

JEE Main/Boards**Exercise 1**

Q.1 Copper can be extracted by hydrometallurgy but not zinc. Explain.

Q.2 Out of C and CO, which is a better reducing agent at 673 K?

Q.3 How is leaching carried out in case of low grade copper ores?

Q.4 Why is zinc not extracted from zinc oxide, through reduction using CO?

Q.5 Name the common elements present in the anode mud in electrolytic refining of copper. Why are they so present?

Q.6 State the role of silica in the metallurgy of copper.

Q.7 What is meant by the term "chromatography"?

Q.8 How is 'cast iron' different from 'pig iron'?

Q.9 Differentiate between "minerals" and "ores".

Q.10 Out of C and CO, which is a better reducing agent for ZnO?

Q.11 What is the role of graphite rod in the electrometallurgy of aluminium?

Q.12 Describe a method for refining nickel.

Q.13 Giving examples, differentiate between 'roasting' and 'calcination'.

Q.14 Why copper matte is put in silica lined converter?

Q.15 What is the role of cryolite in the metallurgy of aluminium?

Q.16 What types of ores are roasted?

Q.17 Name one each of (a) acidic flux (b) basic flux.

Q.18 What is gangue?

Q.19 What name is given to carbon reduction process for extracting the metal?

Q.20 Outline the principles of refining of metals by the following methods:

- (i) Zone refining (ii) Electrolytic refining
- (iii) Vapour phase refining

Q.21 What is the role of depressant in froth floatation process?

Q.22 Why is the extraction of copper from pyrites more difficult than that from its oxide ore through reduction?

Q.23 Explain:

- (i) Zone refining (ii) Column chromatography

Q.24 Write down the reactions taking place in different zones in the blast furnace during the extraction of iron.

Q.25 Write chemical reactions taking place in the extraction of zinc from zinc blende.

Q.26 What criterion is followed for the selection of the stationary phase in chromatography?

Q.27 How can you separate alumina from silica in a bauxite ore associated with silica? Give equations, if any?

Q.28 The value of $\Delta_r G^\circ$ for formation of Cr_2O_3 is -540 kJ mol^{-1} and that of Al_2O_3 is -827 kJ mol^{-1} . Is the reduction of Cr_2O_3 possible with Al?

Q.29 The choice of a reducing agent in a particular case depends on thermodynamic factor. How far do you agree with this statement? Support your opinion with two examples.

Q.30 Name the processes from which chlorine is obtained as a by-product. What will happen if an aqueous solution of NaCl is subjected to electrolysis?

Q.31 Predict conditions under which Al might be expected to reduce MgO.

Exercise 2

Single Correct Choice Type

- Q.1** In presence of oxygen, removal of sulphur from an ore is included in
 (A) Calcination (B) Roasting
 (C) Smelting (D) Fluxing
- Q.2** In the extraction of copper from its sulphide ore, the metal is formed by reduction of Cu_2O with
 (A) FeS (B) CO (C) Cu_2S (D) SO_2
- Q.3** Pyrolusite is a/an
 (A) Oxide ore (B) Sulphide ore
 (C) Carbide ore (D) Not an ore
- Q.4** The metal always found in the free state is
 (A) Au (B) Zn (C) Cu (D) Na
- Q.5** In the extraction of iron, the slag produced is?
 (A) CO (B) FeSiO_3 (C) MgSiO_3 (D) CaSiO_3
- Q.6** Which alloy of aluminium is used in aircraft industry
 (A) Duralumin (B) Magnalium
 (C) Nickeloxy (D) alunico
- Q.7** The common impurities present in the bauxite ore are
 (A) Fe_2O_3 and CuO (B) Fe_2O_3 and PbO
 (C) Fe_2O_3 and SiO_2 (D) SiO_2 and CuO
- Q.8** The material used in solar cell contains
 (A) Si (B) Sn (C) Ti (D) Cs
- Q.9** Cyanide process is used for the extraction of:
 (A) Ag (B) Hg (C) Cu (D) Zn
- Q.10** During smelting, an additional substance is added which combines with impurities to form a fusible product. It is known as
 (A) Slag (B) Mud (C) Gangue (D) Flux
- Q.11** Purification of silicon element used in semi-conductors is done by
 (A) Zone refining (B) Heating
 (C) Froth floatation (D) Heating in vacuum
- Q.12** Aluminothermic process is used for metallurgy of
 (A) Pb (B) Ag
 (C) Al (D) None of these
- Q.13** In electrorefining of copper some gold is deposited as
 (A) Anode mud (B) Cathode mud
 (C) Cathode (D) Electrolyte
- Q.14** Poling process is used
 (A) For the removal of Cu_2O from Cu
 (B) For the removal of Al_2O_3 from Al
 (C) For the removal Fe_2O_3 from Fe
 (D) In all the above
- Q.15** Which of the following is not a basic flux?
 (A) CaCO_3 (B) CaO (C) SiO_2 (D) MgO
- Q.16** Zone refining is a method to obtain
 (A) Very high temperature
 (B) Ultra pure Al
 (C) Ultra pure metal
 (D) Ultra pure oxides
- Q.17** Mac Arthur process is use for
 (A) Ag (B) Fe (C) Cl (D) O_2
- Q. 18** Use of electrolysis is
 (A) Electroplating (B) Electrorefining
 (C) Both (A) and (B) (D) None of these
- Q.19** Calcination is used in metallurgy for removal of
 (A) Water and sulphide (B) Water and CO_2
 (C) CO_2 and H_2S (D) H_2O and H_2S

Q.20 In blast furnace, maximum temperature is in

- (A) Zone of fusion
(B) Zone of combustion
(C) Zone of slag combustion
(D) Zone of reduction

Q.21 Of the following which cannot be obtained by electrolysis of the aqueous solution of their salts?

- (A) Ag (B) Mg and Al (C) Cu (D) Cr

Q.22 Van Arkel method of purification of metals involves converting the metal into a

- (A) Volatile stable compound
(B) Volatile unstable compound
(C) Non-volatile stable compound
(D) None of the above

Q.23 In the froth floatation process for the purification of ores, the ore particles float because

- (A) They are light
(B) Their surface is hydrophobic i.e., not easily wetted by water
(C) They bear electrostatic charge
(D) They are insoluble

Q.24 Which method of purification is represented by the following equations?



- (A) Cupellation (B) Poling
(C) Van Arkel (D) Zone refining

Q.25 Calcination is the process of heating the ore

- (A) In a blast furnace (B) In absence of air
(C) In presence of air (D) None of these

Q.26 Which one of the following metals cannot be extracted by carbon reduction process?

- (A) Pb (B) Al (C) Hg (D) Zn

Q.27 Cyanide process is used for obtaining

- (A) Cr (B) Ag (C) Cu (D) Zn

Previous Year's Questions

Q.1 Which of the following mineral does not contain Al **(1992)**

- (A) Cryolite (B) Mica
(C) Feldspar (D) Fluorspar

Q.2 Which of the following is not an ore **(1982)**

- (A) Bauxite (B) Malachite
(C) Zinc blende (D) Pig iron

Q.3 Copper can be extracted from **(1978)**

- (A) Kupfernickel (B) Dolomite
(C) Galena (D) Malachite

Q.4 Among the following statements, the incorrect one is **(1997)**

- (A) Calamine and siderite are carbonates
(B) Argentite and cuprite are oxides
(C) Zinc blende and pyrites are sulphides
(D) Malachite and azurite are ores of copper

Q.5 Which ore contains both iron and copper **(2005)**

- (A) Cuprite (B) Chalcocite
(C) Chalcopyrite (D) Malachite

(A) If both assertion and reason are true and reason is the correct explanation of assertion, then mark (A)

(B) If both assertion and reason are true but reason is not the correct explanation of assertion, then mark (B)

(C) If assertion is true but reason is false, then mark (C)

(D) If both assertion and reason are false, then mark (D)

Q.6 Assertion: Gold is recovered from its solution containing aurocyanide complex by adding zinc dust. **(1982)**

Reason: Zinc is more electropositive than gold.

Q.7 Assertion: Zinc is used and copper is not used in the recovery of Ag from the complex $[\text{Ag}(\text{CN})_2]^-$. **(1995)**

Reason: Zinc is a powerful reducing agent than copper.

Q.8 Assertion: Coke and flux are used in smelting. **(1998)**

Reason: The phenomenon in which ore is mixed with suitable flux and coke is heated to fusion is known as smelting.

Q.9 Assertion: Leaching is a process of reduction. (1999)

Reason: Leaching involves treatment of the ore with a suitable reagent so as to make it soluble while impurities remains insoluble.

Q.10 Assertion: Ethyl xanthate is used as a collector in froth floatation process. (1999)

Reason: Collectors depress the floatation property of one of the components of the ore and thus help in the separation of different minerals present in the same ore.

