CHAPTER
20
GENERAL PRINCIPLES AND PROCESSES OF ISOLATION OF ELEMENTS

FACT/DEFINITION TYPE QUESTIONS

1. Which one of the following is an ore of silver ?
(a) Argentite (b) Stibnite
(c) Haematite (d) Bauxite

2. Cinnabar is an ore of
(a) Hg (b) Cu
(c) Pb (d) Zn

3. An example of an oxide ore is
(a) Bauxite (b) Malachite
(c) Zinc blende (d) Feldspar

4. The natural materials from which an element can be extracted economically are called
(a) ores (b) minerals
(c) gangue (d) None of these

5. The most abundant metal on the surface of the earth is
(a) Fe (b) Al
(c) Ca (d) Na

6. Which of the following is an ore of tin ?
(a) Carborundum (b) Epsomite
(c) Cassiterite (d) Spodumene

7. Which of the following is chalcopyrite?
(a) $CuFeS_2$ (b) FeS_2
(c) $KMgCl_3.6H_2O$ (d) $Al_2O_3.2H_2O$

8. Haematite is the ore of
(a) Pb (b) Cu
(c) Fe (d) Au

9. Composition of azurite mineral is
(a) $CuCO_3CuO$ (b) $Cu(HCO_3)_2.Cu(OH)_2$
(c) $2CuCO_3.Cu(OH)_2$ (d) $CuCO_3.2Cu(OH)_2$

10. Which one of the following is a mineral of iron ?
(a) Malachite (b) Cassiterite
(c) Pyrolusite (d) Magnetite

11. All ores are minerals, while all minerals are not ores because
(a) the metal can't be extracted economically from all the minerals
(b) minerals are complex compounds
(c) the minerals are obtained from mines
(d) all of these are correct

12. Which one of the following is not a sulphide ore?
(a) Magnetite (b) Iron pyrites
(c) Copper glance (d) Sphalerite

13. The impurities associated with mineral used in metallurgy are called collectively?
(a) Slag (b) Flux
(c) Gangue (d) Ore

14. The most abundant element in the earth's crust (by weight) is
(a) Si (b) Al
(c) O (d) Fe

15. Malachite is an ore of
(a) iron (b) copper
(c) mercury (d) zinc

16. Cassiterite is an ore of
(a) Mn (b) Ni
(c) Sb (d) Sn

17. Galena is an ore of
(a) Pb (b) Hg
(c) Zn (d) None of these

18. The metal always found in the free states is
(a) Au (b) Ag
(c) Cu (d) Na

19. Matrix is defined as –
(a) the unwanted foreign material present in the ore
(b) the flux added to remove the unwanted impurities from ore
(c) the slag formed as a result of the reaction of flux with gangue
(d) the material used in the reduction of metal oxide to metal

20. Which of the following pair is incorrectly matched ?
(a) Magnetite – Fe_3O_4 (b) Copper glance – Cu_2S
(c) Calamine – $ZnCO_3$ (d) Zincite – ZnS

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

22. Froth floatation process is used for the metallurgy of
(a) chloride ores (b) amalgams
(c) oxide ores (d) sulphide ores

23. Cassiterite is concentrated by
(a) levigation
(b) electromagnetic separation
(c) floatation
(d) liquefaction

24. While extracting an element from its ore, the ore is grounded and leached with dil. potassium cyanide solution to form the soluble product potassium argento cyanide. The element is
(a) Lead (b) Chromium
(c) Manganese (d) Silver

25. The method of concentrating the ore which makes use of the difference in density between ore and impurities is called
(a) levigation (b) leaching
(c) magnetic separation (d) liquifaction

26. Leaching is a process of
(a) reduction (b) concentration
(c) refining (d) oxidation

27. Which one of the following ores is concentrated by chemical leaching method?
(a) Galena (b) Copper pyrite
(c) Cinnabar (d) Argentite

28. Electromagnetic separation is used in the concentration of
(a) copper pyrites (b) bauxite
(c) cassiterite (d) cinnabar

29. For which ore of the metal, froth floatation method is used for concentration?
(a) Horn silver (b) Bauxite
(c) Cinnabar (d) Heamatite

30. Which of the following metal is leached by cyanide process ?
(a) Ag (b) Na
(c) Al (d) Cu

31. Which one of the following ores is not concentrated by froth floatation process?
(a) Copper pyrites (b) Pyrargyrite
(c) Pyrolusite (d) Zinc blende

32. In froth flotation process many chemicals (frother , collector, activator, and depressant) are used. Which of the following is a frother ?
(a) $CuSO_4$ (b) NaCN+ alkali
(c) Pine oil (d) Potassium xanthate

33. Froth flotation process is based on
(a) wetting properties of ore particle
(b) specific gravity of ore particles
(c) magnetic properties of ore particles
(d) electrical properties of ore particles

34. In the froth flotation process of concentration of ores, the ore particles float because they:
(a) are light
(b) are insoluble
(c) have the surface which is not wetted easily
(d) have a constant electrical charge

35. Main function of roasting is
(a) to remove volatile substances
(b) oxidation
(c) reduction
(d) slag formation

36. Roasting is generally done in case of the
(a) oxide ores (b) silicate ores
(c) sulphide ores (d) carbonate ores

37. Heating of pyrites in air for oxidation of sulphur is called
(a) roasting (b) calcination
(c) smelting (d) slagging

38. The role of calcination in metallurgical operations is
(a) to remove moisture
(b) to decompose carbonates
(c) to drive off organic matter
(d) to decompose carbonates and drive off moisture and organic matter

39. General method for the extraction of metal from oxide ore is
(a) carbon reduction
(b) reduction by aluminium
(c) reduction by hydrogen
(d) electrolytic reduction

40. Function of the flux added during smelting is
(a) to make ore porous
(b) to remove gangue
(c) to make reduction easier
(d) to precipitate slag

41. Process followed before reduction of carbonate ore is
(a) calcination (b) roasting
(c) liquation (d) polling

42. Calcination is the process in which :
(a) ore is heated above its melting point to expel H_2O or CO_2 or SO_2
(b) ore is heated below its melting point to expel volatile impurities
(c) ore is heated above its melting point to remove S, As and Sb as SO_2 ,As_2O_3 and Sb_2O_3 respectively
(d) ore is heated below its melting point to expel H_2O or CO_2

