Single Correct Answer Type

1. The fact that impurities are more soluble in the molten state than in the solid state of the metal is used in _____
   a) Liquation process
   b) Distillation
   c) Fractional crystallization
   d) Polling

2. Oxides of the various metals are converted into metal by heating but not in
   a) Ag_2O
   b) CuO
   c) HgO
   d) All are correct

3. Roasting is carried out in a/an _____ furnace
   a) Blast
   b) Reverberatory
   c) Muffle
   d) Electric

4. Hall's process is used for purification of _____
   a) White bauxite
   b) Red bauxite
   c) Iron aluminate
   d) Silicates

5. H_3PO_4 can be neutralized by $NaOH, Ca(OH)_2$ and $Al(OH)_3$.1equivalent of H_3PO_4 will require mole of each in the ratio
   a) $1 : 1 : 1$
   b) $1 : 0.5 : 0.33$
   c) $1 : 2 : 3$
   d) $2 : 3 : 6$

6. The slag obtained during the extraction of copper from copper pyrites is composed of
   a) Cu_2S
   b) $CuSiO_3$
   c) $FeSiO_3$
   d) SiO_2

7. The chemical process in the production of steel from haematite ore involves
   a) Reduction
   b) Oxidation
   c) Reduction followed by oxidation
   d) Oxidation followed by reduction

8. Calamine is _____
   a) $ZnSO_4$
   b) ZnO
   c) $Zn(NO_3)_2$
   d) $ZnCO_3$

9. Consider the following redox reactions, $xMnO_4^- + yC_2O_4^{2-} + zH^+ \rightarrow xMn^{2+} + 2yCO_2 + \frac{z}{2}H_2O$
   The values of x, y and z in the reaction are, respectively
   a) 5, 2 and 16
   b) 2, 5 and 8
   c) 2, 5 and 16
   d) 5, 2 and 8

10. When Br_2 is passed into hot aqueous solution of Na_2CO_3,
    a) Br^- is formed by reduction
    b) BrO_3^- is formed by oxidation
    c) CO_2 is evolved
    d) All of the above are correct

11. Pig tin is obtained by _____
    a) Liquation process
    b) Zone refining
    c) Polling
    d) Vapour phase refining

12. In the leaching of Ag_2S with NaCN, a stream of air is also passed. It is because of
    a) Reversible nature of reaction between Ag_2S and NaCN
    b) To oxide Na_2S formed into $Na_2S_2O_3$ and sulphur
    c) Both (a) and (b)
    d) None of the above

13. Blister Cu is about
    a) 60% Cu
    b) 90% Cu
    c) 98% Cu
    d) 100% Cu

14. Select the correct statement(s) about differentiation floatation
    a) It is used to concentrate mixture of sulphides at different stages
    b) Zinc sulphate is used to depress zinc sulphide and PbS forms froth
    c) Copper sulphate is used to activate depressed lead sulphide and O_2 is blown to make froth
    d) All of the above are correct statements

15. Select some statements about metallurgical extraction of Al
    I. Cryolite and fluorspar are added to molten alumina

II. Aqueous solution of Al^{3+} salts cannot be taken as electrolyte

III. Molten $AlCl_3$ can be taken instead by molten alumina

IV. Hall's process is adopted for the beneficiation of low grade red beauxite

Select the correct statements

a) All except III   b) All except II   c) I and II only   d) I and IV only

16. Cementite is

a) Predominant content of cement   b) A mineral of calcium

c) A carbide of iron in steel   d) None of the above

17. 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 (a) and (b)

d) None of the above

18. Which process is NOT involved in extraction of Zn?

a) Roasting   b) Smelting   c) Refining   d) Polling

19. In the oxidation of $Fe_2(C_2O_4)_3$ by MnO_4^-/H^+ which species does not appear in final ionic reaction?

a) Ferric   b) Oxalate   c) Permanganate   d) All of these

20. Roasted copper pyrites on smelting with sand produces _____

a) $FeSiO_3$ as fusible slag and Cu_2S matte

b) $CaSiO_3$ as infusible slag and Cu_2O matte

c) $Ca_3(PO_4)_2$ as fusible slag and Cu_2S matte

d) $Fe_3(PO_4)_2$ as infusible slag and Cu_2S matte

21. Which of the following metal is obtained by leaching process using a solution of NaCN and then precipitating the metal by addition of zinc dust?

a) Copper   b) Silver   c) Nickel   d) Iron

22. Which of the following is used as a foaming agent in froth floatation process?

a) Pine oil   b) Sodium cyanide   c) Copper sulphate   d) Potassium cyanide

23. Which of the following is a carbonate ore?

a) Pyrolusite   b) Malachite   c) Diaspore   d) Cassiterite

24. In blast furnace, the highest temperature is in _____ zone

a) Reduction   b) Slag   c) Fusion   d) Combustion

25. Consider the following statements.

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

26. When $FeCr_2O_4$ (chromite) is reduced with C in an electric-arc furnace

a) Cr and Fe_2O_3 are formed   b) Fe and Cr_2O_3 are formed

c) Fe and Cr (ferrochrome) are formed   d) $FeCrO_4$ is formed

27. In the following reaction, consider the following statements

$2Cr(OH)_3 + 3H_2O_2 + 4OH^- \rightarrow 2CrO_4^{2-} + 8H_2O$

I. There is colour change from green precipitate to yellow coloured solution

II Oxidation number of Cr changes from +3 to +6

III. Oxidation number of O in H_2O_2 changes fro -2 to -1

Select the correct statements(s)

a) I only   b) I and II   c) II only   d) I and III

28. Of the following acids, the one that is strongest is
    a) $HBrO_4$ b) $HOCl$ c) HNO_2 d) H_3PO_3

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

30. Magistral is the burnt pyrites containing
    a) Sulphates of iron and copper   b) Sulphates and oxides of iron and copper
    c) Oxides of iron and copper   d) Sulphides of silver and lead

31. Froth floatation process is used for the concentration of _____
    a) Oxide ores   b) Sulphide ores   c) Chloride ores   d) Amalgams

32. For the electrolytic refining of aluminium, the three fused layers consist of _____

	Bottom layer	Middle layer	Upper layer
a)	Cathode of pure Al	Cryolite and fluorspar	Anode of Al and Cu alloy
b)	Cathode of Al and Cu alloy	Bauxite and cryolite	Anode of pure Al
c)	Anode of impure Al	Cryolite and barium fluoride	Cathode of pure Al
d)	Anode of Al and Cu alloy	Bauxite, cryolite and fluorspar	Cathode of pure Al

33. Some of the common steps involved in the metallurgical operations are
    I. refining
    II. dressing of the ore
    III. conversion of the ore into its oxides or other desired compounds
    Choose the CORRECT order in which these steps are carried out
    a) III, II, I   b) I, II, III   c) II, III, I   d) II, I, III

34. Carbon reduction cannot be applied for the extraction of Al from Al_2O_3. This is based on the followed facts
    Fact I The temperature requirement is very high about 2000°C
    Fact II Based on Ellingham diagram
    Fact III Al obtained in the vapour state is difficult to handle
    Fact IV Al gets converted into Al_2C_3 (carbide)
    Select the correct fats
    a) All except I   b) All except II   c) All except III   d) All are correct facts

35. Electrometallurgy is used for _____ metals
    a) Transition   b) Most reactive   c) Noble   d) Soft

36. In which of the following transformation, oxygen is not the reducing agent?
    a) $Ag_2O \rightarrow 2Ag + \frac{1}{2}O_2$ b) $4NH_3 + 3O_2 \rightarrow 2N_2 + 6H_2O$
    c) $2F_2 + 2H_2O \rightarrow 4HF + O_2$ d) $2AgNO_3 + H_2O_2 \rightarrow 2Ag + 2HNO_3 + O_2$

37. In order to separate two sulphide ores by froth floatation process, _____
    a) Proportion of oil to water is adjusted
    b) Depressants are added
    c) Collectors are added
    d) Either (A) or (B)

38. Bessemer converter is used for the preparation of

a) Steel   b) Wrought iron   c) Pig iron   d) Cast iron

39. Consider the following species.
    1. $CaOCl_2$;
    2. $Na_2S_2O_3$;
    3. Pb_3O_4,
    4. $Na_2S_4O_6$

    Select the species with different oxidation states of the same element

    a) I, II   b) I, II, III   c) II, III, IV   d) I, II, III, IV

40. Pyrometallurgical method used for the extraction of copper from sulphide ore
    a) Is a dry method
    b) Involves concentration by leaching the sulphide ore with dil. H_2SO_4
    c) Involves concentration of the sulphide ore by froth flotation process
    d) Statement given in (b) is incorrect

41. Chemical leaching is useful in the concentration of
    a) Copper pyrites   b) Bauxite   c) Galena   d) Cassiterite

42. Which is NOT the method of chromatography?
    a) Paper chromatography
    b) Gas chromatography
    c) Thin layer chromatography
    d) Vapour chromatography

43. In zone refining, pure metal is obtained at the _____
    a) Right end, if zone is travelling from left to right
    b) Left end, if zone is travelling from left to right
    c) Left end, if zone is travelling from right to left
    d) Centre, if zone is travelling from any side

44. Al_2O_3 can be converted to anhydrous $AlCl_3$ by heating
    a) Al_2O_3 with HCl gas
    b) Al_2O_3 with NaCl in solid state
    c) A mixture of Al_2O_3 and carbon in dry Cl_2 gas
    d) Al_2O_3 with Cl_2 gas

45. H_2O_2 oxidizes MnO_2 to MnO_4^- in basic medium. H_2O_2 and MnO_2 react in the molar ratio of
    a) 1 : 1   b) 2 : 1   c) 2 : 3   d) 3 : 2

46. Equivalent weight of MnO_2 in the following reaction is (Mn = 55)
    $Mn^{3+} \rightarrow Mn^{2+} + MnO_2$
    a) 43.5   b) 87   c) 55   d) 174

47. If the impurity of silica in bauxite is comparatively more, then it is purified by _____
    a) Hall's method   b) Baeyer's method   c) Serpeck's process   d) Pattinson's process

48. Which of the following is not the by-product obtained in the extraction of copper?
    a) SO_2 which is further used in the manufacture of H_2SO_4 by the contact process
    b) Gold, silver and platinum obtained as anode mud
    c) $FeSO_4$ which is used to prepare green vitriol
    d) $FeSiO_3$ obtained as slag, used in road making

49. Electrolytic reduction of alumina to aluminium by Hall-Heroult process is carried out
    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

50. Which one is used for the manufacture of iron?
    a) Cryolite   b) Bauxite   c) Haematite   d) Chalcopyrites

51. In a reaction KCl is converted into $KClO_4$. Change in oxidation number is

a) 3   b) 5   c) 7   d) 8

52. The purest form of iron is _____
   a) Pig iron   b) Wrought iron   c) Steel   d) Both (A) and (C)

53. Gallium arsenide is purified by _____
   a) Froth floatation process
   b) Van Arkel method
   c) Zone – refining method
   d) Electrolytic method

54. The complex $[Fe(H_2O)_5NO]^{2+}$ is formed in the ring test for nitrate ion (NO_3^-) when freshly prepared $FeSO_4$ solution is added to aqueous solution of NO_3^- followed by the addition of conc. H_2SO_4.This complex is formed by charge transfer in which
   a) Fe^{2+} changes to Fe^{3+} and NO^+ changes to NO
   b) Fe^{2+} changes to Fe^{3+} and NO changes to NO^+
   c) Fe^{2+} changes to Fe^+ and NO changes to NO^+
   d) No charge transfer takes place

55. Which is intramolecular oxidation reduction reaction?
   a) $(NH_4)_2Cr_2O_7 \rightarrow N_2 + Cr_2O_3 + H_2O$ b) $NH_4NO_3 \rightarrow N_2O + 2H_2O$
   c) $2KClO_3 \rightarrow 2KCl + 3O_2$ d) All of the above

56. Which metal is found in free state?
   a) Iron   b) Platinum   c) Aluminium   d) Sodium

57. In aluminothermic process, Al acts as a
   a) Flux   b) Oxidizing agent   c) Reducing agent   d) Solder

58. The element which could be extracted by electrolytic reduction of its oxide dissolved in a high temperature melt is
   a) Sodium   b) Magnesium   c) Fluorine   d) Aluminium

59. Which of the following does not contain Mg?
   a) Magnetite   b) Magnesite   c) Asbestos   d) Carnallite

60. For the temperature at which $C \rightarrow CO$ line lie below the metal oxide line in the Ellingham diagram, _____ can be used to reduce the metal oxide
   a) Carbon   b) Carbon monoxide   c) Carbon dioxide   d) All of these

61. In electrorefining of copper, some gold is deposited as
   a) Cathode   b) Electrode   c) Cathode mud   d) Anode mud

62. Purification of aluminium done by electrolytic refining is known as _____
   a) Serpeck's   b) Hall's   c) Baeyer's   d) Hoop's