Q.11 Which of the following factors is of no significance for roasting sulphide ores to the oxides and not subjecting the sulphide ores to carbon reduction directly? (2008)

- (A) Metal sulphides are thermodynamically more stable than CS_2
 (B) CO_2 is thermodynamically more stable than CS_2
 (C) Metal sulphides are less stable than the corresponding oxides
 (D) CO_2 is more volatile than CS_2

Q.12 Which method of purification is represented by the following equation: $Ti + 2I_2 \rightarrow TiI_4$ (2012)

- (A) Zone refining (B) Cupellation
 (C) Poling (D) Van Arkel

Q.13 In the context of the Hall-Heroult process for the extraction of Al, which of the following statements is false? (2015)

- (A) CO and CO_2 are produced in this process
 (B) Al_2O_3 is mixed with CaF_2 which lowers the melting point of the mixture and brings conductivity
 (C) Al^{3+} is reduced at the cathode to form Al
 (D) Na_3AlF_6 serves as the electrolyte

Q.14 Which one of the following ores is best concentrated by froth floatation method? (2016)

- (A) Siderite (B) Galena
 (C) Malachite (D) Magnetite

Q.15 Galvanization is applying a coating of (2016)

- (A) Cr (B) Cu (C) Zn (D) Rb

JEE Advanced/Boards

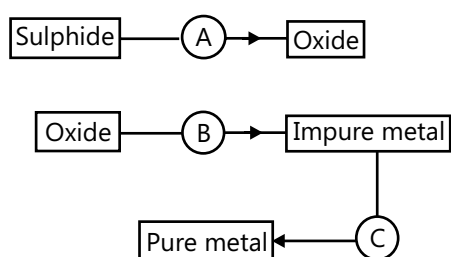
Exercise 1

Q.1 What is Goldschmidt Thermite Process?

Q.2 Al_2O_3 can't be reduced by carbon to get Al metal. Explain.

Q.3 Cu can reduce Ag^+ to metallic Ag but Ag can't reduce Cu^{2+} to metallic Cu. Explain.

Q.4 A metal is in combined state as sulphide. Identify the steps (A), (B), (C)



Q.5 Write chemical equations for metallurgical processes to represent:

- (a) Roasting of galena (PbS).
 (b) Reduction of Cu_2O using charcoal as a reducing agent.
 (c) deposition of pure silver from an aqueous solution of Ag^+ .

Q.6 Why zinc and not copper is used for the recovery of metallic silver from the complex $[Ag(CN)_2]^-$?

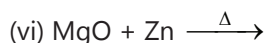
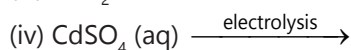
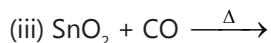
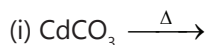
Q.7 Sodium is prepared by the electrolysis of molten NaCl but not by the electrolysis of its aqueous solution.

Q.8 Elements of alkali metal group are strong reducing agent. Explain.

Q.9 In the metallurgy of iron, why limestone is added to the ore.

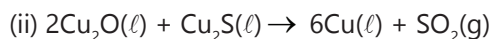
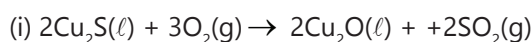
Q.10 What is the actual reducing agent of haematite in blast furnace?

Q.11 Write chemical equations to represent the most probable outcome in each of the following. If no reaction is likely to occur, state so:



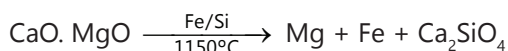
Q.12 Why graphite is used as anode but not diamond?

Q.13 The following reactions take place during the extraction of copper from copper ore:



Identify the oxidizing and reducing agents.

Q.14 Dolomite ($\text{MgCO}_3 \cdot \text{CaCO}_3$) can also be treated to get MgCl_2 which in turn is electrolyzed to get Mg. (Dow natural brine process). Give reactions of this process.



Name this process.

Q.16 Convert Mg into MgO.

Q.17 (i) A black mineral (A) on treatment with dilute sodium cyanide solution in presence of air gives a clear solution of (B) and (C).

(ii) The solution of (B) on reaction with zinc gives precipitate of a metal (D).

(iii) (D) is dissolved in dilute HNO_3 and the resulting solution gives a white precipitate (E) with dilute HCl.

(iv) (E) on fusion with sodium carbonate gives (D).

(v) (E) dissolves in aqueous solution of ammonia giving a colourless solution of (F). Identify compounds (A) to (F) and give chemical equations for reactions in steps (i) to (iv).

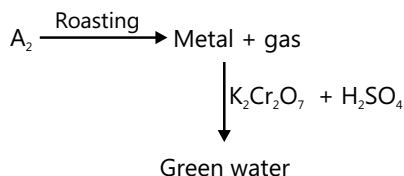
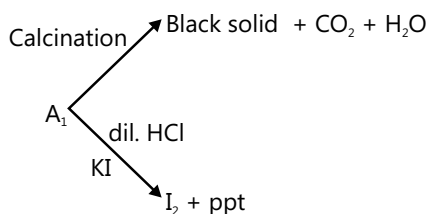
Q.18 Name two metals which are used for reduction in metallurgical process. Give one chemical equation for each

Q.19 Aluminium metal is frequently used as a reducing agent for the extraction of metals such as chromium or manganese from their respective oxides. Why?

Q.20 What is the function of basic furnace linings in steels manufacture?

Q.21 Write down reactions involved in the extraction of Pb. What is the oxidation number of lead in litharge?

Q.22 A_1 and A_2 are two ores of metal M. A_1 on calcination gives black precipitate, CO_2 and water?



Q.23 Gold is also extracted by cyanide process as in case of silver. Outline the reactions.

Q.24 How is Ag extracted from silver coin?

Q.25 In the purification of bauxite ore as preliminary step in the production of Al, $[\text{Al}(\text{OH})_4]^-$ can be converted to $\text{Al}(\text{OH})_3$ by passing CO_2 through it. Write an equation for the reaction that occurs.

Q.26 When the ore hematite is burnt in air with coke around 2000°C along with lime, the process not only produces steel, but also produces a silicate slag that is useful in making building material such as cement. Discuss the same and show through balanced chemical equation.

Q.27 Explain the following

(i) In the metallurgy of iron, lime-stone is added to the ore.

(ii) Although Au is soluble in aqua-regia, Ag is not.

Exercise 2

Single Correct Choice Type

Q.1 Sulphide ores are generally concentrated by

- (A) Froth floatation (B) Roasting
(C) Gravity (D) Reduction by carbon

Q.2 Which method of purification is represented by the following equations?



- (A) Cupellation (B) Poling
(C) Van Arkel (D) Zone refining

Q.3 Cryolite is

- (A) Na_3AlF_6 and is used in the electrolysis of alumina for decreasing electrical conductivity
(B) Na_3AlF_6 and is used in the electrolysis of alumina for lowering the melting point of alumina
(C) Na_3AlF_6 and is used in the electrolytic purification of alumina
(D) Na_3AlF_6 and is used in the electrolysis of alumina

Q.4 Cassiterite is an ore of

- (A) Mn (B) Ni (C) Sb (D) Sn

Q.5 When an aqueous solution of sodium chloride is electrolysed using platinum electrodes, the ions discharged at the electrodes are

- (A) Sodium and hydrogen
(B) Sodium and chloride
(C) Hydrogen and chloride
(D) Hydroxyl and chloride

Q.6 The luster of a metal is due to

- (A) Its high density
(B) Its high polishing
(C) Its chemical inertness
(D) Presence of free electrons

Q.7 Which metal can't be obtained from electrolysis?

- (A) Ca (B) Mg
(C) Cr (D) All of the above

Q.8 The function of flux during smelting of ores is to:

- (A) Make the ore porous
(B) Remove gangues
(C) Facilitate reduction
(D) Precipitate slag

Q.9 The chemical composition of slag formed during the smelting process in the extraction of copper is:

- (A) $\text{Cu}_2\text{O} + \text{FeS}$ (B) FeSiO_3
(C) CuFeS_2 (D) $\text{Cu}_2\text{S} + \text{FeO}$

Q.10 The chemical process in the production of steel from haemotite ore involves:

- (A) Reduction
(B) Oxidation
(C) Reduction followed by oxidation
(D) Oxidation followed by reduction

Q.11 In the commercial electrochemical process for aluminium extraction, the electrolyte used is

- (A) $\text{Al}(\text{OH})_3$ in NaOH solution
(B) An aqueous solution of $\text{Al}_2(\text{SO}_4)_3$
(C) A molten mixture of Al_2O_3 and Na_3AlF_6
(D) A molten mixture of $\text{AlO}(\text{OH})$ and $\text{Al}(\text{OH})_3$

Q.12 Calcination is used in metallurgy to remove

- (A) H_2O and H_2S (B) H_2O and CO_2
(C) CO_2 and H_2S (D) H_2O and H_2S .

Q.13 The metallic luster exhibited by sodium is explained by the presence of

- (A) Na^+ ions
(B) Conducting electrons
(C) Free protons
(D) A body-centred cubic lattice.