43. When a metal is to be extracted from its ore and the gangue associated with the ore is silica, then
(a) an acidic flux is needed
(b) a basic flux is needed
(c) both acidic and basic fluxes are needed
(d) Neither of them is needed

44. Which of the following fluxes is used to remove acidic impurities in metallurgical process?
(a) Silica (b) Lime stone
(c) Sodium chloride (d) Sodium carbonate

45. Which of the following reactions is an example for calcination process ?

(a) $2Ag + 2HCl + (O) \rightarrow 2AgCl + H_2O$

(b) $2Zn + O_2 \rightarrow 2ZnO$

(c) $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$

(d) $MgCO_3 \rightarrow MgO + CO_2$

46. After partial roasting the sulphide of copper is reduced by
(a) cyanide process (b) electrolysis
(c) reduction with carbon (d) self reduction

47. Hydro-metallurgical process of extraction of metals is based on
(a) complex formation (b) hydrolysis
(c) dehydration (d) dehydrogenation

48. $2CuFeS_2 + O_2 \longrightarrow Cu_2S + 2FeS + SO_2$
Which process of metallurgy of copper is represented by above equation?
(a) Concentration (b) Roasting
(c) Reduction (d) Purification

49. Which of the following is not used as a collector ?
(a) Pine oil (b) Xanthates
(c) Cresols (d) Fatty acids

50. Which of the following reaction represents calcination process ?
(a) $2PbS + 3O_2 \longrightarrow 2PbO + 2SO_2$
(b) $CaCO_3.MgCO_3(s) \longrightarrow CaO(s) + MgO(s) + 2CO_2(g)$
(c) $ZnO + C \xrightarrow{\text{coke, } 1673K} Zn + CO$
(d) $Fe_2O_3 + CO \longrightarrow 2FeO + CO_2$

51. According to Ellingham diagram, the oxidation reaction of carbon to carbon monoxide may be used to reduce which one of the following oxides at the lowest temperature ?
(a) Al_2O_3 (b) Cu_2O
(c) MgO (d) ZnO

52. Which of the following condition favours the reduction of a metal oxide to metal?
(a) ΔH = +ve, $T\Delta S$ = + ve at low temperature
(b) ΔH = +ve, $T\Delta S$ = – ve at any temperature
(c) ΔH = –ve, $T\Delta S$ = – ve at high temperature
(d) ΔH = –ve, $T\Delta S$ = + ve at any temperature

53. Ellingham diagram normally consists of plots of
(a) ΔS° vs T (b) $\Delta_f G^\circ$ vs ΔS°
(c) ΔG° vs T (d) ΔH° vs ΔT

54. Δ G° vs T plot in the Ellingham's diagram slopes downward for the reaction

(a) $Mg + \frac{1}{2}O_2 \rightarrow MgO$ (b) $2Ag + \frac{1}{2}O_2 \rightarrow Ag_2O$

(c) $C + \frac{1}{2}O_2 \rightarrow CO$ (d) $CO + \frac{1}{2}O_2 \rightarrow CO_2$

55. In the blast furnace iron oxide is reduced by
(a) silica (b) CO
(c) carbon (d) limestone

56. Furnaces are lined with calcium oxide because
(a) it gives off oxygen on heating
(b) it gives strong light on heating
(c) it is refractory and basic
(d) it is not affected by acids

57. The following reactions take place in the blast furnace in the preparation of impure iron. Identify the reaction pertaining to the formation of the slag.
(a) $Fe_2O_3(s) + 3\,CO(g) \rightarrow 2\,Fe\,(l) + 3\,CO_2\,(g)$
(b) $CaCO_3\,(s) \rightarrow CaO\,(s) + CO_2\,(g)$
(c) $CaO\,(s) + SiO_2(s) \rightarrow CaSiO_3(s)$
(d) $2C(s) + O_2\,(g) \rightarrow 2\,CO(g)$

58. Refractory materials are generally used in furnaces because
(a) they possess great structural strength
(b) they can withstand high temperature
(c) they are chemically inert
(d) they do not require replacement

59. Which of the following reactions taking place in the blast furnace during extraction of iron is endothermic?
(a) $CaCO_3 \rightarrow CaO + CO_2$
(b) $2C + O_2 \rightarrow 2CO$
(c) $C + O_2 \rightarrow CO_2$
(d) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

60. Cast iron is
(a) made by melting pig iron with scrap iron and coke using hot air blast
(b) having slightly lower carbon content (about 3%) as compared to pig iron
(c) extremely hard and brittle
(d) All of the above statements are true

61. In the extraction of copper from its sulphide ore, the metal is finally obtained by the reduction of cuprous oxide with :
(a) Copper (I) sulphide (Cu_2S)
(b) Sulphur dioxide (SO_2)
(c) Iron sulphide (FeS)
(d) Carbon monoxide (CO)

62. Extraction of zinc from zinc blende is achieved by
(a) electrolytic reduction
(b) roasting followed by reduction with carbon
(c) roasting followed by reduction with another metal
(d) roasting followed by self-reduction

63. In the extraction of Cu, the metal is formed in the bessemer converter due to the reaction :
(a) $Cu_2S + 2Cu_2O \longrightarrow 6Cu + SO_2$
(b) $Cu_2S \longrightarrow 2Cu + S$
(c) $Fe + Cu_2O \longrightarrow 2Cu + FeO$
(d) $2Cu_2O \longrightarrow 4Cu + O_2$

64. Aluminothermic process is used for the extraction of metals, whose oxides are
(a) fusible
(b) not easily reduced by carbon
(c) not easily reduced by hydrogen
(d) strongly basic

65. Electrometallurgical process is used to extract
(a) Fe (b) Pb
(c) Na (d) Ag

66. The electrolytic method of reduction is employed for the preparation of metals that
(a) are weakly electropositive
(b) are moderately electropositive
(c) are strongly electropositive
(d) form oxides