63. Electro refining is used for refining of
   a) Cu   b) Fe   c) Pb   d) Al

64. Which statement 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

65. Softened lead is desilverised by
   a) Park's method   b) Pattinson' method   c) Both (a) and (b)   d) None of the above

66. One way to test for the presence of sugars (say in urine sample) is to treat the sample with silver ions in aqueous ammonia (Tollen's test), with glucose, reaction is
   $C_6H_{12}O_6(aq) + 2Ag^+(aq) + 2OH^-(aq) \rightarrow$

In this reaction

a) Glucose is oxidized

b) Silver ion is reduced

c) A silver-mirror is formed

d) All of the above are correct

67. Which does not represent correct method?

a) $TiCl_2 + 2Mg \rightarrow Ti + 2MgCl_2$: Kroll

b) $Ni(CO)_4 \rightarrow Ni + 4CO$: Mond

c) $Ag_2CO_3 \rightarrow 2Ag + CO_2 + \frac{1}{2}O_2$: van-Arkel

d) $ZrI_4 \rightarrow Zr + 2I_2$: van-Arkel

68. Cl_2 changes to Cl^- and ClO^- in cold NaOH.Equivalent weight of Cl_2 will be

a) M

b) $\dfrac{M}{2}$

c) $\dfrac{M}{3}$

d) $\dfrac{2M}{3}$

69. Consider the following reactions,

I. $Fe^{2+} + MnO_4^- + H^+ \rightarrow$

II. $H_2O_2 + MnO_4^- + H^+ \rightarrow$

III. $SO_3^{2-} + MnO_4^- + H^+ \rightarrow$

MnO_4^- is the oxidant in

a) I only

b) I and II

c) I, II and III

d) II only

70. During the electrolysis of carnallite, $MgCl_2$ is decomposed and not KCl. This is because of

a) Lower decomposition voltage of $MgCl_2$ than that of KCl

b) Reverse reaction $MgCl_3 + 2K \rightarrow Mg + 2KCl$ if KCl is decomposed under other experimental condition

c) Both (a) and (b)

d) None of the above

71. The most important method of making steel is

a) BOP process

b) BOD process

c) Pudding process

d) Smelting

72. Which ore contains both iron and copper?

a) Cuprite

b) Copper glance

c) Chalcopyrite

d) Malachite

73. Flux is used to remove _____

a) Acidic impurities

b) Basic impurities

c) All impurities from ores

d) Both (A) and (B)

74. 0.05 mole of $Ca(OH)_2$ can neutralize H_2SO_4.This H_2SO_4 can be neutralized by

a) 0.05 mol of NaOH

b) 0.10 mol of NaOH

c) 0.05 mol of $POH(OH)_2$

d) None is correct

75. Lead pencil contains

a) Graphite

b) Softened lead

c) Galena

d) Anglesite

76. Which one of the following elements constitutes a major impurity in pig iron?

a) Silicon

b) Oxygen

c) Sulphur

d) Graphite

77. In metallurgy, flux is a substance used to convert _____

a) Infusible impurities to fusible material

b) Soluble impurities to insoluble impurities

c) Fusible impurities to infusible material

d) Mineral into silicate

78. CO in passing over heated nickel gives _____

a) $NiCO_3$

b) $Ni(CO)_4$

c) $CO_2 + H_2$

d) $CO + H_2$

79. In the following unbalanced redox reaction, $Cu_3P + Cr_2O_7^{2-} \rightarrow Cu^{2+} + H_3PO_4 + Cr^{3+}$ equivalent weight of H_3PO_4 is

a) $\dfrac{M}{3}$

b) $\dfrac{M}{6}$

c) $\dfrac{M}{7}$

d) $\dfrac{M}{8}$

80. Select the correct statement in the following reaction

$NH_4NO_2 \rightarrow N_2 + 2H_2O$

a) Oxidation number of N has changed from -2 to $+2$

b) Oxidation number of N in NH_4^+ changed from -3 to 0 and that in NO_2^- changed from $+3$ to 0

c) Oxidation number of N in NH_4^+ changed from $+1$ to 0 and that in NO_2^- changed from -1 to 0

d) No change

81. Which of the ore dressing process requires finest size of ore?

a) Froth floatation

b) Wilfley's table method

c) Magnetic separation

d) Leaching

82. Oxidation numbers of Cl atoms in $CaOCl_2$ (bleaching powder) are

a) Zero on each   b) -1 on Cl^* and $+1$ on Cl^{**}

c) $+1$ on Cl^* and -1 on Cl^{**} d) 1 on each

83. Plots of $\Delta G°$ against temperature (in Kelvin) are called _____

a) Ellingham diagrams

b) Free energy curves

c) Temperature curves

d) Energy profile diagrams

84. Reduction of a metal oxide by excess carbon at high temperature is a method for the commercial preparation of some metals. This method can be successfully applied in the case of

a) BeO and Al_2O_3 b) ZnO and Fe_2O_3 c) CaO and Cr_2O_3 d) BaO and U_3O_8

85. In the Ellingham diagram, graph for the formation of CO_2 _____

a) Is a straight line with the negative slope

b) Is a straight line with the positive slope

c) Is a straight line almost parallel to temperature axis

d) Is a curved line with sudden change in the slope

86. During electrolytic refining of zinc, anode and cathode used are made up of _____ respectively

a) Aluminium and lead   b) Lead and aluminium   c) Lead and graphite   d) Aluminium and graphite

87. One mole of ferrous oxalate is oxidized by x mole of MnO_4^- in acidic medium. x is

a) 0.6   b) 0.1   c) 0.3   d) 1.0

88. The ore carnallite is represented by structure

a) $Na_2Al_2O_3$ b) Na_3AlF_6 c) $KClMgCl_2 \cdot 6H_2O$ d) Fe_3O_4

89. Which ore contains both iron and copper?

a) Cuprite   b) Chalcocite   c) Chalcopyrite   d) Malachite

90. The method of zone refining of metals is based on the principal of

a) Greater noble character of the solid metal than that of the impurity

b) Greater solubility of the impurity in the molten state than in the solid

c) Greater mobility of the pure metal than that of impurity

d) Higher melting point of the impurity than that of the pure metal

91. Bessemerisation is carried out for

I: Fe,   II: Cu,   III: Al,   IV: Ag

a) I, II   b) II, III   c) III, IV   d) I, III

92. For the reduction of oxides of chromium, carbon can be used as reducing agent but this is not observed in practice because _____

a) High temperatures are required

b) Chromium forms corresponding carbide under the reaction conditions

c) Chromium forms corresponding carbonates under the reaction conditions

d) Both (A) and (B)

93. During electrolytic refining of copper, some metals present as impurity settle as 'anode mud'. These are _____
    a) Sn and Ag   b) Pb and Zn   c) Ag and Au   d) Fe and Ni
94. Which ore contain both iron and copper?
    a) Cuprite   b) Chalococite   c) Chalcopyrite   d) malachite
95. Which of the following elements is present as the impurity to the maximum extent in pig iron?
    a) Phosphorus   b) Manganese   c) Carbon   d) Silicon
96. Which one of the following statements is correct? In the metallurgy of sodium by electrolysis, excess of calcium chloride is mixed with sodium chloride to
    a) Make the latter a good conductor
    b) Make the latter soft
    c) Generate more energy for the electrolytic cell
    d) Assist liquefication of the latter at a much lower temperature
97. Which of the following pairs of metals is purified by van Arkel method?
    a) Ni and Fe   b) Ga and In   c) Zr and Ti   d) Ag and Au
98. Purification of silicon element used in semiconductors is done by _____
    a) Zone refining   b) Chromatography   c) Froth floatation   d) Electrolysis
99. The smelting of iron in the blast furnace involves all the following process EXCEPT _____
    a) Oxidation   b) Reduction   c) Decomposition   d) Sublimation
100. Bauxite ore is concentrated by _____
    a) Froth flotation
    b) Electromagnetic separation
    c) Chemical separation
    d) Hydraulic separation
101. In order to refine "blister copper" it is melted in a furnace and is stirred with green logs of wood. The purpose is _____
    a) To expel the dissolved gases in blister copper
    b) To bring the impurities to surface and oxidize them
    c) To increase the carbon content of copper
    d) To reduce the metallic oxide impurities with hydrocarbon gases liberated from the wood
102. Zinc spelter contains _____ of zinc
    a) 95% to 99%   b) 97% to 98%   c) 99% to 100%   d) 95% to 97%
103. Which step is not involved in hydrometallurgical process?
    a) $Cu_2S + 2Cu_2O \rightarrow 6Cu + SO_2$
    b) $CuFeS_2 + 2H_2SO_4 \rightarrow CuSO_4 + FeSO_4 + 2H_2S$
    c) $CuSO_4 + Fe \rightarrow FeSO_4 + Cu$
    d) $CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + H_2O + CO_2$
104. In smelting of iron, which of the following reactions takes place in blast furnace at $400°C - 600°C$?
    a) $CaO + SiO_2 \rightarrow CaSiO_3$
    b) $2FeS + 3O_2 \rightarrow 2Fe + SO_2$
    c) $FeO + SiO_2 \rightarrow FeSiO_3$
    d) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
105. Four metals and their methods of refinement are given
    (i) Ni, Cu, Zr, Ga
    (ii) Electrolysis, van-Arkel process, Zone refining, Mond's process
    Choose the right method for each
    a) Ni: Electrolysis, Cu: van-Arkel process, Zr: Zone refining, Ga: Mond's process
    b) Ni: Mond's process, Cu: Electrolysis, Zr: van-Arkel process, Ga: Zone refining
    c) Ni: Mond's process, Cu: van-Arkel process, Zr: Zone refining, Ga: Electrolysis
    d) Ni: Electrolysis, Cu: Zone refining, Zr: van Arkel process, Ga: Mond's process
106. Select the incorrect statement

a) When the lead-silver alloy is rich in silver, lead is removed by the cupellation process

b) When the lead-silver alloy is rich in lead, lead is removed by Parke's r Pattinson's process

c) Zinc forms an alloy with lead from which lead is separated

d) Zinc forms an alloy with silver, from which zinc is separated by distillation

107. Purest form of iron is

    a) Cast iron   b) Wrought iron   c) Pig iron   d) None of these

108. A drunken person was asked to blow a glass tube packed with acidified potassium dichromate. The change in colour of the material from orange to green confirmed the drinking of alcohol. It is due to

I. The oxidation of alcohol with the reduction of dichromate to chromium (III)

II. Complex formation of alcohol and dichromate

III. Change in the coordination number of chromium

Which of the statements given above is/are correct?

    a) I only   b) II only   c) III only   d) II and III

109. When KCN is added to $CuSO_4$ solution there is formation of the stable water soluble complex. This complex is

    a) $K_4[Cu(CN)_6]$ b) $K_3[Cu(CN)_4]$ c) $K_2[Cu(CN)_4]$ d) $K[Cu(CN)_3]$

110. Mg can be obtained

a) By heating $MgCl_2$ (anhydrous) with Na in the atmosphere of coal gas

b) By electrolysis of fused carnallite

c) By both the methods

d) By none of the above methods

111. Which has the maximum number of equivalent per mole of the oxidant?

a) $Zn(s) + VO^{2+}(aq) \rightarrow Zn^{2+}(aq) + V^{3+}(aq)$

b) $Ag(s) + NO_3^-(aq) \rightarrow Ag^+(aq) + NO_2(g)$

c) $Mg(s) + VO_4^{3-}(aq) \rightarrow Mg^{2+}(aq) + V^{2+}(aq)$

d) $I^-(aq) + IO_3^-(aq) \rightarrow I_3^-(aq)$

112. Producer gas is a mixture of _____

    a) $CO + N_2$ b) $CO + H_2$ c) $CH_4 + CO_2$ d) $CO + CO_2$

113. Which of the following reaction is involved in the Hall's method of purification of bauxite?

a) $Al_2O_3.2H_2O + 2NaOH \rightarrow 2NaAlO_2 + 3H_2O$

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

c) $Al_2O_3.2H_2O + 3C + N_2 \rightarrow 2AlN + 3CO + 2H_2O$

d) $2Al_2O_3 + 6F_2 \rightarrow 4AlF_3 + 3O_2$

114. During electrolytic refining of blister copper, _____

a) Copper ions from the anode goes into the electrolyte

b) Copper ions from the cathode goes into the electrolyte

c) Copper ions from the electrolyte gets deposited on the anode

d) Both (B) and (C)