Q.14 Stainless steel contains

- (A) Fe, Cr, Cu (B) Fe, Cr, Ni
(C) Fe, Ni, C (D) Fe, Ni, Cu

Q.15 Which one of the following beneficiation processes is used for the mineral, $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$?

- (A) Froth floatation (B) Leaching
(C) Liqutation (D) Magnetic separation

Q.16 The extraction of which of the following metals involves bessemerisation ?

- (A) Fe (B) Ag (C) Al (D) Cu

Q.17 One of the characteristic properties of non-metals is that they

- (A) Are reducing agents
(B) Form basic oxides
(C) Form cations by electron gain
(D) Are electronegative

Q.18 In the froth floatation process for the purification of ores, the ore particles float because

- (A) They are light
(B) Their surface is hydrophobic i.e., not easily wetted by water
(C) They bear electrostatic charge
(D) They are insoluble

Q.19 Which is not a basic flux?

- (A) CaCO_3 (B) Lime (C) SiO_2 (D) CaO

Q.20 The substance which is added to remove impurities is known as

- (A) Slag (B) Flux (C) Gangue (D) Catalyst

Q.21 Electrolytic reduction method is used in the extraction of

- (A) Highly electronegative elements
(B) Highly electropositive elements
(C) Transition metals
(D) Noble metals

Q.22 The role of calcination in metallurgical operations is

- (A) To remove moisture
(B) To decompose carbonate
(C) To drive off organic matter
(D) To achieve all the above

Comprehension Type

A black coloured compound (A) on reaction with dil H_2SO_4 form a gas 'B' and a solution of compound (C). When gas B is passed through solution of compound (C), a black coloured compound A is obtained which is soluble in 50% HNO_3 and forms blue coloured complex 'D' with excess of NH_4OH and chocolate brown ppt. 'E' with $\text{K}_4[\text{Fe}(\text{CN})_6]$

Q.23 'A' is

- (A) CuS (B) FeS (C) PbS (D) HgS

Q.24 'B' is

- (A) H_2S (B) SO_2 (C) NH_3 (D) SO_3

Q.25 'C' is

- (A) CuS (B) CuSO_4 (C) $\text{Cu}(\text{NO}_3)_2$ (D) HgSO_4

Q.26 'D' is

- (A) $\text{Cu}(\text{OH})_2$ (B) $[\text{Cu}(\text{NH}_3)_2]\text{SO}_4$
(C) $[\text{Cu}(\text{NH}_3)_4](\text{NO}_3)_2$ (D) $[\text{Cu}(\text{NH}_3)_6]\text{SO}_4$

Q.27 'E' is

- (A) $\text{Cu}_2[\text{Fe}(\text{CN})_6]$ (B) $\text{Cu}_4[\text{Fe}(\text{CN})_6]$
(C) $\text{Cu}_3[\text{Fe}(\text{CN})_6]_2$ (D) None of these

Assertion Reasoning Type

(A) If both assertion and reason are true and reason is the correct explanation of assertion, then mark (a)

(B) If both assertion and reason are true but reason is not the correct explanation of assertion, then mark (b)

(C) If assertion is true but reason is false, then mark (c)

(D) If both assertion and reason are false, then mark (d)

Q.28 Assertion: Calamine is a ore of boron.

Reason: Boric acid is a tribasic acid.

Q.29 Assertion: FeS_2 is also known as fools' gold.

Reason: FeS_2 has yellow metallic appearance.

Q.30 Assertion: Pb^{4+} can be reduced easily to Pb^{2+} .

Reason: Pb^{2+} is paramagnetic.

Q.31 Assertion: Diamond is harder than graphite.

Reason: Graphite is more stable than diamond.

Q.32 Assertion: Carbon dioxide and nickel react to form tetracarbonyl nickel (0).

Reason: $\text{Ni}(\text{CO})_4$ decomposes on heating to form Ni and CO.

Previous Years Questions

Q.1 Which ore contains both iron and copper (2005)

- (A) Cuprite (B) Chalcocite
(C) Chalcopyrite (D) Malachite

Q.2 Extraction of zinc from zinc blende is achieved by (2007)

- (A) Electrolytic reduction
(B) Roasting followed by reduction with carbon
(C) Roasting followed by reduction with another metal
(D) Roasting followed by self-reduction

Q.3 Native silver metal forms a water soluble complex with a dilute aqueous solution of NaCN in the presence of (2008)

- (A) Nitrogen (B) Oxygen
(C) Carbon dioxide (D) Argon

Q.4 Oxidation states of the metal in the minerals haematite and magnetite, respectively, are (2011)

- (A) II, III in haematite and III in magnetite
(B) II, III in haematite and II in magnetite
(C) II in haematite and II, III in magnetite
(D) III in haematite and II, III in magnetite

Q.5 Addition of high proportions of manganese makes steel useful in making rails (1998)

- (A) Gives hardness to steel
(B) Helps the formation of oxides of iron
(C) Can remove oxygen and sulphur
(D) Can show highest oxidation state of +7

Q.6 Extraction of metal from the ore cassiterite involves (2011)

- (A) Carbon reduction of an oxide ore
(B) Self-reduction of a sulphide ore
(C) Removal of copper impurity
(D) Removal of iron impurity

Paragraph

Copper is the most noble of the first row transition metals and occurs in small deposits in several countries. Ores of copper include chalcantite ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$), atacamite ($\text{Cu}_2\text{Cl}(\text{OH})_3$), cuprite (Cu_2O), copper glance (Cu_2S) and malachite ($\text{Cu}_2(\text{OH})_2\text{CO}_3$). However, 80% of the world copper production comes from the ore chalcopyrite (CuFeS_2). The extraction of copper from chalcopyrite involves partial roasting, removal of iron and self-reduction. (2010)

Q.7 Partial roasting of chalcopyrite produces

- (A) Cu_2S and FeO (B) Cu_2O and FeO
(C) CuS and Fe_2O_3 (D) Cu_2O and Fe_2O_3

Q.8 Iron is removed from chalcopyrite as

- (A) FeO (B) FeS (C) Fe_2O_3 (D) FeSiO_3

Q.9 In self-reduction, the reducing species is

- (A) S (B) O^{2-} (C) S^{2-} (D) SO_2

Q.10 Match the following Metals listed in column I with extraction processes listed in column II. (1979)

Column I	Column II
(A) Silver	(p) Fused salt Electrolysis
(B) Calcium	(q) Carbon Reduction
(C) Zinc	(r) Carbon monoxide reduction
(D) Iron	(s) Amalgamation
(E) Copper	(t) Self reduction

Q.11 Write the chemical reactions involved in the extraction of silver from argentite. (2000)

Q.12 Write the balanced chemical equation for developing photographic films.

Q.13 Write balanced chemical equation for developing a black and white photographic film. Also give reason, why the solution of sodium thiosulphate on acidification turns milky white and give balance equation of this reaction. (2005)

Q.14 Given the number of water molecule (s) directly bonded to the metal center in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$. (2009)

Q.15 Given the coordination number of Al in the crystalline state of AlCl_3 . (2009)

Q.16 Extraction of zinc from zinc blende is achieved by, (2007)

- (A) Electrolytic reduction
 (B) Roasting followed reduction by reduction with carbon
 (C) Roasting followed by reduction with another metal
 (D) Roasting following by self-reduction

Q.17 Match the conversions in column I with the type (s) of reaction (S) give in column II. (2008)

Column I	Column II
(A) $\text{PbS} \rightarrow \text{PbO}$	(p) Roasting
(B) $\text{CaCO}_3 \rightarrow \text{CaO}$	(q) Calcination
(C) $\text{ZnS} \rightarrow \text{Zn}$	(r) Carbon reduction
(D) $\text{Cu}_2\text{S} \rightarrow \text{Cu}$	(s) Self reduction

Q.18 Sulfide ores are common for the metals (2013)

- (A) Ag, Cu and Pb (B) Ag, Cu and Su
 (C) Ag, Mg and Pb (D) Al, Cu and Pb

Q.19 The carbon-based reduction method is NOT used for the extraction of (2013)

- (A) Tin from SnO_2
 (B) Iron from Fe_2O_3
 (C) Aluminium from Al_2O_3
 (D) Magnesium from $\text{MgCO}_3 \cdot \text{CaCO}_3$

Q.20 Match the anionic species given in column I that are present in the ore (s) given in column II (2015)

Column I	Column II
(A) Carbonate	(p) Siderite
(B) Sulphide	(q) Malachite
(C) Hydroxide	(r) Bauxite
(D) Oxide	(s) Calamine
	(s) Argentite

Q.21 Extraction of copper from copper pyrite (CuFeS_2) involves (2016)