67 Aluminium is extracted from alumina (Al_2O_3) by electrolysis of a molten mixture of
(a) $Al_2O_3 + HF + NaAlF_4$
(b) $Al_2O_3 + CaF_2 + NaAlF_4$
(c) $Al_2O_3 + Na_3AlF_6 + CaF_2$
(d) $Al_2O_3 + KF + Na_3AlF_6$

68. In the extraction of aluminium by Hall-Heroult process, purified Al_2O_3 is mixed with CaF_2 to
(i) lower the melting point of Al_2O_3.
(ii) increase the conductivity of molten mixture.
(iii) reduce Al^{3+} into Al(s).
(iv) acts as catalyst.
(a) (i) and (ii) (b) (i), (ii) and (iii)
(c) (iii) and (iv) (d) (ii), (iii) and (iv)

69. In the extraction of chlorine by electrolysis of brine_____.
(a) oxidation of Cl^- ion to chlorine gas occurs.
(b) reduction of Cl^- ion to chlorine gas occurs.
(c) For overall reaction ΔG^Θ has negative value.
(d) a displacement reaction takes place.

70. Brine is electrolysed by using inert electrodes. The reaction at anode is _____.

(a) $Cl^-(aq.) \longrightarrow \frac{1}{2}Cl_2(g) + e^-$; $E^\Theta_{Cell} = 1.36V$

(b) $2H_2O(l) \longrightarrow O_2(g) + 4H^+ + 4e^-$; $E^\Theta_{Cell} = 1.23V$

(c) $Na^+(aq.) + e^- \longrightarrow Na(s)$; $E^\Theta_{Cell} = 2.71V$

(d) $H^+(aq.) + e^- \longrightarrow \frac{1}{2}H_2(g)$; $E^\Theta_{Cell} = 0.00V$

71. Blister copper is
(a) Impure Cu (b) Cu alloy
(c) Pure Cu (d) Cu having 1% impurity

72. The furnace used to prepare commercial iron is lined with which of the following ?
(a) Haematite (b) Magnetite
(c) Ironpyrites (d) Both (a) and (b)

73. Which form of the iron contains 4% carbon ?
(a) Cast iron (b) Pig iron
(c) Wrought iron (d) Both (a) and (b)

74. Which of the following reaction takes place in blast furnace during extraction of copper ?
(a) $2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$
(b) $2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2$
(c) $2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$
(d) All of these

75. The main reactions occurring in blast furnace during extraction of iron from haematite are_____.
(i) $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$
(ii) $FeO + SiO_2 \longrightarrow FeSiO_3$
(iii) $Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO$
(iv) $CaO + SiO_2 \longrightarrow CaSiO_3$
(a) (i) and (iii) (b) (ii) and (iv)
(c) (i) and (iv) (d) (i), (ii) and (iii)

76. The process of zone refining is used in the purification of
(a) Si (b) Al
(c) Ag (d) Cu

77. Van Arkel method of purification of metals involves converting the metal to a
(a) volatile stable compound
(b) volatile unstable compound
(c) non volatile stable compound
(d) None of the above

78. The method not used in metallurgy to refine the impure metal is
(a) Mond's process
(b) Van–Arkel process
(c) Amalgamation process
(d) Liquation

79. Which of the following pairs of metals is purified by van Arkel method ?
(a) Ga and In (b) Zr and Ti
(c) Ag and Au (d) Ni and Fe

80. The method of zone refining of metals is based on the principle of
(a) greater solubility of the impurities in the molten state than in the solid
(b) greater mobility of the pure metal than that of the impurite
(c) higher melting point of the impurities than that of the pure metal
(d) greater noble character of the solid metal than that of the impurities

81. Method used for obtaining highly pure silicon which is used as a semiconductor material, is
(a) oxidation (b) electrochemical
(c) crystallization (d) zone refining

82. What is anode mud?
(a) Fan of anode
(b) Metal of anode
(c) Impurities collected at anode in electrolysis during purification of metals
(d) All of these

83. The process of zone refining is used in the purification of
(a) Si (b) Al
(c) Ag (d) Cu

84. Which of the following statements regarding chromatography is incorrect ?
(a) It is based on the principle that different components of mixture gets adsorbed differently on an adsorbent
(b) Column chromatography involves column of Al_2O_3 in a glass tube as a stationary phase.
(c) The mobile phase may be a gas, a liquid or a solid.
(d) Component which is more soluble is stationary phase takes longer time to travel.

85. Which of the following metal is used in the manufacture of dye-stuffs and paints ?
(a) Copper (b) Zinc
(c) Aluminium (d) Magnesium

STATEMENT TYPE QUESTIONS

86. Read the following statements
(i) Magnetic separation method is employed when one component either ore or gangue is magnetic in nature.
(ii) Depressant NaCN used in case of ore containing mixture of ZnS and PbS allows ZnS to come with froth and prevents PbS from coming to the froth.
(iii) For concentration powdered bauxite ore is digested with conc.NaOH at 473–523K and 35–36 bar pressure.
Which of the following is the correct code for the statements above ?
(a) TFT (b) TTF
(c) FTF (d) FFT

87. Which of the following statements related to Ellingham diagrams are correct ?
(i) It provides a sound basis for the choice of reducing agent in the reduction of oxides.
(ii) Each Ellingham plot is represented by a straight line untill unless there is some change in phase i.e. solid→liquid, liquid → gas and gas → liquid occurs.
(iii) Diagrams similar to Ellingham can be constructed for sulphides and halides which clearly indicates why reduction of M_xS is difficult in comparison to M_xO.
(iv) Ellingham diagrams predicts the tendency of reduction with a reducing agent and kinetics of the reduction process.
(a) (i), (ii) and (iii) (b) (i) and (iii)
(c) (i), (ii) and (iv) (d) (ii) and (iv)

88. Which of the following statement(s) is/are correct ?
(i) Cast iron is used in the manufacture of railway sleepers
(ii) Wrought iron is used in the manufacture of anchors, bolts, chains etc.
(iii) Nickel steel is used in making pendulums.
(a) Only (i) (b) (i) and (ii)
(c) (i), (ii) and (iii) (d) Only (iii)

