EXERCISE-01 CHECK YOUR GRASP

SELECT THE CORRECT ALTERNATIVE (ONLY ONE CORRECT ANSWER)

1. The most abundant element found in the earth's crust is:-

(A) Tin (B) Hydrogen (C) Silicon (D) Oxygen

2. Which of the following element is found in its native state:-

(A) Sodium (B) Gold (C) Silver (D) Both (B) and (C)

3. Which of the following contain both calcium and magnesium:-

(A) Magnesite (B) Calamine (C) Carnalite (D) Dolomite

4. Which of the following is not an ore of Iron:-

(A) Haematite (B) Limonite (C) Cassiterite (D) Magnetite

5. Litharge is a mineral of:-

(A) Magnesium (B) Lithium (C) Lead (D) Zinc

6. Which one is mineral of manganese:-

(A) Magnesite (B) Malachite (C) Magnetite (D) Pyrolusite

7. Calamine is:-

(A) $BaCO_3$ (B) $ZnCO_3$ (C) ZnS (D) ZnO

8. Black Jack is:-

(A) Silicate ore (B) Oxide ore (C) Carbonate ore (D) Sulphide ore

9. Pyrolusite is:-

(A) MnO (B) Mn_3O_2 (C) SnO_2 (D) MnO_2

10. The impurities present in the ore is called:-

(A) Slag (B) Flux (C) Alloy (D) Gangue

11. Leaching method is used to concentrate the ores of:-

(A) Gold (B) Silver (C) Aluminium (D) All of these

12. Which of the following can be obtained by hydrometallurgy :-

(A) Copper (B) Gold (C) Silver (D) All of these

13. Which is wrongly mached:-

(A) Gun metal- Cu+Zn+Sn (B) Duralumin - Cu+Al+Mn

(C) German silver Cu+Zn+Ni (D) Electron Pb+Sn

14. The process of converting hydrated Alumina into anhydrous Alumina is called:-

(A) Roasting (B) Calcination (C) Smelting (D) Dressing

15. The metallurgical process in which a metal is obtained in a fused state is called:-

(A) Smelting (B) Roasting (C) Calcination (D) Froth floatation

16. Blister copper is:-

(A) Pure copper (B) Ore of copper

(C) Alloy of copper (D) Copper having 2% impurity

17. Among the following pairs of oxides, In which pair both are reduced by carbon :-

(A) SnO_2 , MnO_2 (B) Fe_2O_3, PbO (C) ZnO, K_2O (D) CaO, Cr_2O_3

18. Calomel is the name of :-

(A) $HgCl_2$ (B) Hg_2Cl_2 (C) $HgCl_2 + Hg$ (D) $Hg_2Cl_2 + Hg$

19. "Hydro metallurgy" method is used for the extraction of the following metals :-

(A) Zn & Ag (B) Ag & Cu (C) Zn & Hg (D) Hg & Cu

20. Heating of pyrites to remove sulphur is called as:-

(A) Roasting (B) Calcination (C) Smelting (D) Froth-floatation

21. In which of the following reaction "Philosopher's wool" is formed:-

(A) $Zn + S \xrightarrow{\Delta} ZnS$ (B) $Zn + Cl_2 \xrightarrow{\Delta} ZnCl_2$

(C) $FeS + O_2 \xrightarrow{\Delta} FeO + SO_2$ (D) $Zn + H_2O$ (steam) $\xrightarrow{\Delta} ZnO + H_2$

22. Which one of the following metals can not be extracted by using Al as a reducing agent :-

(A) Na from Na_2O (B) Cr from Cr_2O_3 (C) Mn from MnO_2 (D) Fe from Fe_2O_3

23. The correct set of carbonate ores is : -

(a) Magnesite (b) Siderite (c) Zincite (d) Argentite

(A) a, b (B) a, d (C) c, d (D) b, c

24. Calcination is the process of heating the ore :-

(A) in inert gas (B) in the presence of air

(C) in the absence air (D) in the presence of CaO and MgO

25. Matte :-

(A) $Cu_2S + FeS$ (B) $Cu_2O + FeS$ (C) $Cu_2O + Cu_2S$ (D) $FeS + SiO_2$

26. Which of the following statement is correct for roasting :-

(A) Convert sulphide to oxide (B) Convert sulphide to sulphate

(C) Remove arsenic and sulphur impurities (D) All

27. Among the following statements, the incorrect one is

(A) Cassiterite ore of tin contains the impurities of Wolframite which are separated by electromagnetic separator.

(B) Tin metal is obtained by the carbon reduction of black tin.

(C) In the extraction of lead from galena, the roasting and self-reduction are carried out in the same furnance at different temperature.

(D) None of these

28. Fe can displace which of the following ions from their aqueous solutions ?

(a) Na^+ (b) Zn^{2+} (c) Cu^{2+} (d) Ag^+

(A) a & b (B) b & c (C) c & d (D) b, c, d

29. There are following extraction process of silver but not :

(A) as a side product in electrolytic refining of copper

(B) Parke's process in which Zn is used to extract silver by solvent extraction from molten lead

(C) by reaction of silver sulphide with KCN and then reaction of soluble complex with Zn

(D) by heating $Na[Ag(CN_2)]$

30. Which of the following is not an ore :

(A) malacite (B) calamine (C) stellite (D) cerussite

31. In the Pidgeon process, Mg is produced by :

(A) electrolysis of fused $MgCl_2$

(B) reducing calcined dolomite with ferrosilicon at high temperature under pressure