- (A) Crushing following 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

MASTERJEE Essential Questions

JEE Main/Boards

Exercise 1

- Q.2 Q.6 Q.15
 Q.21 Q.27 Q.30

Exercise 2

- Q.8 Q.24

Previous Years' Questions

- Q.9

JEE Advanced/Boards

Exercise 1

- Q.4 Q.12 Q.17
 Q.20 Q.27

Exercise 2

- Q.2 Q.13 Q.32

Previous Years' Questions

- Q.3 Q.10 Q.15

Answer Key

JEE Mains/Boards

Exercise 2

Single Correct Choice Type

Q.1 B	Q.2 C	Q.3 A	Q.4 A	Q.5 D	Q.6 A	Q.7 C
Q.8 A	Q.9 A	Q.10 D	Q.11 A	Q.12 D	Q.13 A	Q.14 A
Q.15 C	Q.16 C	Q.17 A	Q.18 C	Q.19 B	Q.20 B	Q.21 B
Q.22 A	Q.23 A	Q.24 C	Q.25 B	Q.26 B	Q.27 A	

Previous Years' Questions

Q.1 D	Q.2 D	Q.3 D	Q.4 B	Q.5 C	Q.6 A	Q.7 B
Q.8 B	Q.9 D	Q.10 C	Q.11 A	Q.12 D	Q.13 D	Q.14 B
Q.15 C						

JEE Advanced/Boards

Exercise 2

Single Correct Choice Type

Q.1 A	Q.2 C	Q.3 B	Q.4 D	Q.5 C	Q.6 D	Q.7 C
Q.8 D	Q.9 B	Q.10 D	Q.11 C	Q.12 C	Q.13 C	Q.14 B
Q.15 B	Q.16 D	Q.17 D	Q.18 B	Q.19 C	Q.20 B	Q.21 B
Q.22 D						

Comprehension Type

Q.23 A	Q.24 A	Q.25 B	Q.26 C	Q.27 A
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Assertion Reasoning Type

Q.28 D	Q.29 C	Q.30 C	Q.31 C	Q.32 D
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Previous Years' Question

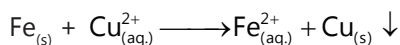
Q.1 C	Q.2 B	Q.3 B	Q.4 D	Q.5 A, C	Q.6 A, D	Q.7 B
Q.8 D	Q.9 C	Q.10 A \rightarrow s; B \rightarrow p; C \rightarrow q; D \rightarrow q, r; E \rightarrow t			Q.16 B	
Q.17 A \rightarrow p; B \rightarrow q; C \rightarrow p, r; D \rightarrow p, s			Q.18 A	Q.19 C, D		
Q.20: A \rightarrow p, q, s; B \rightarrow t; C \rightarrow q, r; D \rightarrow r			Q.21 A, B, C			

Solutions

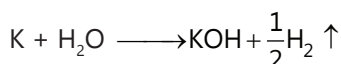
JEE Main/Boards

Exercise 1

Sol 1: The reduction potential of zinc and iron is lower than that of copper. In hydrometallurgy, Zn/Fe can be used to displace Cu from the solution



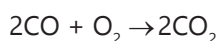
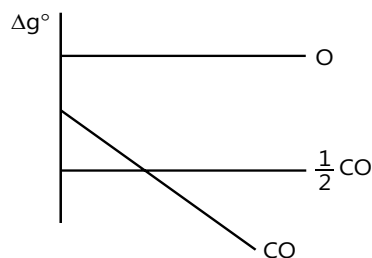
But to displace Zn, more reactive metals i.e. Na, K are required but they violently react with water and gives hydrogen gas.



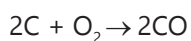
∴ By hydrometallurgy, Cu can be extracted but not Zn.

Sol 2: Ellingham diagrams.

In this range of temperature, diagrams show that carbon monoxide act as stronger reduction agent than carbon.

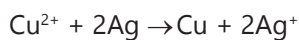


has more negative free energy than



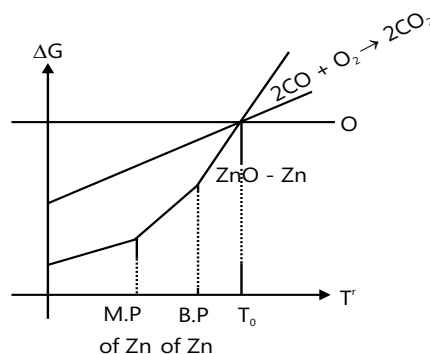
∴ In the upper part of furnace, haematite is reduced by CO even in the presence of C.

Sol 3: In case of low grade copper ores, such as chalcopyrites, Ag is used to reduced the remaining copper.



and by formation of shiny Ag_2S layer, it is confirmed that Cu got reduced.

Sol 4: Ellingham diagram clearly indicates that the CO graph cut at much higher temperature to Zinc oxide's graph.

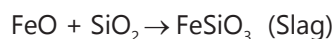


$T_0 > T_{\text{B.P. of Zn}}$ So, Zn will be in vapour form and its very tough to maintain such high temperature in furnace for long time and at this temperature, carbon forms carbides.

Sol 5: Element present in the anode mud:- Se, Te, Ag, Au, Pt and Sb

These elements are very less reactive and are not affected during the purification process. Hence, they settle down below anode as anode mud.

Sol 6: In the process of Bessemerisation, air is blown into molten matte with silica. So, by self reduction CuS gets reduced to Cu but at same time, FeS also gets converted to FeO but to avoid further reaction, silica is added.

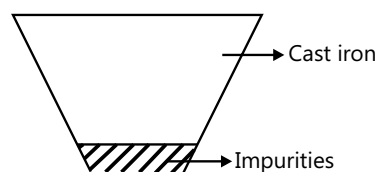


Thomas slag

By this, molten copper gets separated out.

Sol 7: Refer Theory - Chromatography

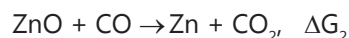
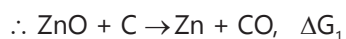
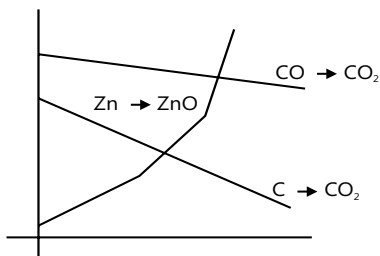
Sol 8: The composition difference between cast and Pig iron is, Pig iron has 4% carbon content whereas cast iron has at least 2% carbon content.



After extracting from furnace, we get pig iron and we put them in a case from which impurities can be cut out so there is difference of amount in impurity.

Sol 9: Minerals are the substances in which metals are present either in native or combined forms but ores are that minerals from which metal can be extracted economically and conveniently.

Sol 10: From Ellingham diagram, graph of C cuts the Zn graph at lower temperature than CO.



$|\Delta G_1| > |\Delta G_2|$ so, first reaction is favourable

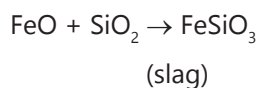
\therefore C is better reducing agent than CO.

Sol 11: Graphite rod is used as an anode and graphite line iron as cathode during the electrolysis of alumina.

Sol 12: Refer theory

Sol 13: Refer theory

Sol 14: Copper matte contains sulfides of copper and iron. While reducing, it is Bessemer converter by self-reduction, CuS gets converted to Cu but to avoid Fe in the final product, silica is used which forms slag with FeO



Sol 15: Generally, aluminium is extracted by using electrometallurgy, but for that purpose Al should be in molten state. But, melting point of aluminium is very high. So, to increase the solubility and to decrease the melting point, cryolite is added.

Sol 16: Roasting is a process in which ore is heated in presence of oxygen to convert it into corresponding oxides. So the ores whose oxides can be easily reduced by C/CO or by self reduction are roasted. E.g. CuS, FeS, but ores of Al, Na, K cannot be roasted.

Sol 17: (a) Acidic flux:- Used to remove basic gangues

E.g. SiO_2 , $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$

(b) Basic flux:- Used to remove acidic gangues

E.g. CaO, MgCO_3 , CaCO_3 .

Sol 18: Gangue:- (Matrix)

These are the non-metallic impurities present in the ore. In fact, impurities associated with an ore is known as gangue.

Sol 19: Refer theory

Sol 20: (1) Zone Refining: Fractional crystallisation :-Based on difference in solubilities of impurities in molten and solid state.

E.g. Ge, Ga, Si etc (To extrapurify the metal)

(2) Electrolytic Refining: Faraday's law of electrolysis

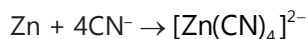
Metals which are not reduced by C/CO, are reduced by this method. E.g. Na, Ca, K, Al etc.

(3) Vapour phase refining:

$\text{Ni} + 4\text{CO} \rightarrow [\text{Ni}(\text{CO})_4] \xrightarrow{\Delta} \text{Ni} \downarrow + 4\text{CO}$ Purification by forming volatile carbonyl complex.

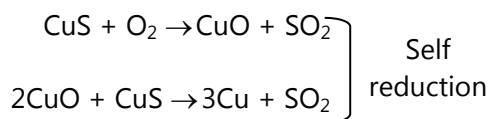
Sol 21: Froath floatation:- Based on the different wetting property of the ore and gangue with oil and water. Depressants are used to depress the frothing tendency of the frothing agent Eg. NaCN, KCN

Example: In the selective froth floatation of PbS, ZnS can be depressed using depressant.

