

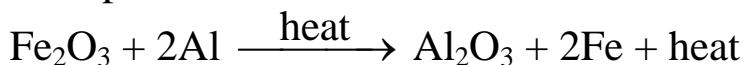
Question Bank

Metallurgy II

1. Give the names of the following metals :

- (i) A metal commonly used for preventing rusting of iron. [1]
- (ii) Two metals which can be prepared by electrolysis from their fused chlorides [1]
- (iii) A metal which when alloyed with aluminium makes it as hard as steel [1]
- (iv) A metal whose oxide can be reduced by aluminium powder. Support your answer by a chemical equation. [2]

- Ans.**
- (i) Zinc metal is commonly used for preventing rusting of iron.
 - (ii) Sodium and potassium are prepared by the electrolysis of their fused chlorides.
 - (iii) Magnesium metal on alloying with aluminium forms magnalium, which is as hard as steel.
 - (iv) Iron metal. It can be extracted from its oxide by heating with aluminium powder



- 2. Name the (i) carbonate ores, (ii) sulphide ores of the following metals (a) zinc (b) lead (c) copper (d) iron. [4]**

Ans.

<i>Metal</i>	<i>Carbonate ore</i>	<i>Sulphide ore</i>
(a) Zinc	Calamine (ZnCO_3)	Zinc blende (ZnS)
(b) Lead	Lead carbonate (PbCO_3)	Galena (PbS)
(c) Copper	Malachite ($\text{CuCO}_3 \cdot \text{Cu(OH)}_2$)	Copper pyrites (CuFeS_2)
(d) Iron	Siderite (FeCO_3)	Iron pyrites (FeS_2)

3. Define the following terms :

- (i) mineral (ii) ore (iii) gangue (iv) metallurgy [4]

Ans. (i) Mineral : The metallic compounds occurring in nature are called minerals.

(ii) **Ore :** A naturally occurring mineral from which a metal can be conveniently extracted, is called an ore.

(iii) **Gangue :** The unwanted impurities which are associated with ore are called gangue or matrix. Stone, sand and clay, etc., constitute gangue.

(iv) **Metallurgy :** The processes involved in the extraction of pure metals from their ore are collectively called metallurgy.

4. (i) What do you understand by the term concentration of ore ? [1]

(ii) Name three processes used for the concentration of ore and name one specific ore which can be concentrated by the named process. [3]

Ans. (i) Concentration of ore : The various processes which help in the removal of gangue from dressed ore, thereby increasing the percentage of metal in ore are called concentration of ore.

(ii) (a) **Magnetic separation :** used for concentrating iron ores.

(b) **Gravity process or hydraulic washing :** used for concentrating zinc oxide ore.

(c) **Froth floatation process :** used for concentrating lead sulphide ore.

5. (i) What do you understand by the term calcination ? [1]

(ii) What is the importance of calcination in the extraction of metals ? [2]

Ans. (i) Calcination : The process of heating the ore in a limited supply of air, such that temperature is not sufficient to melt the ore, is called calcination.

(ii) **Objectives achieved during calcination** : (i) It removes moisture from ore (ii) It makes the ore porous (iii) It expels volatile impurities (iv) It decomposes carbonate ores to their oxides (v) It removes water of crystallization from their hydrated salts.

6. (i) What do you understand by the term roasting of ore ? [1]

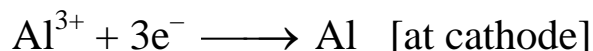
(ii) What is the importance of roasting in the extraction of metals ? [2]

Ans. (i) Roasting : The process of strongly heating the ore in excess of air is called roasting.

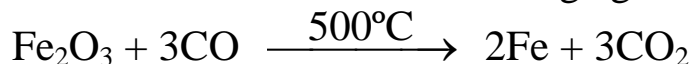
(ii) **Objectives achieved during the roasting of ore** : In addition to all the objectives achieved during calcination, it oxidises sulphide ores to oxide ores.

7. Name the process used and the reducing agent employed for the extraction of (i) aluminium from aluminium oxide (ii) iron from haematite (iii) chromium from chromium oxide (iv) lead from lead sulphide. Write chemical equations in support of your answer. [2 × 2]

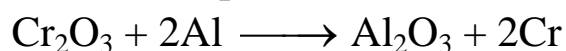
Ans. (i) Electric current is the reducing agent for the reduction of aluminium oxide.



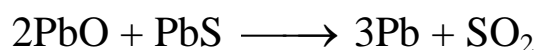
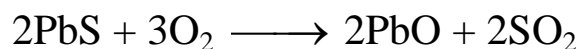
(ii) Carbon monoxide is the reducing agent.