(C) both are correct

(D) none is correct

32. "Fool's gold" is

(A) iron pyrites (B) horn silver (C) copper pyrites (D) bronze

33. Which one of the following reactions is an example for calcination process :-

(A) $2Ag + 2HCl + (O) \longrightarrow 2AgCl + H_2O$

(B) $2\ Zn + O_2 \longrightarrow 2ZnO_2$

(C) $2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$

(D) $MgCO_3 \longrightarrow MgO + CO_2$

34. Identify the process to which the following reaction belongs :

$Al_2O_3.2H_2O + Na_2CO_3 \longrightarrow 2NaAlO_2 + 2H_2O + CO_2$

$2NaAlO_2 + 2H_2O + CO_2 \xrightarrow{50-60°C} Al_2O_3.2H_2O + Na_2CO_3$

(A) Hall's process (B) Baeyer's process

(C) Serpeck's process (D) None of these

35. (Ag + Pb) alloy $\xrightarrow{\text{Melt and add zinc}}$ (Ag + Pb + Zn) melt $\xrightarrow{\text{Cool}}$ $\boxed{\frac{\text{LayerX}}{\text{LayerY}}}$

Select correct statement based on above scheme :

(A) Layer X contains zinc and silver

(B) Layer Y contains lead and silver but amount of silver in this layer is smaller than in the layer X

(C) X and Y are immiscible layers

(D) All are correct statements

36. Formation of metallic copper from the sulphide ore in the normal thermo-metallurgical process **essentially** involves which one of the following reaction :

(A) $CuS + \frac{3}{2}O_2 \longrightarrow CuO + SO_2$; $CuO + C \longrightarrow Cu + CO$

(B) $CuS + \frac{3}{2}O_2 \longrightarrow CuO + SO_2$; $2CuO + CuS \longrightarrow 3Cu + SO_2$

(C) $CuS + 2O_2 \longrightarrow CuSO_4$; $CuSO_4 + CuS \longrightarrow 2Cu + 2SO_2$

(D) $CuS + \frac{3}{2}O_2 \longrightarrow CuP + SO_2$; $CuO + CO \longrightarrow Cu + CO_2$

37. Bessemerisation is carried out for

(i) Fe (ii) Cu (iii) Al (iv) silver

(A) i, ii (B) ii, iii (C) iii, iv (D) i, iii

38. Consider the following statement :

Roasting is carried out to :

(i) convert sulphide to oxide and sulphate

(ii) remove water of hydration

(iii) melt the ore

(iv) remove arsenic and sulphur impurities

Of these statements :

(A) (i), (ii) and (iii) are correct

(B) (i) and (iv) are correct

(C) (i), (ii) and (iv) are correct

(D) (ii), (iii) and (iv) are correct

39. For extraction of sodium from NaCl, the electrolytic mixture NaCl + Na_3AlF_6 + $CaCl_2$ is used. During extraction process, only sodium is deposited on cathode but K and Ca do not because

(A) Na is more reactive than K and Ca

(B) Na is less reactive than K and Ca

(C) NaCl is less stable than Na_3AlF_6 and $CaCl_2$

(D) the discharge potential of Na^+ is less than that of K^+ and Ca^{2+} ions.

40. Among the following statements, the incorrect one is :

(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

41. Pb and Sn are extracted from their chief ore by :

(A) Carbon reduction and self reduction respectively.

(B) Self reduction and carbon reduction respectively.

(C) Electrolysis and self reduction respectively.

(D) Self reduction and electrolysis respectively.

CHECK YOUR GRASP					ANSWER KEY						EXERCISE-1				
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	D	D	D	C	C	D	B	D	D	D	D	D	D	B	A
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	D	B	B	B	A	D	A	A	C	A	D	D	C	D	C
Que.	31	32	33	34	35	36	37	38	39	40	41				
Ans.	B	A	D	A	D	B	A	C	D	B	B				

SELECT THE CORRECT ALTERNATIVES (ONE OR MORE THEN ONE CORRECT ANSWERS)

1. During the extraction of Ag and Au using a KCN solution, cyanide ions react with metal ions as
(A) a reducing agent (B) a complexing agent (C) an oxidizing agent (D) a lewis base

2. Which of the following is dolomite:-
(A) $CaCO_3$. $MgCO_3$ (B) Cu_2S Fe_2S_3 (C) CdS (D) ZnS

3. Which of the following ores is a double salt composition :-
(A) Carnallite (B) Alum (C) Dolomite (D) Cerrusite

4. The following metal- ore combination is correct :-
(A) Pb-Galena (B) Fe-siderite (C) Al-Bauxite (D) Mn-Magnesite

5. NaCN used in the froth floatation method for the purification of ore is:-
(A) ZnS which contain PbS (B) Cu_2S which contain Fe_2S_3
(C) PbS which contain ZnS (D) PbS which contain SiO_2

6. Which of the following metal can not be extracted by smelting process:-
(A) Lead (B) Zinc (C) Iron (D) Aluminium

7. The reduction of Cr_2O_3, by heating it with aluminium is known as:-
(A) Smelting (B) Roasting (C) Calcination (D) Aluminothermic process

8. Which metal is leached from its ore by the use of KCN :-
(A) Copper (B) Zinc (C) Gold (D) Iron

9. Name the flux to remove the impurity of SiO_2 :-
(A) P_4O_{10} (B) CaO (C) N_2O_5 (D) Al_2O_3

10. Mercury containers are made of:-
(A) Fe (B) Pb (C) Sn (D) Zn

11. Autoreduction process is used in the extraction of:-
(A) Cu & Pb (B) Zn & Hg (C) Cu & Al (D) Fe & Pb

12. When Alumina is electrolysed in presence of cryolite, the gas liberated at graphite anode is:-
(A) F_2 (B) O_2 (C) CF_4 (D) Cl_2

13. In the extraction of copper, metal is formed in the Bessemer converter due to reaction:-
(A) $Cu_2S + 2Cu_2O \rightarrow 6Cu + SO_2$ (B) $Cu_2S \rightarrow 2Cu + S$
(C) $Fe + Cu_2O \rightarrow 2Cu + FeO$ (D) $2Cu_2O \rightarrow 4Cu + O_2$

