Additional Problems for Self Practice (APSP)

✍ **Marked questions are recommended for Revision.**

This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

PART - I : PRACTICE TEST-1 (IIT-JEE (MAIN Pattern))

Max. Marks : 100 **Max. Time : 1 Hr.**

Important Instructions :

1. The test is of **1 hour** duration.
2. The Test Booklet consists of **25** questions. The maximum marks are **100.**
3. Each question is allotted **4 (four)** marks for correct response.
4. Candidates will be awarded marks as stated above in Instructions No. 3 for correct response of each question.
   ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
5. **Test Paper consists of Two (2) Sections.**
   Section-1 contains **20** multiple choice questions. Each question has four choices (1), (2), (3) and (4) out of which **one** is correct. For each question in Section-1, you will be awarded 4 marks if you give the corresponding to the correct answer and zero mark if no given answers. In all other cases, minus one **(–1)** mark will be awarded.
   Section-2 contains **5** questions. The answer to each of the question is a **Numerical Value.** For each question in Section-2, you will be awarded 4 marks if you give the corresponding to the correct answer and zero mark if no given answers. No negative marks will be answered for incorrect answer in this section. In this section answer to each question is **NUMERICAL VALUE** with two digit integer and decimal upto two digit. If the numerical value has more than two decimal places **truncate/round-off** the value to **TWO** decimal placed.

SECTION-1

This section contains **20** multiple choice questions. Each questions has four choices (1), (2), (3) and (4) out of which Only **ONE** option is correct.

1. The process of removing lighter gangue particles by washing in a current of water is called :
(1) levigation (2) liquation (3) leaching (4) cupellation.

2. Gravity separation method is based upon :
(1) preferential washing of ores and gangue particles.
(2) difference in densities of ore particles and impurities.
(3) difference in chemical properties of ore particles and impurities.
(4) none of these.

3. In the froth floatation process for the purification of minerals the particles float because :
(1) they are light. (2) they are insoluble.
(3) their surface is preferentially wetted by oil. (4) they bear an electrostatic charge.

4. An ore of tin containing $FeCr_2O_4$ is concentrated by :
(1) magnetic separation (2) froth floatation
(3) leaching method (4) gravity separation.

5. ✍ In roasting :
(1) moisture is removed. (2) non–metals as their volatile oxide are removed.
(3) ore becomes porous. (4) all the above.

6. Which one of the following reactions is an example of calcination process ?
(1) $2Ag + 2HCl + [O] \rightarrow 2AgCl + H_2O$ (2) $2Zn + O_2 \rightarrow 2ZnO$.
(3) $2ZnS + 3O_2 \rightarrow 2ZnO + 2\ SO_2$ (4) $MgCO_3 \rightarrow MgO + CO_2$.

7. An ore after levigation is found to have basic impurities. Which of the following can be used as flux during smelting ?
(1) H_2SO_4 (2) $CaCO_3$ (3) SiO_2 (4) Both CaO and SiO_2 .

8. Among the following statements, the incorrect one is :
(1) calamine and siderite are carbonates (2) argentite and cuprite are oxides
(3) zinc blende and iron pyrites are sulphides (4) malachite and azurite are ores of copper

9. Electrolytic reduction method is used in the extraction of :
(1) highly electronegative elements. (2) highly electropositive elements.
(3) transition metals. (4) noble metals.

10. Among the following groups of oxides, the group that cannot be reduced by carbon to give the respective metals.
(1) Cu_2O, SnO_2 (2) Fe_2O_3, ZnO (3) CuO, K_2O (4) PbO, FeO.

11. Cryolite is :
(1) Na_3AlF_6 and is used in the electrolysis of alumina for decreasing electrical conductivity.
(2) Na_3AlF_6 and is used in the electrolysis of alumina for lowering the melting point of alumina.
(3) Na_3AlF_6 and is used in the electrolytic purification of alumina.
(4) Na_3AlF_6 and is used in the electrolysis of alumina for increasing the melting point and electrical conductivity.

12. Van Arkel method of purification of metals involves converting the metal to :
(1) volatile stable compound. (2) volatile unstable compound.
(3) non-volatile stable compound. (4) none of these.

13. Copper and tin are refined by :
(1) liquation (2) cupellation (3) bessemerisation (4) poling.

14. Tin and zinc can be refined by :
(1) cupellation (2) liquation (3) poling (4) bessemerisation.

15. Match the ores listed in column-I with the type of ores listed in column-II and select the correct. alternate.

	Column-I		**Column-II**
(a)	Limonite.	(p)	Carbonate ore.
(b)	Argentite.	(q)	Halide ore.
(c)	Carnallite	(r)	Sulphide ore.
(d)	Calamine.	(s)	Oxide ore.

Code :

	(a)	(b)	(c)	(d)		(a)	(b)	(c)	(d)
(1)	(s)	(r)	(q)	(p)	(2)	(p)	(s)	(q)	(r)
(3)	(p)	(q)	(r)	(s)	(4)	(s)	(r)	(p)	(q)

16. Match the method of concentration of the ore in column I with the ore in column II and select the correct alternate.

	Column I		**Column II**
(a)	Leaching.	(p)	Copper pyrite.
(b)	Calcination.	(q)	Siderite.
(c)	Froth floatation.	(r)	Bauxite.
(d)	Magnetic separation.	(s)	Chromite.

Code :

	(a)	(b)	(c)	(d)		(a)	(b)	(c)	(d)
(1)	(s)	(q)	(p)	(r)	(2)	(r)	(q)	(p)	(s)
(3)	(p)	(q)	(r)	(s)	(4)	(q)	(r)	(p)	(s).

17. Match the extraction process listed in column I with metals listed in column II and choose the correct option.

	Column I		Column II
(a)	Self reduction.	(p)	Copper from copper glance
(b)	Carbon and carbon monoxide reduction.	(q)	Silver from argentite.
(c)	Electrolytic reduction in fused state.	(r)	Aluminium from bauxite.
(d)	Complex formation and displacement by metal.	(s)	Iron from haematite.

Code :

	(a)	(b)	(c)	(d)		(a)	(b)	(c)	(d)
(1)	(p)	(s)	(r)	(q)	(2)	(p)	(r)	(s)	(q)
(3)	(s)	(p)	(r)	(q)	(4)	(p)	(r)	(s)	(q)

18. The iron obtained from the blast furnace is called :
(1) pig iron (2) cast iron (3) wrought iron (4) steel

19. The extraction of zinc from zinc blende involves :
(1) the electrolytic reduction.
(2) the roasting followed by reduction with carbon.
(3) the calcination followed by reduction with another metal.
(4) the roasting at molten temperature.

20. Carbon cannot be used in the reduction of Al_2O_3 because :
(1) it is non-metal (2) the heat of formation of CO_2 is more than that of Al_2O_3
(3) pure carbon is not easily available (4) the heat of formation of Al_2O_3 is too high

21. Roasting is carried out in how many of the following ores-
(1) galena (2) iron pyrites (3) copper glance (4) Calamine
(5) Siderite

22. How many of the following metals can be extracted by carbon reduction?
(1) Pb (2) Fe (3) Zn (4) Al.

23. In the extraction of Cu how many reaction does not take place in Bessemer converter :
(1) $2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$ (2) $2CuFeS_2 + O_2 \rightarrow Cu_2S + FeS + SO_2$
(3) $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$ (4) $2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$

24. How many of the following statements are correct about the extractive metallurgy of copper ?
(1) Matte chiefly consists of iron sulphide and some ferrous oxide.
(2) The impurity of iron sulphide is removed as fusible slag, $FeSiO_3$ during roasting.
(3) The copper pyrite is concentrated by froth floatation process.
(4) Copper is obtained by carbon reduction in bessemer converter.

