

# Chemistry-Std-XII-Science

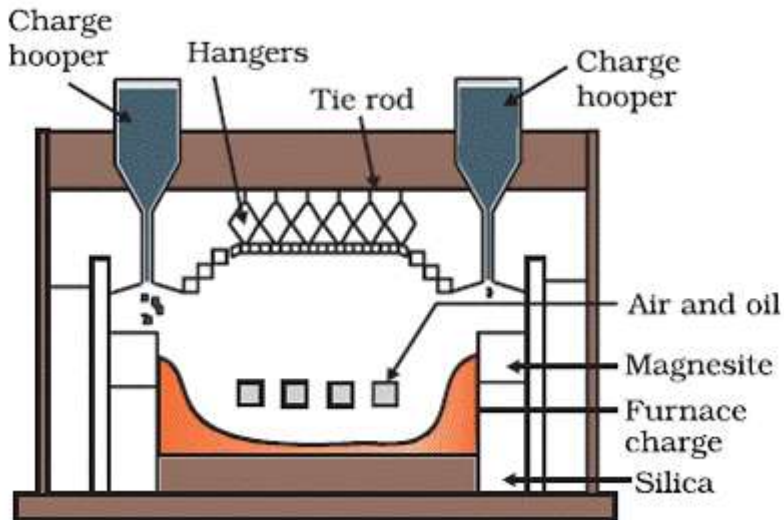
## Chapter: Isolation of elements

### Occurrence and extraction

Question 1

Draw a well labeled diagram of reverberatory furnace.

Ans.



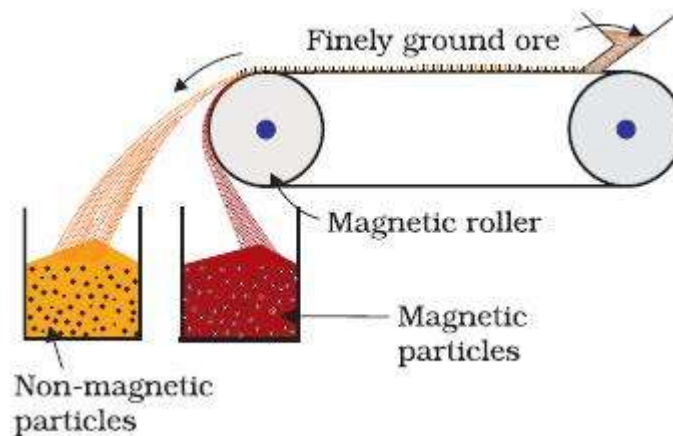
A section of a modern reverberatory furnace.

Question 2

Name the process by which Haematite and Magnetite ores can be concentrated, Also draw a well labeled diagram of this process.

Ans.

Haematite and Magnetite ores can be concentrated by magnetic separation.



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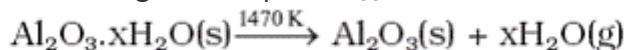
Question 3

**What is the significance of leaching in the extraction of aluminium?**

**Ans.**

Aluminium is extracted from bauxite which contains  $\text{SiO}_2$ , iron oxide and titanium IV oxide as impurities. The ore is concentrated by digesting the powdered ore with 45% caustic soda solution at 473-523 K and 35-36 bar pressure. In this way  $\text{Al}_2\text{O}_3$  is leached out as sodium aluminate.

$\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}(\text{s}) + 2\text{NaOH}(\text{aq}) + \text{H}_2\text{O} \longrightarrow 2\text{Na}[\text{Al}(\text{OH})_4](\text{aq})$  The aluminate in solution is hydrolyzed by passing  $\text{CO}_2$  gas and hydrated  $\text{Al}_2\text{O}_3$  is precipitated. Now the solution is seeded with freshly prepared sample of hydrated  $\text{Al}_2\text{O}_3$  which induces precipitation. The sodium silicate remains in the solution and hydrated alumina is dried, filtered and heated to give back pure  $\text{Al}_2\text{O}_3$ .



Question 4

**What is the role of each of the following in froth floatation process**

**(i) Collectors**

**(ii) Froth stabilizers**

**(iii) Depressants**

**Ans.**

Collectors- They increase the non-wettability of mineral particles.