14. x, y and z in the following processes are respectively:-
(i) P_2O_5 + ...x..... $\rightarrow$ $Ca_3(PO_4)_2$
(ii) $2Cu_2O + Cu_2S \rightarrow$ .....y..... + $SO_2\uparrow$
(iii) $Fe_2O_3 + 3CO \rightarrow$ .....z ..... + $3CO_2\uparrow$
(A) 3Ca, $CuSO_4$, Fe (B) $3Ca(OH)_2$, 6Cu, FeO (C) 3CaO, 6Cu, 2Fe (D) $3CaO_2$, CuS, FeO

15. Which of the following process involves smelting
(A) $2\ PbS + 3O_2 \rightarrow 2PbO + 2SO_2\uparrow$ (B) $Al_2O_3.\ 2H_2O \rightarrow Al_2O_3 + 2H_2O$
(C) $Fe_2O_3 + CO \rightarrow 2Fe + 2CO_2$ (D) $Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr$ + Heat

16. Out of the following, which ores are calcinated during extraction :-

(a) Copper pyrites (b) Malachite (c) Bauxite

Correct answer is :-

(A) a, b, c (B) b, c (C) Only a (D) All

17. Which of the following match are incorrect :-

(A) Goldschmidt aluminothermite process - Cr_2O_3 (B) Mac Arther cyanide process - Fe

(C) Mond process - Ni (D) Van Arkel process – Au

18. Malachite on calcination gives $\rightarrow$'A' + CO_2 + H_2O. Compound 'A' on reduction with carbon gives $\rightarrow$CO + 'B' . Here 'A' and 'B' are :-

(A) Fe_2O_3, Fe (B) CuO, Cu (C) $CuCO_3$, CuO (D) MgO, Mg

19. Which of the following ores are calcinated during extraction :-

(A) Argentite (B) Calamine (C) Azurite (D) Copper pyrites

20. Which method of purification is represented by the following equations

$Ti + 2I_2 \xrightarrow{523K} TiI_4 \xrightarrow{1700\ K} Ti + 2I_2$

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

21. Which are correctly is matched :-

(A) Poling – refining of copper (B) Cupellation – refining of silver

(C) Smelting – An oxidation process (D) Roasting – An oxidation process

22. Which of the following reaction is a part of Serpeck's process :-

(A) $Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$

(B) $Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$

(C) $AlN + 3H_2O \rightarrow Al(OH)_3 + NH_3$

(D) $Al_2O_3.\ 2H_2O + 2Na_2CO_3 \rightarrow 2NaAlO_2 + CO_2 + 2H_2O$

23. The following equation represents a method of purification of nickel by :-

$Ni + 4CO \xrightarrow{320K} Ni(CO)_4 \xrightarrow{420K} Ni + 4CO$

impure pure

(A) Cupellation (B) Mond's process (C) Van Arkel method (D) Zone refining

24. Which substance is used as basic refractory material in furnace :-

(A) Al_2O_3 (B) SiO_2 (C) CaO (D) Fe_2O_3

25. Carbon cannot be used in the reduction of Al_2O_3 because :-

(A) it is an expensive

(B) the enthalpy of formation of CO_2 is more than that of Al_2O_3

(C) pure carbon is not easily available

(D) the enthalpy of formation of Al_2O_3 is too high

26. Which of the following reaction is not involved in themite process :-

(A) $3Mn_3O_4 + 8Al \longrightarrow 9Mn + 4Al_2O_3$ (B) $Cr_2O_3 + 2AI \longrightarrow Al_2O_3 + 2Cr$

(C) $2Fe + Al_2O_3 \longrightarrow 2Al + Fe_2O_3$ (D) $B_2O_3 + 2Al \longrightarrow 2B + Al_2O_3$

27. Which of the following reduction processes are correct :-

(A) $Fe_2O_3 + C \xrightarrow{\text{Reduction}} Fe$ (B) $ZnO + C \xrightarrow{\text{Reduction}} Zn$

(C) $SnO_2 + C \xrightarrow{\text{Reduction}} Sn$ (D) $PbO + C \xrightarrow{\text{Reduction}} Pb$

28. Consider the following steps :

$Cu_2S \xrightarrow{\text{roast in air}} A \xrightarrow{\text{Heating without air}} B$

Which is not the correct statement :

(A) it is self-reduction

(B) A is only Cu_2O & B is a mixture of Cu & SO_3

(C) A is a mixture of Cu_2O and Cu_2S and B is a mixture of Cu & SO_2

(D) all are incorrect statements

29. Main source of lead is PbS. It is converted to Pb by :-

(i) $PbS \xrightarrow[\Delta]{\text{air}} PbO + SO_2 \xrightarrow[\Delta]{C} Pb + CO_2$

(ii) $PbS \xrightarrow[\Delta]{\text{air}} PbO + PbS \xrightarrow{\Delta} Pb + SO_2$

Self reduction process is :

(A) i (B) ii (C) Both (D) None

30. $Ag_2S + NaCN \longrightarrow A$

$A + Zn \longrightarrow B$

B is a metal. Hence A and B :-

(A) $Na_2[Zn(CN)_4]$, Zn (B) $Na[Ag(CN)_2]$, Ag (C) $Na[Ag(CN)_4]$, Ag (D) $Na_3[Ag(CN)_4]$, Ag

31. $Ca_3(PO_4)_2$ is :-

(A) Thomas slag (B) Used in cement manufacturing

(C) Used in manufacturing of phosphorus fertilizer (D) Used as a refactory material

32. Bauxite is purified by :-

(A) Hall's process (B) Baeyer's process (C) Serpeck's process (D) L.D. process

33. The processes which do use catalysts are :-

(A) Contact process (B) Thermite process (C) Ostwald's process (D) Haber's process