25. How many of the following rows are correctly matched :

	Column I		Column II
I.	Cyanide process.	$\rightarrow$	Ultra pure Ge
II.	Froth floatation process.	$\rightarrow$	Pine oil.
III.	Electrolytic reduction.	$\rightarrow$	Extraction of Al.
IV.	Zone refining.	$\rightarrow$	Extraction of Au.

Give your answer in the form of sum of row numbers

Practice Test-1 (IIT-JEE (Main Pattern))

OBJECTIVE RESPONSE SHEET (ORS)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25					
Ans.										

PART - II : JEE (MAIN) / AIEEE OFFLINE PROBLEMS (PREVIOUS YEARS)

1. Refining of impure copper with zinc impurity is to be done by electrolysis using electrodes as : **[AIEEE-2002, 3/225]**

Cathode	Anode	Cathode	Anode
(1) pure copper	pure zinc	(2) pure zinc	pure copper
(3) pure copper	impure copper	(4) pure zinc	impure zinc

2. Aluminium is extracted by the electrolysis of : **[AIEEE-2002, 3/225]**
(1) alumina (2) bauxite
(3) molten cryolite (4) alumina mixed with molten cryolite

3. The metal extracted by leaching with a cyanide is : **[AIEEE-2002, 3/225]**
(1) Mg (2) Ag (3) Cu (4) Na

4. Which one of the following ores is best concentrated by froth floatation method ? **[AIEEE-2004, 3/225]**
(1) magnetite (2) cassiterite (3) galena (4) malachite.

5. Heating mixture of Cu_2O and Cu_2S will give : **[AIEEE-2005, 3/225]**
(1) Cu_2SO_3 (2) CuO + CuS (3) Cu + SO_3 (4) Cu + SO_2

6. During the process of electro-refining of copper some metals present as impurity settle as anode mud. These are : **[AIEEE-2005, 3/225]**
(1) Sn and Ag (2) Pb and Zn (3) Ag and Au (4) Fe and Ni

7. 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 ? **[AIEEE-2008, 3/105]**
(1) CO_2 is thermodynamically more stable than CS_2
(2) Metal sulphides are less stable than the corresponding oxides
(3) CO_2 is more volatile than CS_2
(4) Metal sulphides are thermodynamically more stable than CS_2

8. Which method of purification is represented by the following equation : **[AIEEE-2012, 4/120]**

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

(1) Zone refining (2) Cupellation (3) Polling (4) Van Arkel

9. In the context of the Hall-Heroult process for the extraction of Al, which of the following statements is false? **[JEE-Main 2015, 4/120]**
(1) CO and CO_2 are produced in this process
(2) Al_2O_3 is mixed with CaF_2 which lowers the melting point of the mixture and brings conductivity
(3) Al^{3+} is reduced at the cathode to form Al
(4) Na_3AlF_6 serves as the electrolyte

10. Which one of the following ores is best concentrated by froth floatation method? **[JEE-Main 2016, 4/120]**
(1) Siderite (2) Galena (3) Malachite (4) Magnetite

11. When metal 'M' is treated with NaOH, a white gelatinous precipitate 'X' is obtained, which is soluble in excess of NaOH. Compound 'X' when heated strongly gives an oxide which is used in chromatography as an adsorbent. The metal 'M' is : **[JEE-Main 2018, 4/120]**
(1) Al (2) Fe (3) Zn (4) Ca

PART - III : NATIONAL STANDARD EXAMINATION IN CHEMISTRY (NSEC) STAGE-I

1. Which of the following metal is extracted by thermal reduction process : **[NSEC-2000]**
(A) Al (B) Fe (C) Cu (D) Mg

2. In the gold plating process, sodium cyanide solution is used as an electrolyte instead of nitric acid because
(A) cyanide forms a complex with gold and thus helps uniform deposition of gold. **[NSEC-2003]**
(B) sodium cyanide is a better solvent for gold ions.
(C) cyanide binds with impurity ions and keeps the impurities in solution.
(D) deposition of gold from nitric acid bath is slow.

3. Goldsmiths use borax while making gold jewelry. They heat the mixture of a gold sample and borax on a flame, through which air is passed using a blow pipe because **[NSEC-2003]**

(A) heat and air convert the impurities into their oxides that react with molten borax forming a slag which can be separated from gold

(B) gold oxide formed by heat and air gets reduced by borax to pure gold

(C) air increases the heating temperature at which gold dissolves in borax, and on cooling gets recrystallised in pure form

(D) borax reduces the hardness of gold at high temperature so that it can be stretched to form jewelry easily.

4. High purity germanium is obtained by a technique that is based on **[NSEC-2004]**

(A) fractional distillation (B) recrystallization

(C) fractional crystallisation (D) diffusion.

5. The metal that cannot be displaced from its aqueous solution by zine is **[NSEC-2004]**

(A) Cu (B) Ag (C) Al (C) Hg.

6. Stainless steel contains iron along with **[NSEC-2006]**

(A) Cr + Cu + C (B) Ni + Zn + Cr (C) Cr + Ni + C (D) Ni + Cu + Mn.

7. Sapphire is a mineral of : **[NSEC-2008]**

(A) Cu (B) Zn (C) Al (D) Mg

8. Van Arkel method of purification of metals involves converting the metal to a **[NSEC-2013]**

(A) Volatile compound (B) Volatile unstable compound

(C) Non-volatile stable compound (D) Non-volatile unstable compound

9. Out of the following metal extraction processes, those in which carbon – based reduction methods are not used are **[NSEC-2014]**

(I) Sn from SnO_2 (II) Fe from Fe_2O_3 (III) Al from Al_2O_3 (IV) Mg from $MgCO_3.CaCO_3$

(A) (I) and (IV) (B) (II) and (III) (C) (III) and (IV) (D) (II) and (IV)

10. Aluminium and copper are extracted from their oxide and sulphide ores respectively. Which of the following is correct? **[NSEC-2018]**