(iii) Aluminium powder is used as a reducing agent.



(iv) By roasting in limited supply of air, when self-reduction takes place.



8. Name four different methods for the refining of metals. Support your answer with a specific example. [4]

Ans. (i) Distillation : This method is employed for the purification of zinc and mercury.

(ii) Liquefaction : This method is employed for the purification of lead and tin.

(iii) Oxidation : This method is employed for the purification of iron.

(iv) Polling : This method is employed for the purification of copper.

9. Give the chemical formulae of the following naturally occurring ores :

(i) Cryolite (ii) Galena (iii) Corundum (iv) Dolomite

(v) Zincite (vi) Malachite (vii) Cinnabar

(viii) Gypsum (ix) Horn silver (x) Epsom salt. [10]

Ans. (i) Cryolite : Na_3AlF_6

(ii) Galena : PbS

(iii) Corundum : Al_2O_3

(iv) Dolomite : $\text{CaCO}_3 \cdot \text{MgCO}_3$

(v) Zincite : ZnO

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

(vii) Cinnabar : HgS

(viii) Gypsum : $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$

(ix) Horn silver : AgCl

(x) Epsom salt : $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$

10. What is meant by the term metallurgy? Differentiate between a mineral and ore?

Ans. Metallurgy : The different processes involved in the extraction of pure metals from their ore are collectively called metallurgy.

Any metallic or non-metallic compounds occurring in nature are called mineral, whereas a metallic mineral, from which a metal can be profitably extracted, is called ore.

11. Give the (i) common name, (ii) chemical formula and (iii) chemical name of two ores each of aluminium, zinc and iron. [3]

Ans. Ores of aluminium

- (i) Bauxite ; $[Al_2O_3 \cdot 2H_2O]$; Hydrated aluminium
(ii) Cryolite ; $[Na_3AlF_6]$; Sodium aluminium fluoride

Ores of zinc

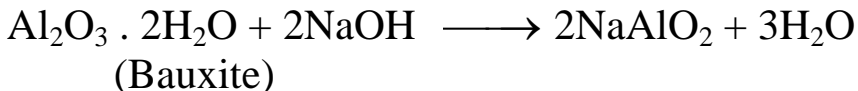
- (i) Zincite ; $[ZnO]$; Zinc Oxide
Zinc blende ; (ZnS) ; Zinc sulphite.

Ores of Iron

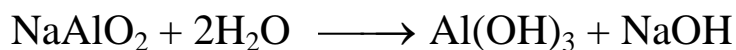
- (i) Haematite ; $[Fe_2O_3]$; Iron (III) oxide
(ii) Magnetite ; $[Fe_3O_4]$; Iron (II, III) oxide.

12. How will you convert impure bauxite to pure aluminium by the use of conc. sodium hydroxide? [4]

Ans. Impure bauxite is digested with conc. NaOH for 2 hours when the aluminium oxide dissolves to form sodium aluminate, but the impurities like iron oxide and sand settle down.



The reaction mixture is filtered so as to obtain a clear solution. To this solution is added excess of water, which hydrolyses sodium aluminate to insoluble aluminium hydroxide.



The aluminium hydroxide is filtered, washed with hot water and then strongly heated to obtain pure alumina.



13. By stating reason give one use of aluminium.
(a) as a metal (b) in powder form (c) in the form of foil (d) in the form of wire (e) in the form of an alloy.

Ans. (a) As a metal it is used for making utensils as it a good conductor of heat.

(b) In powder form, it is mixed with linseed oil and is used as paint in protecting iron from rusting, as it does not get oxidised quickly.

- (c) Aluminium foil is used in packing and food processing industry as it is highly malleable.
- (d) In the form of wires, it is used for electric transmission wires as it is good conductor of electricity.
- (e) In form of alloy, it is used in the construction of aircraft bodies as it is very light-weight.

14. State a reason, why is zinc used in

- (i) Galvanisation (ii) dry cells (iii) alloys? [5]

Ans. (i) Galvanisation is the process of coating iron sheets with thin layer of molten zinc, so as to protect iron from rusting.

The zinc is self protecting metal. It initially reacts with atmospheric oxygen to form a thin layer of zinc oxide which is a very hard and sticky substance. Thus, zinc oxide, cut off atmospheric oxygen and hence protects the zinc as well as iron underneath from rusting.

- (ii) Zinc acts as cathode (– ive terminal) of the dry cell. It is because, it is a fairly active metal which ionises easily to generate electrons.

- (iii) Zinc is alloyed with copper in case of brass and copper and tin in case of bronze. These alloys do not corrode unlike pure copper and can be easily cast or welded.