89. Read the following statements
(i) The principle that the impurities are more soluble in the melt than in the solid state is used in the manufacture of high purity semiconductors.
(ii) Van Arkel method of refining Zr involves heating of crude metal with Cl_2 to form corresponding halide.
(iii) Mond process for refining of nickel involves formation of metal carbonyls as an intermediate.
Which of the following is the correct code for the statements above ?
(a) TTT (b) FFT
(c) TFT (d) FTF

MATCHING TYPE QUESTIONS

90. Match the columns

Column - I	Column - II
(A) $Fe_2O_3.xH_2O(s) \xrightarrow{\Delta} Fe_2O_3(s) + xH_2O(g)$	(p) Slag formation
(B) $FeO + SiO_2 \longrightarrow FeSiO_3$	(q) Reduction of iron oxide
(C) Discharge gas produced during this process is utilised in manufacture of H_2SO_4.	(r) Calcination
(D) $Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO$	(s) Roasting

(a) A–(r), B–(p), C–(s), D–(q)
(b) A–(p), B–(r), C–(s), D–(q)
(c) A–(r), B–(s), C–(p), D–(q)
(d) A–(r), B–(p), C–(q), D–(s)

91. Match the columns

Column - I	Column - II
(A) According to $\Delta_rG^{\ominus}$ vsT graph, oxide of this metal can be easily reduced to corresponding metal by heating with coke	(p) Sulphur oxide
(B) Substance responsible for the blistered appearence of the copper obtained as result of extraction of copper from cuprous oxide	(q) Copper
(C) Metal which during purification is distilled off and collected by rapid chilling	(r) Na_3AlF_6 or CaF_2
(D) On addition to Al_2O_3 its melting point gets reduced and conductivity gets enhanced	(s) Zinc

(a) A – (p), B – (q), C – (s), D – (r)
(b) A – (q), B – (s), C – (p), D – (r)
(c) A – (q), B – (p), C – (s), D – (r)
(d) A – (q), B – (p), C – (r), D – (s)

92. Match the columns.

Column-I	Column-II
(A) Blisterred Cu	(p) Aluminium
(B) Blast furnace	(q) $2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$
(C) Reverberatory furnace	(r) Iron
(D) Hall-Heroult process	(s) $FeO + SiO_2 \rightarrow FeSiO_3$
	(t) $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$

(a) A – (q), B – (r), C – (s), D – (p)
(b) A – (p), B – (q), C – (r), D – (t)
(c) A – (t), B – (s), C – (r), D – (q)
(d) A – (s), B – (t), C – (r), D – (q)

93. Match the columns.

Column-I	Column-II
(A) Coloured bands	(p) Zone refining
(B) Impure metal to volatile complex	(q) Fractional distillation
(C) Purification of Ge and Si	(r) Mond Process
(D) Purification of mercury	(s) Chromatography
	(t) Liquation

(a) A – (p), B – (q), C – (s), D – (t)
(b) A – (s), B – (r), C – (p), D – (q)
(c) A – (r), B – (s), C – (p), D – (q)
(d) A – (t), B – (s), C – (r), D – (q)

94. Match the columns.

Column-I	Column-II
(A) Cyanide process	(p) Ultrapure Ge
(B) Froth Floatation Process	(q) Dressing of ZnS
(C) Electrolytic reduction	(r) Extraction of Al
(D) Zone refining	(s) Extraction of Au
	(t) Purification of Ni

(a) A – (s), B – (q), C – (r), D – (p)
(b) A – (q), B – (r), C – (p), D – (t)
(c) A – (p), B – (q), C – (r), D – (s)
(d) A – (r), B – (s), C – (t), D – (p)

95. Match the columns

Column-I	Column-II
(A) Cyanide process	(p) Ultrapure Ge
(B) Floatation process	(q) Pine oil
(C) Electrolytic reduction	(r) Extraction of Al
(D) Zone refining	(s) Extraction of Au

(a) A – (r), B – (p), C – (s), D – (q)
(b) A – (s), B – (q), C – (r), D – (p)
(c) A – (r), B – (q), C – (s), D – (p)
(d) A – (s), B – (p), C – (r), D – (q)

96. Match the columns

Column-I	Column-II
(A) Distillation	(p) Zr
(B) Electrolytic refining	(q) Ga
(C) Liquation	(r) Cu
(D) Zone refining	(s) Hg
(E) Vapour phase refining	(t) Sn

(a) A – (r), B – (s), C – (t), D – (q), E – (p)
(b) A – (s), B – (r), C – (t), D – (q), E – (p)
(c) A – (s), B – (t), C – (r), D – (q), E – (p)
(d) A – (s), B – (r), C – (p), D – (q), E – (t)

97. Match the columns

Column-I	Column-II
(A) This metal is used in extraction of chromium and manganese.	(p) Zinc
(B) Common metal in brass and bronze.	(q) Aluminium
(C) Common metal in brass and german silver.	(r) Copper
(D) Substance used in making cycles, automobiles, utensils, etc.	(s) Stainless steel

(a) A – (q), B – (r), C – (p), D – (s)
(b) A – (r), B – (q), C – (p), D – (s)
(c) A – (q), B – (p), C – (r), D – (s)
(d) A – (q), B – (r), C – (s), D – (p)

ASSERTION-REASON TYPE QUESTIONS

Directions : Each of these questions contain two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

98. **Assertion :** Levigation is used for the separation of oxide ores from impurities.
Reason : Ore particles are removed by washing in a current of water.

99. **Assertion :** Zinc can be used while copper cannot be used in the recovery of Ag from the complex $[Ag(CN)_2]^-$.
Reason : Zinc is a powerful reducing agent than copper.

100. **Assertion :** Leaching is a process of reduction.
Reason : Leaching involves treatment of the ore with a suitable reagent so as to make it soluble while impurities remains insoluble.

101. **Assertion :** Coke and flux are used in smelting.
Reason : The phenomenon in which ore is mixed with suitable flux and coke is heated to fusion is known as smelting.

102. **Assertion :** Copper obtained after bessemerization is known as blister copper.
Reason : Blisters are produced on the surface of the metal due to escaping of dissolved SO_2.

103. **Assertion :** Lead, tin and bismuth are purified by liquation method.
Reason : Lead, tin and bismuth have low m.p. as compared to impurities.