I. Copper is extracted by the auto reduction of copper oxide by copper sulphide

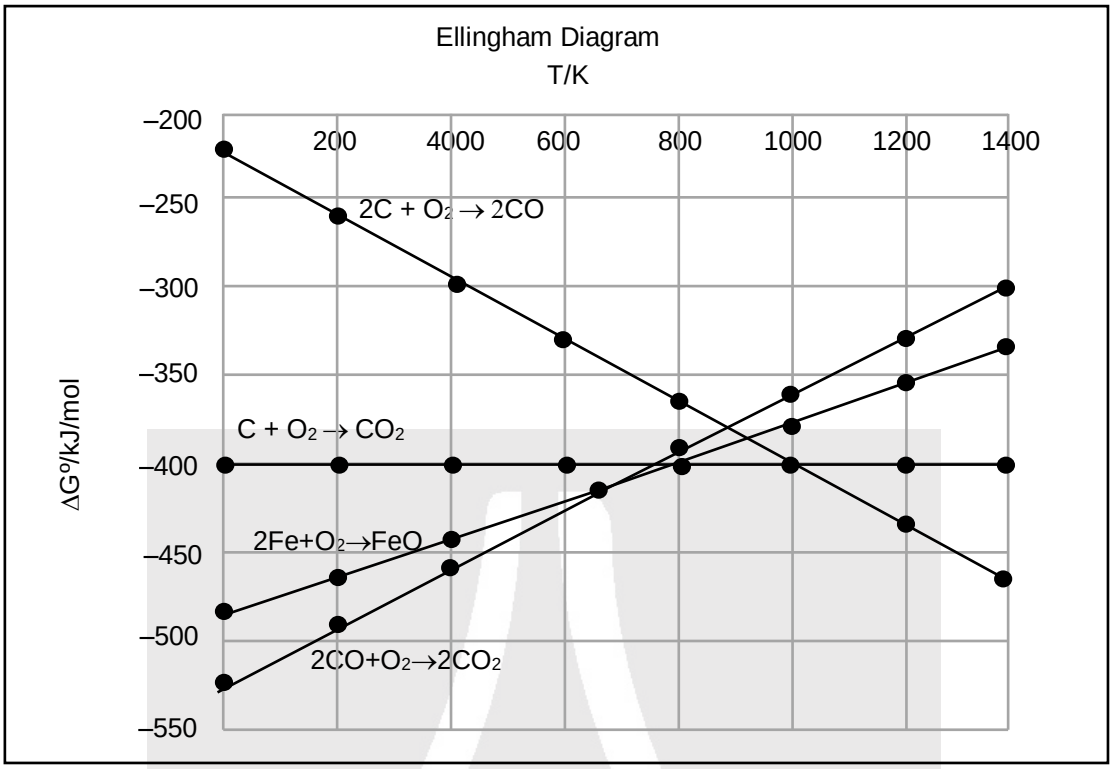
II. Aluminium cannot be obtained by chemical reduction due to its strong affinity for oxygen

III. In electrometallurgy of Al, graphite is used as cathode to avoid reoxidation of Al into Al_2O_3 by preventing formation of O_2.

IV. Sulphide ores of copper are difficult to be reduced than the oxide ores

(A) I, II, IV (B) II and III (C) II and III (D) II and IV

11. The following Ellingham diagram depicts the oxidation of 'C', 'CO' and Fe'. Which of the following is correct? **[NSEC-2019]**



FeO can be reduced by C below 600 K

II. FeO can be reduced by CO below 600 K

III. FeO can be reduced by C above 1000 K

IV. FeO can be reduced by CO above 1000 K

(A) II and III (B) I and IV (C) I and III (D) II and IV

PART - IV : ADDITIONAL THEORY

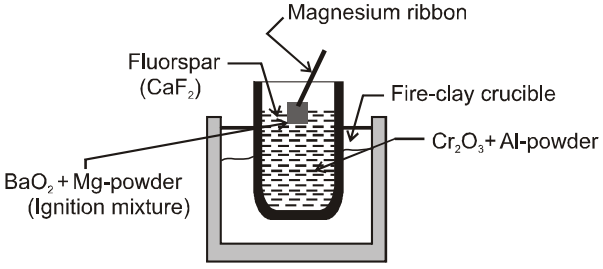
Cr_2O_3 is mixed with requisite amount of Al-powder (this mixture is called thermite mixture) and is placed in a large fire-clay crucible. An intimate mixture of Na_2O_2 or BaO_2 and Mg powder (called *ignition mixture* or *igniter)* is placed in a small depression made in the thermite mixture. The crucible is surrounded by sand which prevents the loss of heat by radiation. A piece of Mg ribbon is struck into the ignition mixture and the charge is covered by a layer of fluorspar (CaF_2) which acts as a heat insulator. Now Mg-ribbon is ignited so that ignition mixture catches fire and flame is produced, leading to a violent reaction between Mg and BaO_2 with the evolution of large amount of heat.

$$Mg + BaO_2 \rightarrow BaO + MgO + Heat$$

Heat produced in the above reaction makes Cr_2O_3 and Al-powder react together.

$$Cr_2O_3 + Al \rightarrow 2Cr\ (\ell) + Al_2O_3$$

Molten Cr-metal formed settles down at the bottom of the crucible.



Reduction of Cr_2O_3 by Al-powder (Aluminothermic process).

An application of aluminothermic process has been used for joining the broken pieces of iron (welding). In this process thermite mixture consisting of Fe_2O_3 and Al-powder in 3 : 1 ratio is placed in a funnel shaped crucible lined internally with magnesite and having a plug hole at its bottom. The thermite mixture is covered with a mixture of BaO_2 plus Mg-powder (ignition mixture) in which a piece of Mg ribbon is inserted. The ends of the iron pieces to be welded are thoroughly cleaned and surrounded by a fire-clay mould. When Mg ribbon is ignited, ignition mixture catches fire and Fe_2O_3 gets reduced to Fe by Al-powder.

Leaching pitch blends with H_2SO_4 or sodium carbonate to dissolve uranium:

$$U_3O_8 + 3\ Na_2CO_3 + \frac{1}{2}O_2 \longrightarrow 3\ Na_2UO_4 + 3\ CO_2$$

$$U_3O_8 + 3\ H_2SO_4 + \frac{1}{2}O_2 \longrightarrow 3\ UO_2SO_4 + 3\ H_2O$$

Precipitation of $Mg(OH)_2$ from sea water using lime solution :

$$MgCl_2 + Ca(OH)_2 \longrightarrow Mg(OH)_2 + CaCl_2.$$

Oxidation Reduction :

Besides reductions, some extractions are based on oxidation particularly for non-metals.

(a) A very common example of extraction based on oxidation is the extraction of chlorine from brine (chlorine is abundant in sea water as common salt).

$$2Cl^-(aq) + 2H_2O(l) \longrightarrow 2OH^-(aq) + H_2(g) + Cl_2(g)$$

The ΔG^o for this reaction is + 422 kJ. When it is converted to E^o (using $\Delta G^o = -nE^oF$), we get $E^o = -2.2$ V. Naturally, it will require an external e.m.f. that is greater than 2.2 V. But the electrolysis requires an excess potential to overcome some other hindering reactions. Thus, Cl_2 is obtained by electrolysis giving out H_2 and aqueous NaOH as by-products. Electrolysis of molten NaCl is also carried out. But in that case, Na metal is produced and not NaOH.

From Magnesite : The concentrated ore is calcined at higher temperature

$$MgCO_3 \xrightarrow[\text{Strongly}]{\text{Heated}} MgO + CO_2$$

The calcined ore is heated with coke in a current of dry chlorine gas.

$$MgO + C + Cl_2 \xrightarrow{\Delta} MgCl_2 + CO$$

The magnesium chloride is fused and then electrolysed.

