CHAPTER 15

General Principles and Processes of Isolation of Elements

Section-A JEE Advanced/ IIT-JEE

A Fill in the Blanks

1. Casseterite is ore of..... *(1980)*
2. In the thermite process ..... is used as reducing agent. *(1980)*
3. In the basic Bessemer process for the manufacture of steel the lining of the converter is made of..... . The slag formed consists of ..... *(1980)*
4. In extractive metallurgy of zinc partial fusion of ZnO with coke is called ..... and reduction of the ore to the molten metal is called ..... .
(smelting, calcining, roasting, sintering) *(1988 - 1 Mark)*

C MCQs with One Correct Answer

1. Copper can be extracted from *(1978)*
   (a) Kupfernical
   (b) Dolomite
   (c) Malachite
   (d) Galena
2. In the alumino-thermite process, aluminium acts as *(1983 - 1 Mark)*
   (a) an oxidizing agent
   (b) a flux
   (c) a reducing agent
   (d) a solder
3. The chemical composition of 'slag' formed during the smelting process in the extraction of copper is *(2001S)*
   (a) $Cu_2O + FeS$
   (b) $FeSiO_3$
   (c) $CuFeS_2$
   (d) $Cu_2S + FeO$
4. Which of the following process is used in the extractive metallurgy of magnesium? *(2002S)*
   (a) fused salt electrolysis
   (b) self reduction
   (c) aqueous solution electrolysis
   (d) thermite reduction
5. Which ore contains both iron and copper? *(2005S)*
   (a) Cuprite
   (b) Chalcocite
   (c) Chalcopyrite
   (d) Malachite
6. Extraction of zinc from zinc blende is achieved by
   (a) electrolytic reduction *(2007)*
   (b) roasting followed by reduction with carbon
   (c) roasting followed by reduction with another metal
   (d) roasting followed by self-reduction
7. 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
8. In the cyanide extraction process of silver from argentite ore, the oxidising and reducing agents used are
   (a) O_2 and CO respectively *(2012)*
   (b) O_2 and Zn dust respectively
   (c) HNO_3 and Zn dust respectively
   (d) HNO_3 and CO respectively
9. Sulfide ores are common for the metals *(JEE Adv. 2013)*
   (a) Ag, Cu and Pb
   (b) Ag, Mg and Pb
   (c) Ag, Cu and Sn
   (d) Al, Cu and Pb

D MCQs with One or More Than One Correct

1. Of the following, the metals that cannot be obtained by electrolysis of the aqueous solution of their salts are :
   (a) Ag (b) Mg *(1990 - 1 Mark)*
   (c) Cu (d) Al
   (e) Cr.

2. 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

3. The carbon-based reduction method is **NOT** used for the extraction of *(JEE Adv. 2013)*
   (a) Tin from SnO_2
   (b) Iron from Fe_2O_3
   (c) Aluminium from Al_2O_3
   (d) Magnesium from $MgCO_3.CaCO_3$

4. Upon heating with Cu_2S, the reagent(s) that give copper metal is/are *(JEE Adv. 2014)*
   (a) $CuFeS_2$
   (b) CuO
   (c) Cu_2O
   (d) $CuSO_4$

5. Copper is purified by electrolytic refining of blister copper. The correct statement(s) about this process is(are) *(JEE Adv. 2015)*
   (a) Impure Cu strip is used as cathode
   (b) Acidified aqueous $CuSO_4$ is used as electrolyte
   (c) Pure Cu deposits at cathode
   (d) Impurities settle as anode-mud

6. Extraction of copper from copper pyrite ($CuFeS_2$) involves *(JEE Adv. 2016)*
   (a) crushing followed 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

E Subjective Problems

1. (a) Write the chemical equations involved in the extraction of lead from galena by self reduction process.
   (b) Match the following extraction processes with the appropriate metals listed below :

(i)	Silver	(A)	Fused salt electrolysis
(ii)	Calcium	(B)	Carbon reduction
(iii)	Zinc	(C)	Carbon monoxide reduction
(iv)	Iron	(D)	Amalgamation
(v)	Copper	(E)	Self reduction *(1979)*

2. Write the matching pairs: *(1980)*

Bleaching agent	Aluminium
Smelling salt	Carbon
Cryolite	Tin
Bell metal	Ammonium carbonate
Fluorspar	Ammonium phosphate
Fertilizer	Calcium
Anthracite	Chlorine