115. Bauxite has the formula _____

    a) Na_3AlF_6 b) $Al_2O_3.2H_2O$ c) $FeCO_3$ d) $Al_2O_3.2SiO_2.2H_2O$

116. In the reaction, 4 moles of electrons are transferred to 1 mole of HNO_3. The possible product obtained due to reduction

    a) 0.4 mole of N_2 b) 0.5 mole of N_2O c) 1 mole of NO_2 d) 1 mole of NH_3

117. Which method of purification is represented by following equations?

$$Zr + 2I_2 \xrightarrow{875 \text{ K}} ZrL_4$$

$$ZrI_4 \xrightarrow[\text{Tungsten filament}]{2075 \text{ K}} Zr + 2I_2$$

    a) Zone refining   b) Van Arkel   c) Polling   d) Liquation

118. Which ordering of compounds is according to the decreasing order of the oxidation state of nitrogen?

    a) HNO_3, NO, NH_4Cl, N_2 b) HNO_3, NO, N_2, NH_4Cl c) HNO_3, NH_4Cl, NO, N_2 d) NO, HNO_3, NH_4Cl, N_2

119. O_3 is estimated by I^- in iodometric method. Balanced reaction is
    a) $2H^+ + O_3 + 2I^- \rightarrow I_2 + O_2 + H_2O$
    b) $2I^- + O_3 + H_2O \rightarrow I_2 + O_2 + 2OH^-$
    c) Both (a) and (b)
    d) None of the above
120. Zinc blende ore can be concentrated by _____
    a) Gravity separation
    b) Electromagnetic separation
    c) Froth floatation process
    d) All of these
121. Froth floatation method is successful in separating impurities from ores because _____
    a) The pure ore is lighter than water containing additives like pine oil, fatty acid, etc
    b) The pure ore is soluble in water containing additives like pine oil, fatty acid, etc
    c) The impurities are soluble in water containing additives like pine oil, fatty acid, etc
    d) The pure ore is not as easily wetted by water as by pine oil, fatty acid, etc
122. Which is not the disproportionation reaction?
    a) $3H_3PO_2 \rightarrow 2H_3PO_3 + PH_3$
    b) $HCHO + OH^- \rightarrow HCOO^- + CH_3OH$
    c) $NH_4NO_3 \rightarrow N_2O + 2H_2O$
    d) $3Cl_2 + 6OH^- \rightarrow 5Cl^- + ClO_3^- + 3H_2O$
123. Oxidation number of Cr is +5 in
    a) K_3CrO_8 b) $(NH_3)_3CrO_4$ c) K_2CrO_4 d) $[Cr(NH_3)_5(H_2O)]Cl_3$
124. In the reaction,
    $Cu + H_2SO_4 \rightarrow CuSO_4 + H_2O + SO_2$
    a) H^+ is the oxidizing agent   b) SO_4^{2-} is the oxidizing agent
    c) Both (a) and (b) correct   d) None of the above is correct
125. Oxidation states of the metal in the minerals given are
    Haematite   Magnesite
    a) II, III   III   b) II, III   II
    c) II   II, III   d) III   II, III
126. In bessemerization, the sulphide of copper is reduced by _____
    a) Reduction by carbon   b) Electrolysis   c) Auto reduction   d) Cyanide process
127. Silica is added to roasted copper ore during smelting in order to remove _____
    a) Cuprous sulphide   b) Cuprous oxide   c) Ferrous oxide   d) Ferrous sulphide
128. Refining of silver is done by
    a) Liquation   b) Poling   c) Cupellation   d) Van-Arkel method
129. The process of calcination is carried out in case of _____
    a) Hydroxide ores only
    b) Carbonate ores and sulphide ores
    c) Hydroxide and carbonate ores
    d) Hydroxide and sulphide ores
130. The method of zone refining of metals is based on the principle of
    a) Greater noble character of the solid metal than that of the impurity
    b) Greater solubility of the impurity in the molten state than in the solid
    c) Greater mobility of the pure metal than that of impurity
    d) Higher melting point of the impurity than that of the pure metal
131. In the extraction of metals from their oxides by reduction process, the choice of reducing agent and the temperature that has to be maintained is decided based on the thermodynamic property called _____
    a) Change in enthalpy   b) Entropy   c) Free energy   d) All of these
132. Froth floatation process used for the concentration of sulphide ore

a) Is based on the difference in wettability of different minerals

b) Uses sodium ethyl xanthate, $C_2H_5\ OCS_2Na$ as collector

c) Uses NaCN as depressant in the mixture of ZnS and PbS when ZnS forms soluble complex and PbS form froth

d) All of the above are correct

133. Which combination appears odd $w.r.t.$ oxidation number per atom of the underlined?

    a) $H_2SO_5, H_2S_2O_8, K_2Cr_2O_7$ b) $CrO_5, CrO_4^{2-}, SO_4^{2-}$

    c) Both (a) and (b)   d) None of the above

134. During the process of polling, _____

    a) Metals are oxidised to their corresponding carbonates

    b) Metals are oxidised to their corresponding oxides

    c) Metals are oxidised to their corresponding nitrates

    d) Metal oxides are reduced to metals

135. CuS is dissolved in dil. HNO_3. Balanced equation with correct products is

    a) $CuS + 2H^+ + 3NO_3^- \rightarrow Cu(NO_3)_2 + H_2S + H_2O + NO_2$

    b) $3CuS + 8H^+ + 8NO_3^- \rightarrow 3Cu(NO_3)_2 + 3S + 4H_2O + 2NO$

    c) $CuS + 4NO_3^- \rightarrow Cu(NO_3)_2 + H_2S + H_2O$

    d) None of the above is correct

136. In an experiment, 20 g of vanadium (V) oxide (molar mass = 182) was reduced by excess of zinc dust in acidic solution to vanadium (II) ions. The required number of moles of iodine to reoxidise vanadium (II) to VO^{2+} is

    a) 0.22   b) 0.11   c) 0.30   d) 0.23

137. Oxidation number of Cr in the following compounds are x, y, z and w respectively

    $K[CrO(O_2)(OH)], K_3[Cr(O_2)_4], (NH_3)_3[Cr(O_2)_2]$,

      X   Y   Z

    CrO_2Cl_2

    W

    These values are

    a) 6, 13, 5 ,6   b) 4, 4 , 4 , 6   c) 4, 5, 4, 6   d) 4, 5, 6, 6

138. The electrolytic method of reduction its employed for the extraction of metals that are _____

    a) Strongly electronegative

    b) Strongly electropositive

    c) Transition metals

    d) Non – metals

139. Example of autoreduction is

    a) $2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$

    b) $FeO + SiO_2 \rightarrow FeSiO_3$

    c) $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$

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

140. 0.05 mole of $Ca(OH)_2$ can neutralize H_2SO_4. This H_2SO_4 can be neutralized by

    a) 0.05 mole of NaOH   b) 0.10 mole of NaOH

    c) 0.05 mole of $POH(OH)_2$ d) None of the above is correct

141. The role of calcination in metallurgical operations is to _____

    a) Remove moisture

    b) Decompose carbonate

    c) Drive off organic matter

    d) All of these

142. In the Hoop's process for refining of aluminium, the fused materials form three different layers and they remain separated during electrolysis also. This is because _____

    a) The upper layer is kept attracted by the cathode and the lower layer is kept attracted by the anode

b) There is special arrangement in the cell to keep the layers separate

c) The 3 layers have different densities

d) The 3 layers are maintained at different temperatures

143. Consider the following unbalanced reactions

I. $Zn + dil.\,H_2SO_4 \rightarrow ZnSO_4 + H_2$

II. $Zn + conc.\,H_2SO_4 \rightarrow ZnSO_4 + SO_2 + H_2O$

III. $Zn + HNO_3 \rightarrow Zn(NO_3)_2 + NH_4NO_3 + H_2O$

Oxidation number of hydrogen changes in

 a) I, II, III   b) I, II   c) II, III   d) I

144. The methods chiefly used for the extraction of lead and tin from their ores are respectively

 a) Self reduction and carbon reduction   b) Self reduction and electrolytic reduction

 c) Carbon reduction and self reduction   d) Cyanide process and carbon reduction

145. During electrolysis of copper sulphate, copper ions move towards _____

 a) Anode   b) Cathode   c) Both electrodes   d) Does not move

146. When a metal is to be extracted from its ore, if 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 flux are needed

 d) Neither of them is needed

147. In which case oxidation number of Cr has been affected?

 a) $2CrO_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{2-} + H_2O$

 b) $Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$

 c) $(NH_4)_2Cr_2O_7 \rightarrow N_2 + Cr_2O_3 + 4H_2O$

 d) $CrO_2Cl_2 + 2OH^- \rightarrow CrO_4^{2-} + 2HCl$

148. Tin and lead can be refined by _____

 a) Distillation   b) Liquation   c) Levigation   d) Leaching

149. 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 be evaporated in the furnace

 c) Presence of it may increase the melting point of charge

 d) It may not decompose completely

150. Which of the following metals are found in native state?

Ag, Pt, C, Si, N, O, Mg, Na, Pb

 a) Ag, Pt, C, N, O   b) Ag, Pt, Mg   c) Ag, Pt, Pb, Mg   d) Ag, Pt

151. Bauxite is an oxide ore of _____

 a) Barium   b) Boron   c) Bismuth   d) Aluminium

152. A metal which is refined by polling is _____

 a) Sodium   b) Blister copper   c) Zinc   d) Silver

153. In the following redox reaction,

$5Fe^{2+} + MnO_4^- + 8H^+ \rightleftharpoons Mn^{2+} + 5Fe^{3+} + 4H_2O$

Given, $Fe^{3+} + e^- \rightarrow Fe^{2+}, E_1^\circ$

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O, E_2^\circ$

Potential at the equivalence point is

 a) $E = (E_1^\circ + E_2^\circ) - 0.08\,pH$

 b) $E = \dfrac{E_1^\circ + 5E_2^\circ}{6} - 0.08\,pH$

 c) $E = (E_1^\circ - E_2^\circ) - 0.08\,pH$

 d) $E = \dfrac{E_1^\circ - 5E_2^\circ}{6} + 0.08\,pH$

154. Alumina is _____

a) $Al(OH)_3$ b) $AlCl_3$ c) AlN d) Al_2O_3

155. In $[Cr(O_2)(NH_3)_4(H_2O)]Cl_2$ oxidation number of Cr is +3, then O_2 will be in the form
   a) Dioxo b) Peroxo c) Superoxo d) Oxo

156. Strongest conjugate base is
   a) ClO^- b) ClO_2^- c) ClO_3^- d) ClO_4^-

157. The dissolve argentite ore which of the following is used
   a) $Na[Ag(CN)_2]$ b) NaCN c) NaCl d) HCl

158. Equivalent weight of H_3PO_2 in a reaction is found to be half of its molecular weight. It can be due to its
   a) Reaction of its two H^+ ions b) Oxidation to H_3PO_3
   c) Both (a) and (b) d) None of the above

159. Oxidation number of P in $Ba(H_2PO_2)_2$ is
   a) $+3$ b) $+2$ c) $+1$ d) -1

160. For the extraction of chromium from Cr^2O_3, the process adopted is _____ process
   a) Carbon reduction b) Alumino thermite c) Electrolytic d) Chromium thermite

161. In the extraction of nickel by Mond's process, the metal is obtained by
   a) Electrochemical reduction b) Thermal decomposition
   c) Chemical reduction by aluminium d) Reduction by carbon

162. Which one of the following is not a method of concentration of metals?
   a) Gravity separation b) Froth floatation process
   c) Electromagnetic separation d) Smelting

163. The vertical retort is made up of _____ bricks
   a) Silicon hydride b) Silicon carbide c) Zinc carbide d) Zinc hydride

164. For a titration of $100\ cm^3$ of 0.1 M ($0.1\ mol\ L^{-1}$)Sn^{2+} to Sn^{4+}, $50\ cm^3$ of 0.40 M Ce^{4+} solution was required. The oxidation state of cerium in the reduction product is
   a) +1 b) +2 c) +3 d) 0

165. Consider a titration of potassium dichromate solution with acidified Mohr's salt solution using diphenylamine as indicator. The number of moles of Mohr's salt required per mole of dichromate is
   a) 3 b) 4 c) 5 d) 6

166. Extraction of silver from its sulphide ore is carried by cyanide process. This process is also called
   a) Linz-Donawitz (LD) process b) Van-Arkel process
   c) Hall's process d) Mac-Arthur Forrest process

167. 1 mole of FeC_2O_4 is oxidized by x moles of $Cr_2O_7^{2-}$ in acidic medium, x is
   a) 3 b) 1.5 c) 0.5 d) 1.0

168. Naturally occurring substances from which a metal can be profitably (or economically) extracted are called _____
   a) Minerals b) Ores c) Gangue d) Salts

169. Prussian blue has two types of iron with oxidation number as shown : $\overset{III}{Fe}[\overset{II}{Fe}(CN)_6].$ What is the net charge on Prussian blue?
   a) -1 b) $+1$ c) 0 d) -2

170. Which of the following is used in van Arkel method?
   a) CaF_2 b) NaCN c) I_2 d) CO

171. Liquation process for refining of crude metal is used when _____
   a) Impurity has higher melting point than metal
   b) Impurity has low melting point than metal
   c) Metals have low boiling point
   d) Impurities have low boiling point

172. 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

173. The most abundant ore of Zn is _____
    a) Zinc blende   b) Calamine   c) Zincite   d) Willemite

174. Blister copper is
    a) Impure copper
    b) Obtained in self-reduction process during bessemerisation
    c) Both (a) and (b) are correct
    d) None of the above is correct