Froth stabilizers- They are used to stabilize the froth formed.

Depressants- They are used to prevent certain type of particles from forming the froth.

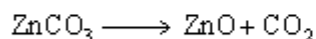
Question 5

**What is the difference between calcinations and roasting?**

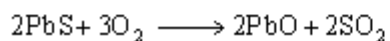
**Ans.**

Calcination is carried out in limited supply of air while roasting is done in excess of air where oxidation of ore is also needed.

Examples of Calcination:



Example of Roasting



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Question 6

**Name the various steps involved in metallurgy.**

**Ans.**

The various steps involved in metallurgy are:

- (i) Crushing and grinding of the ore
- (ii) Concentration of the ore
- (iii) Preliminary treatment of the concentrated ore
- (iv) Reduction
- (v) Purification or refining of crude metal

Question 7

**What is the formula of Iron pyrite and Copper pyrite?**

**Ans.**

The formula of Iron pyrite is  $\text{FeS}_2$  and copper pyrite is  $\text{CuFeS}_2$ .

Question 8

**Predict the reactivity of metals that occur in nature in the form of their chlorides, sulphates or carbonates.**

**Ans.**

Metals that occur in nature in combined state as their chlorides, sulphates or carbonates are highly reactive.

Question 9

**In which state do moderately reactive metals such as iron occur in nature?**

**Ans.**

In nature, the moderately reactive metals such as iron occur in the form of their oxides.

Question 10

**What type of metals exists in native state in nature?**

**Ans.**

The less reactive metals exist in native state in nature. These metals lie below hydrogen in the activity series. Example are gold, silver, platinum etc.

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## Principles of metallurgy

### Question 1

Describe the principle behind each of the following processes:

- (i) Vapour phase refining of a metal.
- (ii) Electrolytic refining of a metal.
- (iii) Recovery of silver after ore was leached with NaCN.

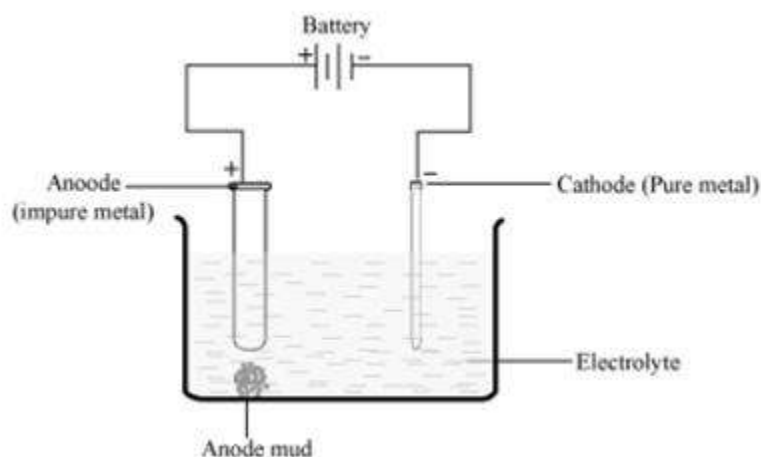
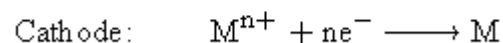
Ans.

(i) Vapour phase refining: Vapour phase refining is the process of refining metal by converting it into its volatile compound and then, decomposing it to obtain a pure metal. The basic principle involved in this process are:

- (a) The metal should form a volatile compound with an available reagent, and
- (b) The volatile compound should be easily decomposable so that the metal can be easily.

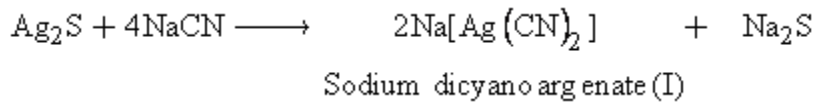
Nickel, zirconium, and titanium are refining using this method.