CRITICAL THINKING TYPE QUESTIONS

104. Copper can be extracted from
(a) Kupfernical (b) Dolomite
(c) Malachite (d) Galena

105. Which of the following metal is correctly matched with its ore?

	Metal	Ore
(a)	Zinc	Calamine
(b)	Silver	Ilmenite
(c)	Magnesium	Cassiterite
(d)	Tin	Azurite

106. Which ore contains both iron and copper?
(a) Cuprite (b) Chalcocite
(c) Chalcopyrite (d) Malachite

107. Sulfide ores are common for the metals
(a) Ag, Cu and Pb (b) Ag, Mg and Pb
(c) Ag, Cu and Sn (d) Al, Cu and Pb

108. Which one of the following does not occur as sulphide ore?
(a) Zn (b) Cr
(c) Ag (d) Fe

109. Pyrolusite is a/an
(a) oxide ore (b) sulphide ore
(c) carbide ore (d) Not an ore

110. Sulphide ores of metals are usually concentrated by froth flotation process. Which one of the following sulphide ores offer an exception and is concentrated by chemical leaching?
(a) Galena (b) Copper pyrite
(c) Sphalerite (d) Argentite

111. Which of the following statements is correct ?
(a) Gangues are carefully chosen to combine with the slag present in the ore to produce easily fusible flux to carry away the impurities
(b) Slags are carefully chosen to combine with the flux present in the ore to produce easily fusible gangue to carry away the impurities
(c) Gangues are carefully chosen to combine with the flux present in the ore to produce easily fusible slag to carry away the impurities
(d) Fluxes are carefully chosen to combine with the gangue present in the ore to produce easily fusible slag to carry away the impurities

112. Carbon and CO gas are used to reduce which of the following pairs of metal oxides for extraction of metals ?
(a) FeO, SnO (b) SnO, ZnO
(c) BaO, Na_2O_2 (d) FeO, ZnO

113. In the cyanide extraction process of silver from argentite ore, the oxidising and reducing agents used are
(a) O_2 and CO respectively
(b) O_2 and Zn dust respectively
(c) HNO_3 and Zn dust respectively
(d) HNO_3 and CO respectively

114. Consider the following reactions at 1000°C

A. $Zn(s) + \frac{1}{2}O_2(g) \rightarrow ZnO(s);\ \Delta G° = -360\,kJ\,mol^{-1}$

B. $C(gr) + \frac{1}{2}O_2(g) \rightarrow CO(g);\ \Delta G° = -460\,kJ\,mol^{-1}$

Choose the correct statement at 1000°C
(a) zinc can be oxidised by carbon monoxide.
(b) zinc oxide can be reduced by graphite
(c) carbon monoxide can be reduced by zinc.
(d) both statements (a) and (b) are true

115. Which of the following statements, about the advantage of roasting of sulphide ore before reduction is not true?
(a) The ΔG_f^o of the sulphide is greater than those for CS_2 and H_2S.
(b) The ΔG_f^o is negative for roasting of sulphide ore to oxide.
(c) Roasting of the sulphide to the oxide is thermodynamically feasible.
(d) Carbon and hydrogen are suitable reducing agents for reduction of metal sulphides.

116. Which of the following statement is not correct about Ellingham diagram?
(a) ΔG increases with an increase in temperature
(b) It consists of plots of $\Delta_f G^o$ vs T for formation of oxides
(c) a coupling reaction can be well expressed by this diagram
(d) It express the kinetics of the reduction process

117. A coupled reaction takes place as follow–
$A + B \longrightarrow C + D, \quad \Delta G^o = +x\,kj$
$D + E \longrightarrow F \quad \Delta G^o = -y\,kj$
for the spontaneity of reaction $A + B + E \longrightarrow C+F$, which of the following is correct?
(a) $2x = y$ (b) $x < y$
(c) $x > y$ (d) $x = (y) \times T\Delta S$

118. The value of $\Delta_f G^o$ for formation of Cr_2O_3 is – 540 $kJmol^{-1}$ and that of Al_2O_3 is – 827 kJ mol^{-1} What is the value of $\Delta_r G^\circ$ for the reaction?

$$\frac{4}{3}Al(s) + \frac{2}{3}Cr_2O_3(s) \rightarrow \frac{2}{3}Al_2O_3(s) + \frac{4}{3}Cr(s).$$

(a) $-574\,kJ\,mol^{-1}$ (b) $-287\,kJ\,mol^{-1}$
(c) $+574\,kJ\,mol^{-1}$ (d) $+287\,kJ\,mol^{-1}$

119. Before introducing FeO in blast furnace , it is converted to Fe_2O_3 by roasting so that
(a) it may not be removed as slag with silica
(b) it may not evaporate in the furnace
(c) presence of it may increase the m.pt. of charge
(d) None of these.

120. The temperature in °C at which Fe_2O_3 is finally reduced to Fe in the blast furnace is
(a) 993 (b) 797
(c) 897 (d) 1597

121. When copper ore is mixed with silica, in a reverberatory furnace copper matte is produced. The copper matte contains_____.
(a) sulphides of copper (II) and iron (II)
(b) sulphides of copper (II) and iron (III)
(c) sulphides of copper (I) and iron (II)
(d) sulphides of copper (I) and iron (III)

122. In the metallurgy of aluminium _____.
(a) Al^{3+} is oxidised to Al (s).
(b) graphide anode is oxidised to carbon monoxide and carbon dioxide.
(c) oxidation state of oxygen changes in the reaction at anode.
(d) oxidation state of oxygen changes in the overall reaction involved in the process.