☞ MgO + C (Other reducing agents like Si, Al can be used) $\xrightarrow[\text{Vaccume}]{2000^oC}$ Mg + CO

PART - V : PRACTICE TEST-2 (IIT-JEE (ADVANCED Pattern))

Max. Time : 1 Hr. **Max. Marks : 66**

Important Instructions

A. General :

1. The test is of 1 hour duration.
2. The Test Booklet consists of 22 questions. The maximum marks are 66.

B. Question Paper Format :

3. Each part consists of five sections.
4. Section-1 contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE is correct.
5. Section-2 contains 5 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE OR MORE THAN ONE are correct.
6. Section-3 contains 6 questions. The answer to each of the questions is a single-digit integer, ranging from 0 to 9 (both inclusive).
7. Section-4 contains 1 paragraphs each describing theory, experiment and data etc. 3 questions relate to paragraph. Each question pertaining to a partcular passage should have only one correct answer among the four given choices (A), (B), (C) and (D).
8. Section-5 contains 1 multiple choice questions. Question has two lists (list-1 : P, Q, R and S; List-2 : 1, 2, 3 and 4). The options for the correct match are provided as (A), (B), (C) and (D) out of which ONLY ONE is correct.

C. Marking Scheme :

9. For each question in Section-1, 4 and 5 you will be awarded 3 marks if you darken the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (–1) mark will be awarded.
10. For each question in Section-2, you will be awarded 3 marks. If you darken all the bubble(s) corresponding to the correct answer(s) and zero mark. If no bubbles are darkened. No negative marks will be answered for incorrect answer in this section.
11. For each question in Section-3, you will be awarded 3 marks if you darken only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. No negative marks will be awarded for incorrect answer in this section.

SECTION-1 : (Only One option correct Type)

This section contains 7 multiple choice questions. Each questions has four choices (A), (B), (C) and (D) out of which Only ONE option is correct.

1. Give the correct order of initials **T** or **F** for following statements. Use **T** if statement is true and **F** if it is false.
(i) In Gold Schmidt thermite process aluminium acts as a reducing agent.
(ii) Mg is extracted by electrolysis of aqueous solution of $MgCl_2$
(iii) Extraction of Pb is possible by carbon reduction of PbO in smelting.
(iv) Red bauxite is purified by Serpeck`s process
(A) T T T F (B) T F F T (C) F T T T (D) T F T F

2. Leaching of Ag_2S is carried out by heating it with a dilute solution of :
(A) NaCN only (B) HCl (C) NaOH (D) NaCN in presence of O_2

3. In which of the following pair of metals, both are commercially extracted from their respective ores by self reduction method ?
(A) Zn, Cu (B) Pb, Cu (C) Sn, Zn (D) Al, Ag

4. Consider the following isolation / purification processes.
(I) Heating impure metal with I_2 at 150–200ºC and passing the resulting volatile iodide on hot tungsten filament at 1400ºC to get the pure metal.
(II) Heating the sulphide ore in air until a part is converted to oxide and then further heating in the absence of air to let the oxide react with unchanged metal sulphide to get the metal.
(III) Electrolysis of the molten electrolyte containing metal oxide and cryolite or florspar to obtain the metal.
The processes used for obtaining aluminium, titanium and lead are respectively :
(A) (I), (II) and (III) (B) (II), (III) and (I)
(C) (III), (I) and (II) (D) (II), (I) and (III)

5. **Consider the following statements :**
S_1 : In extraction of iron from haematite ore, the reduction reactions take place only in the lower temperature range in the blast furnace.
S_2 : Calamine is an carbonate ore of zinc.
S_3 : The principal ore of aluminium, bauxite, usually contains silica, iron oxides and titanium oxide as impurities.
S_4 : Solidified copper obtained from silica lined convertor (Bessemer converter) has blistered appearance due to the evolution of SO_2.
and arrange in the order of true/false.
(A) F T T T (B) F T F F (C) F F T T (D) T F F T

6. In the extraction of aluminium
Process X : employed for red bauxite to remove iron oxide (main impurity)
Process Y : (Serpeck`s process) : used for white bauxite to remove Z (main impurity) then,
Select correct option for the process X and impurity Z.
(A) X = Hall and Heroult`s process and Z = SiO_2
(B) X = Bayer`s process and Z = SiO_2
(C) X = Serpeck`s process and Y = iron oxide
(D) X = Bayer`s process and Y = iron oxide

7. Which of the following metals may be present in the anode mud during electrorefining of copper?
I. Gold ; II. Iron, III. Silver ; IV Magnesium
(A) I and II (B) II and IV (C) I and III (D) III and IV

Section-2 : (One or More than one options correct Type)

This section contains 5 multipole choice questions. Each questions has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

8. Select the correct statement :
(A) Dolomite contains both magnesium and calcium.
(B) Extraction of lead from galena involves roasting in limited supply of air at moderate temperature followed by self reduction at higher temperature (to melt the charge).
(C) Extraction of zinc from zinc blende involves roasting followed by reduction with carbon.
(D) The chemical composition of 'slag' formed during the extraction of iron and copper is $FeSiO_3$.

9. The reaction(s) which does (do) not occur in the reduction zone in the extraction of iron from haematite ore is (are) :
(A) $Fe_2O_3 + CO \rightarrow 2\,FeO + CO_2$ (B) $FeO + CO \rightarrow Fe + CO_2$
(C) $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$ (D) $CaO + SiO_2 \rightarrow CaSiO_3$

10. Which of the following is a correct statement ?
(A) Calamine is the ore of zinc. (B) Proustite is the ore of silver.
(C) Cassiterite is the ore of tin. (D) Diaspore is the ore of aluminium.

11. Froth floatation :
(A) is a physical method of separating mineral from the gangue
(B) is a method of concentration of ore depending on the difference in wetability of gangue and the ore particles.
(C) is used for the concentration of sulphide ores
(D) is a method in which impurities sink to the bottom and ore particles pass on to the surface with froth.

12. Which of the following reduction reactions are actually employed in commercial extraction of metals?
(A) $Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$
(B) $Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr$
(C) $2Na[Au(CN)_2] + Zn \rightarrow Na_2[Zn(CN)_4] + 2Au$
(D) $Cu_2S + 2CuO \rightarrow 6Cu + SO_2$

Section-3 : (One Integer Value Correct Type.)

This section contains 6 questions. Each question, when worked out will result in one integer from 0 to 9 (both inclusive)

13. The minimum potential difference needed to reduce Al_2O_3 at 500ºC is :
The reaction for decomposition is :

$$\frac{2}{3}Al_2O_3 \longrightarrow \frac{4}{3}Al + O_2 \qquad \Delta G = +\,960\ kJ \text{ at } 500^oC.$$

(Report your answer as potential difference × 2)

14. How many of the following minerals are oxides of metals/metalloids.

(i) Bauxite	(ii) Corundum	(iii) Dolomite
(iv) Malachite	(v) Magnetite	(vi) Pyrolucite
(vii) Argentite	(viii) Horn silver	(ix) Quartz
(x) Cryolite	(xi) Siderite	(xii) Zincite
(xiii) Calamine	(xiv) Syline	(xv) Carnellite

15. Calculate number of metals which can be extracted by self reduction method –
Cu, Al, Fe, Mg, Zn, Sb, Sn, Pb

16. Poling process is applied when impurity is a compound of a metal and a non-metal. Atomic number of non-metal is ..... .

17. How many of following metals can be purified by electro refining by using metal as impure anode.
Cu, Al, Pb, Sn, Ag, Zn, Ca, Mg

18. How many of the following refining processes are correctly matched with their element ?
Liquation-Tin, Fractional distillation-Zinc, Zone refining-Germanium, Poling-Tin, Van Arkel-Titanium, Cupellation-Silver.