34. Metallurgy involves steps :-

(A) concentration of ore (B) Oxidation of ore (C) purification (D) Reduction of ore

35. Which of the following metals are extracted by electrolytic reduction ?

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

36. Which of the following ores is/are oxide ore(s) ?

(A) Cassiterite (B) Bauxite (C) Cryolite (D) Haematite

37. Which of the following are correctly matched ?

(A) Schweitzer's reagent $\longrightarrow$ An ammoniacal solution of cupric sulphate

(B) Bordeaus mixture $\longrightarrow$ $CuSO_4$ and $Ca(OH)_2$

(C) Semiconductor $\longrightarrow$ Ge

(D) Horn silver $\longrightarrow$ $AgNO_3$

38. In which of the following pair(s), the minerals are converted in to metals by self-reduction process?

(A) Cu_2S, PbS (B) PbS, HgS (C) PbS, ZnS (D) Ag_2S, Cu_2S

39. Cassiterite ore (SnO_2) is purified by :-

(A) Magnetic separator (B) Roasting (C) Leaching (D) Calcination

40. The reaction(s) which does (do) not occur in the reduction zone in the extraction of iron from haematite ore is (are) :-

(A) $Fe_2O_3 + CO \rightarrow 2FeO + CO_2$

(B) $FeO + CO \rightarrow Fe + CO_2$

(C) $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$

(D) $CaO + SiO_2 \rightarrow CaSiO_3$

41. Which of the following statement(s) is (are) true ?

(A) In process of the precipitation of silver sodium dicyano argentate (I), the zinc acts as reducing agent as well as complexing agent.

(B) In process of the roasting, the copper pyrites is converted into a mixture of Cu_2S & FeS which, in turn, are partially oxidised

(C) Limonite, haematite and magnesite are ores of iron.

(D) Tin and lead both are extracted from their ores by self-reduction.

42. The role of fluorspar (CaF_2) which is added in the electrolytic reduction of alumina dissolved in fused cryolite is (are) :-

(A) to acts as a catalyst

(B) to make the fused mixture very conducting

(C) to lower the temperature of the melt

(D) to decrease the rate of oxidation of carbon at the anode

43. Which of the followgin are correctly mathched ?

(A) Turquoise $\longrightarrow$ $(CuAl_6PO_4)_4 (OH)_8 . 4H_2O$

(B) Peacock ore $\longrightarrow$ Cu_4FeS_2

(C) Malachite $\longrightarrow$ $CuCO_3 . Cu(OH)_2$

(D) Chalcopyrites $\longrightarrow$ $CuFeS_2$

44. Which of the following statements are correct in connection with the extraction of silver ?

(A) Silver is obtained as a by-product in the extraction of copper, lead and zinc.

(B) Silver is obtained from the anode slime formed in the electrolytic refining of copper and zinc

(C) Zinc is used to extract silver by solvent extraction from molten lead in Parke's process.

(D) Pttinsons process is used for desilverization of lead

45. Which of the following does not disproportionate ?

(A) Cu^+ (B) Au^{3+} (C) Cu^{2+} (D) Au^+

BRAIN TEASERS					ANSWER KEY						EXERCISE-2				
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	B,D	A	A,B,C	A,B,C	C	D	D	C	B	A	A	B	A	C	C
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	B	B,D	B	B,C	C	A,B,D	C	B	C	D	C	A,B,C,D	B	B	B
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	A,B,C	A,B,C	A,C,D	A,C,D	B,C	A,B,D	A,B,C	A,B	A	C,D	A,B	B,C	A,C,D	A,B,C,D	B,C

TRUE / FALSE

1. Metals can be recovered from their ores by chemical methods.
2. Sulphide ore of copper can be concentrated by froth floatation process.
3. Silver is purified by distillation process.
4. Highly pure metal can be obtained by zone refining.
5. Zinc is precipitated from a solution of zinc sulphate by addition of iron.
6. The slag obtained during the extraction of copper pyrites is composed mainly of $FeSiO_3$.
7. In calcination, ore is heated strongly in the absence of air.

FILL IN THE BLANKS

1. The most abundant metal in the earth's crust is .....
2. Cassiterite is an ore of ..... .
3. In the metallurgical process for the electro-refining of the metal, the anode is made of ..... metal.
4. In a thermite process, ... is used as a reducing agent.
5. The mineral carnallite contains magnesium and ..... metal.
6. The actual reducing agent of haematite in blast furnace is .....
7. In the basic Bessemer's process of the manufacture of steel, the linning of the converter is made of ..... The slag formed consists of .....
8. The transition metal present in the alloy gun metal is .....
9. The slag formed during the metallurgy of copper pyrites is .....
10. Iron is ..... copper in the electrochemical series and hence displaces ..... from a solution of copper sulphate.

MATCH THE COLUMN

1.

Column-I (Ore)		Column-II (Created formula & properties)	
(A)	Iron pyrites	(p)	FeS_2
(B)	Fool's gold	(q)	Sulphide ore
(C)	Galena	(r)	Fe_2O_3
(D)	Haematite	(s)	Concentrated by froth

2.

Column-I (Metal)		Column-II	
(A)	Magnesite	(p)	Ore of magnesium
(B)	Siderite	(q)	Ore of aluminium
(C)	Corundum	(r)	Oxide ore
(D)	Bauxite	(s)	Carbonate ore

3.

Column-I (Ore)		Column-II	
(A)	Iron	(p)	Carbon reduction method
(B)	Lead	(q)	Self reduction
(C)	Copper	(r)	Thermite process
(D)	Chromium	(s)	Hydrometallurgical process

ASSERTION & REASON QUESTIONS

These questions contains, Statement-I (assertion) and Statement-II (reason).