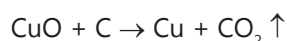


Sol 22: Copper pyrites $\rightarrow \text{CuFeS}_2$ composes sulfides of CuS and FeS both.

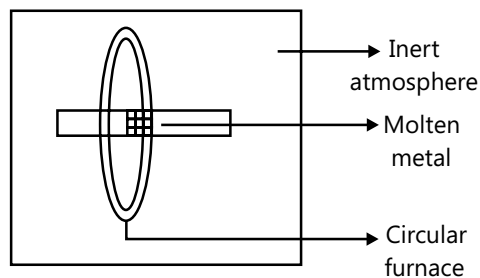
While extracting copper from pyrites, when we oxidise the ore $2\text{FeS} + 3\text{O}_2 \rightarrow 2\text{FeO} + 2\text{SO}_2$, ferrous oxide also gets formed which has to be removed by slag formation



But in simple oxide 'CuO', it can be easily reduced by carbon reduction



Sol 23: (i) Zone Refining: Method to obtain metals of very high purity metals like Ge, Ga, Si etc. This method is based on difference in solubilities of impurities in molten and solid state. This refining is as shown below:



Heater melts that part of metal and impurities flows in the molten part and by moving this, eventually get at the end and cut out, this process is repeated several times.

(ii) Column Chromatography:- This technique is based on different adsorbing power of different metal ions on a surface. This technique is used for that metals whose separation is difficult. Eg. Lanthanoids, actinoids.

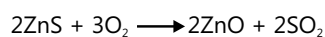
Sol 24: At 600-900°C: $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$

At 900-1000°C ; $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$; $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$

Sol 25: Extraction of any ore is done in 3 parts.

(i) Concentration:- froth floatation process.

(ii) Roasting:-



Carbon Reduction

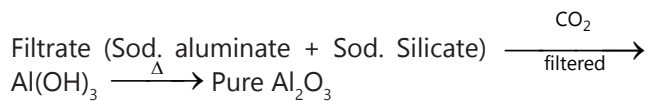
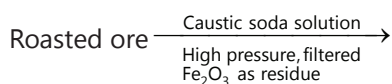
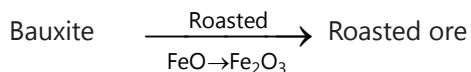


(iii) Purification:- fractional distillation & electrolysis.

Sol 26: Refer theory

Sol 27: Silica in alumina is a natural impurity and before electrolysis, this impurity should be removed. So any of the following chemical process can be used to purify alumina from bauxite.

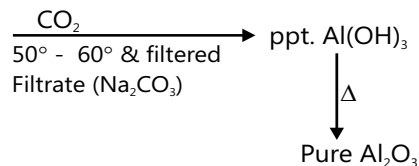
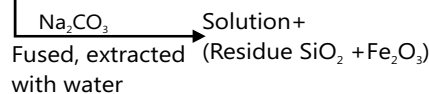
(i) Bayer's process:- Finely powdered



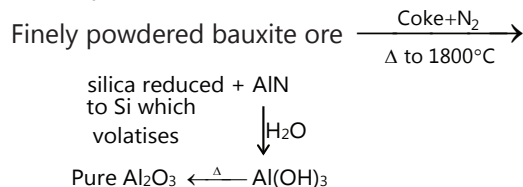
(ii) Hall's process:

Finely Bauxite:

Finely Bauxite:-



(iii) Serpeck's Process:-



Sol 28: Refer Elingham diagram

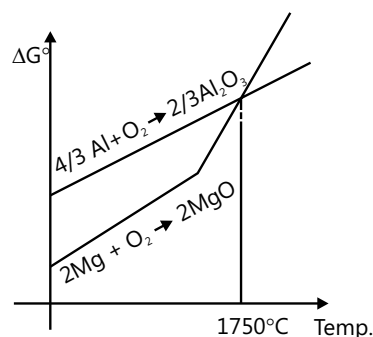
Sol 29: Yes, Reducing agent's selection widely depends on thermodynamic factor because free energy is the factor which decides the reaction feasibility.

E.g. (1) In the upper part of blast furnace, carbon monoxide is better reducing agent than carbon because in that temperature range, ΔG of CO's reaction is less than for C.

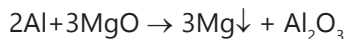
(2) Reduction of ZnO is not feasible by carbon because it can be only possible at high temperature at which both compounds are in vapour phase.

Sol 30: In the electrolysis of NaCl, Cl_2 is obtained as a by-product

Sol 31: Ellingham Diagram:-



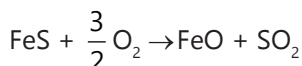
Reduction of MgO by Al is feasible at very high temperature around 1750°C



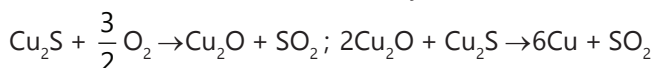
Because ΔG is negative after this temperature. So, aluminothermite is not useful to extract Mg from MgO. Thus, electrolytic reduction is used.

Exercise 2

Sol 1: (B) During roasting, air is blown to convert metal sulphides into metal oxides.

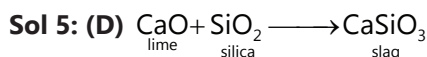


Sol 2: (C) Cu can be reduced by self-reduction. So,



Sol 3: (A) Pyrolusite $\rightarrow \text{MnO}_2$

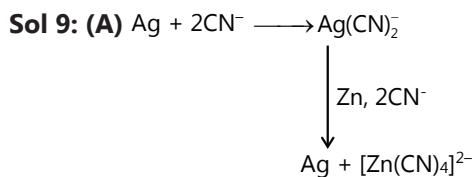
Sol 4: (A) Ag, Au, Hg, Pt are chemically inert metals.



Sol 6: (A) Duralumin an alloy of aluminium is used in aircraft industry

Sol 7: (C) Bauxite ore impurities:- $\underset{\text{Acidic}}{\text{SiO}_2} + \underset{\text{impurities}}{\text{Fe}_2\text{O}_3}$

Sol 8: (A) Si is a semi-conductor.



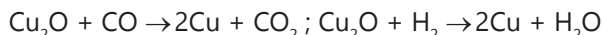
Sol 10: (D) Flux + Gangue \rightarrow slag.

Sol 11: (A) Zone refining:- Purification is done at microscopic level because we need ultra-purified element to use in semi-conductors. Zone refining is based on fractional crystallisation.

Sol 12: (D) None of this elements can be reduced by Al but other example are Cr, Mn, Ti, etc.

Sol 13: (A) Anode mud are the elements which get deposited in the bottom of anode Eg. Ag, Au, Pt.

Sol 14: (A) Poling:- Molten metal is stirred with green anode poles which releases hydrocarbon (gas) which reduces the oxide e.g. Cu



Sol 15: (C) SiO_2 is an acidic flux $\underset{\text{Acidic}}{\text{SiO}_2} + \underset{\text{Basic}}{\text{CaO}} \longrightarrow \text{CaSiO}_3$

Sol 16: (C) Zone refining is a method to obtain ultra pure metal.

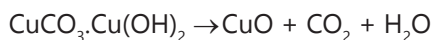
Sol 17: (A) Mac Arthur process is basically cyanide process.

Sol 18: (C) Electroplating: To deposit a specific metal on some other to protect the inner ore is done by electrolysis.

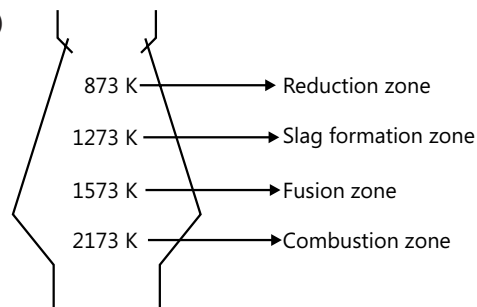
Electrorefining: Electrochemical series decide which metal to be deposited first on anode and using it, we can remove the impurities by electrolysis.

Sol 19: (B) Calcination: Ore is heated at high temperature in the absence of air.

E.g. Applied for carbonate and hydrated ores.



Sol 20: (B)

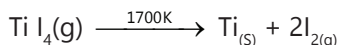
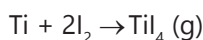


Sol 21: (B) Mg and Al's aqueous solution on electrolysis gives hydrogen at anode.

\therefore Molten mixture is used.

Sol 22: (A) Van-Arkel method:- Metal is converted into a volatile stable compound (e.g., Iodine) and impurities are not affected during compound formation

E.g. Zr, Ti



Sol 23: (A) In the froth floatation process for the purification of ores, the ore particles float because they are light.

Sol 24: (C) Van arkle method is used.

Sol 25: (B) Calcination is the process of heating the ore in absence of air.

Sol 26: (B) Highly electropositive metal can not be reduced because it requires high temperature at which carbide formation occurs.

Sol 27: (A) Cyanide process is used for obtaining Cr.