SECTION-4 : Comprehension Type (Only One options correct)

This section contains 1 paragraphs, each describing theory, experiments, data etc. 3 questions relate to the paragraph. Each question has only one correct answer among the four given options (A), (B), (C) and (D)

Paragraph for Questions 19 to 21

Metallic gold frequently is found in aluminosilicate rocks and it is finely dispersed among other minerals. It may be extracted by treating the crushed rock with aerated sodium cyanide solution. During this process metallic gold is slowly converted to $[Au(CN)_2]^-$, which is soluble in water. After equilibrium has been reached, the aqueous phase is pumped off and the metallic gold is recovered from it by reacting the gold complex with zinc, which is converted to $[Zn(CN)_4]^{2-}$. Gold in nature is frequently alloyed with silver which is also oxidised by aerated sodium cyanide solution.

19. The correct ionic reaction for the process are
(A) $4Au + 8CN^- + 2H_2O + O_2\,(air) \rightarrow 4[Au(CN)_2]^-\,(soluble) + 4OH^-$
(B) $Au + 2CN^- \longrightarrow Au[(CN)_2]^-$
(C) $Zn + 2CN^- \longrightarrow Zn[(CN)_2]^-$
(D) $Zn + 4CN^- \longrightarrow Zn[(CN)_4]^{2-}$

20. There have been several efforts to develop alternative gold extraction processes which could replace this one. Why ?
(A) Sodium cyanide solutions corrode mining machinery
(B) Sodium cyanide escapes into ground water and produces hydrogen cyanide which is toxic to many animals.
(C) Gold obtained by this process is not pure.
(D) The amount of gold in aluminosilicate rocks is very less.

21. The process described above in the passage is represents :
(A) ore concentration
(B) pyrometallurgical extraction
(C) hydrometallurgical extraction
(D) purification of metal

SECTION-5 : Matching List Type (Only One options correct)

This section contains 1 questions, each having two matching lists. Choices for the correct combination of elements from List-I and List-II are given as options (A), (B), (C) and (D) out of which one is correct.

22. Match the name of the processes given in **column-I** with type(s) of metallurgical methods given in **column-II**.

	Column – I		**Column – II**
(P)	Hall–Heroult process	**(1)**	Molten $Al_2O_3 + Na_3AlF_6$ electrolysis.
(Q)	Dow's sea water process	**(2)**	Molten $MgCl_2 + CaCl_2 + NaCl$ electrolysis.
(R)	Hoop's process	**(3)**	Molten impure aluminium + fluorides of Na^+, Ba^{2+} and Al^{3+} electrolysis.
(S)	Mac-Arthur Forrest process	**(4)**	Complex formation and displacement method.

Code :

	P	Q	R	S		P	Q	R	S
(A)	4	2	3	1	(B)	1	2	4	3
(C)	2	1	3	4	(D)	1	2	3	4

Practice Test-2 ((IIT-JEE (ADVANCED Pattern))

OBJECTIVE RESPONSE SHEET (ORS)

Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.										
Que.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Ans.										
Que.	**21**	**22**								
Ans.										

APSP Answers

PART - I

1.	(1)	**2.**	(2)	**3.**	(3)	**4.**	(1)	**5.**	(4)
6.	(4)	**7.**	(3)	**8.**	(2)	**9.**	(2)	**10.**	(3)
11.	(2)	**12.**	(2)	**13.**	(4)	**14.**	(2)	**15.**	(1)
16.	(2)	**17.**	(1)	**18.**	(1)	**19.**	(2)	**20.**	(4)
21.	(3)	**22.**	(3) (1, 2 & 3)	**23.**	(3)	**24.**	2 (2 & 3)	**25.**	5 (2 + 3)

PART - II

1.	(3)	**2.**	(4)	**3.**	(2)	**4.**	(3)	**5.**	(4)
6.	(3)	**7.**	(3)	**8.**	(4)	**9.**	(4)	**10.**	(2)
11.	(1)								

PART - III

1.	(B)	**2.**	(A)	**3.**	(A)	**4.**	(C)	**5.**	(C)
6.	(C)	**7.**	(C)	**8.**	(B)	**9.**	(C)	**10.**	(A)
11.	(A)								

PART - V

1.	(D)	**2.**	(D)	**3.**	(B)	**4.**	(C)	**5.**	(A)
6.	(B)	**7.**	(C)	**8.**	(ABC)	**9.**	(CD)	**10.**	(ABCD)
11.	(ABCD)	**12.**	(BCD)	**13.**	5	**14.**	06	**15.**	3
16.	8	**17.**	08	**18.**	6	**19.**	(A)	**20.**	(B)
21.	(C)	**22.**	(D)						

APSP Solutions

PART – I

1. Lighter gangue particles are washed in a current of water by a process called levigation. In levigation the powdered ore is agitated with water or washed with a upward stream of running water, the lighter particles of sand, clay etc are washed away leaving behind heavier ore particles.

2. Hydraulic washing or Gravity separation or Levigation method is based on the difference in the densities of the gangue and ore particles.

3. This method is commonly used for the concentration of the low grade sulphide ores like galena, PbS (ore of Pb) ; copper pyrites $CuFeS_2$ (ore of copper) ; zinc blende, ZnS (ore of zinc) etc., and is based on the fact that gangue and ore particles have different degree of wettability with water and pine oil; the gangue particles are preferentially wetted by water while the ore particles are wetted by oil.

4. An ore of tin containing $FeCr_2O_4$ is concentrated by magnetic separation as $FeCr_2O_4$ is ferromagnetic.

5. Roasting removes easily oxidisable volatile impurities like arsenic (as As_2O_3), sulphur (as SO_2), phosphorus (as P_4O_{10}) and antimony (as Sb_2O_3).

$4M\ (M = As, Sb) + 3O_2 \longrightarrow 2M_2O_3 \uparrow$

$S + O_2 \longrightarrow SO_2 \uparrow$; $P_4 + 4O_2 \longrightarrow P_4O_{10} \uparrow$

Organic matter, moisture if present in the ore, also get expelled and the ore becomes porous.

6. Conversion of a carbonate into oxide is an example of calcination

$MgCO_3 \xrightarrow[\text{absence of air}]{\Delta} MgO + CO_2 \uparrow$.

7. Acidic flux is used. It is an acidic oxide (oxide of a non-metal) like SiO_2, P_2O_5, B_2O_3 (from borax). It is used to remove the basic impurity like CaO, FeO, MgO etc. The acidic flux combines with the basic impurity and forms a slag.

8. (1) Calamine is $ZnCO_3$ and siderite is $FeCO_3$.
(2) Argentite is Ag_2S while cuprite is Cu_2O.
(3) Zinc blende is ZnS and iron pyrites is FeS_2.
(4) Malachite is $CuCO_3\ Cu(OH)_2$ and azurite is $2CuCO_3\ Cu(OH)_2$.

9. Electrolytic reduction method is used in the extraction of highly electropositive elements as they themselves are stronger reducing agents. They lie above hydrogen in electrochemical series.

10. (1) $Cu_2O + C \xrightarrow{\Delta} 2Cu + CO$; $SnO_2 + 2C$ (anthracite) $\xrightarrow{1800°C} Sn + 2CO$.
(2) $2Fe_2O_3 + 3C \longrightarrow 4Fe$ (spongy iron) $+ 3CO_2$; $ZnO + C \xrightarrow{1200°C} Zn + CO$.
(3) Oxides of highly reactive metals (like K_2O) are not reduced by carbon. K lie above hydrogen in electrochemical series and so it acts as strong reducing agent. K is obtained by electrolytic reduction of their fused salts.
(4) $FeO + C \longrightarrow Fe + CO$; $PbO + C \longrightarrow Pb + CO$

11. Cryolite is Na_3AlF_6 and is used in the electrolysis of alumina. It reduces the melting point of alumina and increase the electrical conductivity of electrolyte.