175. In hydrometallurgy of copper, iron scrap is used instead of zinc scarp because _____
    a) Cost of zinc scrap is comparatively higher than the iron scrap
    b) Zinc scrap is not easily available
    c) Handling of zinc scrap is dangerous
    d) Both (B) and (C)

176. Which of the following ore is concentrated by both, magnetic and gravimetric separation?
    a) Dolomite   b) Tinstone   c) Galena   d) Bauxite

177. An example of halide ore is _____
    a) Galena   b) Bauxite   c) Copper glance   d) Cryolite

178. Which of the following ores does NOT represent the ore of iron?
    a) Haematite   b) Magnetite   c) Cassiterite   d) Limonite

179. Diaspore is _____
    a) Al_2O_3 b) Na_3AlF_6 c) $Al_2O_3.H_2O$ d) $Al_2O_3.2H_2O$

180. _____ is added as flux in the extraction of iron
    a) Silica   b) Feldspar   c) Limestone   d) Alumina

181. Which method of purification is represented by the equation?

    $Ti + 2I_2 \xrightarrow{500\ K} TiI_4 \xrightarrow{1675\ K} Ti + 2I_2$
    Impure   Pure
    a) Liquation   b) Polling   c) Van Arkel   d) Chromatography

182. $Cr_2O_7^{2-} + 2I^- + 14H^+ \rightarrow I_2 + 2Cr^{3+} + 7H_2O$
    Which are not in balanced position?
    a) H^+ and H_2O b) $Cr_2O_7^{2-}$ and Cr^{3+}
    c) I^- and I_2 d) All the above are balanced

183. In extraction of copper, we use _____
    a) Copper glance   b) Malachite   c) Silver argentocyanide   d) Copper pyrites

184. $Ag_2S + NaCN + Zn \rightarrow Ag$
    This method of extraction of Ag by complex formation and then its displacement is called
    a) Parke's method   b) Mac Arthur-Forrest method
    c) Serpeck method   d) Hall's method

185. Which of the following is FALSE?
    a) Column chromatography is used when impurities and the element to be purified differ only slightly in their chemical properties
    b) Gold is extracted by cyanide process
    c) Calcination of an ore requires excess of air
    d) Mond's process is vapour phase refining technique

186. Which of the following is NOT an ore?
    a) Bauxite   b) Malachite   c) Zinc blende   d) Pig iron

187. Wilfley's table method for the concentration of an ore can be used when _____
    a) Gangue particles are heavier than the ore particles
    b) Ore particles are heavier than the gangue particles
    c) Ore particles are magnetic in nature
    d) Gangue particles are magnetic in nature

188. Flux is used to remove
a) Basic impurities
b) Acidic impurities
c) All types of impurities
d) Acidic and basic both impurities

189. Which one of the following reactions is an example for calcination process?
a) $2Ag + 2HCl + O \rightleftharpoons 2AgCl + H_2O$
b) $2Zn + O_2 \rightleftharpoons 2ZnO$
c) $2ZnS + 3O_2 \rightleftharpoons 2ZnO + 2SO_2$
d) $MgCO_3 \rightleftharpoons MgO + CO_2$

190. 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.	Magnetic separation	Ag_2S
B.	Froth floatation	$FeCr_2O_4$
C.	Gravity separation	$Al_2(SiO_3)_3$

Codes

	A	B	C			A	B	C
a)	1	2	3	b)	2	1	3
c)	3	1	2	d)	2	3	1

191. Oxidation states of sulphur atoms in $S_4O_6^{2-}$ from left to right respectively are
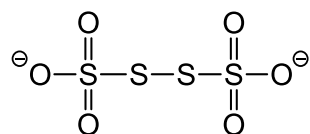
a) $+6, 0, 0, +6$
b) $+3, +1, +1, +3$
c) $+5, 0, 0, +5$
d) $+4, +1, +1, +4$

192. Alumino thermite 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

193. In the following reaction, $VO_3^{2-} + MnO_4^- \rightarrow Mn^{2+} + VO_4^{3-}$ 1 mole of VO_3^{2-} is oxidized by MnO_4^- using
a) 0.2 mol
b) 0.4 mol
c) 0.8 mol
d) 1.0 mol

194. Photographic paper is developed with alkaline hydroquinone
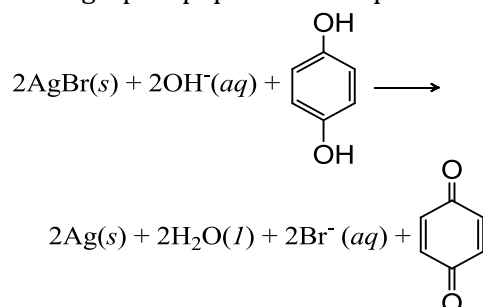
Select the correct statement
a) Hydroquinone is the oxidant
b) Ag^+ is the oxidant
c) Br^- is the oxidant
d) Ag^+ is the reductant

195. The reaction,
$Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr$ $(\Delta G° = -421$ kJ$)$ is thermodynamically feasible as a apparent from the Gibbs energy value. But it does not take place at room temperature, because
a) At room temperature activation energy required for the reduction is not attained
b) Reaction is exothermic
c) Reaction is endothermic
d) Reverse reaction is spontaneous

196. Blister copper is _____
    a) 99% pure copper
    b) 99.95% pure copper
    c) 99.99% pure copper
    d) 99.95 – 99.99% pure copper
197. When a manganeous salt is fused with a mixture of KNO_3 and solid NaOH, change in oxidation number of Mn is
    a) 2　　　　　　　　b) 6　　　　　　　　c) 8　　　　　　　　d) 4
198. Silver may be obtained by _____
    a) Reduction of Ag_2S by (Zn + HCl)
    b) Melting Ag_2S with NaCl
    c) Ag_2S treated with NaCN then by adding zinc powder
    d) Ag_2S when treated with ZnS
199. Which of the following processes is used in extractive metallurgy of magnesium?
    a) Fused salt electrolysis　　　　　　　b) Self reduction
    c) Aqueous solution electrolysis　　　　d) Thermite reduction
200. Consider the following metallurgical processes
    I. Heating impure metal with CO and distilling the resulting volatile carbonyl (b.p. 43°C) and finally decomposing at 150° to 200°C 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 sulphide
    III. Electrolysing the molten electrolyte containing approximately equal amounts of the metal chloride and $CaCl_2$ to obtain the metal
    The processes used for obtaining sodium, nickel and copper are respectively
    a) I, II and III　　　b) II, III and I　　　c) III, I and II　　　d) II, I and III
201. 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
202. A process of extracting metals from aqueous solutions of their salts using suitable reducing agents is called _____
    a) Pyrometallurgy　　b) Hydrometallurgy　　c) Electrometallurgy　　d) Catalytic reduction
203. A sandy, earthy and other unwanted impurities present in the ore are called _____
    a) Slag　　　　　　　b) Mineral　　　　　　c) Gangue　　　　　　d) Flux
204. In metallurgical processes, the flux used for removing basic impurities is _____
    a) Silica　　　　　　b) Sodium chloride　　c) Limestone　　　　d) Sodium carbonate
205. Self reduction of the sulphide ore takes place during
    a) Roasting　　　　　b) Smelting　　　　　c) Calcinations　　　d) Cupellation
206. Froth floatation is a process of
    a) Oxidation　　　　　b) Reduction　　　　　c) Refining　　　　　d) Concentration
207. Which is not the correct statement?
    a) Cassiterite, chromite and pitchblende are concentrated by hydraulic washing (Tabling)
    b) Pure Al_2O_3 is obtained from the bauxite ore by leaching in the Baeyer's process
    c) Sulphide ore is concentrated by calcination method
    d) Roasting can convert sulphide into oxide or sulphate and part of sulphide may also act as a reducing agent
208. Which of the following is NOT an alkaline flux?
    a) $CaCO_3$　　　　　b) CaO　　　　　　　c) SiO_2　　　　　　d) All of these
209. Which mineral has been named incorrectly?
    a) Bauxite　　　: $Al_2O_3 \cdot 2H_2O$　　　　　　b) Corundum : Al_2O_3

c) Cryolite : $3NaF \cdot AlF_3$ d) Feldspar : $Be_3Al_2Si_6O_{18}$
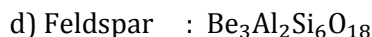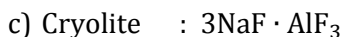
210. Pig iron _____
   a) Is the iron containing the carbon and other impurities
   b) Is a pure form of iron
   c) Is similar to wrought iron
   d) Is similar to steel

211. Which of the following processes is related with the removal of sulphur by heating in the air?
   a) Smelting   b) Calcination   c) Annealing   d) Roasting

212. The process of heating and suddenly cooling of steel is known as
   a) Tempering   b) Annealing   c) Hardening   d) Quenching

213. The following reactions take place in the blast furnace in the preparation of impure iron. Identify the reaction pertaining to the formation of slag
   a) $Fe_2O_{3(s)} + 3CO_{(g)} \rightarrow 2Fe_{(l)} + 3CO_{2(g)}$
   b) $CaCO_{3(s)} + CaO_{(s)} + CO_{2(g)}$
   c) $CaO_{(s)} + SiO_{2(s)} \rightarrow CaSiO_{3(s)}$
   d) $2C_{(s)} + O_{2(g)} \rightarrow 2CO_{(g)}$
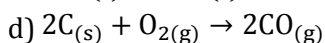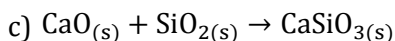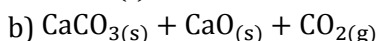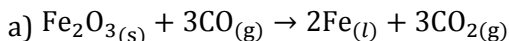
214. NaCN is sometimes added in the froth floatation process as a depressant when ZnS and PbS minerals are expected because
   a) $Pb(CN)_2$ is precipitated while no effect as ZnS
   b) ZnS form soluble complex $Na_2[Zn(CN)_4]$ while PbS forms froth
   c) PbS forms soluble complex $Na_2[Pb(CN)_4]$ while ZnS forms froth
   d) NaCN is never added in froth floatation process
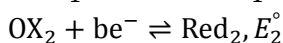
215. If $OX_1 + ae^- \rightleftharpoons Red_1, E_1^\circ$
   $OX_2 + be^- \rightleftharpoons Red_2, E_2^\circ$
   Then potential at the equivalence point is
   a) $E = \dfrac{aE_1^\circ + bE_2^\circ}{(a+b)}$ b) $E = \dfrac{aE_1^\circ - bE_2^\circ}{(a+b)}$ c) $E = \dfrac{bE_2^\circ - aE_1^\circ}{(a+b)}$ d) $E = \dfrac{aE_1^\circ - bE_2^\circ}{(a-b)}$

216. Corundum is….. mineral of Al
   a) Silicate   b) Oxide   c) Double salt   d) Sulphate

217. Main function of roasting is _____
   a) To remove volatile substances
   b) Oxidation
   c) Reduction
   d) Slag formation

218. Roasting of concentrated zinc sulphide ore is completed at the temperature of 1200 K to _____
   a) Ensure complete decomposition of $ZnSO_4$ to ZnO
   b) Ensure complete melting of zinc
   c) Ensure evaporation of the volatile impurities
   d) All of these

219. In the metallurgy of iron, when limestone is added to the blast furnace, the calcium ion ends up in _____
   a) Slag   b) Gangue   c) Metallic Ca   d) Calcium carbonate

220. Inert atmosphere of argon is used during zone refining to prevent _____
   a) Thermal decomposition of the metal
   b) Thermal reduction of the metal
   c) Oxidation of the metal
   d) Corrosion of the metal

221. Of the following substances the one which does NOT contain oxygen is _____
   a) Bauxite   b) Epsom salt   c) Cryolite   d) Dolomite

222. 0.05 equivalent of H_3PO_4 is neutralized by
   a) 0.05 equivalent of NaOH   b) 0.05 mol of $Al(OH)_3$

c) Both (a) and (b) correct   d) None of the above is correct

223. Which has the least number of equivalent per mole of the reactant?
   a) MnO_4^- changes to MnO_2
   b) MnO_4^- changes to Mn^{2+}
   c) MnO_4^- changes to MnO_4^{2-}
   d) MnO_4^- changes to Mn_2O_3

224. Calcium is obtained by the
   a) Roasting of limestone
   b) Electrolysis of solution of calcium chloride in H_2O
   c) Electrolysis of molten anhydrous calcium chloride
   d) Reduction of calcium chloride with carbon

225. Zone refining is a method to obtain _____
   a) Very high temperature
   b) Ultra pure Al
   c) Ultra pure metals
   d) Ultra pure oxides

226. Selection of temperature to carry out a reduction process depends so as to make
   a) ΔG negative   b) ΔG positive   c) ΔH negative   d) ΔH positive

227. Iron obtained from blast furnace is
   a) Wrought iron   b) Cast iron   c) Pig iron   d) Steel

228. Which of the following have been arranged in the decreasing order of oxidation number of sulphur?
   a) $S_2O_6^{2-} > S_2O_7^{2-} > S_2O_3^{2-} > S_8$
   b) $H_2SO_4 > SO_2 > H_2S > H_2S_2O_8$
   c) $SO_2^{2+} > SO_4^{2-} > SO_3^{2-} > HSO_4^-$
   d) $H_2SO_5 > H_2SO_3 > SCl_2 > H_2S$