Previous Years' Questions

Sol 1: (D) Fluorspar (CaF_2), Cryolite (Na_3AlF_6), Feldspar (KAlSi_3O_8), Mica ($\text{K}_2\text{O} \cdot 3\text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2 \cdot 2\text{H}_2\text{O}$).

Sol 2: (D) Pig iron \rightarrow It is the most impure form of iron and contains highest proportion of carbon (2.5 – 4%)

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

Zinc blende $\rightarrow \text{ZnS}$

Bauxite $\rightarrow \text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$

Sol 3: (D) Malachite ($\text{Cu}(\text{OH})_2 \cdot \text{CuCO}_3$).

Sol 4: (B) Cuprite (Cu_2O) and Argentite (Ag_2S).

Sol 5: (C) Among cuprite [Cu_2O], Chalcocite [Cu_2S], Chalcopyrite [CuFeS_2] & Malachite [$\text{Cu}(\text{OH})_2 \cdot \text{CuCO}_3$].

Sol 6: (A) Au is recovered from the solution by the addition of electropositive metal.

$2\text{NaAu}(\text{Cu})_2 + \text{Zn} \rightarrow \text{Na}_2\text{Zn}(\text{CN})_4 + 2\text{Au}\uparrow$

Soluble complex

Sol 7: (B) Both assertion and reason are true and reason is the correct explanation of assertion.

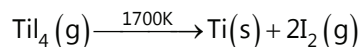
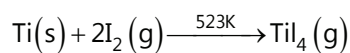
Sol 8: (B) Both assertion and reason are true but reason is not the correct explanation of assertion. Non-fusible mass present in ore in mixing with suitable flux are fused which are then reduced by coke to give free metal.

Sol 9: (D) Leaching is a process of concentration.

Sol 10: (C) Assertion is true but reason is false. Collectors absorb themselves on polar groups to grains of ores and thus derive them on the surface to pass on into the froth.

Sol 11: (A) Metal sulphides are thermodynamically more stable than CS_2

Sol 12: (D) Van Arkel method



Sol 13: (D) 13 In the context of the Hall-Heroult process for the extraction of Al, Na_3AlF_6 serves as the electrolyte

Sol 14: (B) Galena = Pbs

For sulphur ores froth floatation is carried out.

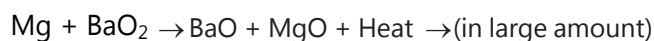
Sol 15: (C) Galvanization is applying a coating of Zn.

JEE Advanced/Boards

Exercise 1

Sol 1: Goldschmidt thermite process:- Reduction by powdered aluminium. This process is employed in cases where metals have very high m.pt and are to be extracted from their oxides.

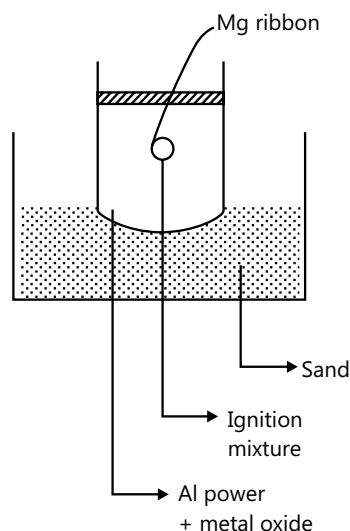
Process:-

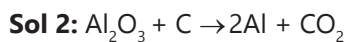


Ignition mixture



E.g. Reduction of Cr, Ti, W, Mn etc.



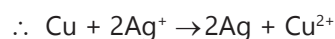


ΔG of this reaction is negative at very high temperature, so there are 2 reasons that it is not useful:-

- (i) Such high temperature is difficult to achieve in furnace for very long time and at such temperature, Al_2O_3 will also be in vapour phase.
- (ii) At high temperature, C instead of reducing forms carbide Al_4C_3 with aluminium.

Sol 3: Redox reaction depends upon standard reduction potential of that metals.

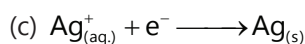
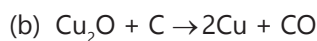
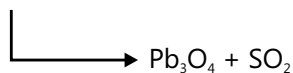
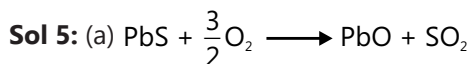
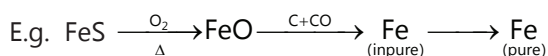
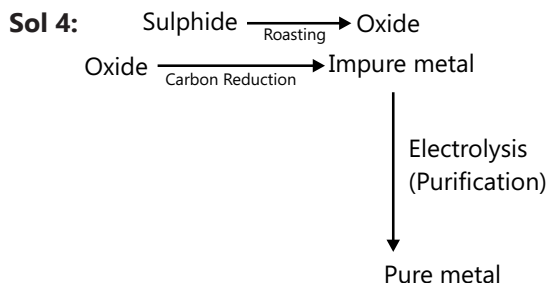
$E^\circ_{\text{Ag}^+/\text{Ag}} - E^\circ_{\text{Cu}^{2+}/\text{Cu}} > 0$ and to fease the reaction, E° should be positive of that whole reaction.



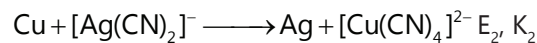
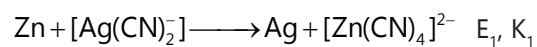
Oxidation half:- $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$; $E_1 = -E^\circ_{\text{Cu}^{2+}/\text{Cu}}$

Reduction half:- $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$; $E_2 = E^\circ_{\text{Ag}^+/\text{Ag}}$

$E^\circ_{\text{Reaction}} = 2E^\circ_{\text{Ag}^+/\text{Ag}} - E^\circ_{\text{Cu}^{2+}/\text{Cu}} > 0$



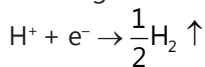
Sol 6: $E^\circ_{(\text{OP})}$ of Zn is more positive than E°_{OP} of Cu and this Zn is more powerful reductant than Cu and thus, Zn can easily replace Ag from $[\text{Ag}(\text{CN})_2]^-$



$K_1 \gg K_2$ because $|E_1| > |E_2|$

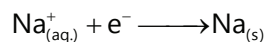
Furthermore, Zn being cheaper in comparison to Cu.

Sol 7: Instead of molten NaCl, if we use aqueous solution of NaCl, then, at cathode, Na^+ ions are not discharged at cathode on the contrary, H^+ ions get discharged to form H_2 .



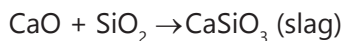
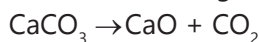
At anode, $\text{Cl}_2 \uparrow$ will form irrespective of solvent.

In molten NaCl, there is no competition for Na^+ to get discharged at cathode.



Sol 8: The members of group 1 i.e. alkali metals have low ionization potential value and thus possess high electropositive character as well as high oxidation potential which enables them to get easily oxidised so that's why they are strong reducing agent but they are not widely used because they react violently with water
 $\text{Na} + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{H}_2 \uparrow$

Sol 9: In blast furnace, lime stone, CaCO_3 is useful in fusion zone, where at $800^\circ\text{C} - 1200^\circ\text{C}$, CaCO_3 gets dissociated in $\text{CaO} + \text{CO}_2$ and it acts as flux, which reacts with acidic gangue SiO_2 to form slag.

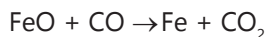
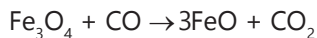
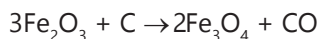


Sol 10: In blast furnace, temperature differs widely from top to bottom.

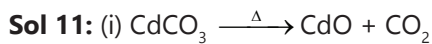
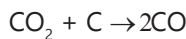
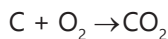
So, in different temperature range different compound behaves as a reducing agent.

At $300 - 800^\circ\text{C}$,

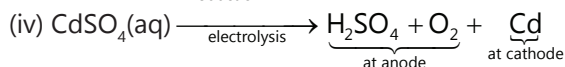
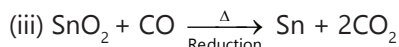
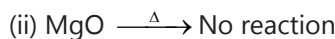
CO is better reducing agent than C

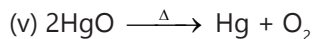


For this, in zone of combustion.

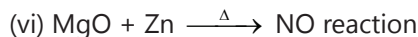


Thermal decomposition

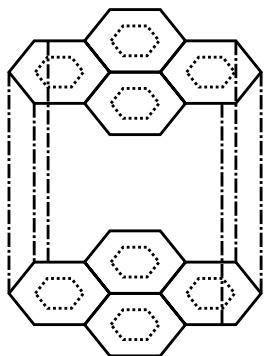




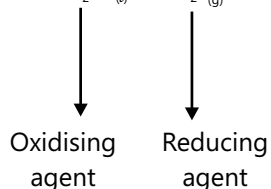
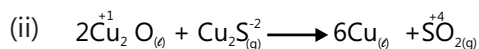
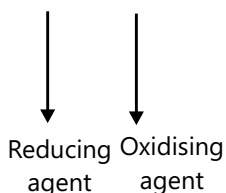
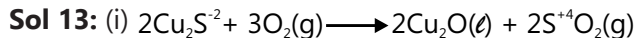
Thermal decomposition



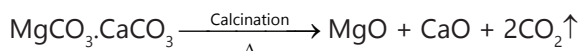
Sol 12: Graphite and diamond, both are isomers but their physical properties differ widely.