(ii) Electrolytic refining of a metal is the process of refining impure metals by using electricity. In this process, impure metal is made the anode and a strip of pure metal is made the cathode. A solution of a solution salt of the same metal is taken as the electrolyte. When an electric current is passed, metal ions from the electrolyte are deposited at the cathode as pure metal and the impure metal from the anode dissolves into the electrolyte in the form of ions. The impurities present in the impure metal gets collected below the anode. This is known as anode mud.



(iii) In the process of leaching, the finely divided silver is treated with dilute solution of sodium cyanide while a current of air is continuously passed. As a result, silver pass into the solution forming solution dicyanoargenate(I) while the impurities remain unaffected which are filtered off.

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Question 2

**Describe how the following changes are brought about:**

- (i) Pig iron into steel.**
- (ii) Zinc oxide into metallic zinc.**
- (iii) Impure titanium into pure titanium.**

**OR**

**Describe the role of**

- (i) NaCN in the extraction of gold from gold ore.**
- (ii) SiO<sub>2</sub> in the extraction of copper from copper matte.**
- (iii) Iodine in the refining of zirconium.**

**Write chemical equations for the involved reactions.**

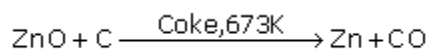
**Ans.**

(i) Pig iron into steel:

Pig iron is converted to cast iron by heating molten pig iron with scrap iron and coke using hot air blast in specially designed furnaces. Cast iron is used in the manufacture of steel by mixing it with other metals.

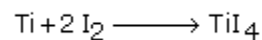
(ii) Zinc oxide into metallic zinc:

Zinc oxide is converted to metallic zinc by reacting it with coke at 673 K.

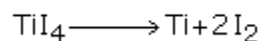


(iii) Impure titanium into pure titanium:

The crude titanium is heated in an evacuated vessel with iodine. The metal iodide being more covalent volatilizes.



Titanium iodide vapour are collected and then decomposed on a tungsten filament by electrically heating to about 1800K. The pure metal is thus deposited on the filament.

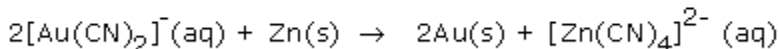
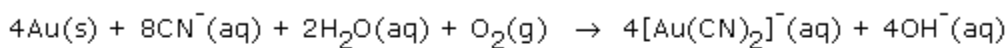


**OR**

(i) NaCN in the extraction of gold from gold ore:

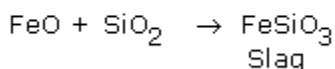
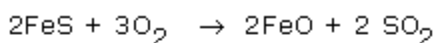
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In the metallurgy of gold, gold metal is leached with a dilute solution of NaCN in the presence of air (for O<sub>2</sub>). The gold metal is then obtained from the product by displacement reaction.



(ii) SiO<sub>2</sub> in the extraction of copper from copper matte:

Copper matte consists of Cu<sub>2</sub>S and FeS. In the converter FeS is converted to FeO. Silica helps in removal of FeO impurity as slag.



## Question 3

Describe the principle involved in each of the following processes.

- (i) Mond process for refining of Nickel.
- (ii) Column chromatography for purification of rare elements.

**Ans.**

- i. Mond's process for refining of nickel:  
It is based on the principle of vapour phase refining:  
This method is based on the fact that certain metals are converted to their volatile compounds while the impurities are unaffected during compound formation.
- ii. Column chromatography for purification of rare elements:  
This technique of chromatography is based on the principle that different components of a mixture are differently adsorbed on an adsorbent. The components of the mixture get adsorbed on the column at different places.

## Question 4

Describe the principle involved in each of the following processes.

- (i) Mond process for refining of Nickel.
- (ii) Column chromatography for purification of rare elements.

**Ans.**

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This technique of chromatography is based on the principle that different components of a mixture are differently adsorbed on an adsorbent. The components of the mixture get adsorbed on the column at different places.

## Question 5

What is the role of graphite in the electrometallurgy of aluminium?

**Ans.**

Graphite is used as the anode during the electrolysis of molten alumina. Its role is to prevent the formation of  $O_2$  at the anode otherwise some of the aluminium may be oxidized by oxygen.