(A) Statement-I is True, Statement-II is True ; Statement-II is a correct explanation for Statement-I

(B) Statement-I is True, Statement-II is True ; Statement-II is NOT a correct explanation for Statement-I

(C) Statement-I is True, Statement-II is False.

(D) Statement-I is False, Statement-II is True.

1. **Statement-I** : All the ores are mineral
   Statement-II : Most of the ores contains metals in combined state

2. **Statement-I** : In the extraction of Ag the complex $Na[Ag(CN)_2]$ is reacted with Zn
   Statement-II : Zn is transition metal according to electronic theory

3. **Statement-I** : Thermite mixture Fe_2O_3+Al (powder) is used in the welding.
   Statement-II : Al is a good reductant

4. **Statement-I** : $CuFeS_2$ is concentrated by froath floatation method
   Statement-II : $CuFeS_2$ is main ore of copper

5. **Statement-I** : In the smelting of copper ore coke is added in the blast furnace.
   Statement-II : Coke reduces, CuO into Cu.

6. **Statement-I** : Extraction of iron metal from iron oxide ore is carried out by heating with coke.
   Statement-II : The reaction $Fe_2O_3(s) \xrightarrow{\Delta} Fe(s) + 3/2O_2(g)$ is a spontaneous process at standarde condition.

7. **Statement-I** : Wolframite impurities are separated from cassiterite by electromagnetic separation.
   Statement-II : Cassiterite being magnetic is attached by the magnet and forms a separate heap.

8. **Statement-I** : Lead, tin and bismuth are purified by liquation method.
   Statement-II : Lead, tin and bismuth have low m.p. as compared to impurities.

COMPREHENSION BASED QUESTIONS

Comprehension # 1

Dow's process of extraction of Mg involves extraction of Mg from sea water. Sea water is concentrated in sun light and is then treated with skaked lime. Magnesium hydroxide is heated in a stream of HCl to give $MgCl_2$ which is electrolysed to dischatge Mg. The mixture is in the ratio 35% $MgCl_2$ + 50% NaCl + 15% $CaCl_2$. NaCl and $CaCl_2$ are added to lower the fusion temperature and to increase the conductance.

$$Mg^{2+} + Ca(OH)_2 \longrightarrow Mg(OH)_2 + Ca^{2+}$$

$$Mg(OH)_2 + 2HCl \longrightarrow MgCl_2 + 2H_2O \text{ (liquid)}$$

Electrolysis of fused $MgCl_2$ $\xrightarrow{\text{Anode}}$ $2Cl^- \longrightarrow Cl_2 + 2_{-1}e$

$$\xrightarrow{\text{Cathode}} Mg^{2+} + 2_{-1}e \longrightarrow Mg$$

Mg electrolysed is protected from atmospheric oxidation by a blanket of inert gases.

1. $Mg^{2+} + Ca(OH)_2 \longrightarrow Mg(OH)_2 \downarrow + Ca^{2+}$

This reaction indicates :

(A) $Mg(OH)_2$ is weaker base than $Ca(OH)_2$

(B) Soubility products of $Mg(OH)_2$ is less than that of $Ca(OH)_2$

(C) Polarising power of Mg^{2+} is more than that of Ca^{2+} ion

(D) Both (B) and (C).

2. In the hydrated chloride of Mg the value of of x is

(A) 6 (B) 4 (C) 8 (D) 10

3. Molten mixture contains Mg^{2+}, Na^{+} and Ca^{2+} but at cathode only Mg is discharged because :

(A) Standard reduction potential of Mg is least among the three

(B) Standard oxidation potential of Mg is least among the three

(C) Discharge potential of Mg is highest

(D) None of these

4. Molten mixture of NaCl of $CaCl_2$ is added to the heated $MgCl_2.xH_2O$ with dry HCl gas because :

(A) $MgCl_2.xH_2O$ + dry HCl $\xrightarrow{973-1023\ K}$ Partially dehydrated $MgCl_2$ and molten ($NaCl + CaCl_2$) makes it fully dehydrated

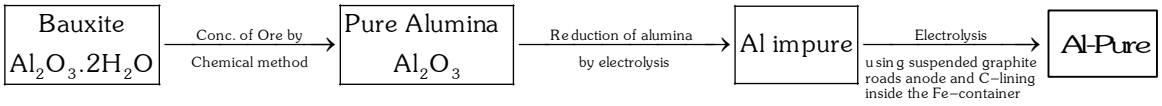
(B) $CaCl_2$ is dehydrating agent

(C) ($CaCl_2$ + NaCl) lowers the m.pt. of $MgCl_2$

(D) None of the above

Comprehension # 2

Extraction of Aluminium can be understand by :



electrolytic reduction of Al_2O_3

Electrolyte : (Al_2O_3 + Cryolite)

Cathode : Graphite inside the Fe container

Anode : Graphite rods

1. The purpose of adding cryolite is :

(A) to increase the electrical conductivity of pure aluminium

(B) to lower the melting point of Al_2O_3

(C) to remove the impurities as slag

(D) to increase the Al% in the yield

2. Coke powder is spreaded over the molten electrolyte due to :

(A) prevent the heat radiation from the surface

(B) prevent the corrosion of graphite anode

(C) prevent oxidation of molten aluminium by air

(D) both (A) & (B)

3. The function of fluorspar (CaF_2) is :

(A) to decrease the melting point of electrolyte

(B) to increase electrolytic conductivity power

(C) to remove the impurities as slag

(D) all of the above

4. The molten electrolytes contains Na^+, Al^{3+}, Ca^{2+} but only Al gets deposited at cathode because :

(A) Standard reduction potential of Al is more than those of Na & Ca

(B) Standard oxidation potential of Al is more than those of Na & Ca

(C) Discharge potential of Al^{3+} is higher than Na^+ & Ca^{2+}

(D) Graphite reacts only with Al^{3+} and not with Na^+ & Ca^{2+}

5. What is wrong if anode is made of nickel instead of graphite?

(A) Ni is costly

(B) Anode will be affected by produced Cl_2

(C) Graphite remain unaffected by produced Cl_2

(D) Ni may be affected by high temp.