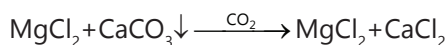
Graphite conducts electricity because there exist free electrons between two sheets of graphite. On the other hand, diamond is a bad conductor because it does not have free electrons and during electrolysis, it is important for anode to conduct electricity and complete the circuit.



Sol 14: Calcination:-



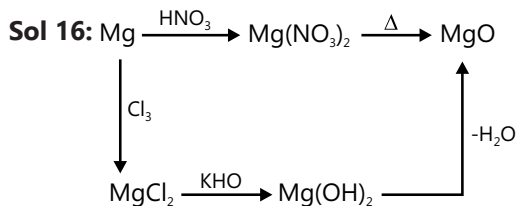
Dolomite



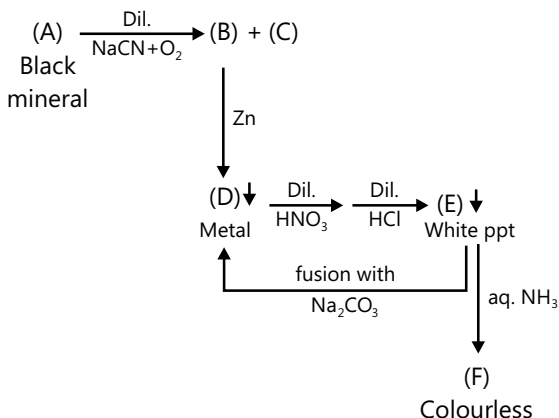
Now, electrolysis of MgCl_2 gives Mg



Sol 15: Calcination



Sol 17:



(A) \rightarrow (D) leaching process

\therefore these are the compounds of Ag

\therefore (A) Ag_2S

(B) $[\text{Ag}(\text{CN})_2]^- \text{Na}^+$

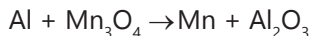
(C) Na_2S

(D) Ag

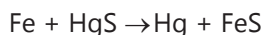
(E) AgCl

(F) $[\text{Ag}(\text{NH}_3)_2]\text{Cl}$

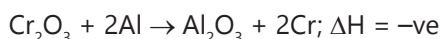
Sol 18: (i) Aluminium:- Gold Schimdt process:-



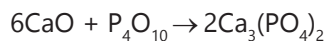
(ii) Fe is also used



Sol 19: Aluminium metal is frequently used as a reducing agent for the extraction of metal such as Cr and Mn from their respective oxides because aluminium is more electropositive than Cr/Mn. The process of reduction is known as Aluminothermite process (Gold schmidt process)



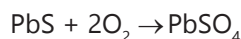
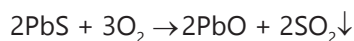
Sol 20: During the extraction of iron (Fe) from haematite (Fe_2O_3) it contains some impurities such as P_4O_{10} or SO_2 , which are acidic in nature. So, to remove this gangue as slag basic lining of lime (CaO) or magnesia (MgO) is used



Sol 21: Lead is extracted from its mineral galena (PbS).

(i) It is firstly concentrated by froth floatation process.

(ii) Roasting in reverberatory furnace

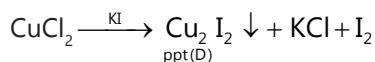
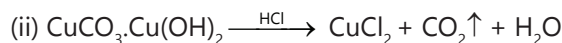
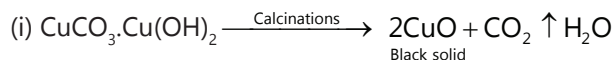


The idea of Cu ores come from calcined black solid and ppt. after reaction with KI.

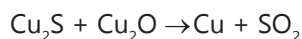
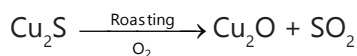
Sol 22: A_1 will be malachite i.e., $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$

A_2 will be copper glance i.e., Cu_2S The confirmatory reaction are

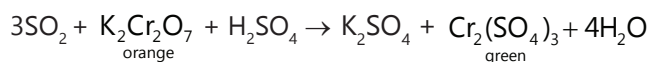
(a) For malachite



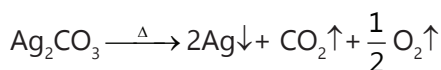
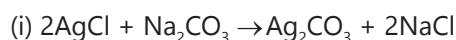
(b) For copper glance



SO_2 is the gas which gives green colour with acidified $\text{K}_2\text{Cr}_2\text{O}_7$ as

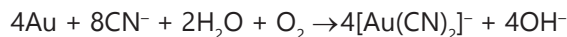


Now reduction of AgCl,

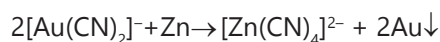


(ii) Cyanide process with AgCl.

Sol 23: Cyanide process is a type of leaching process which a chemical reaction is used to extract metal from ore. In this process, crushed rock containing traces of gold is treated with 0.1 – 0.2% solution of NaCN and aerated O_2 (air) oxidized free metal to Au^+ which complexes with CN^-



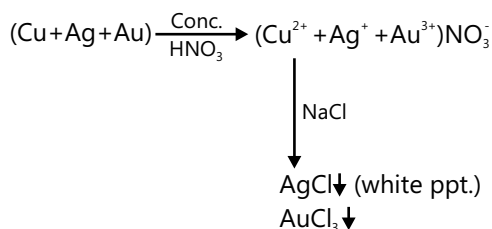
The pure metal is displaced from solution by an active metal



Sol 24: Silver coin contains Ag, Au and Cu also. So, to extract silver, it should undergo various processes.

So, individually every metal impurities can be removed.

Silver coin

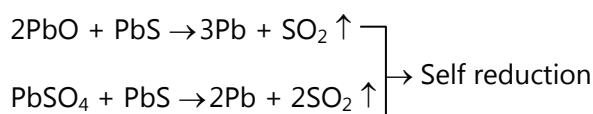


Now, since Ag, Au, both are noble metals, they possess similar chemical properties.

But due to difference in physical properties, Au can be removed by fractional distillation.

After oxidising minerals,

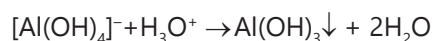
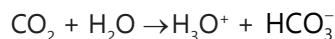
The roasted mineral is smelted into lead



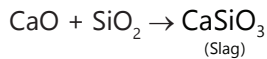
PbO (litharge) oxidation state $\rightarrow +2$

Purification is done by cupellation, polling and most importantly, electrolysis.

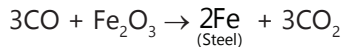
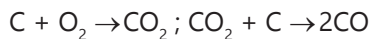
Sol 25: In the purification of bauxite, due to impurities such as silica (SiO_2) and other silicates, Bauxite is converted into alumina by Bayer's process. During this process, CO_2 is passed through it. Aqueous solution of CO_2 is acidic. Hence, CO_2 when passed into $[\text{Al}(\text{OH})_4]^-$ solution makes it acidic. Hence, $\text{Al}(\text{OH})_3$ is precipitated.



Sol 26: Haematite ore majorly contain $[\text{Fe}_2\text{O}_3/\text{FeO}]$ but also contains silica (SiO_2). So, during roasting in blast furnace, carbon reduction is done along with lime. So, silica can be removed as slag.

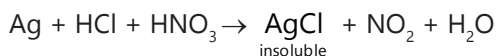


Simultaneously, Fe also gets reduced



So difference in densities make them easily separable at the bottom of furnace and this calcium silicate because of its hard nature is widely used in cement industry.

Sol 27: (ii) Au and Ag both are generally chemically inert but they differ during their reaction with HCl + HNO_3



So, in Aquaregia, Au forms a soluble complex compound, HAuCl_4 but Ag forms a precipitate which do not dissolve.

Exercise 2

Single Correct Choice Type

Sol 1: (A) Sulphides have fundamental property based on the different wetting property of the ore and gangue with oil and water.

Sol 2: (C) Van Arkel

This is vapour phase refining process by forming volatile complex compound.

Sol 3: (B) Cryolite- Na_3AlF_6 is used during the electrolysis of alumina to increase the electrical conductivity and decrease the melting point of alumina (Al_2O_3).

Sol 4: (D) Cassiterite is an ore of Sn.

Sol 5: (C) Discharging of element at cathode and anode depends upon various factors mainly on

- (i) standard reduction potential
- (ii) Nature of electrode

Using platinum and graphite electrode, we get different products so it is entirely experimental.

Sol 6: (D) Metal makes lattices in which nucleus is arranged in specific array of position but valence electrons are free to move into whole lattice this property gives lustre to a metal.