15. State two uses each of (i) pig iron (ii) mild steel (iii) hard steel. [3]

Ans. (i) (a) It is used for making manhole covers and pipes.

(b) It is used for making immovable parts of machinery.

- (ii) (a) It is used for making steel furniture and steel almirah.

(b) It is used for making springs.

- (iii) (a) It is used for making machinery.

(b) It is used in construction of buildings.

16. Complete the statements pertaining to the extraction of aluminium.
- (i) The impurity which separates out on addition of conc. solution of alkali to impure bauxite is _____ [PbO/Fe₂O₃/CuO/ZnO]
 - (ii) The conversion of aluminium hydroxide to pure alumina is carried out by _____ [addition of Al(OH)₃ crystals/thermal decomposition/precipitation].
 - (iii) Addition of cryolite in the molten state to alumina _____ [lowers/raises] melting point of mixture.
 - (iv) During electrolytic reduction of alumina, Al³⁺ ions are discharged at cathode in preference to _____ [Na⁺/Zn²⁺/Fe²⁺] ions.
 - (v) During electrolytic reduction of alumina, the inert electrode is _____ [reduced/oxidised] to a neutral gas.

Ans. (i) Fe₂O₃ (ii) Thermal decomposition
(iii) Lowers (iv) Na⁺ (v) Oxidised

17. With reference to properties of metals fill the statements with correct words
- (i) Aluminium powder is a constituent of paints and prevents _____ [conduction of electric current/formation of rust/heat radiation].
 - (ii) Aluminium is utilised in cooking utensils, since it is _____ [good conductor of heat/good conductor of electricity/ shiny in appearance].
 - (iii) Transmission wires are made of aluminium, since aluminium is _____ [corrosion resistant/good conductor of heat/good conductor of electricity].
 - (iv) Aluminium is an important constituent metal in duralumin since it is _____ [a good conductor of heat/light in weight/unacted by acids].
 - (v) A thermite mixture contains iron(III) oxide and aluminium in which _____ [aluminium/iron(III) oxide] is higher in ratio in the mixture.

- (vi) In a thermite mixture, aluminium _____
[oxidises/reduces] iron (III) oxide.
- (vii) Zinc is used in galvanising, since iron forms Fe^{2+} ions
_____ [less/more] readily than zinc.
- (viii) In a dry cell the zinc container acts as _____
[anode/cathode].
- (ix) _____ [pig iron/steel] is used in machine parts due to its
_____ [low/high] tensile strength.
- (x) _____ [pig iron/steel] is used in the manufacture of gutter
lids and railings, since it can be easily cast and expands on
solidification.

Ans. (i) formation of rust

(ii) good conductor of heat

(iii) good conductor of electricity

(iv) light in weight

(v) iron (III) oxide

(vi) reduces

(vii) less (viii) cathode

(ix) steel, high

(x) pig iron

18. Name the substance labelled from A to J which are reactants for the products formed. Also write fully balanced chemical equations. [2×10]

(i) Impure bauxite $\xrightarrow{\text{A}}$ Sodium aluminate.

(ii) Sodium Aluminate $\xrightarrow{\text{B}}$ Aluminium hydroxide

(iii) Aluminium $\xrightarrow{\text{C}}$ H_2 gas. [C is an acid]

(iv) Aluminium $\xrightarrow{\text{D}}$ SO_2 gas. [D is an acid]

(v) Aluminium $\xrightarrow{\text{E}}$ Potassium aluminate

(vi) Aluminium $\xrightarrow{\text{F}}$ Iron

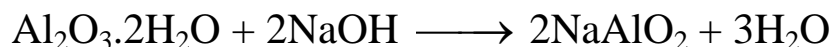
(vii) Iron $\xrightarrow{\text{G}}$ Iron (III) chloride

(viii) Iron (III) chloride $\xrightarrow{\text{H}}$ Iron (II) chloride

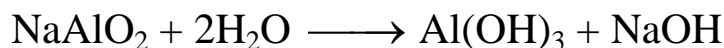
(ix) Zinc $\xrightarrow{\text{I}}$ Potassium zincate

(x) Iron $\xrightarrow{\text{J}}$ Iron (II) sulphide.

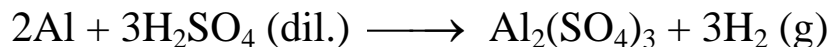
Ans. (i) A is sodium hydroxide



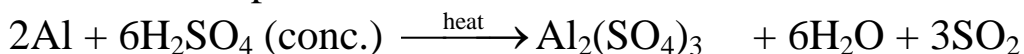
(ii) B is water



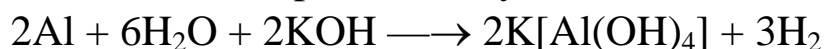
(iii) C is dilute sulphuric acid



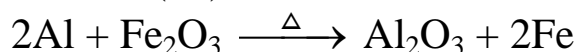
(iv) D is conc. sulphuric acid



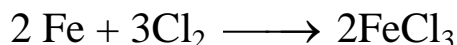
(v) E is concentrated potassium hydroxide.