MISCELLANEOUS TYPE QUESTION — ANSWER KEY — EXERCISE -3

- ***True / False***

  1. T **2.** T **3.** F **4.** T **5.** F **6.** T **7.** T

- ***Fill in the Blanks***

  1. Al **2.** Tin **3.** Impure **4.** Al **5.** K **6.** CO **7.** MgO,CaO, silicate, phosphate

  8. Cu **9.** $FeSiO_3$ **10.** Above, Cu

- ***Match the Column***

  1. (A) → p,q,s; (B) → p,q,s ; (C) → q,s ; (D) → r **2.** (A) → p,s ; (B) → s ; (C) → q,r ; (D) → q,r

  3. (A) → p ; (B) → p,q ; (C) → q,s ; (D) → r

- ***Assertion - Reason Questions***

  1. B **2.** C **3.** B **4.** B **5.** C **6.** C **7.** C **8.** A

- ***Comprehension Based Questions***

  Comprehension #1 : 1. D **2.** A **3.** B **4.** C

  Comprehension #2 : 1. B **2.** D **3.** B **4.** A **5.** B

1. Which of the metals Na, Ag and Fe are extracted by,

   (i) Complex formation

   (ii) Reduction with carbon and

   (iii) Electrolysis of fused salt ?

2. How the following impurities can be removed?

   (a) An impurity of lead in silver.

   (b) An impurity of cuprous oxide in copper.

   (c) Impurities of Fe, Cu etc. in aluminium.

3. Tin stone is amphoteric. Explain.

4. Predict the mode of occurance of the following three type of metal.

   (i) Highly reactive (Na) (ii) Moderatyl reactive (Fe) (iii) Noble Metal (Au)

5. Which is better reducing agent at 710^0C, Coke or CO.

6. Name the process from which chlorine is obtained as by product. What will happen if an aqueous solution of NaCl is subjected to electrolysis.

7. What is Lintz-Dusenverfahren (L–D) process?

8. Identify (A) to (F) in the following :

   $FeSO_4 \xrightarrow{\Delta} \underset{\text{Solid}}{(A)} + \underbrace{(B)+(C)}_{\text{gas}}$

   $(B) \xrightarrow{O_2} (C)$

   $(E) \xrightarrow{H_2O} (D)$ brown ppt

   $(D) \xrightarrow{\Delta} (A)$

   $(A) \xrightarrow{HCl}$ deep yellow solution (E)

   $(E) \xrightarrow{K_4[Fe(CN)_6]}$ blue ppt. (F)

CONCEPTUAL SUBJECTIVE EXERCISE — ANSWER KEY — EXERCISE -4(A)

1. Na – (iii), Ag–(i), Fe–(ii)
2. (a) Cupellation, (b) Poling, (c) Electrolytic (Hoop's process)
3. $SnO_2 + 2H_2SO_4 \rightarrow Sn(SO_4)_2 + H_2O$ (SnO_2 react with both acid and base)

   $SnO_2 + NaOH \longrightarrow Na_2SnO_3$
4. (i) Na $\rightarrow$ Combined form (ii) Fe $\rightarrow$ Combined form (iii) Au $\rightarrow$ Native/Noble form
5. CO (Ellingham diagram)
6. Down cell process
   NaOH, H_2, Cl_2
7. It is pyrometallurgical process in the manufacturing of steel to oxidise impurities.
8. (A) : Fe_2O_3 (B) : SO_2 (C) : SO_3 (D) : $Fe(OH)_3$ (E) : $FeCl_3$ (F) : $KFe^{III}[Fe^{II}(CN)_6]$, Prussian blue.

1. Write example of two metals which are manufactured by the electrolysis of their fused salts.

2. Write example of two metals which are used for the reduction in metallurgical process.

3. Which of the following metals can be obtained by the electrolytic reduction of aqueous solution of their salts – Al, Na, Cu and Ag ?

4. Zinc and not copper is used for the recovery of Ag from the complex $[Ag(CN)_2]^-$.

5. Partial roasting of sulphide ore is done in the metallurgy of copper.

6. Why is chalcocite roasted and not calcined during recovery of copper?

7. Egg shell is made up of a chemical. In which of the two ores this chemical is present.

8. You are provided with sample of some impure metal. Such as zinc, copper and germanium which method would you recommended for the purification of each of these metal.

9. Name the metal which are associated with the following term in their extraction from their ores.

   (i) Bessmer's convertor

   (ii) Blast furnace

   (iii) Alumino thermic process

   (iv) Magnetic separation

10. Carbon monoxide is more effective reducing agent than carbon below 983 K but above this temperature the reverse is true. How would you explain this?