229. NH_3 is oxidized to NO by O_2 (air) in basic medium. Number of equivalent of NH_3 oxidized by 1 mole of O_2 is
   a) 4   b) 5   c) 6   d) 7

230. The metal which cannot be extracted by smelting process
   a) Zn   b) Al   c) Pb   d) Fe

231. Which of the following processes makes the ore porous?
   a) Distillation   b) Reduction   c) Calcination   d) All of these

232. Softening of lead means
   a) Melting pure lead at high temperature
   b) Removal of impurities, except silver, present in commercial lead
   c) Formation of lead alloy
   d) Formation of 100% pure lead

233. The most abundant metal in the earth's crust is _____
   a) Na   b) Mg   c) Al   d) Fe

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

235. Sapphire is a valuable precious stone containing _____
   a) Cu   b) Zn   c) Al   d) Mg

236. Select the correct statement
   a) In the decomposition of an oxide, into oxygen and gaseous metal, entropy increases
   b) Decomposition of an oxide is an endothermic change
   c) To make $\Delta G°$ negative, temperature should be high enough so that $T \Delta S° > \Delta H°$
   d) All of the above are correct statements

237. In zone-refining method the molten zone

a) Consists of impurities only

b) Contains more impurity than the original metal

c) Contains the purified metal only

d) Moves to either side

238. Which of the following ore does NOT show the correct formula?

a) Cuprite - Cu_2O b) Zinc blende - ZnS   c) Magnesite - Fe_3O_4 d) Siderite - $FeCO_3$

239. Which of the following statement is incorrect?

a) Pure aluminium oxide is obtained by heating aluminium hydroxide

b) Cryolite lowers down the melting point of bauxite in electrolytic cell for extraction of aluminium

c) Carbonate ores are converted into oxides by roasting ore in air

d) Mercury cannot be produced by roasting the cinnabar ore in air

240. Equivalent weight of HCHO in the following reaction

$2HCHO + OH^- \rightarrow HCOO^- + A$

is 30. A can be

a) HCOOH   b) CH_3OH c) $(CH_3)_2CHOH$ d) CH_3CH_2OH

241. Cu^{+2} ions are more stable than Cu^+ ions because Cu^{+2} ions _____ as compared to Cu^+ ions

a) Have higher charge

b) Have smaller ionic size

c) Undergo extensive hydration

d) All of these

242. In the following half-reaction in basic medium

$Bi^{3+}(aq) \rightarrow BiO_3^-(aq)$

One mole of Bi^{3+} is equivalent to

a) 1   b) 2   c) 3   d) 4

243. Extraction of gold and silver involves leaching the metal with CN^- ion. The metal is recovered by

a) Displacement of metal by some other metal from the complex

b) Roasting of metal complex

c) Calcination followed by roasting

d) Thermal decomposition of metal complex

244. Cassiterite is an ore of

a) Mn   b) Ni   c) Sb   d) Sn

245. The chemical process in the production of steel from haematite ore involves

a) Reduction

b) Oxidation

c) Reduction followed by oxidation

d) Oxidation followed by reduction

246. Which represent correct matching of metals with their minerals?

Mg   Na   Cu   Al

a) Chloride   chloride   sulphide   silicate   b) Carbonate   chloride   sulphide   oxide

c) Carbonate   carbonate   oxide   phosphate   d) Oxide   chloride   sulphide   oxide

247. In the following redox reaction,

$Cr_2O_7^{2-} + Fe^{2+} \rightarrow Fe^{3+} + Cr^{3+}$ 1 mole of $Cr_2O_7^{2-}$ oxidises

a) 1 mole of Fe^{2+} b) 3 moles of Fe^{2+} c) 4 moles of Fe^{2+} d) 6 moles of Fe^{2+}

248. Si of high purity to be used in semiconductor can be prepared by the following methods

I. $SiO_2 + 2C \rightarrow Si + 2CO$

II. $Si + 2Cl_2 \rightarrow SiCl_4$

$SiCl_4 + 2Mg \rightarrow Si + 2MgCl_2$

Better method is

a) I   b) II   c) Both (a) and (b)   d) None of these

249. Self-reduction of CuS to Cu can be carried out in

a) Bessemer converter

b) Pierce-Smith converter

c) Both (a) and (b)

d) None of these

250. If the following is balanced reaction

$$4O_2^{x-} + 2H_2O \rightarrow 4OH^- + 3O_2$$

Then x is and O_2^{x-} is

a) -1 and species is superoxide

b) -2 and species is peroxide

c) -4 and species is oxide

d) -1 and species is peroxide

251. Which of the following is INCORRECT regarding modern vertical process?

a) It is a commercial, economical and continuous process

b) It has roll discharge mechanism

c) It involves oxidation at high temperature of about 1673 K

d) The heating jacket is heated by burning producer gas

252. Which of the following is a disproportionation reaction?

a) $CaCO_3 + 2H^+ \rightarrow Ca^{2+} + H_2O + CO_2$

b) $2CrO_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{2-} + H_2O$

c) $Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$

d) $Cu_2O + 2H^+ \rightarrow Cu + Cu^{2+} + H_2O$

253. Which is the chloride ore of Mg?

a) Kieserite   b) Carnallite   c) Epsomite   d) Dolomite

254. Auto-reduction process is used in the extraction of _____

a) Cu   b) Zn   c) Al   d) Fe

255. The common method for the extraction of metals from oxide ores involves _____

a) Reduction with carbon

b) Reduction with aluminium

c) Reduction with hydrogen

d) Electrolytic method

256. Which of the following metal is purified by Mond carbonyl method?

a) Zr   b) Ti   c) Ge   d) Ni

257. Smelting is done in _____ furnace

a) Blast   b) Muffle   c) Open – hearth   d) Electric

258. The froth floatation process is applied for sulphide ores and sodium ethyl xanthate acts as a collector of sulphide ore. In this process

a) The hydrophobic end prefers to stay in air and the hydrophilic end prefers to stay in water

b) The hydrophobic end prefers to stay in water and the hydrophilic end prefers to stay in air

c) Both ends prefer to stay in water

d) Both ends prefer to stay in air

259. SnO_2 is reduced to metallic Sn on smelting oxide with anthracite, limestone and sand

In this, function of sand is

a) It acts as a flux

b) It removes basic impurities a slag

c) Both as in (a) and (b)

d) None of the above

260. The substance used in the thermite process for reducing metal oxide is _____

a) Aluminium   b) Thorium   c) Heated Pt gauge   d) Carbon

261. Which of the following metals can be separated from their crude form by liquation?

a) Bi   b) Ge   c) Ni   d) All of these

262. Cryolite is _____

a) Sodium hexachloro aluminate (III)

b) Sodium hexabromo aluminate (III)

c) Sodium hexafluoro aluminate (III)

d) Sodium hexaiodo aluminate (III)

263. Purification of aluminium by electrolytic refining is known as

a) Hall's process   b) Baeyer' process   c) Hoop's process   d) Serpeck' process

264. If CO_2 is passed into waste water containing CrO_4^{2-} (yellow) then solution turns

a) Green due to the formation of Cr^{3+}

b) Blue due to the formation of CrO_5

c) Orange due to the formation of $Cr_2O_7^{2-}$ d) Black due to the formation of Cr_2O_3

265. Splitting of silver is
   a) Reduction of ammoniacal silver nitrate solution by tartarate
   b) Extraction of silver from its ore Ag_2S, by hydrometallurgy
   c) Making of silver amalgam during filling of teeth
   d) Cooling of molten, silver with the evolution of oxygen causing violent spurting

266. During polling, heat of molten metal makes the green logs of wood to liberate _____
   a) Sulphur dioxide   b) Carbon dioxide   c) Carbon monoxide   d) Hydrocarbon gases

267. Thomas slag is
   a) $Ca_3(PO_4)_2 \cdot 2H_2O$ b) $Ca_3(PO_4)_2 \cdot CaSiO_3$ c) $MgSiO_3$ d) $CaSiO_3$

268. Roasting involves _____
   a) Only volatilization of volatile impurities
   b) Volatilization of volatile impurities and decomposition of the ore
   c) Volatilization of volatile impurities and decomposition and oxidation of the ore
   d) Oxidation and reduction of the ore and slag formation

269. The chief impurity present in red bauxite is _____
   a) SiO_2 b) Fe_2O_3 c) K_2SO_4 d) NaF

270. $NaHC_2O_4$ is neutralized by NaOH and can also be oxidized by $KMnO_4$ (in acidic medium). Equivalent weight is related to molecular weight (M) of $NaHC_2O_4$ in these two reactions as
   a) M, M b) $2M, 2M$ c) $\dfrac{M}{2}, M$ d) $M, \dfrac{M}{2}$

271. 1.575 g of a dibasic acid required 0.025 equivalent of NaOH. Hence, molar mass of dibasic acid (mol^{-1}) is
   a) 15.75 g   b) 25 g   c) 63 g   d) 126 g

272. Depressant used in separation of PbS and ZnS in froth floatation process is _____
   a) $CuSO_4$ b) $NaCN$ c) KCN d) Na_2SO_4

273. Which method is not correct given for the refining of crude metals?
   a) **Distillation** zinc and mercury   b) **Liquation** tin
   c) **Van-Arkel** Zirconium   d) **Mond** process lead

274. Which impurity is NOT present is zinc spelter?
   a) Copper   b) Cadmium   c) Iron   d) Lead

275. NaCl and $CaCl_2$ are also added to fused $MgCl_2$ in the electrolysis of $MgCl_2$ since
   a) Melting point is decreased and conductivity is increased
   b) Melting point is increased and conductivity is decreased
   c) Melting point and conductivity both are decreased
   d) Melting point and conductivity both are increased

276. Which of the following is not an iron ore?
   a) Caniterite   b) Magnetite   c) Limonite   d) Copper pyrite

277. Difference in density is the basis of _____
   a) Ultrafiltration   b) Molecular sieving   c) Gravity separation   d) Molecular attraction

278. Copper matter is converted into blister copper by taking it into a silica lined convertor. Blistered appearance is due to which reaction?
   a) $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$ b) $Cu_2O + C \rightarrow 2Cu + CO$
   c) $2Cu_2O + Cu_2S \rightarrow 6Cu + CO$ d) $Cu^{2+} + Zn \rightarrow Zn^{2+} + Cu$

279. Among the following statements, the incorrect one is
   a) Zinc blende and iron pyrites are sulphides
   b) Calamine and siderite are carbonates
   c) Malachite and chalcocite are the copper ore
   d) Argentite and cuprite are oxides

280. When $PbS(s)$ is treated with warm dilute HNO_3, the products most likely will be
   a) Pb^{2+}, S, NO_2 b) Pb^{2+}, S, NO c) PbO, S, NO d) PbO_2, SO_4^{2-}, N_2

281. Briquettes used in modern vertical retort process are made up of _____

a) $ZnSO_4$

b) $ZnO(40\%)$ + coke/charcoal (60%)

c) $ZnS(40\%)$ + coke/charcoal (60%)

d) ZnS

282. In the cup and cone arrangement of blast furnace, the cone enables _____

   a) Introduction of pre-heated air into the furnace

   b) Prevention of loss of gases

   c) Uniform distribution of charge

   d) All of these

283. Which is not the correct process-mineral matching in metallurgical extraction?

   a) Leaching : Ag   b) Zone-refining : Sn   c) Liquation : Sn   d) Van-Arkel : Zr

284. Which of the following is required during electrolytic refining?

   a) Electrolytic bath containing soluble salt of same metal

   b) Impure metal as cathode

   c) Strip of pure metal as anode

   d) All of these

285. In the following redox reactions, NH_3 appears either in reactant or product. In which case equivalent weight of NH_3 is maximum?

   a) $N_2 + 3H_2 \rightarrow 2NH_3$

   b) $=4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

   c) $2NH_3 + 2Na \rightarrow 2NaNH_2 + H_2$

   d) Equal in all the above cases

286. FeS_2 is

   a) Magnetite   b) Pyrite   c) Limonite   d) Haematite

287. 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 metals

   d) Roasting followed by self – reduction

288. Name the metal that is purified by placing the impure metal on sloping hearth of a reverberatory furnace and heating that above its melting point in absence of air

   a) Mercury   b) Gallium   c) Zirconium   d) Copper

289. The mixture of $Na_3AlF_6 + CaF_2$ is mixed in electrolytic reduction of alumina _____

   a) To make alumina soluble

   b) To decrease the electrical conductivity and increase the melting point

   c) To increase the electrical conductivity and decrease the melting point

   d) To avoid evaporation

290. Ores like magnetite or cassiterite are concentrated by _____

   a) Froth – floatation

   b) Magnetic separation

   c) Gravity separation

   d) Electrostatic separation

291. Metal can be obtained by the carbon reduction method

   $ZnO + C \rightarrow Zn + CO$

   Which of the following curves can be taken that the metal obtained is in vapour state by this method?