12. $Ti\ (impure) + 2I_2(g) \xrightarrow{50-250°C} TiI_4(g) \xrightarrow[\text{Tungsten filament}]{1400°C} Ti(pure) + 2I_2(g)$

13. This process is used for the purification of copper and tin to remove the impurities of their oxides.
Green wood $\rightarrow$ Hydrocarbons $\rightarrow CH_4$; $4CuO + CH_4 \rightarrow 4Cu$ (pure metal) $+ CO_2 + 2H_2O$
Green wood $\rightarrow$ Hydrocarbon $\rightarrow CH_4$; $2SnO_2 + CH_4 \rightarrow 2Sn + CO_2 + 2H_2O$

14. This process is used for the purification of the metal, which itself is readily fusible, but the impurities present in it are not, i.e., the impurities are infusible. This process is used for the purification of Sn and Zn, and for removing Pb from Zn-Ag alloy, which is obtained at the end of Parke's process and contains Pb as impurity.

15. (a) Limonite is $Fe_2O_3.3H_2O$. (b) Argentite is Ag_2S.
(c) Carnallite is $KCl.MgCl_2.6H_2O$. (d) Calamine is $ZnCO_3$.

16. (a) Bauxite is leached with NaOH (concentrated) to form soluble $Na[Al(OH)_4]$ complex and insoluble impurities are filtered off.
(b) Carbonate and hydroxide ores are heated in absence of air below their melting point to convert in to their oxides in reverberatory furnace. This is called calcination. So siderite, $FeCO_3$ is subjected to calcination.
(c) This method is commonly used for the concentration of the low grade sulphide ores like galena, PbS (ore of Pb) ; copper pyrites $CuFeS_2$ (ore of copper) ; zinc blende, ZnS (ore of zinc) etc., and is based on the fact that gangue and ore particles have dIfferent degree of wettability with water and pine oil; the gangue particles are preferentially wetted by water while the ore particles are wetted by oil.
(d) Chromite ore ($FeO.Cr_2O_3$) having magnetic properties is separated from non–magnetic silicious impurities by magnetic separator.

17. (a) **Self-reduction method :** This method is also called auto-reduction method or air reduction method. If the sulphide ore of some of the less electropositive metals like Hg, Cu, Pb etc. are heated in air, a part of these is changed into oxide or sulphate that then reacts with the remaining part of the sulphide ore to give its metal and SO_2.

$Cu_2S + 3O_2 \longrightarrow 3Cu_2O + 2\ SO_2$

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

(b) Reduction with carbon / carbon monoxide :

$2Fe_2O_3 + 3C \longrightarrow 4Fe$ (spongy iron) $+ 3CO_2$

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

$Fe_3O_4 + 4CO \longrightarrow 3Fe + CO_2$

(c) Electrolytic reduction (Hall-Heroult process) : The purified Al_2O_3 is mixed with Na_3AlF_6 (cryolite) or CaF_2 (fluorspar) which lowers the melting point of the mixture and increases conductivity. The fused matrix is electrolysed.

The electolysis of the molten mass is carried out in an electrolytic cell using carbon electrodes. The oxygen liberated at anode reacts with the carbon of anode producing CO and CO_2.

Cathode : Al^{3+} (melt) $+ 3e^- \longrightarrow Al(l)$

Anode : $C(s) + O^{2-}$ (melt) $\longrightarrow CO(g) + 2e^-$

$C(s) + 2O^{2-}$ (melt) $\longrightarrow CO_2\ (g) + 4e^-$

(d) Complex formation and displacement by metal : Extraction of Ag and Au. Metals like Au and Ag can be precipitated for their salt solution by electropositive metals for example, Zn.

Metallic Ag is dissolved from its ore in dilute NaCN solution, and the solute so obtained is treated with scrap Zn when Ag is precipitated. Air is blown into the solution oxidize Na_2S. Leaching the metals like silver, gold with CN^- is an oxidation reaction ($Ag \rightarrow Ag^+$ or $Au \rightarrow Au^+$)

$Ag_2S\ (s) + 4CN^-\ (aq) \longrightarrow 2[Ag(CN)_2]^-\ (aq) + S^{2-}\ (aq)$

$2Ag(CN)_2^-\ (aq) + Zn\ (s) \longrightarrow [Zn\ (Cn)_4]^{2-}\ (aq) + 2Ag\ (s)$

Here Zn acts as reducing agent.

18. Molten iron from blast furnace is taken in to sand pigs for solidification. Therefore iron obtained from blast furnace is called pig iron.

19. $2ZnS + 3O_2 \xrightarrow{\text{roasting}} 2ZnO + 2SO_2$; $ZnO + C \xrightarrow{1100^oC} Zn + CO$.

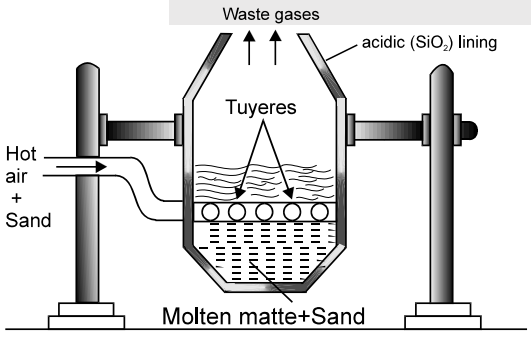
Therefore, (2) option is correct.

20. In Ellingham diagram, the $\Delta_f G^o$ of Al_2O_3 lies below that of CO_2. If reduction is carried out at very high temperature, the Al produced will react with carbon forming Al_4C_3.

21. Generally the sulphides of Zn, Pb, Fe, Cu etc. are subjected to roasting to convert in to their oxides prior to reduction by carbon.

22. Electrolytic reduction method is used in the extraction of highly electropositive elements as they themselves are stronger reducing agents. They lie above hydrogen in electrochemical series. The heat of formation of Al_2O_3 is very high and therefore, at higher temperature there will be the possibility of formation of Al_4C_3 with carbon.

23.



Bessemer convertor

Reactions involved :

$2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2$; $FeO + SiO_2 \longrightarrow FeSiO_3$

$2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$; $2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$ (self reduction)

24. In actual process the ore is heated in a reverberatory furnace after mixing with silica. In the furnace, iron oxide 'slags off' as iron silicate and copper is produced in the form of copper matte which contains mostly Cu_2S and some FeS.

25. **(I)** $4Au / Ag\ (s) + 8CN^-(aq) + 2H_2O(aq) + O_2(g) \longrightarrow 4[Au / Ag\ (CN)_2]^-(aq) + 4OH–(aq)$

$2[Au / Ag\ (CN)_2]^-(aq) + Zn(s) \longrightarrow 2Au / Ag\ (s) + [Zn(CN)_4]^{2-}\ (aq)$

(II) This method is based on the fact that gangue and ore particles have different degree of wettability with water and pine oil; the gangue particles are preferentially wetted by water while the ore particles are wetted by oil.