11. Write balanced equations for the extraction of aluminium from bauxite by electrolysis.

12. The following are two reaction schemes involving Mg.

   Scheme-I : Mg $\xrightarrow{\text{air } \Delta}$ colourless solid A $\xrightarrow{HCl}$ colourless soltuion B $\xrightarrow{Na_2CO_3}$ white ppt C $\xrightarrow{\Delta}$ D colourless gas E $\xrightarrow{Ca(OH)_2}$ white ppt F

   Scheme-II : Mg $\xrightarrow{\text{dil. } H_2SO_4}$ colourless solution G $\xrightarrow{NaOH}$ white ppt H $\xrightarrow{HNO_3}$ colourless solution $\xrightarrow{\text{evaporate}}$ I $\xrightarrow{\Delta}$ J gas + O_2 + D

1. Na, Al

2. Al, Mg, Na

3. Cu, Ag,

4. Zn is powerful, Reducing agent than Cu

5. Self/auto reduction

6. Chalcosite is a sulphide ore so on roasting it converted into oxide.

7. Lime stone : $CaCO_3$ Dolomite : $CaCO_3.MgCO_3$

8. Zn $\rightarrow$ Fractional distillation Cu $\rightarrow$ Poling & electro refining Ge $\rightarrow$ Zone refining/fractional crystallisation

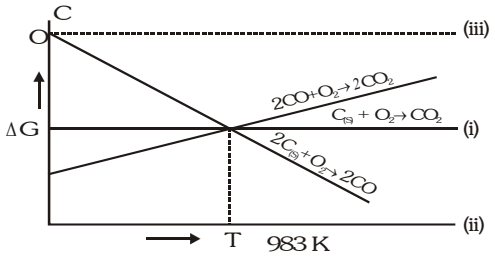
9. (i) Cu (ii) Fe (iii) Al (iv) Tin stone and Chromite ore

10. The three reactions are as :

$C_{(s)} + O_2 \longrightarrow CO_2$ .....(i)

$2C_{(s)} + O_2 \longrightarrow 2CO$ .....(ii)

$2CO + O_2 \longrightarrow 2CO_2$ .....(iii)



Below 983 K reaction $2CO + O_2 \longrightarrow 2CO_2$ is more favoured due to more negative ΔG value thus CO is better reducing agent than carbon.

Above 983 K, reaction $2C_{(s)} + O_2 \longrightarrow 2CO$ has more negative ΔG than oxidation of CO to CO_2, so carbon will be better reducing agent.

11. The following reactions take place.

$4AlF_3 \longrightarrow 4Al^{3+} + 12F^-$

$12F^- \longrightarrow 12F + 12e$

At cathode : $2Al_2O_3 + 12F \longrightarrow 4AlF_3 + 3O_2$

$4C + 3O_2 \longrightarrow 2CO + 2CO_2$

At Anode : $4Al^{3+} + 12e^- \longrightarrow 4Al_1$

12. A : MgO; B : $MgCl_2$; C : $MgCO_3$; D : MgO; E : CO_2; F : $CaCO_3$; G : $MgSO_4$;

H : $Mg(OH)_2$; I : $Mg(NO_3)_2$; J : NO_2

1. Aluminium is extracted by the electrolysis of :-
(1) Bauxite [AIEEE-2002]
(2) Alumina
(3) Alumina mixed with molten cryolite
(4) Molten cryolite

2. Pyrolusite is a/an :- [AIEEE-2002]
(1) Oxide ore (2) Sulphide ore
(3) Carbide ore (4) Not an ore

3. Which one of the following ores is best concentrated by froth-flotation method : [AIEEE-2004]
(1) Galena (2) Cassiterite
(3) Magnetite (4) Malachite

4. 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]
(1) Metal sulphides are thermodynamically more stable than CS_2
(2) CO_2 is thermodynamically more stable than CS_2
(3) Metal sulphides are less stable than the corresponding oxides
(4) CO_2 is more volatile than CS_2

5. In context with the industrial preparation of hydrogen from water gas (CO + H_2), which of the following is the correct statement? [AIEEE-2008]
(1) CO and H_2 are fractionally separated using differences in their densities
(2) CO is removed by absorption in aqueous Cu_2Cl_2 solution
(3) H_2 is removed through occlusion with Pd
(4) CO is oxidised to CO_2 with steam in the presence of a catalyst followed by absorption of CO_2 in alkali

6. Which method of purification is represented by the following equation : [AIEEE-2012]

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

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

PREVIOUS YEARS QUESTIONS **ANSWER KEY** EXERCISE -5 [A]

Que.	1	2	3	4	5	6
Ans	3	1	1	3	4	1

EXERCISE–05 [B] PREVIOUS YEARS QUESTIONS

1. When the ore haematite is burnt in air with coke around 2000 C alongwith lime, the process not only produces steel but also produces a silicate slag, that is useful in making building materials such as cement. Discuss the same and show through balanced chemical equation : **[1998 ; 4M]**

2. In the commercial electrochemical process for aluminium extraction, the electrolyte used as: **[IIT-1999]**

(A) $Al(OH)_3$ in NaOH solution

(B) An aqueous solution of $Al_2(SO_4)_3$

(C) A molten mixture of Al_2O_3 and Na_3AlF_6

(D) A molten mixture of AlO(OH) and $Al(OH)_3$

3. Write the chemical reactions involved in the extraction of metallic silver from argentite. **[IIT-2000]**

4. Write down reactions involved in the extraction of Pb. What is the oxidation number of lead in litharge? **[IIT-2000]**

5. The chemical process in the production of steel from haematite ore involve : **[IIT-2000]**

(A) Reduction (B) Oxidation

(C) Reduction followed by oxidation (D) Oxidation followed by reduction

6. Electrolyte reduction of alumina to aluminium by Hall-Heroult process is carried out : **[IIT-2000]**

(A) In the presence of NaCl

(B) In the presence of fluorite

(C) In the presence of cryolite which forms a melt with lower melting temperature

(D) In the presence of cryolite which forms a melt with higher melting temperature

7. The chemical composition of slag formed during smelting process in the extraction of Cu is : **[IIT-2001]**

(A) $Cu_2O + FeS$ (B) $FeSiO_3$ (C) $CuFeS_2$ (D) $Cu_2S + FeO$

8. Which of the process is used in the extractive metallurgy of Mg : **[IIT-2002]**

(A) Fused salt electrolysis (B) Self reduction

(C) Aqueous solution electrolysis (D) Thermite reduction

9. Roasted gold ore + $CN^- + H_2O \xrightarrow{O_2} [X] + OH^-$ **[IIT-2003]**

$[X] + Zn \longrightarrow [Y] + Au.$

[X] and [Y] are :