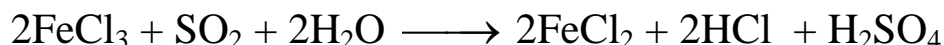
(vi) F is iron (III) oxide



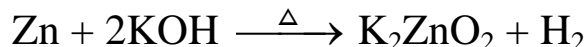
(vii) G is chlorine gas



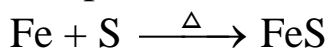
(viii) H is sulphur dioxide solution



(ix) I is conc. potassium hydroxide solution



(x) J is sulphur



19. Name the following :

- (i) Two metals rendered passive by conc. or fuming nitric acid.
- (ii) A metal other than zinc which displaces copper from copper (II) sulphate
- (iii) A metal present in sodium amalgam, other than sodium.
- (iv) A form of iron which contains 0.1% to 0.5% impurity and is used for making nut and bolts.
- (v) A metal other than manganese present in duralumin.

Ans. (i) Iron and aluminium (ii) Iron
(iii) Mercury (iv) Mild steel
(v) Copper

20. (a) State two large-scale uses of :
(1) zinc (2) aluminium. [2]
- (b) Compare cast iron and wrought iron with regard to: (i) one physical property (ii) chemical composition. [2]
- (c) State one method of preventing rusting of iron. [1]

Ans. (a) Uses of Zinc :

1. It is used for galvanising iron sheets. Galvanising protects iron from rusting.
2. It is extensively used in dry cell industry.

Uses of Aluminium :

- (i) It is used for making cheap household appliances.
- (ii) It is used in electric transmission wires.

(b) (i) **Physical property** : Cast iron is extremely hard and brittle in nature, whereas wrought iron is malleable and ductile.

(ii) **Chemical composition** : Cast iron contains between 2.5% to 5% of carbon as impurity. The wrought iron contains less than 0.25% of carbon as impurity.

(c) By galvanising iron, i.e., coating it with zinc metal.

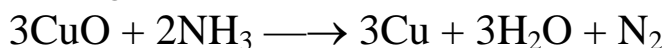
21. Metallic elements occur in the earth's crust, combined with non-metallic elements. After suitable treatment, the compounds are reduced to produce the metals.
- (i) Name two naturally occurring compounds of metals and give their formulae. [2]
 - (ii) What is galvanised iron and for what purpose is it used? [2]

Ans. (i) Bauxite [$\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$] and Galena [PbS].

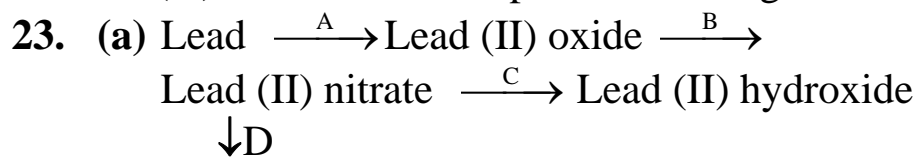
(ii) When iron is coated with a zinc metal, it is called galvanised iron. Galvanised iron sheets are used for making roofs of sheds, factories, as they do not rust in moist air.

22. (a) Answer the following questions :
- (i) When aqueous iron (III) chloride and aqueous caustic soda are mixed, the colour of precipitate is _____ due to the formation of _____. [2]
 - (ii) Name two elements whose hydroxides are very soluble in water and produce alkaline solutions. [2]
 - (iii) Name one metal which forms more than one type of positive ions. [1]
 - (iv) Name one ion responsible for the blue colour of an aqueous solution of copper sulphate. [1]
 - (v) When a certain gas is passed over heated cupric oxide, the products formed are copper, nitrogen and steam. Name the gas and write a balanced equation. [2]
- (b) Metals may be obtained from their ores by various methods depending upon their position in the electrochemical series. The methods which may be employed to extract metals include:
- A—Electrolysis of molten ore.
 - B—Reduction of ore with carbon in a furnace.
 - C—Physical separation from rock in which metal occurs native.
- (i) Which method A, B or C would be used for the extraction of:
(1) Copper (2) Magnesium (3) Iron? [3]
 - (ii) What type of chemical process is common to both methods as given in A and B? Give a reason for your statement. [2]
 - (iii) What elements are added to iron in controlled amount in order to produce stainless steel? [1]
 - (iv) State two conditions which promote rusting of iron. [1]

- Ans. (a) (i) The colour of precipitate is **reddish brown** due to the formation of **ferric hydroxide**.
- (ii) Elements are sodium and potassium.
 - (iii) Iron metal forms more than one type of positive ions.
 - (iv) Copper (II) ions $[Cu^{++}]$ are responsible for the blue colour.
 - (v) The gas is ammonia.



