aluminium**.
- ✓ The constituents of alnico are Fe, Al, Ni, Co etc.
- ✓ **Alnico** is used for making **permanent magnets**.

Corrosion of metals

- ✓ Corrosion of metal is a process in which the metal reacts with a surrounding medium and undergoes chemical change.
- ✓ The metals occupying higher positions in the reactivity series readily corrode upon contact with atmospheric air.
- ✓ The rate of corrosion decreases as we move down.
- ✓ The oxide coatings on metals such as aluminium, zinc and tin are thin and nonporous and therefore protect the metal from further corrosion.
- ✓ The hydrated iron oxide (rust) that forms on the surface of iron is porous and powdery. So this process of corrosion continues until the metal is completely destroyed.
- ✓ The factors given below influence the corrosion of metals.
    - Nature of the metal
    - Moisture in which gases or salts are dissolved
    - Contact with other metals

Cathdic protection

- ✓ Cathodic protection is a metal protection process in which when two metals are in contact, the metal acting as the anode is destroyed and the metal acting as the cathode is protected.

Example 1 : The iron nail in contact with copper corrodes easily [Reason : Iron is more reactive than copper and act as anode]

Example 2 : The iron nail in contact with magnesium is protected. [Reason : Iron is less reactive than Magnesium and hence act as cathode]

Question : Why is it not advisable to join aluminium wires and copper wires, and to join iron materials to copper piping for electrical purposes?

Answer : When aluminium and copper are in contact, the more reactive metal, aluminium acts as anode and corrode easily. Similarly, when we join iron materials to copper piping for electrical purpose, the more reactive metal iron may get destroyed.

Question : Why are zinc or magnesium blocks always attached to sea bridges and ship hulls?

Answer : Both the metals zinc and magnesium are more reactive than iron. When these metals are in contact with iron, they act as anode and protect iron from corrosion.

Let us assess

1. Define the following and answer the given questions.

(1) Ore - What is the ore of aluminium?

(2) Roasting - Which type of ores are subjected to roasting?

(3) Reducing agent - What is the reducing agent used in the manufacture of aluminium?

(4) Flux - Which flux is used in the manufacture of copper? Why?

(5) Leaching - Which metal ore is leached with sodium cyanide?

2. Find the relation and write the answer.

Zinc sulphide : Roasting

Calcium carbonate : .....

Magnetite : Magnetic separation

Bauxite : .....

3. The chemical reaction that occurs when calcium carbonate is heated is given.

$$CaCO_3 \xrightarrow{heat} CaO + CO_2$$

How is this chemical change of calcium carbonate utilised in the industrial preparation of iron?

4. Following are two facts related to the manufacture of an industrially important metal.

- The ore is treated with hot NaOH solution.
- Electricity is used as the reducing agent to extract the metal.

(i) These facts are related to the production of which metal?

(ii) What is the reason for using electricity as the reducing agent?

(iii) Which substance is used as the electrolyte here?

(iv) Which gas is liberated at the anode?

5. A portion of the periodic table is given.

(i) Which method given below is more possible for the production of gallium?

(Reduction using carbon, electrolysis)

(ii) If gallium chloride ($GaCl_3$) is electrolysed, what is the product formed at the cathode. Write the chemical equation.

(iii) Write the subshell electron configuration of the outermost shell of gallium.

	^{5}B	
	^{13}Al	^{14}Si
	^{31}Ga	

6. Corrosion is a process by which iron is converted into its oxide. This is an oxidation reaction.

(i) What is oxidation?

(ii) Complete the following chemical equation.

..... Fe + ... O_2 → ..... Fe_2O_3

(iii) Suggest two methods for preventing the corrosion of iron.

7. Alloys containing iron are given. Find a, b, c, d.

Alloys	Constituent elements	Uses
Alnico	(a)	(b)
(c)	Fe, Cr, Ni, C	Resist the corrosion of iron
Silicon steel	Fe, Si, C	(d)

Answers

1. (1) Any mineral from which a metal can be extracted easily and economically is called an ore of that metal.

Bauxite is the ore of aluminium.

(2) Roasting refers to heating the concentrated ore at a temperature below the melting point in the presence of air.

Sulphide ores are generally subjected to roasting

(3) Reducing agent is a substance that loses electrons to another species in a redox reaction.

In the manufacture of aluminium electricity is used as the reducing agent.

(4) Flux is the substance added during metallurgical process to remove the remaining impurities in the ore after concentration.

Sand (SiO_2) which is **acidic** in nature, is used as a flux in the manufacture of copper, because the impurity **iron oxide** is **basic** in nature.

(5) Leaching is the process of separating impurities from powdered ore by mixing it with a suitable solvent.

The ore of gold is leached with sodium cyanide.

2. Calcium carbonate : Calcination

Bauxite : Leaching

3. At higher temperature, calcium carbnate decomposes into calcium oxide and carbondioxide. This calcium oxide reacts with sand (SiO_2), the gangue in iron ore and is converted into calcium silicate (slag), which melts easily.