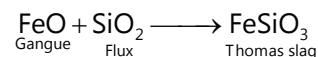
Sol 7: (C) For Cr, instead of electrolysis, we can use more cheaper process, aluminothermite, because electrolysis gives high yield but it's a very costly process.

Sol 8: (D) Flux's basic use is to combine with gangues/matrix or other impurities and then remove them by slag formation.

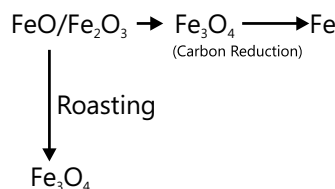
E.g. Formation of CaSiO_3 in extraction of iron (Fe).

Sol 9: (B) In extraction of Cu, FeO is a gangue to remove it, SiO_2 (silica) is added and it forms

Thomas slag



Sol 10 (D) In blast furnace



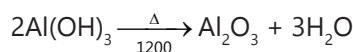
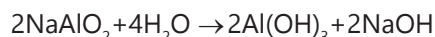
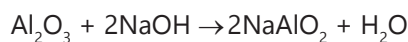
Sol 11: (C) Al_2O_3 is used in molten state because aqueous solution will give H_2 at cathode and Na_3AlF_6 is used to increase the conductivity of Al_2O_3 and to decrease the melting point of mixture.

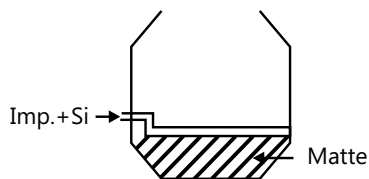
Sol 12: (C) Calcination is used in metallurgy to remove CO_2 and H_2S

Sol 13: (C) The metallic luster exhibited by sodium is explained by the presence of Free protons

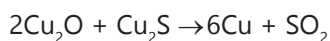
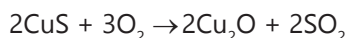
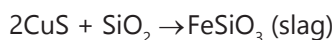
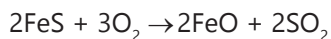
Sol 14: (B) Stainless steel:- Fe + Cr + Ni

Sol 15: (B) Leaching:-

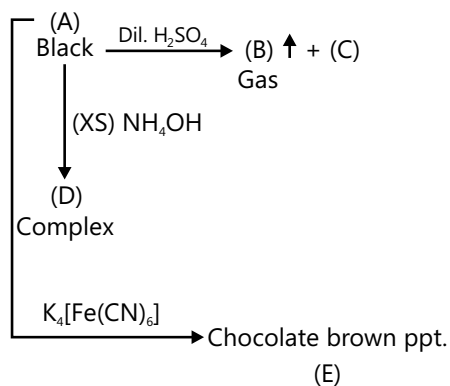


Sol 16: (D) Bessemerisation of Cu

Bessemer converter

**Sol 17: (D)** Generally they are more electronegative than metals.**Sol 18: (B)** In the froth floatation process for the purification of ores, the ore particles float because their surface is hydrophobic i.e. not easily wetted by water**Sol 19: (C)** SiO_2 Acidic flux.**Sol 20: (B)** Flux + Gangue \rightarrow slag**Sol 21: (B)** E.g. Na, K, Ca, Al, etc.

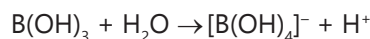
Group I, II metals.

Sol 22: (D) The role of calcination in metallurgical operations is to remove moisture, to decompose carbonate, to drive off organic matter.**Comprehension type****Sol 23: (A)** CuS**Sol 24: (A)** H_2S **Sol 25: (B)** CuSO_4 **Sol 26: (C)** $[\text{Cu}(\text{NH}_3)_4](\text{NO}_3)_2$ **Sol 27: (A)**

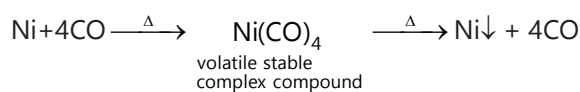
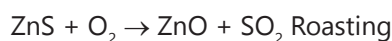
Chocolate brown ppt. form with Cu metal

(E) is $\text{Cu}_2[\text{Fe}(\text{CN})_6]$ **Assertion Reasoning Type****Sol 28: (D)** Calamine (ZnCO_3)

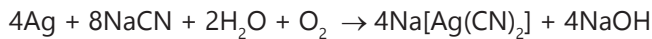
(R) Boric acid is monobasic acid

**Sol 29: (D)** Based on experiments.**Sol 30: (C)** Pb^{4+} is easily reduced to Pb^{2+} because of inert pair effect.(R) Pb^{2+} is diamagnetic.**Sol 31: (C)** Diamond is hardest natural occurring substance because of its strong 4 valence lattice.

(R) Graphite is more stable because of electrical conductivity and availability of free electrons.

Sol 32: (C) Mond's Process:-**Previous Years' Questions****Sol 1: (C)** Chalcopyrite contain both iron and copper.**Sol 2: (B)** Zinc blende contain ZnS which is first roasted partially and then subjected to reduction with carbon

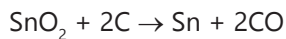
Sol 3: (B) A water soluble complex with silver and dilute aqueous solution of NaCN is $\text{Na}[\text{Ag}(\text{CN})_2]$. In the cyanide process, the native silver is crushed and treated with aqueous NaCN solution and aerated.



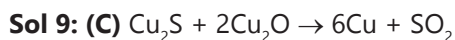
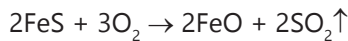
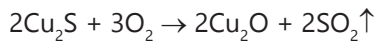
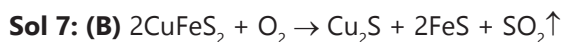
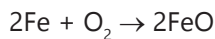
Sol 4: (D) Haematite is Fe_2O_3 , in which oxidation number of iron is III. Magnetite is Fe_3O_4 which is infact a mixed oxide ($\text{FeO} \cdot \text{Fe}_2\text{O}_3$), hence, iron is present in both II and III oxidation state.

Sol 5: (A, C) Addition of manganese to iron improve hardness of steel as well as remove oxygen and sulphur.

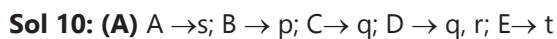
Sol 6: (A, D) The important ore of tin is cassiterite (SnO_2). Tin is extracted from cassiterite ore by carbon reduction method in a blast furnace.



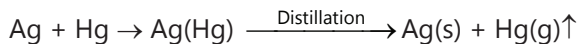
The product often contain traces of iron which is removed by blowing air through the melt to oxidize to FeO which then floats to the surface.



In Cu_2S , sulphur is S^{2-} and in SO_2 , sulphur is in +4 state. Hence, S^{2-} is acting as a reducing agent.

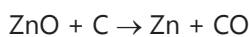


Silver is extracted by amalgamation process

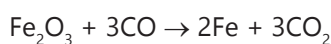
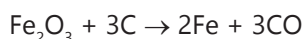


(B) Calcium is extracted by electrolysis of fused CaCl_2 .

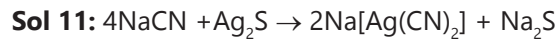
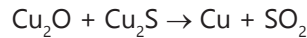
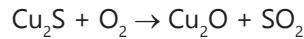
(C) Zinc is extracted by carbon reduction method



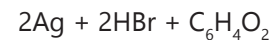
(D) Iron is extracted by both, carbon reduction method and CO reduction methods



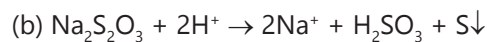
(E) Copper is extracted by self-reduction methods



Sol 12: The common photographic film is coated with AgBr and during developing of photographic film, the unreacted AgBr is removed by $\text{Na}_2\text{S}_2\text{O}_3$ as

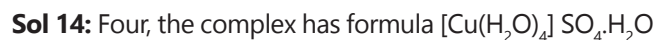


(developer) quinone



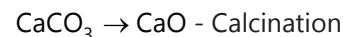
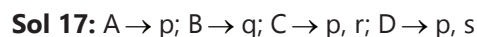
Colloidal

Sulphur



Sol 15: In crystalline state, AlCl_3 has rock-salt like structure with coordination number of Al = 6.

Sol 16: (B) Extraction of zinc from zinc blende is achieved by



Sol 18: (A)

Sulfinde ore of Ag \rightarrow Argentite (Ag_2S)

Pb \rightarrow Galena (PbS)

Cu \rightarrow Copper glance (Cu_2S)

Hence (A) is correct.

Sol 19: (C, D) Fe_2O_3 and SnO_2 undergoes C reduction. Hence (C) and (D) are correct.

Sol 20: A → p, q, s; B → t; C → q, r; D → r

Siderite FeCO_3

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

Bauxite $\text{AlO}_x(\text{OH})_{3-2x}$; $0 < x < 1$

Calamine ZnCO_3

Argentite Ag_2S

Sol 21: (A, B, C) Extraction of copper from copper pyrite (CuFeS_2) involve crushing following by concentration of the ore by froth-flotation, removal of iron as slag, self-reduction step to produce 'blister copper' following evolution of SO_2