c)

d)
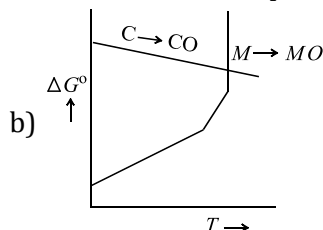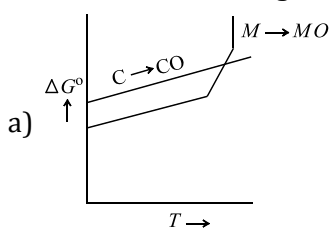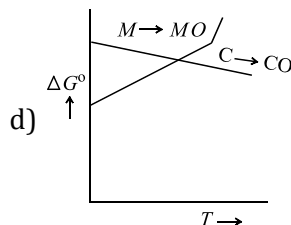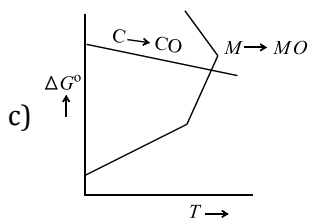
292. If a small amount of $KMnO_4$ is added to conc. H_2SO_4, a green coloured solution with oxidation number of Mn as $+7$ is formed. Probable compound is

a) MnO_3HSO_4 b) K_2MnO_4 c) MnO_2HSO_4 d) MnO_2

293. Oxidation number of carbonyl carbon in methanol and methanoic acid are respectively

a) $0, 0$ b) $0, +2$ c) $+1, +2$ d) $+1, +3$

294. Phosphorus separates, in the extraction of iron, as

a) Slag, $Ca_3(PO_4)_2$ b) Volatile, P_2O_5 c) Slag, $Mg_3(PO_4)_2$ d) Ca_3P_2

295. Mai source of lead is PbS. It is converted to Pb by

I. $PbS \xrightarrow[\triangle]{air} PbO + SO_2$

       $\xrightarrow{C} Pb + CO_2$

II. $PbS \xrightarrow[\triangle]{air} PbO + PbS$

       $\xrightarrow{PbS} Pb + CO_2$
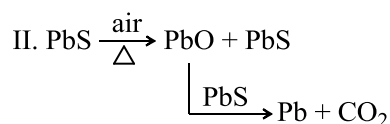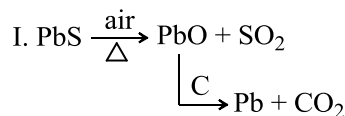
Self-reduction process is

a) I   b) II   c) Both (a) and (b)   d) None of these

296. When limestone is heated, CO_2 is given off. The metallurgical operation is _____

a) Smelting   b) Reduction   c) Calcination   d) Roasting

297. Which of the following mineral of iron has the highest sulphur content?

a) Siderite   b) Magnetite   c) Iron pyrites   d) Limonite

298. During smelting of copper pyrites, the charge which is introduced in the blast furnace consists of _____

a) Roasted ore, coke and sand

b) Roasted ore, coke and limestone

c) Roasted ore, coke and quick lime

d) Roasted ore, coke and sodalime

299. 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   b) Sulphur (IV) dioxide   c) Iron (II) sulphide   d) Copper (II) sulphide

300. Colour of solid zinc is _____

a) Reddish brown   b) Green   c) Silvery white   d) Bluish white

301. Polling process is used in purifying _____

a) Hg   b) Fe   c) Cu   d) Ag

302. How is limestone in Fe extraction?

a) Oxidation of Fe ore

b) Reduction of Fe ore

c) Formation of slag

d) Purification of Fe formed

303. In the extraction of Cu, the reaction takes place in bassemer converter is

a) $2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$ b) $2CuFeS_2 + O_2 \rightarrow Cu_2S + FeS + SO_2$

c) $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$ d) $2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$

304. In the following unbalanced redox reaction $H_2S(g) + SO_2(g) \rightarrow S(s) + H_2O$ total number of equivalent of SO_2 is

a) 4   b) 3   c) 2   d) 1

305. $H_2S_2O_8$ and H_2SO_5 both have $+6$ oxidation state of sulphur. It is due to

a) Presence of peroxy group   b) Presence of superoxo group
c) Presence of neutral O_2 d) Presence of ozone

306. Malachite is an ore of
  a) Silver   b) Mercury   c) Magnesium   d) Copper

307. The minimum voltage required to electrolyse alumina in the Hall-Heroult process is
  Given, $\Delta G_f^{\circ}(Al_2O_3) = -1520 \text{ kJ mol}^{-1}$
  $\Delta G_f^{\circ}(CO_2) = -394 \text{ kJ mol}^{-1}$
  a) 1.575 V   b) 1.60 V   c) 1.312 V   d) -2.62 V

308. Hydro – metallurgical process of extraction of metals is based on _____
  a) Complex formation   b) Hydrolysis   c) Dehydration   d) Dehydrogenation

309. $6CO_2 + 12H_2O \xrightarrow{\text{Sun light}} C_6H_{12}O_6 + 6O_2 + 6H_2O$ Equivalent weights of CO_2 and $C_6H_{12}O_6$ respectively are
  a) 11, 7.5   b) 44, 180   c) 22, 15   d) 44, 90

310. By annealing, steel
  a) Becomes soft   b) Becomes liquid
  c) Becomes hard and brittle   d) Is covered with a thin film of Fe_3O_4

311. $N_2 + 3H_2 \rightarrow 2NH_3$. In this reaction equivalent weight of N_2 is
  a) 4.67   b) 28   c) 14   d) 2.33

312. Select the correct statement
  a) Based on reactivity series, occurrence of certain elements takes place in native state
  b) Due to basic nature of oxides of alkaline earth elements, they combine with atmospheric acidic oxides giving salts
  c) Both (a) and (b) are correct
  d) None of the above is correct

313. Which of the following changes required a reducing agent?
  a) $CrO_4^{2-} \rightarrow Cr_2O_7^{2-}$ b) $BrO_3^- \rightarrow BrO^-$ c) $H_3AsO_3 \rightarrow HAsO_4^{2-}$ d) $Al(OH)_3 \rightarrow Al(OH)_4^-$

314. Tempering of steel
  a) Is the heating the steel to appropriate temperature and then cooling it rapidly
  b) Increases mechanical strength
  c) Changes ratio of carbon in cementite
  d) All of the above

315. The INCORRECT statement among the following is _____
  a) In calcination, ore decomposes to form metal oxide
  b) Zirconium is refined by van Arkel method
  c) The sulphide ore galena is concentrated by froth floatation
  d) In the metallurgy of iron, the flux used is SiO_2

316. 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) $Al_2O_3 + KF + Na_3AlF_6$

317. 1 mole of N_2H_4 loses 10 moles of electrons to form a new compound Y. Assuming that all the nitrogen appear in the new compound, what is the oxidation state of nitrogen in Y? (no change in the oxidation state of H)
  a) -1 b) -3 c) $+3$ d) $+5$

318. Which one of the following statements is not correct?
  a) Nickel forms $Ni(CO)_4$
  b) All the transition metals form monometallic carbonyls
  c) $Ni(CO)_4$ is volatile and decomposes into Ni and CO
  d) Transition metals form complexes

319.

$$\boxed{\text{Bauxite}} \xrightarrow[N_2]{+C} \boxed{\text{AlN}} \xrightarrow{H_2O} Al(OH)_3 \xrightarrow{\triangle} Al_2O_3$$

with CO shown above AlN
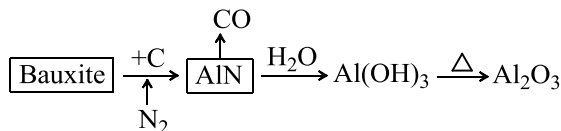
This flow-sheet is for

a) Baeyer's process   b) Serpeck's process   c) Hall's process   d) Kroll' process

320. Consider the following statements

I. Pig iron is malleable and ductile

II. Pig iron can be melted to produce cast iron of desired shapes

III. Wrought iron is obtained by heating pig iron with iron oxide in a furnace

Which of the statement(s) given above is/are correct

a) I only   b) I and II   c) II and III   d) III only

321. The chemical composition of 'slag' formed during the smelting process in the extraction of copper is

a) $Cu_2O + FeS$ b) $FeSiO_3$ c) $CuFeS_2$ d) $Cu_2S + FeO$

322. Purpose of smelting of an ore is _____

a) To oxidise it   b) To reduce it   c) To remove vaporizable impurities   d) To obtain an alloy

323. Baeyer's process is used for the purification of bauxite containing _____ as impurity

a) SiO_2 b) $CaCO_3$ c) Fe_2O_3 d) ZnO

324. Iron exhibits property of ferromagnetism _____

a) Above 1800 K   b) At 1800 K   c) Below 1042 K   d) Above 1042 K

325. $Ag_2S + NaCN \rightarrow (A)$

$(A) + Zn \rightarrow (B)$

(B) is a metal. Hence, (A) and (B) are

a) $Na_2[Zn(CN)_4], Zn$ b) $Na[Ag(CN)_2], Ag$ c) $Na_2[Ag(CN)_4], Ag$ d) $Na_3[Ag(CN)_4], Ag$

326. Which of the following minerals does NOT contain copper?

a) Malachite   b) Cuprite   c) Azurite   d) Corundum

327. Refractory materials are generally used in furnaces because _____

a) They posses great structural strength

b) They can withstand high temperature

c) They are chemically inert

d) They do not require replacement

328. Iron ore is concentrated by _____

a) Froth floatation   b) Electrolysis   c) Roasting   d) Magnetic treatment

329. Which of the following is slag?

a) CaO b) $CaSO_4$ c) $CaSiO_3$ d) SiO_2

330. In the equation, $4M + 8CN^- + 2H_2O + O_2 \rightarrow 4[M(CN)_2]^- + 4OH^-$, the metal M is _____

a) Copper   b) Iron   c) Gold   d) Zinc

331. A newly discovered metal 'M' was found to have its graph of formation of oxide above the graph line of silver, in the Ellingham diagram, this indicates that _____

a) Metal 'M' can be easily decomposed at moderate temperature

b) Metal 'M' can be reduced using silver

c) Silver can be reduced using metal 'M'

d) Both (A) and (B)

332. In cyanide method, silver metal is obtained as $2K[Ag(CN)_2] + Zn \rightarrow K_2[Zn(CN)_4] + 2Ag$ in this

a) Ag has been oxidized and Zn has been reduced

b) Ag has been reduced and Zn has been oxidized

c) Both the metals have been oxidized

d) Both the metals have been reduced

333. In the following redox reaction

$Zn(s) + NO_3^-(aq) + H^+(aq) \rightarrow Zn^{2+}(aq) + NH_4^+(aq)$ $Zn(s)$ and $NO_3^-(aq)$ respectively are

a) Oxidant, reductant   b) Reductant, oxidant   c) Both oxidant   d) Bothe reductant

334. Aluminium is produced on a large scale by electrolysis of alumina, dissolved in fused cryolite and a little fluorspar. These two electrolytes, cryolite and fluorspar are respectively _____
   a) Na_3AlF_6 and CaF_2 b) AlF_3 and KF c) Al_2O_3 and KCl d) $KCl. MgCl_2. 6H_2O$ and Mg

335. Which of the following is not an ore?
   a) Malachite   b) Calamine   c) Satellite   d) Cerussite

336. In electrolysis of Al_2O_3 by Hall-Heroult process
   a) Cryolite $Na_3[AlF_6]$ lowers the m.p. of Al_2O_3 and increases its electrical conductivity
   b) Al is obtained at cathode and probably CO_2 at anode
   c) Both (a) and (b) are correct
   d) None of the above is correct

337. In Hall Heroult's process, products liberated at anode and cathode are _____
   a) Oxygen and aluminium respectively
   b) Carbon monoxide and aluminium respectively
   c) Carbon dioxide and aluminium respectively
   d) All of these

338. Van Arkel method of purification of metals involves converting the metal to a _____ compound
   a) Volatile stable
   b) Volatile unstable
   c) Non – volatile stable
   d) Non – volatile unstable

339. In Hall and Heroult's process, the molten electrolyte is covered with the layer of powdered coke, which helps to _____
   a) Prevent oxidation
   b) Prevent reduction
   c) Prevent loss of heat due to radiation
   d) Both (A) and (C)

340. Specific gravity of slag is _____
   a) Always higher than molten metal
   b) Always less than molten metal
   c) Same as molten metal
   d) Varies according to molten metal

341. A flux is often added to remove impurities from an ore in a blast furnace. In the reaction, $CaO + SiO_2 \rightarrow CaSiO_3$ the slag and the flux are _____ respectively
   a) $CaSiO_3$ and SiO_3 b) $CaSiO_3$ and CaO c) CaO and SiO_2 d) SiO_2 and $CaSiO_3$