4. (i) Aluminium

(ii) Due to high reactivity of aluminium and high stability of aluminium compounds.

(iii) Alumina mixed with molten cryolite.

(iv) Oxygen

5. (i) Electrolysis

(ii) Galium is obtained at cathode

$$GaCl_3 \rightarrow Ga^{3+} + 3\ Cl^-$$

$$Ga^{3+} + 3\ e^- \rightarrow Ga$$

(iii) Outermost subshell electron configuration of

$$\text{Boron (B)} = 2s^2 2p^1$$

$$\text{Aluminium (Al)} = 3s^2 3p^1$$

$$\text{Gallium (Ga)} = 4s^2 4p^1$$

6. (i) Oxidation is the process of losing electrons during a chemical reaction.

(ii) $4\ Fe + 3\ O_2 \rightarrow 2\ Fe_2O_3$

(iii) Cathodic protection

Metallic coating or non metallic coating

7. (a) Al, Ni, Co, Fe

(b) Used for making permanent magnets

(c) Stainless steel

(d) used in the core of electromagnetic instruments like motors, generators, transformers etc.

Question bank with Answers

1. Some statements related to the manufacture of aluminium are given. (1)

(i) The ore is treated with hot NaOH solution.

(ii) Electricity is used as the reducng agent to extract the metal.

(iii) As a result of electrolysis, aluminium is obtained at the anode.

Which of the following is **correct**?

a. Statements (i) and (iii) are correct, but (ii) is not correct.

b. Statements (i) and (ii) are correct, but (iii) is not correct

c. Statements (ii) and (iii) are correct, but (i) is not correct

d. Statements (i), (ii) and (iii) are correct

2. Zinc blende is an ore of zinc.

a. Which is the concentration method suitable for zinc blende? (1)

b. Which is the process used to convert the concentrated ore into its oxide? (1)

3. Various types of steels are used for industrial purposes.

a. Write the steel that can be used for the given purposes. (2)

(i) For the manufacture of springs, knives and drills.

(ii) Construction of railway tracks and rafters.

b. Write one use of electric steel. (1)

4. A very dilute sodium chloride solution is taken in two test tubes. Put an iron nail wrapped in copper wire in one test tube and iron nail wrapped in magnesium wire in the other test tube. Keep the test tubes for few days.

a. In which test tube does the nail undergo rusting? Write the reason. (2)

b. Although aluminium is a very reactive metal, it resists corrosion to a certain extent. Why? (1)

5. Some statements related to refining of metals are given below. (1)

Statement (1) : Metals like tin and lead are purified by distillation.

Statement (2) : In electrolytic refining, the impure metal is used as the cathode.

Statement (3) : When metals with low melting point contain impurities with high melting point, the method used is liquation.

Which of the following is correct regarding these statements ?

a. Statements (1), (2) and (3) are correct.

b. Statement (1) is incorrect but (2) and (3) are correct.

c. Statements (1) and (2) are incorrect but (3) is correct

d. Statements (1) and (2) are correct but (3) is incorrect

6. Calamine is an ore of zinc.

a. Write 'its chemical formula. (1)

b. Which method is used to convert the concentrated ore into oxide? (1)

7. Bauxite ore is concentrated by leaching with sodium hydroxide.

a. Which compound is formed when bauxite dissolves in hot NaOH ? (1)

b. How is metal hydroxide precipitated from the solution ? (1)

c. How is the precipitate converted to alumina ? (1)

8. Iron is produced in a steel towers, known as blast furnaces, which are 25. to 30 meters high. The mixture known as charge is fed from the top of the furnace via the cup and cone arrangement.

a. What are the substances contained in the mixture known as charge, in addition to iron ore? (1)

b. Which compound acts as the reducing agent here? (1)

c. Write the chemical equation for the reduction of iron ore in the blast furnace. (1)

9. An ore is selected from minerals. Write any four qualities of a mineral which is used as an ore to extract a metal. (2)

Answers

1. b. Statements (i) and (ii) are correct, but (iii) is not correct

2. a. Froth floatation

b. Roasting

3. a. i. High carbon steel

ii. Medium steel

b. used in the core of electromagnetic instruments like

motors, generators, transformers etc.

4. a. The iron nail wrapped with copper undergo rusting. Because iron is more reactive than copper and less reactive than magnesium.

b. The oxide (Aluminium oxide) coatings on aluminium is thin and nonporous and therefore protect the metal from further corrosion.

5. c. Statements (1) and (2) are incorrect but (3) is correct

6. a. $ZnCO_3$

b. Calcination

7. a. Sodium aluminate $(NaAlO_2)$

b. A little aluminium hydroxide $(Al(OH)_3)$ is added to the solution of sodium aluminate and stirred vigorously. It is diluted by adding water. As a result, pure aluminium hydroxide separates out from the solution.

c. If the aluminium hydroxide thus obtained is heated strongly, anhydrous alumina (Al_2O_3) is obtained.

8. a. coke, limestone

b. Carbon monoxide (CO)

c. $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

9.

- Abundance
- Ease of extraction
- High metal content
- Low production cost