- (b) (i)(1) Method C is suitable for copper.
 (2) Method A is suitable for magnesium.
 (3) Method B is suitable for iron.
 (ii) In methods A and B, reduction takes place. In case of A, reduction is brought about by electricity, whereas in case of B reduction is brought about by carbon.
 (iii) Chromium (14%) and Nickel (2%).
 (iv) Moisture and air promote rusting of iron.



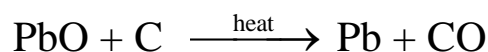
Lead (II) carbonate

For each of conversions A to D in the scheme above, state briefly how the conversions can be carried out. Write an equation for conversions. [5]

- (b) (i) What is pig iron? [1]
 (ii) Briefly describe and explain what has to be done to pig iron in order to convert it into steel. [2]
 (iii) What is stainless steel? [1]
 (iv) State two differences between steel and pig iron. [2]
 (c) State two uses each of cast iron and steel. [2]

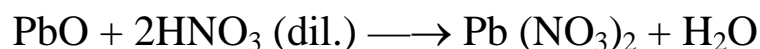
Ans. (a) **Conversion A :**

Mix lead oxide with coke and heat strongly, then lead oxide is reduced to lead metal.



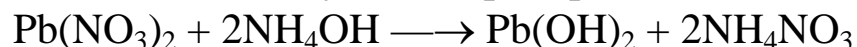
Conversion B :

Dissolve lead oxide in dilute and warm nitric acid, then lead nitrate solution is formed.



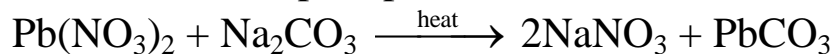
Conversion C :

To the solution of lead nitrate add ammonium hydroxide solution, when lead hydroxide precipitates.



Conversion D :

To the solution of lead nitrate add sodium carbonate solution, then lead carbonate precipitates.



- (b) (i) The impure iron containing more than 1.5% carbon as an impurity is called pig iron.

(ii) Steel and its manufacture by Bessemer process :

Steel is an alloy of iron, containing carbon between 0.1 % to 1.5 %. Special properties to steel can be imparted, by adding to it small amount of other metals, such as nickel, chromium, vanadium manganese, etc.

Molten cast iron is poured in Bessemer converter and hot air from tuyeres is blown in, when impurities react with oxygen to form their volatile oxides which are blown out along with slag. A flame appears at the mouth of Bessemer converter because of the presence of specks of carbon present in the gases.

When the flame dies, it is an indication that all impurities have been blown out. Now spiegeleisen (an alloy of 74 % iron, 20 % manganese and 6% carbon) is added in calculated amount. The molten mass is stirred when it forms steel.

- (iii) An alloy of steel, which does not rust or react with mild acids and alkalis is called stainless steel.
- (iv) 1. Pig iron is hard and brittle, whereas steel is tensile and ductile.
2. Pig iron contains carbon more than 1.5%, whereas carbon content in steel is between 1.5% to 0.5%.

(c) Use of cast iron :

- (1) It is used in the manufacture of wrought iron and steel.
- (2) It is used for making drain pipes and manhole covers.

Uses of steel :

1. It is used for making movable parts of machinery.
2. It is used for making girders for bridges.

24. (a) In industry, certain metals are extracted from their oxides by heating with carbon in the form of coke. Give the name of one such metal. [1]
- (b) Give the name of a metal which will evolve hydrogen when warmed with hydrochloric acid and with aqueous sodium hydroxide solution. [1]
- (c) Most of the pig iron obtained from blast furnace is converted into steel. Suggest a reason for this. [1]
- (d) Describe three changes which you would observe, if excess of powdered zinc were added to copper (II) sulphate and well stirred, with a thermometer. [3]

Ans. (a) Zinc metal.

(b) Zinc metal.

(c) It is because steel is a very versatile material which finds wide applications in building industry, ship making as it is highly tensile and ductile whereas pig iron is hard and brittle in nature.

(d) (i) The blue colour of copper sulphate fades to form colourless solution.

(ii) The zinc powder dissolves and red precipitate (copper) appears.

(iii) Thermometer registers the rise in temperature.