342. The silver is extracted by Parke's process. The basis of this method is
   a) Silver is immiscible in molten Zn
   b) Ag is miscible in NaCN
   c) Ag is more miscible in molten zinc than in molten Pb
   d) Ag is more miscible in molten Pb in comparison to molten zinc

343. Heating of pyrites in air for oxidation of sulphur is called _____
   a) Roasting   b) Calcination   c) Smelting   d) Slagging

344. Which of the following is the example of a disproportionation reaction?
   a) $CaCO_3 \rightarrow CaO + CO_2$
   b) $2HCuCl_2 \rightarrow Cu + Cu^{2+} + 4Cl^- + 2H^+$
   c) $PCl_5 \rightarrow PCl_3 + Cl_2$
   d) $2H_2S + SO_2 \rightarrow 3S + 2H_2O$

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

346. Which of the following ores is subjected to roasting during metallurgical operations for getting the metal

oxide?

a) Zincite   b) Zinc blende   c) Malachite   d) Limonite

347. Blast furnace is employed in the smelting of oxide ore with coke and flux in the metallurgy of _____

a) Iron   b) Copper   c) Aluminium   d) Both (A) and (B)

348. Corundum is an ore of _____

a) Copper   b) Boron   c) Aluminium   d) Sodium

349. In column chromatography, the mixture whose different components are to be separated is dissolved in _____

a) Stationary phase   b) Mobile phase   c) Eluents   d) Alumina

350. In the process of extraction of gold,

Roasted gold ore $+CN^- + H_2O \xrightarrow{O_2} [X] + OH^-$

$[X] + Zn \rightarrow [Y] + Au$

Identify the complexes $[X]$ and $[Y]$

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) $X = [Au(CN)_4]^-, Y = [Zn(CN)_4]^{2-}$

351. Which reaction is suitably matched?

a) $\begin{array}{l} CHO \\ | \\ CHO \end{array} + OH^- \longrightarrow \begin{array}{l} CH_2OH \\ | \\ COO^- \end{array}$

(Crossed Cannizzaro reaction)

b) $3H_3PO_2 \rightarrow 2H_3PO_3 + PH_3$ (Disproportionation reaction)

c) $\begin{array}{l} CHO \\ | \\ CHO \end{array} + OH^- \longrightarrow \begin{array}{l} COO^- \\ | \\ COO^- \end{array} + \begin{array}{l} CH_2OH \\ | \\ COO^- \end{array}$

(Intramolecular Cannizzaro)

d) $MnO_2 \xrightarrow{OH^-} MnO_4^- + Mn^{2+}$ (Redox)

352. Manufacture of cast iron is done in _____

a) Blast furnace

b) Bessemer converter

c) Reverberatory furnace

d) Modern vertical retort

353. Zone refining is used for the purification of _____

a) Cu   b) Au   c) Ge   d) Ag

354. Froth floatation process is based on _____ ore particles

a) Wetting properties of

b) Specific gravity of

c) Magnetic properties of

d) Electrical properties of

355. When alloy of silver and lead is rich in silver

a) Cupellation process is used   b) Parke's method is used

c) Pattinson's method is used   d) Any of the above methods can be used

356. 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

357. Which of the following is a carbonate ore?

a) Pyrolusite   b) Malachite   c) Diaspore   d) Cassiterite

358. Which one of the following is a mineral of iron?

a) Malachite   b) Cassiterite   c) Pyrolusite   d) Magnetite

359. Calcination is the process of heating the ore _____

a) In a blast furnace   b) In absence of air   c) In excess of air   d) In excess of carbon

360. Out of the following reactions which does not indicate slag formation?
a) $Fe_2O_3 + P_2O_5 \rightarrow 2FePO_4$
b) $PbO + SiO_2 \rightarrow PbSiO_3$
c) $3MgO + P_2O_5 \rightarrow Mg_3(PO_4)_2$
d) None of the above

361. $AgCl + Na_2CO_3 \rightarrow Ag_2CO_3 \xrightarrow{\Delta} X, X$ is
a) Ag_2O and CO_2
b) Ag, O_2 and CO_2
c) Ag_2O_2 and CO_2
d) No effect

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

a) $CuS + \dfrac{3}{2}O_2 \rightarrow CuO + SO_2$

b) $CuS + \dfrac{3}{2}O_2 \rightarrow CuO + SO_2$
$2CuO + CuS \rightarrow 3Cu + SO_2$

c) $CuS + 2O_2 \rightarrow CuSO_4$

d) $CuS + \dfrac{3}{2}O_2 \rightarrow CuO + SO_2$
$CuSO_4 + CuS \rightarrow 2Cu + 2SO_2$
$CuO + CO \rightarrow Cu + CO_2$

363. Main ore of aluminium is _____
a) Bauxite
b) Corundum
c) Cryolite
d) Magnetite

364. When MnO_4^- and I^- react in a strongly basic solution, the products will most likely be
a) Mn and I_2
b) MnO_4^{2-}, IO_3^-
c) MnO_2, O_2, IO^-
d) Mn^{2+}, I_2

365. Chromatography is based on the principle of selective _____
a) Absorption
b) Adsorption
c) Wettability
d) Evaporation

366. The process used for purification $Al_2O_3 \cdot 2H_2O$ is
a) Magnetic separation
b) Froth floatation
c) Leaching
d) Liquation

367. Oxidation state of P in $H_4P_2O_5, H_4P_2O_6$ and $H_4P_2O_7$ are respectively
a) $+3, +4, +5$
b) $+3, +5, +4$
c) $+5, +3, +4$
d) $+5, +4, +3$

368. A sulphur containing species that cannot be a educing agent is
a) SO_2
b) SO_3^{2-}
c) H_2SO_4
d) S^{2-}

369. I^- reduces IO_3^- to I_2 and itself oxidized to I_2 in acidic medium. Final reaction is
a) $I^- + IO_3^- + 6H^+ \rightarrow I_2 + 3H_2O$
b) $I^- + IO_3^- \rightarrow I_2 + O_3$
c) $5I^- + IO_3^- + 6H^+ \rightarrow 3I_2 + 3H_2O$
d) None of the above

370. Which has the maximum oxidation number of the underlined atom in the following?
a) $\underline{Mn}O_4^{2-}$
b) $\underline{Cr}O_5$
c) $\underline{Cr}O_2Cl_2$
d) Equal

371. The concentrated ore containing trace elements can be best purified by _____
a) Electrolytic refining
b) Vapour phase refining
c) Zone refining
d) Chromatography

372. Equivalent weights of $KMnO_4$ in acidic medium, concentrated alkaline medium and dilute basic medium respectively are $\dfrac{M}{5}, \dfrac{M}{1}, \dfrac{M}{3}$. Reduced products can be
a) $MnO_2, MnO_4^{2-}, Mn^{2+}$
b) $MnO_2, Mn^{2+}, MnO_4^{2-}$
c) $Mn^{2+}, MnO_4^{2-}, MnO_2$
d) $Mn^{2+}, MnO_2, MnO_4^{2-}$

373. Ore dressing is the process, in which _____
a) Ore size is reduced to required size
b) Drying of ore takes place
c) Removal of gangue material takes place
d) Treating the ore with alkalies

374. In alumino – thermite process, aluminium is used as a/an _____
a) Oxidizing agent
b) Flux
c) Reducing agent
d) Solder

375. Leaching is a process in which _____ of ore is carried out
a) Reduction
b) Concentration
c) Refining
d) Oxidation

376. Which is NOT the mineral of iron?
a) Dolomite
b) Magnetite
c) Haematite
d) Limonite

377. The reduction of an oxide by aluminium is called
    a) Ellingham process
    b) Goldschmidt's aluminothermite process
    c) Kroll's process
    d) Van-Arkel process
378. Flux is used to remove
    a) Silica   b) Metal oxide   c) Silica and metal oxide   d) Impurities from ore
379. The substance which is mixed with the ore for removal of impurities is termed as _____
    a) Slag   b) Gangue   c) Flux   d) Catalyst
380. Turbunbull's blue has two types of iron with oxidation number as shown $Fe[\overset{II}{Fe}(CN)_6]$
    What is the net charge on Turbunbull's blue?
    a) -1 b) $+1$ c) 0   d) -2
381. Match Column I with Column II and select the correct answer using the codes gives below the Columns

	Column I	Column II
A.	Van-Arkel method	Manufacture of caustic soda
B.	Solvay process	Purification of titanium
C.	Cupellation	Manufacture of Na_2CO_3
D.	Poling	Purification of copper
		Refining of silver

    Codes
    A   B   C   D
    a) 2   1   3   4   b) 4   3   2   5
    c) 2   3   5   4   d) 5   1   3   4
382. High quantity of heat is produced in the formation of Al_2O_3. This property is used for _____
    a) Oxidation   b) Roasting   c) Calcination   d) Thermite welding
383. Black tin is
    a) An alloy of Sn   b) An allotrope of Sn   c) 60-70 per cent SnO_2 d) 100 per cent SnO_2
384. Which of the following reactions does NOT occur in blast furnace?
    a) Combustion of coke with oxygen from the hot air
    b) Conversion of ferrous oxide into ferric oxide
    c) Reduction of ferric oxide to iron
    d) Formation of slag by reaction between limestone and impurities like alumina, silica, etc
385. Sulphide ores are common for the metals
    a) Ag, Cu, Pb   b) Ag, Cu, Sn   c) Ag, Mg, Pb   d) Al, Cu, Pb
386. Metallurgy is the process of _____
    a) Concentrating the ore
    b) Roasting the ore
    c) Extracting the metal from the ore
    d) Adding carbon to the ore in blast furnace
387. In metallurgy of iron, charge introduced in the blast furnace consists of _____
    a) Roasted ore, silica and calcium hydroxide
    b) Roasted ore, coke and calcium hydroxide
    c) Roasted ore, coke and calcium carbonate
    d) Roasted ore, coke and calcium silicate
388. When a sulphide ore is roasted, the product obtained is usually a/an _____
    a) Metal   b) Sulphite   c) Oxide   d) Nitride
389. Sodium is made by the electrolysis of molten mixture of about 40% NaCl and 60% $CaCl_2$ because

a) $CaCl_2$ helps in conduction of electricity

b) Ca^{2+} can reduce NaCl to Na

c) Ca^{2+} can displace Na from NaCl

d) This mixture has a lower melting point than NaCl

390. 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 $Na[Ag(CN)_2]$

391. Wolframite ore is separated from tin stone ore by the process of

a) Roasting   b) Electromagnetic   c) Smelting   d) Calcination

392. Main process for extracting nickel in the pure form uses which one of the following?

a) Vapour phase refining   b) Zone refining

c) Electrolysis   d) Solvent extraction

393. Refining of tin cannot be done by

a) Cupellation   b) Liquation   c) Poling   d) Electrorefining

394. When molten copper is cooled slowly, blister copper is obtained because _____ gas comes out

a) Sulphur dioxide   b) Carbon dioxide   c) Carbon monoxide   d) Oxygen

395. In balancing the half-reaction

$CN^- \rightarrow CNO^-$ (skeletal)

The number of electrons that must be added is

a) 0   b) 1 on the right   c) 1 on the left   d) 2 on the right

396. In the Baeyer's process

a) Al_2O_3 goes into solution as soluble $Al(OH)_4^-$ while other basic oxides as TiO_2 and Fe_2O_3 remain insoluble

b) Al_2O_3 changes to AlN which in turn decomposed by H_2O

c) Al_2O_3 changes to $Al_2(CO_3)_3$ which changes to $AlCl_3$

d) None of the above is correct

397. Which of the following metal is exclusively found in free state?

a) Copper   b) Gold   c) Silver   d) Mercury

398. Calamine is

a) ZnS   b) $PbCO_3$ c) $ZnCO_3$ d) $MgCO_3$

399. Out of Cu_2S, HgS, Ag_2S and ZnS, roasting will convert the minerals into metal in case of

a) Cu_2S, ZnS b) HgS, ZnS c) Cu_2S, Ag_2S d) HgS, Ag_2S

400. During roasting of concentrated zinc sulphide ore, which of the following gets formed?

a) $ZnCO_3$ b) ZnO   c) $ZnSO_4$ d) Both (B) and (C)

401. 1 mole of MnO_4^- will oxidize x moles of ferric oxalate in acidic medium, x is

a) $\dfrac{5}{6}$ b) $\dfrac{6}{5}$ c) 5   d) 6

402. In the Ellingham diagram, sudden change in the graph indicates _____

a) Phase change from solid to vapour stage

b) Phase change from solid to liquid stage

c) Phase change from liquid to vapour stage

d) Either (B) or (C)