(III) Electrolytic reduction (Hall-Heroult process) :

The purified Al_2O_3 is mixed with Na_3AlF_6 (cryolite) or CaF_2 (fluorspar)) which lowers the melting point of the mixture and increases conductivity. The fused matrix is electrolysed. The electrolytic reactions are :

Cathode : $Al^{3+}\ (melt) + 3e^- \longrightarrow Al(l)$

Anode : $C(s) + O^{2-}\ (melt) \longrightarrow CO(g) + 2e^-$

$C(s) + 2O^{2-}\ (melt) \longrightarrow CO_2\ (g) + 4e^-$

(IV) This process is used when metals are required in very high purity, for specific application. For example pure Si and Ge are used in semiconductors and hence are purified by this method. Zone refining method is based on the principle that an impure molten metal on gradual cooling will deposit crystals of the pure metal, while the impurities will be left in the remaining part of the molten metal.

PART - II

1. Pure metal always deposits at cathode according to the following reactions.

Anode (oxidation) : $M(s) \longrightarrow M^{2+}(aq) + 2e^-$ (M = Cu, Zn, Fe)

Cathode (reduction) : $Cu^{2+}\ (aq) + 2e^- \longrightarrow Cu(s)$

Thus, the net cell reaction simply involves transfer of Cu metal from the impure anode to the pure cathode, Cu obtained by this process is 99.95% pure.

2. Electrolyte consists of molten Al_2O_3, Na_3AlF_6 or CaF_2. Cryolite or fluorspar lowers the melting point and increase the conductivity of electrolyte. So option (4) is correct.

3. Silver ore forms a soluble complex when leached with NaCN solution and from which silver is precipitated using scrap zinc.

Ag_2S (conc. ore) + $2NaCN \underset{}{\overset{Air}{\rightleftharpoons}} 2AgCN + Na_2S$.

$4Na_2S + 5O_2 + 2H_2O \longrightarrow 2Na_2SO_4 + 4NaOH + 2S$

Na_2S is converted in to Na_2SO_4. Hence equilibrium shifts towards right side.

$AgCN + NaCN \longrightarrow Na[Ag(CN)_2]$ (soluble complex).

4. Froth-floatation method is used for the concentration of sulphide ores. The method is based on the preferential wetting properties with the frothing agent and water. Here galena (PbS) is the only sulphide ore.

5. $2Cu_2O + Cu_2S \xrightarrow{\Delta} 6Cu + SO_2$. (self reduction)

6. Anode mud contains Ag, Pt, Sb, Se, Te and Au as impurities. (NCERT)

7. (3) It is true that this statement has no significance for roasting sulphide ores to the oxides.

The Gibb's energies of formation of most sulphides are greater than that for CS_2. In fact, CS_2 is an endothermic compound. There, the $\Delta_f G^\ominus$ of M_XS is not compensated. So reduction of M_XS is difficult. Hence it is common practice to roast sulphide ores to corresponding oxides prior to reduction.

8. The process is known as Van Arkel method.

9. (1) In this process, carbon anode is oxidised to CO and CO_2.

(2) It is a fact

(3) At cathode, Al^{3+} from Al_2O_3 is reduced to Al.

(4) Al_2O_3 is the electrolyte, which is undergoing the redox process. So, Al_2O_3 serves as electrolyte and Na_3AlF_6, although an electrolyte, serves as solvent.

10. Galena = PbS
For sulphur ores froth floatation is carried out.

11. $(A\ell)M + NaOH \longrightarrow (X)A\ell(OH)_3\downarrow \xrightarrow{\Delta} A\ell_2O_{3(s)}$

Gelatinous white ppt — Silica Gel. used as adsorbent in chromatography

$\xrightarrow[\text{Excess}]{NaOH} Na[Al(OH)_4]_{aq}$ soluble in water

PART - V

1. (i) $\overset{+3}{Cr}_2O_3 + 2\overset{0}{Al} \xrightarrow{\Delta} \overset{+3}{Al}_2O_3 + 2\overset{0}{Cr}$

(ii) Mg is extracted by electrolytic reduction of fused $MgCl_2$. As Mg lies above hydrogen in electrochemical series.

(iii) $PbO + C \xrightarrow{\Delta} Pb + CO$; $CaO + SiO_2 \xrightarrow{\Delta} CaSiO_3$

(iv) Red bauxite (contains impurity of iron oxide) is purified by Bayer's / Hall's process.

2. Ag_2S (conc. ore) + $2NaCN \overset{Air}{\rightleftharpoons} 2AgCN + Na_2S$.

Ag_2S and AgCN are in equilibrium so Na_2S is oxidised by air in to Na_2SO_4. Hence equilibrium shifts towards right side.

$4Na_2S + 5O_2 + 2H_2O \longrightarrow 2Na_2SO_4 + 4NaOH + 2S$

$AgCN + NaCN \longrightarrow Na[Ag(CN)_2]$ (soluble complex)

$2Na[Ag(CN)_2] + Zn\ (dust) \longrightarrow 2Ag\downarrow + Na_2[Zn(CN)_4]$.

3. (i) Extraction of tin (carbon reduction) :

$SnO_2 + C \rightarrow SnO + CO\uparrow$

(ii) Extraction of zinc (carbon reduction) :

$ZnO + C \xrightarrow{coke,673} Zn + CO$

(iii) Extraction of lead (self reduction) :

$PbS + 2O_2 \longrightarrow PbSO_4$; $PbS + 3O_2 \longrightarrow 2PbO + 2SO_2$

$PbS + 2PbO \longrightarrow 3Pb + SO_2$; $PbS + PbSO_4 \longrightarrow 2Pb + 2SO_2$

(iv) Extraction of copper (self reduction) :

$2CuFeS_2 + 4O_2 \longrightarrow Cu_2S + 2FeO + 3SO_2$

$Cu_2S + FeO + SiO_2 \longrightarrow FeSiO_3$ (fusible slag) + Cu_2S (matte)

$2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$; $2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$

(v) Extraction of aluminium (electrolytic reduction, Hall-Heroult process) :

The purified Al_2O_3 is mixed with Na_3AlF_6 (cryolite) or CaF_2 (fluorspar)) which lowers the melting point of the mixture and increases conductivity. The fused matrix is electrolysed.