123. In the extraction of chlorine from brine_____.
(i) $\Delta G^{\ominus}$ for the overall reaction is negative.
(ii) $\Delta G^{\ominus}$ for the overall reaction is positive.
(iii) $E^{\ominus}$ for overall reaction has negative value.
(iv) $E^{\ominus}$ for overall reaction has positive value.
(a) (i) and (ii) (b) (ii) and (iii)
(c) (i) and (iv) (d) (iii) and (iv)

124. $Cu_2S + 2Cu_2O \longrightarrow 6Cu + SO_2$
In which process of metallurgy of copper, above equation is involved?
(a) Roasting (b) Self reduction
(c) Refining (d) Purification

125. Which of the following statements regarding metallurgy of iron is incorrect ?
(a) Reaction $Fe_3O_4 + 4CO \longrightarrow 3Fe + 4CO_2$ belongs to lower temperature range (500 – 800K) of the blast furnace.
(b) Reaction $FeO + CO \longrightarrow Fe + CO_2$ belongs to higher temperature range (900 – 1500K) of the blast furnace.
(c) The iron obtained from blast furnace is cast iron with 3% carbon.
(d) For reduction of iron oxide to occur ΔG of the couple of following reactions should be negative

$$FeO(s) \longrightarrow Fe(s) + \frac{1}{2}O_2(g)$$

$$C(s) + \frac{1}{2}O_2(g) \longrightarrow CO(g)$$

126. Extraction of which of the following is based on oxidation ?
(a) Highly reactive metals
(b) Moderately reactive metals
(c) Non-metals
(d) Both (a) and (c)

127. Which of the following reaction(s) occur in temperature range 500 – 800 K in blast furnace.
(i) $Fe_2O_3 + CO \longrightarrow 2FeO + CO_2$
(ii) $Fe_3O_4 + 4CO \longrightarrow 3Fe + 4CO_2$
(iii) $FeO + CO \longrightarrow Fe + CO_2$
(iv) $C + CO_2 \longrightarrow 2CO$
(a) (i) and (ii) (b) (i), (ii) and (iii)
(c) (iii) and (iv) (d) (iv) only

128. In Hall-Heroult process how much carbon anode is burnt away to produce each 1kg of aluminium ?
(a) 0.3 kg (b) 0.5 kg
(c) 1 kg (d) 0.1 kg

129. In electro-refining of metal the impure metal is used to make the anode and a strip of pure metal as the cathode, during the electrolysis of an aqueous solution of a complex metal salt. This method cannot be used for refining of
(a) Silver (b) Copper
(c) Aluminium (d) Sodium

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

131. If the impurities in a metal has a greater affinity for oxygen and is more easily oxidised than the metal, then the purification of metal may be carried out by
(a) distillation (b) zone refining
(c) electrolytic refining (d) cupellation

132. Germanium of very high purity is obtained by
(a) liquation (b) vapour phase refining
(c) distillation (d) zone refining

133. Which of the following statements regarding electrolytic refining of copper is incorrect ?
(a) In this process anode is made up of impure copper and pure copper strips are taken as cathode.
(b) Acidic or basic solution of copper sulphate is used as electrolyte
(c) Antimony, tellurium, silver and gold are some of the metals deposits as anode mud during this process
(d) Zinc can be also refined by electrolytic refining method.

134. Which of the following is incorrectly matched ?

	Metal	**Uses**
(a)	Wrought iron	Casting stoves, gutter pipes, toys etc.
(b)	Copper	Coinage alloy
(c)	Aluminium	Extraction of chromium and manganese
(d)	Nickel steel	Measuring tapes

HINTS AND SOLUTIONS

FACT/DEFINITION TYPE QUESTIONS

1. (a) Argentite or silver glance (Ag_2S) is an ore of Ag.

2. (a) Cinnabar (HgS) is an ore of Hg.

3. (a) Bauxite ore of aluminium is $Al_2O_3.2H_2O$.

4. (a)

5. (b) Al is most abundant metal on the surface of the earth.

6. (c) Carborundum - SiC
Epsomite or Epsom salt - $MgSO_4.7H_2O$
Cassiterite - SnO_2
Spodumene - Ore of lithium

7. (a) Chalcopyrite : $CuFeS_2$
Fool's gold : FeS_2
Carnalite : $KMgCl_3.6H_2O$
Bauxite : $Al_2O_3.2H_2O$

8. (c) Haematite is Fe_2O_3. Thus it is the ore of iron (Fe).

9. (c) Azurite is a basic carbonate ore of copper.
$2CuCO_3.Cu(OH)_2$

10. (d) Fe_3O_4 – Magnetite
$CuCO_3 \cdot Cu(OH)_2$ – Malachite
Pyrolusite – MnO_2 and Cassiterite – SnO_2.

11. (a)

12. (a) The formula of magnetite is Fe_3O_4.

13. (c) Impurities associated with minerals are called gangue or matrix.

14. (c)

15. (b) Malachite is an ore of copper $Cu(OH)_2.CuCO_3$.

16. (d) Cassiterite is an ore of Sn also known as tin stone SnO_2.

17. (a) Galena is an ore of lead. It is PbS.

18. (a) Gold being least reactive found native.

19. (a)

20. (c) Zincite is ZnO.

21. (c) Galena is PbS and thus purified by froth floatation method.
Froth flotation method is used to concentrate sulphide ores. This method is based on the fact that the surface of sulphide ores is preferentially wetted by oils while that of gangue is preferentially wetted by water.

22. (d) Froth floatation process is used for the concentration of sulphide ores.

23. (b) Cassiterite contains the magnetic impurities of $FeSO_4$ and thus concentrated by electromagnetic separation.

24. (d) Cyanide process is used in the metallurgy of Ag

$$2Ag_2S + 8NaCN + O_2 + 2H_2O \longrightarrow 4Na[Ag(CN)_2] + 4NaOH + 2S$$

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

25. (a)

26. (b) Leaching is a process used for concentration of ore. In this process, a powdered ore is treated with a suitable reagent (such as acids, bases or other chemicals) which can selectively dissolve the ore, but not the impurities.

27. (d) Au and Ag can be extracted from their native ores by leaching (Mac-Arthur Forrest cyanide process).

28. (c)

29. (c) Cinnabar is sulphide ore (HgS). Hence purified by froth floatation process.

30. (a) Ag is leached by cyanide process.

31. (c) Pyrolusite is MnO_2. Hence not concentrated by froth floatation process.

32. (c) Froth reduces the surface tension of water and the solution forms froth.

33. (a) Froth flotation process is based on wetting properties of ore particles.