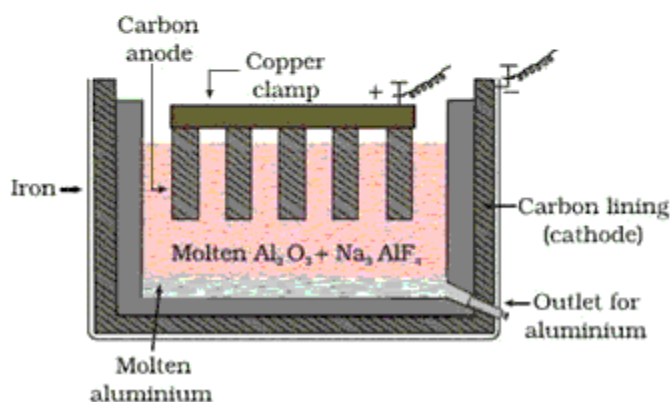
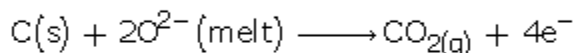
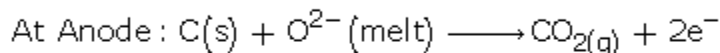
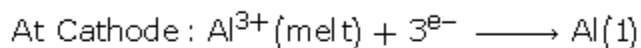
## Question 6

**Describe Hall-Heroult process used for the electrolysis of pure alumina?**

**Ans.**

In Hall-Heroult process, purified  $Al_2O_3$  is mixed with  $Na_2AlF_6$  or  $CaF_2$  which lowers the melting point of matrix and brings conductivity. The fused matrix is electrolysed. The cathode and anode is made of steel and graphite respectively.

The various reactions which take place at cathode and anode are:



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Question 7

**What do you understand by the terms quenching and tempering. Also name the metal with which these terms are associated?**

**Ans.**

The hardness of steel is controlled by heat treatment. Following methods are used for this purpose:

Quenching - In this process, the steel article is heated to redness (1123 K) and then suddenly cooled by plunging it in water or oil. The steel obtained by this treatment is hard and brittle.

Tempering - In this process the quenched steel is heated to a temperature of about 550K and kept at that temperature for sometime and then cooled slowly, the steel obtained by this treatment is quite hard but less brittle.

Question 8

**Give some important uses of silver.**

**Ans.**

- i) Silver is used for making ornaments.
- ii) It is used in silver plating.
- iii) Silver salts are extensively used in photography.
- iv) Silver-tin alloy is used for filling teeth.
- v) Palladium-Silver alloy is used for making potentiometer, winding of some special instruments.

Question 9

**Define chromatography.**

**Ans.**

Chromatography is the process of separating the components of a mixture based on the difference in their adsorbability. The components are separated by mixing them with some suitable solvents. Different components are adsorbed at different levels on the chromatographic column.

Question 10

**What are the conditions that are necessary for vapour phase refining?**

**Ans.**

The conditions necessary for vapour phase refining are:

- i) The metal should form a volatile compound with an available reagent.
- ii) The volatile compound should decompose easily so that it is recovered easily.



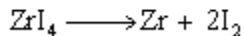
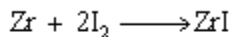
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Question 11

**Explain the process used for refining Zirconium or Titanium?**

**Ans.**

Van Arkel method is used for refining Zirconium or Titanium. In this method oxygen and nitrogen, present as impurity are removed by heating metal in an evacuated vessel with iodine. The metal iodide volatilize and it is decomposed on a tungsten filament, heated to about 1800K. The pure metal is deposited on the filament.



Question 12

**Which metal is used in the extraction of chromium and manganese from their oxides?**

**Ans.**

Aluminium is used in the extraction of chromium and manganese from their oxides.

Question 13

**Name the purest form of iron.**

**Ans.**

Wrought iron is the purest form of iron and contains carbon and other impurities less than 0.2%

Question 14

**How is Zinc dust prepared from zinc metal?**

**Ans.**

Zinc dust is prepared by atomizing molten zinc with a blast of air.

Question 15

**Name the method which is used for the purification of germanium, silicon and gallium used in semiconductors?**

**Ans.**

Zone refining is used for the purification of germanium, silicon and gallium used in semiconductors.

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