Examples :

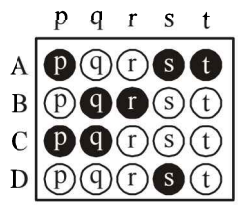
Bleaching agent
Chlorine
Smelling salt
Ammonium carbonate

3. Give reasons for the following :
   (*i*) Metals can be recovered from their ores by chemical methods. *(1984 - 1 Mark)*
   (*ii*) High purity metals can be obtained by zone refining method. *(1984 - 1 Mark)*
   (*iii*) Why is chalcocite roasted and not calcinated during recovery of copper? *(1987 - 1 Mark)*

4. Give the equations for the recovery of lead from Galena by air reduction. *(1987 - 1 Mark)*

F Match the Following

Each question contains statements given in two columns, which have to be matched. The statements in Column-I are labelled A, B, C and D, while the statements in Column-II are labelled p, q, r, s and t. Any given statement in Column-I can have correct matching with ONE OR MORE statement(s) in Column-II. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example :
If the correct matches are A-p, s and t; B-q and r; C-p and q; and D-s then the correct darkening of bubbles will look like the given.



1. Match the extraction processes listed in **Column I** with metals listed in **Column II** : *(2006 - 6M)*

Column I	*Column II*
(A) Self reduction	(p) Lead
(B) Carbon reduction	(q) Silver
(C) Complex formation and displacement by metal	(r) Copper
(D) Decomposition of iodide	(s) Boron

2. Match the conversions in **Column I** with the type(s) of reaction(s) given in **Column II**. *(2008 - 6M)*

Column I	*Column II*
(A) $PbS \rightarrow PbO$	(p) roasting
(B) $CaCO_3 \rightarrow CaO$	(q) calcination
(C) $ZnS \rightarrow Zn$	(r) carbon reduction
(D) $Cu_2S \rightarrow Cu$	(s) self reduction

3. Match the anionic species given in Column-I that are present in the ore(s) given in Column-II. *(JEE Adv. 2015)*

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

Section-B JEE Main / AIEEE

1. Aluminium is extracted by the electrolysis of **[2002]**
   (a) bauxite
   (b) alumina
   (c) alumina mixed with molten cryolite
   (d) molten cryolite.

2. The metal extracted by leaching with a cyanide is **[2002]**
   (a) Mg
   (b) Ag
   (c) Cu
   (d) Na.

3. Which one of the following ores is best concentrated by froth-flotation method ? **[2004]**
   (a) Galena
   (b) Cassiterite
   (c) Magnetite
   (d) Malachite

4. During the process of electrolytic refining of copper, some metals present as impurity settle as 'anode mud'. These are **[2005]**
   (a) Fe and Ni
   (b) Ag and Au
   (c) Pb and Zn
   (d) Sn and Ag

5. 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

6. 29.5 mg of an organic compound containing nitrogen was digested according to Kjeldahl's method and the evolved ammonia was absorbed in 20 mL of 0.1 M HCl solution. The excess of the acid required 15 mL of 0.1 M NaOH solution for complete neutralization. The percentage of nitrogen in the compound is **[2010]**
   (a) 59.0
   (b) 47.4
   (c) 23.7
   (d) 29.5

7. Which method of purification is represented by the following equation ? **[2012]**

$$Ti(s) + 2I_2(g) \xrightarrow{523K} TiI_4(g) \xrightarrow{1700K} Ti(s) + 2I_2(g)$$

   (a) Zone refining
   (b) Cupellation
   (c) Polling
   (d) Van Arkel

8. The metal that cannot be obtained by electrolysis of an aqueous solution of its salts is: **[JEE M 2014]**

(a) Ag

(b) Ca

(c) Cu

(d) Cr

9. In the context of the Hall - Heroult process for the extraction of Al, which of the following statements is **false** ? **[JEE M 2015]**

(a) Al^{3+} is reduced at the cathode to form Al

(b) Na_3AlF_6 serves as the electrolyte

(c) CO and CO_2 are produced in this process

(d) Al_2O_3 is mixed with CaF_2 which lowers the melting point of the mixture and brings conductivit112y

10. Which one of the following ores is best concentrated by froth floatation method? **[JEE M 2016]**

(a) Galena (b) Malachite

(c) Magnetite (d) Siderite