34. (c) The surface of particles not wetted hence they float at the surface

35. (a) To remove moisture and non-metallic impurities like S, P and As are oxidised and are removed as volatile substances.

$$S_8 + 8O_2 \rightarrow 8SO_2 \uparrow ;\ P_4 + 5O_2 \rightarrow P_4O_{10} \uparrow$$

$$4As + 3O_2 \rightarrow 2As_2O_3 \uparrow$$

36. (c) In this process sulphide ores are converted into oxide ores.

$$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2 \uparrow$$

37. (a) **38. (d)**

39. (a) Carbon reduction, $Fe_2O_3 + 3\,C \rightarrow 2Fe + 3CO$

40. (b) Flux + Gangue $\rightarrow$ Slag

41. (a) Calcination is heating ore in absence of air to remove moisture and volatile impurities. Carbonate ores decomposed to corresponding oxides as a result of calcination.

42. (d) Calcination is a process of heating a substance to a high temperature but below the melting or fusion point, causing loss of moisture, reduction or oxidation and dissociation into simpler substances.

43. (b) Since silica is acidic impurity the flux must be basic.

$$CaO + SiO_2 \rightarrow CaSiO_3$$

44. (b) To remove acidic impurities basic flux is added which is $CaCO_3$.

45. (d) Decomposition of carbonates and hydrated oxides.

46. (d) $2CuO + CuS \rightarrow 3Cu + SO_2$ (Self - reduction)

47. (a) For example, Ag_2S is converted into $Na[Ag(CN)_2]$. When Zn is added, Ag is displaced.

48. (b)

49. **(c)** Cresol is used as froth stabiliser.

50. **(b)** Calcination involves heating when the volatile matter escapes leaving behind the metal oxide.

51. **(b)** In the graph of $\Delta_r G°$ vs T for formation of oxides, the Cu_2O line is almost at the top. So, it is quite easy to reduce oxide ores of copper directly to the metal by heating with coke both the lines of C, CO and C, CO_2 are at much lower temperature (500 - 600 K).

$$Cu_2O + C \longrightarrow 2Cu + CO$$

52. **(d)**

53. **(c)** Ellingham diagram normally consists of plots of $\Delta_f G^\circ$ Vs T for the formation of oxides of elements.

54. **(c)**

55. **(b)** $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

56. **(c)**

57. **(c)** In blast furnace at about 1270 K, calcium carbonate is almost completely decomposed to give CaO which acts as a flux and combines with SiO_2 present as impurity (gangue) in the ore to form calcium silicate (fusible slag)

$$CaO(s)\ (\text{basic flux}) + SiO_2\ (s)\ (\text{acidic flux}) \longrightarrow CaSiO_3\ (s)\ (\text{slag})$$

58. **(b)** These are the substances which can withstand very high temperature without melting or becoming soft.

59. **(a)**

60. **(d)** Cast iron is different from pig iron and is made by melting pig iron with scrap iron and coke using hot air blast. It has slightly lower carbon content (about 3%) and is extremely hard and brittle.

61. **(a)** Cuprous oxide formed during roasting of cuprous sulphide is mixed with few amount of cuprous sulphide and heated in a reverberatory furnace to get metallic copper.

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

62. **(b)** Extraction of Zn from ZnS (Zinc blende) is achieved by roasting followed by reduction with carbon.

$$2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$$

$$ZnO + C \longrightarrow Zn + CO$$

63. **(d)** Decomposition of carbonates and hydrated oxides.

64. **(b)** Aluminothermite process involves reduction of oxides which are not satisfactorily reduced by carbon such as Fe_2O_3, Mn_3O_4, Cr_2O_3, etc. to metals with aluminium.

$$Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr \quad \Delta H = -ve$$

65. **(c)** Because Na is very reactive and cannot be extracted by means of the reduction by C, CO etc. So it is extracted by electrolysis.

66. **(c)**

67. **(c)** Fused alumina (Al_2O_3) is a bad conductor of electricity. Therefore, cryolite (Na_3AlF_6) and fluorspar (CaF_2) are added to purified alumina which not only make alumina a good conductor of electricity but also reduce the melting point of the mixture to around 1140 K.

68. **(a)** **69.** **(c)** **70.** **(a)**

71. **(d)** Blister-Copper contains 1 – 2 % impurities. It is obtained after Bessemerisation of crude copper.

72. **(a)**

73. **(b)** Pig iron contains 4% carbon and many impurities in smaller amount.

74. **(d)** **75.** **(c)** **76.** **(a)**

77. **(a)** $Ti + 2I_2 \xrightarrow{523K} \underset{\substack{\text{Volatile}\\\text{Stable compound}}}{TiI_4} \xrightarrow{1700K} \underset{\text{Pure metal}}{Ti + 2I_2}$

78. **(c)** Liquation process, Mond's process and, van Arkel process these are the refining processes that are applied depending upon the nature of the metal under treatment and nature of the impurities whereas amalgamation process is used for the extraction of noble metals like gold, silver, etc, from native ores. The metal is recovered from the amalgam by subjecting it to distillation, where the mercury distils over leaving behind the metal.

$$Ore + Hg \rightarrow Amalgam \xrightarrow{\text{Distilled}} \begin{cases} \text{Hg-vapours} \\ \text{Metal} \end{cases}$$

79. **(b)** Zr and Ti are purified by van Arkel method.

$$Zr(s) + 2I_2(g) \xrightarrow{870K} ZrI_4(g)$$

$$ZrI_4(g) \xrightarrow[\text{Tugsten filament}]{2075K} Zr(s) + 2I_2(g)$$

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

$$\downarrow 1700K$$

$$\underset{\text{Pure titanium}}{Ti(s) + 2I_2(g)}$$

80. **(a)** Zone refining is based on the difference in solubility of impurities in molten and solid state of the metal. This method is used for obtaining metals of very high purity.

81. **(d)** Si obtained by reduction of $SiCl_4$ with H_2 is further purified by zone refining method to get Si of very high purity. Silicon is purified by zone-refining process because the impurities present in it are more soluble in the liquid phase than in the solid phase.

82. **(c)** **83.** **(a)**

84. **(c)** Mobile phase cannot be solid.

85. **(b)** Zinc dust is used as a reducing agent in the manufacture of dye-stuffs, paints etc.

STATEMENT TYPE QUESTIONS

86. **(a)** For ore containing mixture of ZnS and PbS, depressant NaCN allows PbS to come with froth and prevents ZnS from coming to the froth.