(A) X = $[Au(CN)_2]^-$; Y = $[Zn(CN)_4]^{2-}$ (B) X = $[Au(CN)_4]^{3-}$; Y = $[Zn(CN)_4]^{2-}$

(C) X = $[Au(CN)_2]^-$; Y = $[Zn(CN)_6]^{4-}$ (D) X = $[Au(CN)_4]^{3-}$; Y = $[Zn(CN)_6]^{2-}$

10. The methods chiefly used for the extraction of lead and tin from their ores are respectively : **[IIT-2004]**

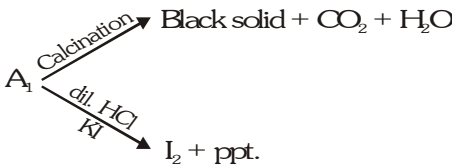
(A) self reduction and carbon reduction (B) self reduction and electrolytic reduction

(C) carbon reduction and self reduction (D) cyanide process and carbon reduction

11. Which ore contains both iron and copper? **[IIT-2004]**

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

12. A_1 and A_2 are two ores of metal M. A_1 on calcination gives black precipitate, CO_2 and water. **[IIT-2004]**



$A_2 \xrightarrow{\text{Roasting}} \text{Metal} + \text{gas} \xrightarrow[H_2SO_4]{K_2Cr_2O_7} \text{Green Colour}$

Identify A_1 and A_2.

13. **Match the column :**

Column I		Column II [IIT-2006]	
(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

14. Extraction of zinc from zinc blende is achieved by : **[IIT-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

15. **Match the column :**

Column I		Column II [IIT-2008]	
(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

16. Native silver metal forms a water soluble complex with a dilute aqueous solution of NaCN in the presence of **[IIT-2008]**

(A) nitrogen (B) oxygen

(C) carbon dioxide (D) argon

Paragraph for questions 17 to 19

Copper is the most nobel of the first row transition metals and occurs in small deposits in several countries. Ores of copper include chalcanthite ($CuSO_4 \cdot 5H_2O$), atacamite ($Cu_2Cl(OH)_3$), cuprite (Cu_2O), copper glance (Cu_2S) and malachite ($Cu_2(OH)_2CO_3$). 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.

17. Partial roasting of chalcopyrite produces :- **[IIT-2010]**

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

18. Iron is removed from chalcopyrite as :-

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

19. In self-reduction, the reducing species is :-

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

20. Extraction of metal from the ore cassiterite involves **[IIT-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

21. Oxidation states of the metal in the minerals haematite and magnetite, respectively, are **[IIT-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

22. In the cyanide extraction process of silver from argentite ore, the oxidizing and reducing agents used are :

(A) O_2 and CO respectively. (B) O_2 and Zn dust respectively. **[IIT-2012]**

(C) HNO_3 and Zn dust respectively. (D) HNO_3 and CO respectively.

23. Sulfide ores are common for the metals - **[IIT-2013]**

(A) Ag, Cu and Pb (B) Ag, Cu and Sn

(C) Ag, Mg and Pb (D) Al, Cu and Pb

24. The carbon-based reduction method is NOT used for the extraction of **[IIT-2013]**

(A) tin from SnO_2 (B) Iron from Fe_2O_3

(C) aluminium from Al_2O_3 (D) magnesium from $MgCO_3.CaCO_3$

PREVIOUS YEARS QUESTIONS — ANSWER KEY — EXERCISE -5 [B]

1. Heamatite (Fe_2O_3) on burning with coke and lime at 2000 K in blast furnace results in the following.

(i) **Upper zone**

(400 C to 700 C) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

$3Fe_2O_3 + CO \rightarrow 2Fe_3O_4 + CO_2$

$Fe_3O_4 + CO \rightarrow 3FeO + CO_2$

$FeO + CO \rightarrow Fe + CO_2$

This reaction occurs in following steps:

(ii) **Middle zone**

(800 C to 1000 C) $C + CO_2 \rightarrow 2CO$

$FeO + CO \rightarrow Fe(s) + CO_2$

(iii) **Upper lower zone** Impure iron metals

(1200 C to 1500 C) $CaO + SiO_2 \rightarrow CaSiO_3$ (slag)

(iv) **Lower zone** Phosphates and silicates are reduced.

(1500 C to 1600 C) P and S pass into molten iron

$C + O_2 \rightarrow CO_2$

2. (C)

3. $Ag_2S + 4\ NaCN \rightleftharpoons 2Na[Ag(CN)_2] + Na_2S$

Argentite (0.7% solution) sodium argentocyanide

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

This Na_2S is oxidised into Na_2SO_4 to avoid reversibility of reaction.

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

4. $\left.\begin{array}{l} 2PbS + 3O_2 \longrightarrow 2PbO + 2SO_2\uparrow \\ PbS + 2O_2 \longrightarrow PbSO_4 \end{array}\right\}$ Roasting

The roasted mineral is smelted into lead.

$\left.\begin{array}{l} 2PbO + PbS \longrightarrow 3Pb + 3SO_2\uparrow \\ PbSO_4 + PbS \longrightarrow 2Pb + 2SO_2 \end{array}\right\}$ Smelting

This lead is purified by any suitable method. In litharge (PbO) oxidation state of lead is +2.

5. D **6.** C **7.** B **8.** A **9.** A **10.** A

11. C **12.** A_1 : Malachite A_2 : Copper glance **13.** (A) → p,r ; (B) → p ; (C) → q ; (D) → s

14. B **15.** (A) → p ; (B) → q ; (C) → p,r ; (D) → p,s **16.** B **17.** A

18. D **19.** C **20.** (A, C, D) **21.** D **22.** B

23. (A) **24.** (C, D)