Cathode : Al^{3+} (melt) + $3e^- \longrightarrow Al(l)$

Anode : $C(s) + O^{2-}(melt) \longrightarrow CO(g) + 2e^-$

$C(s) + 2O^{2-}(melt) \longrightarrow CO_2(g) + 4e^-$

(vi) Extraction of gold/silver (leaching and displacement method) :

$4Au / Ag\ (s) + 8CN^-(aq) + 2H_2O(aq) + O_2(g) \longrightarrow 4[Au / Ag\ (CN)_2]^-(aq) + 4OH^-(aq)$

$2[Au / Ag\ (CN)_2]^-(aq) + Zn(s) \longrightarrow 2Au / Ag\ (s) + [Zn(CN)_4]^{2-}\ (aq)$

4. (I) $Ti\ (s)\ (impure) + 2I_2(g) \xrightarrow{150-250^oC} TiI_4\ (volatile) \xrightarrow[\text{tungsten filament}]{1400^oC} Ti\ (s)\ (pure) + 2I_2\ (g)$

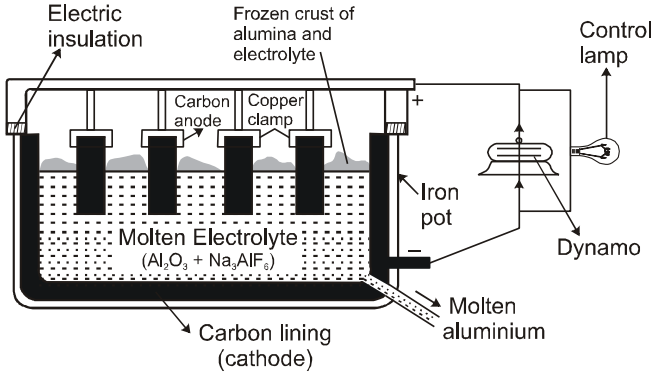
(II) $2PbS + 3O_2 \xrightarrow{\Delta} 2PbO + 2SO_2$

$PbS + 2PbO \xrightarrow[\text{temp.}]{\text{high}} 3Pb + SO_2$

(III) Cathode : $Al^{3+}(melt) + 3e^- \longrightarrow Al(l)$

Anode : $C(s) + O^{2-}(melt) \longrightarrow CO(g) + 2e^-$

$C(s) + 2O^{2-}(melt) \longrightarrow CO_2(g) + 4e^-$



5. S_1 : At 500–800 K (lower temperature range in the blast furnace)

$3\,Fe_2O_3 + CO \longrightarrow 2\,Fe_3O_4 + CO_2$

$Fe_3O_4 + CO \longrightarrow 3Fe + 4\,CO_2$

$Fe_2O_3 + CO \longrightarrow 2FeO + CO_2$

At 900–1500 K (higher temperature range in the blast furnance): $FeO + CO \longrightarrow Fe + CO_2$

S_2 : calamine is $ZnCO_3$

S_3 : It contains Fe_2O_3, SiO_2 and TiO_2 as impurities

S_4 : The surface of solidified copper has blistered like appearances due to the evolution of SO_2 and so it is called blister copper.

6. (X) Red bauxite contains the impurities of oxides of iron and silicates. In Bayer process, alumina is dissolved by reacting sodium hydroxide solution leaving behind the insoluble oxide of iron.

(Y) White bauxite contains the impurity of silica which is removed by Serpeck's method.

$Al_2O_3 + N_2 + 3C \xrightarrow{1800^\circ C} 2AlN + 3CO$; $SiO_2 + 2C \xrightarrow{1800^\circ C} Si\uparrow + 2CO\uparrow$

$AlN + 3H_2O \longrightarrow Al(OH)_3\downarrow + NH_3$; $2Al(OH)_3 \xrightarrow{\Delta} Al_2O_3 + 3H_2O$.

7. Anode mud contains Ag, Au as impurities.

8. (A) dolomite is $CaCO_3.MgCO_3$

(B) $2PbS + 3O_2 \xrightarrow{\text{Roasting}} 2PbO + 2SO_2$; $PbS + 2PbO \xrightarrow{\text{Self reduction}} 3Pb + SO_2$

(C) $2ZnS + 3O_2 \xrightarrow{\text{Roasting}} 2ZnO + 2SO_2$; $ZnO + C \xrightarrow{\text{Carbon reduction}} Zn + CO$

(D) In extraction of iron the slag obtained is $CaSiO_3$ where as in copper it is $FeSiO_3$.

9. $C + O_2 \longrightarrow CO_2$ (combustion zone)

$C + CO_2 \longrightarrow 2CO$ (fusion zone) ; $FeO + C \longrightarrow Fe + CO$ (fusion zone)

$CaO + SiO_2 \longrightarrow CaSiO_3$ (slag formation zone) ; $FeO + CO \longrightarrow Fe + CO_2$ (slag formation zone)

$3Fe_2O_3 + CO \longrightarrow 2Fe_3O_4 + CO_2$ (reduction zone) ; $Fe_3O_4 + CO \longrightarrow 3FeO + CO_2$ (reduction zone)

10. (A) Calamine, $ZnCO_3$ is the ore of zinc. (B) Proustite, Ag_3AsS_3 is the ore of silver.

(C) Cassiterite, SnO_2 is the ore of tin. (D) Diaspore, $Al_2O_3.H_2O$ is the ore of aluminium.

11. This method is commonly used for the concentration of the low grade sulphide ores like galena, PbS (ore of Pb); copper pyrites $CuFeS_2$ (ore of copper); zinc blende, ZnS (ore of zinc) etc., and is based on the fact that gangue and ore particles have dIfferent degree of wettability with water and pine oil; the gangue particles are preferentially wetted by water while the ore particles are wetted by oil.

12. (A) $2Al + Fe_2O_3 \longrightarrow Al_2O_3 + 2Fe$ (molten); $\Delta H = -3230$ kJ (The reaction is used for thermite welding)

(B) Aluminonthermic process : $Cr_2O_3 + Al \rightarrow 2Cr$ (molten) + Al_2O_3

(C) Extraction of gold : $4Au\,(s) + 8\,CN^-\,(aq) + O_2\,(g) + 2H_2O\,(l) \longrightarrow 4\,[Au(CN)_2]^-\,(aq) + 4OH^-\,(aq)$

$2[Au(CN)_2]^-\,(aq) + Zn\,(s) \longrightarrow [Zn(CN)_4]^{2-}\,(aq) + 2\,Au\,(s)$

(D) Self-reduction method : $Cu_2S + 3O_2 \longrightarrow 3Cu_2O + 2\,SO_2$; $2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$

13. Hence, the change in oxidation number of aluminium is 3 per mole. Since 4/3 moles of Al are produced
$n = 3 \times 4/3 = 4$

$$E_{ext} = \frac{960000}{4 \times 96490} = 2.5 \text{ V}$$

A potential difference of at least 2.5 V must be applied to the oxide to bring about reduction.

14. (i), (ii), (v), (vi), (ix), (xii)

15. Self reduction method can be used for Cu, Pb, and Sb

16. Impurity is of metal oxide.

17. Cu, Pb, Sn, Zn, Ag : In aqueous medium
Al, Ca, Mg : In molten state

19. Dissolution of gold in NaCN forming soluble complex is reversible, so it is carried out in presence of air bubbling. Oxygen contained in air oxidises Au to Au^+ which then complexes with CN^- to form soluble complex.

20. (B) HCN produced with water by NaCN and KCN is poisonous and have carcinogenic activity.

21. The process which involves the dissolution of ore in to a suitable reagent and then extraction of metal from the solution by more electropositive element is called hydrometallurgy.

22. (A) Hall- Heroult process is the electrolytic reduction of molten Al_2O_3 dissolved in cryolite or fluorspar.
(B) Dow's sea water process involves the isolation of Mg from sea water as $MgCl_2$ and then electrolytic reduction of molten $MgCl_2$ dissolved in $CaCl_2$ and NaCl.
(C) Hoop's process is the electrolytic purification of impure aluminium. The cell has three liquid layers upper most layer containts impure Al, middle one contains fluorides of Na^+, Ba^{2+} and Al^{3+}, lower most layer has pure Al (obtained by cathodic oxidation).
(D) Mac-Arthur forest cyanide process is the process used for the extraction of gold and silver. Extraction of gold and silver involves leaching the metal with CN^-. The metal is later recovered by displacement method.