87. **(b)** Ellingham diagram represents plot between ΔG and T therefore with increase in temperature phase change Gas $\rightarrow$ Liquid is not possible. Ellingham diagram does not give any information about kinetics of the reduction reaction.

88. (c)

89. (c) Van Arkel method involves heating crude Zr with iodine to form corresponding iodide. The metal iodide being more covalent volatilises.

MATCHING TYPE QUESTIONS

90. (a) **91. (c)** **92. (a)** **93. (b)** **94. (a)**

95. (b) Cyanide process is for gold (A - s); floatation process - pine oil (B - q); Electrolytic reduction - Al (C - r); Zone refining -Ge (D - p).

96. (b) **97. (a)**

ASSERTION-REASON TYPE QUESTIONS

98. (c) Assertion is true but reason is false.
Oxide ores being heavier than the earthy or rocky gangue particles, settle down while lighter impurities are washed away.

99. (a)

100. (d) Assertion is false but reason is true. Leaching is a process of concentration.

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

102. (a) Both assertion and reason are correct and reason is the correct explanation of assertion.

103. (a)

CRITICAL THINKING TYPE QUESTIONS

104. (c) Malachite is $CuCO_3 . Cu(OH)_2$ it is ore of copper.

105. (a)

(a)	Zinc	Calamine is $ZnCO_3$
(b)	Silver	Ilmenite is $FeTiO_3$
(c)	Magnesium	Cassiterite is SnO_2
(d)	Tin	Azurite is $[2CuCO_3.Cu(OH)_2]$

106. (c) Cuprite : Cu_2O; Chalcocite : Cu_2S; Chalcopyrite : $CuFeS_2$; Malachite: $Cu(OH)_2.CuCO_3$. We see that $CuFeS_2$ contains both Cu and Fe.

107. (a) Silver, copper and lead are commonly found in earth's crust as Ag_2S (silver glance), $CuFeS_2$ (copper pyrites) and PbS (galena)

108. (b) Except chromium all the given metals exists as their sulphides.
Zn exists as zinc blende ZnS.
Silver exists as silver glance Ag_2S.
Iron exists as iron pyrites FeS_2.
Mercury exists as mercuric sulphide HgS.

109. (a) MnO_2 is pyrolusite (oxide ore).

110. (d) Leaching is the selective dissolution of the desired mineral leaving behind the impurities in a suitable dissolving agent e.g.,
Argentitie or Silver glance, Ag_2S is an ore of silver. Silver is extracted from argentite by the mac-Arthur and Forest process (leaching process).

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

$$4Au + 8KCN + 2H_2O + O_2 \rightarrow 4K[Au(CN)_2] + 4KOH$$

111. (d) **112. (d)**

113. (b) The reactions involved in cyanide extraction process are :

$$\underset{\text{(argentite)}}{Ag_2S} + 4NaCN \rightarrow 2Na[Ag(CN)_2] + Na_2S$$

$$4Na_2S + \underset{\substack{\text{Oxiding}\\ \text{agent}}}{5O_2} + 2H_2O \rightarrow 2Na_2SO_4 + 4NaOH + 2S$$

$$2Na[Ag(CN)_2] + \underset{\substack{\text{(reducing}\\ \text{agent)}}}{Zn} \rightarrow Na_2[Zn(CN)_4] + 2Ag\downarrow$$

114. (b)

115. (d) The sulphide ore is roasted to oxide before reduction because the ΔG_f^o of most of the sulphides are greater than those of CS_2 and H_2S, therefore neither C nor H can reduce metal sulphide to metal. Further, the standard free energies of formation of oxide are much less than those of SO_2. Hence oxidation of metal sulphides to metal oxide is thermodynamically favourable.

116. (d) Ellingham diagrams are based on thermodynamic concepts. It does not tell anything about the kinetics of the reduction process.

117. (d) For a spontaneous reaction , ΔG^o must be negative and it can be possible only in this case when $x < y$

118. (b) The two equation are:

$$\frac{4}{3}Al(s) + O_2(g) \rightarrow \frac{2}{3}Al_2O_3(s),\ \Delta_f G^o = -827 kJ\ mol^{-1} \quad \ldots(1)$$

$$\frac{4}{3}Cr(s) + O_2(g) \rightarrow \frac{2}{3}Cr_2O_3(s),\ \Delta_f G^o = -540 kJ\ mol^{-1} \quad \ldots(2)$$

Subtracting equation (ii) from equation (i) we have,

$$\frac{4}{3}Al(s) + \frac{2}{3}Cr_2O_3(s) \rightarrow \frac{2}{3}Al_2O_3(s) + \frac{4}{3}Cr(s),$$

$$\Delta_r G^\circ = -287 kJ\ mol^{-1}$$

119. (a) FeO is capable forming slag with SiO_2

$$SiO_2 + FeO \rightarrow FeSiO_3$$

120. (a) In blast furnace Fe_2O_3 is finally reduced to Fe at 993°C

121. (c) **122. (b)** **123. (b)**

124. (b) This process is also called autoreduction process or air reduction process. The sulphide ores of less electropositive metals are heated in air to convert part of the ore into oxide or sulphate which then react with the remaining sulphide ore to give the metal and sulphur dioxide.

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

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

125. (c) The iron obtained from blast furnace is pig iron with 4% carbon and impurities like S, P, Mn etc., in small amount.

126. (c) Extraction of non-metals are based on oxidation. For example extraction of chlorine from brine.

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

127. (a) (iii) and (iv) reactions occur in the temperature range of 900 – 1500K in blast furnace.

128. (b) For each kg of Al produced, about 0.5 kg of carbon anode is burnt away.

129. (d) Na reacts vigorously with water (exothermic process)

130. (b) During the process of electrolytic refining of copper Ag and Au are obtained as anode mud.

131. (d)

132. (d) Metals of high purity are obtained by zone refining e.g., silicon, germanium, boron, gallium, indium.

133. (b) During electrolytic refining of copper electrolyte used is acidified solution of copper sulphate.

134. (a) Wrought iron is used in making anchors, wires, bolts chains and agricultural implements.