403. In the following reaction, $Zn + 2OH^- + 2H_2O \rightarrow Zn(OH)_4^{2-} + H_2$ species which has been reduced is

a) Zn   b) OH^- c) H_2O d) None of these

404. In the above reaction of question (75), one equivalent of $H_2S(g)$ will reduce

a) 1 mole of SO_2 b) 0.5 mole of SO_2 c) 0.25 mole of SO_2 d) 2 moles of SO_2

405. The process of purification of metals is represented by the following scheme

$Ti + 2I_2 \xrightarrow{250°C} TiI_4 \xrightarrow{1400°C} Ti + I_2$

pure
a) Cupellation   b) Poling   c) Electrolytic refining   d) Van-Arkel method

406. Forth floatation process for the concentration of ores is an illustration of the practical application of
_____

a) Adsorption   b) Absorption   c) Coagulation   d) Sedimentation

407. Mac Arthur process is used for the extraction of

a) Al   b) Ag   c) Cu   d) Zn

408. For the formation of metal oxide, $\Delta G°$ increases with the _____ temperature

a) Increase in   b) Decrease in   c) Constant   d) None of these

409. Railway refining is used for refining of

a) Tempering   b) Annealing   c) Sherar dising   d) Case hardening

410. In the metallurgy of iron, when $CaCO_3$ is added to blast furnace, calcium ion appears as

a) CaO   b) Metallic Ca   c) Gangue   d) Slag

411. Poling process

a) Reduced SnO_2 to Sn

b) Oxidses impurities like iron and removes as scum

c) Uses green poles

d) Involves all of the above

412. Chalcopyrites is an ore of

a) Gallium   b) Copper   c) Calcium   d) Magnesium

413. Formation of $Ni(CO)_4$ and subsequent its decomposition into Ni and CO (recycled) makes the basis of Mond's process

$Ni + 4CO \xrightarrow{T_1} Ni(CO)_4 \xrightarrow{T_2} Ni + 4CO$

T_1 and T_2 are

a) $100°C, 50°C$ b) $50°C, 100°C$ c) $50°C, 230°C$ d) $230°C, 50°C$

414. Select the incorrect reduction process

a) $2[Ag(CN)_2]^- + Zn \rightarrow [Zn(CN)_4]^{2-} + 2Ag$ b) $CuO + H_2 \rightarrow Cu + H_2O$

c) $ZnO + H_2 \rightarrow Zn + H_2O$ d) $MgO + C \rightarrow Mg + CO$

415. What is the molecular state of sulphur as reactant in, $sulphur + 12OH^- \rightarrow 4S^{2-} + 2S_2O_3^{2-} + 3H_2O$?

a) S_8^{2-} b) $2S_4^{2-}$ c) S_8 d) S_8^-

416. In the following redox reaction,

$Cu(OH)_2(s) + N_2H_4(aq) \rightarrow Cu(s) + N_2(g)$

Number of moles of $Cu(OH)_2$ reduced by 1 mole of N_2H_4 is

a) 1   b) 2   c) 3   d) 4

417. Inner layer of blast furnace is made of _____

a) Graphite bricks   b) Silica bricks   c) Fire – clay bricks   d) Basic bricks

418. Out of following redox reactions

I. $NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$

II. $NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$

III. $PCl_5 \xrightarrow{\Delta} PCl_3 + Cl_2$

Disproportionation is not shown in

a) I, II   b) II, III   c) I, III   d) I, II and III

419. In order to bring initial chemical change in the ore, the process of heating of ore below its melting point in the presence of excess of air is known as _____

a) Reduction   b) Smelting   c) Calcination   d) Roasting

420. In the following reaction (unbalanced), equivalent weight of As_2S_3 is related to molecular weight M by

$As_2S_3 + H^+ + NO_3^- \rightarrow NO + H_2O + AsO_4^{3-} + SO_4^{2-}$

a) $\dfrac{M}{2}$ b) $\dfrac{M}{4}$ c) $\dfrac{M}{28}$ d) $\dfrac{M}{24}$

421. Native silver metal forms a water soluble complex with a dilute aqueous solution of NaCN in the presence of
　　a) Nitrogen　　　　　　b) Oxygen　　　　　　c) Carbon dioxide　　　d) argon

422. Which of the following ore is best concentrated by froth-floatation method?
　　a) Galena　　　　　　　b) Cassiterite　　　　　c) Magnetite　　　　　d) Malachite

423. Extraction for zinc from zinc blende is achived by
　　a) Electrolytic reduction
　　b) Roasting following by reduction with carbon
　　c) Roasting followed by reduction with another metal
　　d) Roasting followed by self-reduction

424. Calcination is the process of heating the ore
　　a) In inert gas　　　　　　　　　　　　　　b) In the presence of air
　　c) In the absence of air　　　　　　　　　　d) In the presence of CaO and MgO

425. Annealing of steel is the process of heating steel
　　a) To a bright red hot and then cooling it slowly
　　b) To a bright red hot and then cooling it suddenly
　　c) To a temperature much below redness and cooling it slowly
　　d) None of the above

426. Bleaching powder ($CaOCl_2$) has two types of chlorine atoms with oxidation number of $+1$ and -1.It can be represented as
　　a) $Ca^{2+}(ClO_2^-)Cl^-$　　b) $Ca^{2+}(ClO_3^-)Cl^-$　　c) $Ca^{2+}(ClO^+)Cl^-$　　d) $Ca^{2+}(ClO^-)Cl^-$

427. Which of the following processes is used in extractive metallurgy of magnesium?
　　a) Fused salt electrolysis　　　　　　　　b) Self reduction
　　c) Aqueous solution electrolysis　　　　　d) Thermite reduction

428. A reaction showing slag formation is _____
　　a) $Cu_2S + 2Cu_2O \rightarrow 6Cu + SO_2$
　　b) $ZnCO_3 \rightarrow ZnO + CO_2$
　　c) $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$
　　d) $FeO + SiO_2 \rightarrow FeSiO_3$

429. Extraction of Al from bauxite is carried out by various stages in Hall' process which involves
　　I. Removal of sand and heavier impurities by gravity separation method
　　II. Removal of magnetic impurities by magnetic separator
　　III. Fusing the concentrated finely divided ore with Na_2CO_3 and $CaCO_3$ and then extracting with H_2O
　　IV. Ignition at 1100℃
　　V. Passing CO_2
　　Correct order of these steps are
　　a) I, II, III, V, IV　　　b) II, I, III, V, IV　　　c) V, IV, III, I, II　　　d) I, III, V, IV, II

430. The hardest naturally occurring substance is
　　a) Iron　　　　　　　　b) Graphite　　　　　　c) Diamond　　　　　　d) Astatine

431. Colemanite is
　　a) $Ca[B_3O_4(OH_2)] \cdot 2H_2O$　　　　　　　　b) $Ca_2B_6O_{11} \cdot 5H_2O$
　　c) $Ca(OH)_2$　　　　　　　　　　　　　　　　d) $Na_2B_4O_7 \cdot 2H_2O$

432. Which of the following statement is NOT correct?
　　a) All ores are minerals　　b) All minerals are ores　　c) All ores contain gangue　　d) A metal may occur in several minerals

433. Heating mixture of Cu_2O and Cu_2S will give _____
　　a) $Cu + SO_3$　　　　　b) $Cu + SO_2$　　　　　c) Cu_2SO_3　　　　　d) $CuO + CuS$

434. Ellingham diagram represents
　　a) Change of ΔG with temperature
　　b) Change of ΔH with temperature

c) Change of ΔG with pressure

d) Change of $(\Delta G - T\Delta S)$ with temperature

435. How is ore of aluminium concentrated?

    a) By roasting   b) By leaching   c) By froth floatation   d) By using Wilfley table

436. CN^- solution is used in extraction of which metal?

    a) Ag   b) Ti   c) Zn   d) Sn

437. _____ is necessary to obtain purest form of copper metal

    a) Carbon reduction   b) Hydrogen reduction   c) Electrolytic process   d) Thermite process

438. Sulphur atoms are of two environments in $S_4O_6^{2-}$, difference in oxidation states of two types of sulphur is

    a) 5   b) 6   c) 7   d) 10

439. Galena is an ore of _____

    a) Pb   b) Hg   c) Sn   d) Zn

440. For the reaction between MnO_4^- and $C_2O_4^{2-}$ in basic solution, the unbalanced equation is

$$MnO_4^- + C_2O_4^{2-} \rightarrow MnO_2(s) + CO_3^{2-}$$

In a balanced equation, the number of OH^- ions is

    a) 0   b) 4 on the right   c) 4 on the left   d) 2 on the left

441.

$(Ag + Pb)$ alloy $\xrightarrow[\text{is added}]{\text{melt and zinc}}$ $(Ag + Pb + Zn)$ melt $\xrightarrow{\text{cool}}$

| Layer X |
| Layer Y |

Select the correct statement(s) based on the above scheme

a) Larger X contains zinc and silver

b) Larger 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 of the above are correct statements

442. Values of p, q, r, s and t are in the following redox reaction

$$pBr_2 + qOH^- \rightarrow rBr^- + sBrO_3^- + tH_2O$$

$p\ q\ r\ s\ t$

    a) 3 6 1 5 3   b) 3 6 5 3 1   c) 3 6 5 1 3   d) 3 5 1 6 3

443. Which is the sulphate ore of Mg?

    a) Dolomite   b) Carnallite   c) Magnesite   d) Kieserite

444. For the formation of carbon dioxide, $\Delta G°$ _____

a) Increases with the increase in temperature

b) Decreases with the decrease in temperature

c) Does not vary much with the temperature

d) None of these

445. Liquation process is carried out using _____

a) Blast furnace

b) Hydraulic classifier

c) Reverberatory furnace

d) Wilfley's washing table

446. In the extraction of chlorine by electrolysis of brine

a) Oxidation of Cl^- ion to chlorine gas occurs at cathode

b) Reduction of Cl^- ion to chlorine gas occurs at anode

c) For overall reaction $\Delta G°$ has a negative value

d) A displacement reaction takes place

447. On igniting Fe_2O_3 at 1400°C, the product obtained is

    a) Fe_2O_3 melt   b) FeO   c) Fe_3O_4 d) Metallic iron

448. Extraction of gold (Au) involves the formation of complex ions 'X' and 'Y'

Gold ore $\xrightarrow[CN^-, H_2O, O_2]{}$ $HO^- + 'X' \xrightarrow{Zn} 'Y' + Au$

X and Y are respectively _____

a) $[Au(CN)_2]^-$ and $[Zn(CN)_4]^{2-}$

b) $[Au(CN)_4]^{3-}$ and $[Zn(CN)_4]^{2-}$

c) $[Au(CN)_3]^-$ and $[Zn(CN)_6]^{4-}$

d) $[Au(CN)_4]^-$ and $[Zn(CN)_3]^-$

449. Extraction of aluminium from aluminium oxide (Al_2O_3) is best done by

    a) Electrolytic reduction of Al_2O_3 b) Reduction of Al_2O_3 with carbon

    c) Reduction of Al_2O_3 with sodium   d) Reduction of Al_2O_3 with CO

450. A green colour product is formed when acidified $K_2Cr_2O_7$ reacts with

    a) Fe^{2+} b) SO_2 c) SO_3^{2-} d) All of these

Multiple Correct Answers Type

451. Out of $H_2SO_4, H_2S_2O_8, H_2SO_5, H_2S_2O_3$ and $H_2S_2O_7$

    1.   (II)   (III)   (IV)   (V)

    a) Oxidation number of sulphur is +6 in all except IV

    b) Peroxy linkage is in I, II and III

    c) Peroxy linkage is in II and III

    d) Oxidation number of sulphur is -2 in I and V

452. Consider the following reaction, $Br_2 + OH^- \rightarrow BrO_3^- + Br^- + H_2O$(unbalanced)

    Select the correct statement.

    a) Equivalent weight of Br_2 when it is reduced to Br^- is 80

    b) Equivalent weight of Br_2 when it is oxidized to BrO_3^- is 96

    c) Net equivalent weight of Br_2 is 96

    d) It is a disproportionation reaction

453. One mole of ferric oxalate is titrated with acidified potassium permanganate solution. In this

    a) 3 moles of potassium permanganate are required

    b) 1.2 moles of potassium permanganate are required

    c) Oxalate ion is oxidized to carbon dioxide

    d) Ferric ion is oxidized to ferrate (VI) ion

454. Boron can be obtained by various methods but not by

    a) Thermal decomposition of B_2H_6

    b) Pyrolysis of BI_3 (van-Arkel)

    c) Reducing BCl_3 with H_2

    d) Electrolysis of fused BCl_3

455. The carbon-based reduction method is not used for the extraction of

    a) Tin from SnO_2 b) Iron from Fe_2O_3

    c) Aluminium from Al_2O_3 d) Magnesium from $MgCO_3 - CaCO_3$

456. In the following cases, equivalent weight of the underlined may be equal to molecular weight

    a) $\underline{2CuSO_4} + 4KI \rightarrow Cu_2I_2 + 2K_2SO_4 + I_2$

    b) $\underline{2Na_2S_2O_3} + I_2 \rightarrow 2NaI + Na_2S_4O_6$

    c) $\underline{P_4} + 3NaOH + 3H_2O \rightarrow 3NaH_2PO_2 + PH_3$

    d) $\underline{H_2SO_4} + NaOH \rightarrow NaHSO_4 + H_2O$

457. Consider the following steps

    $CuS \xrightarrow{\text{roast in air}} (A) \xrightarrow{\text{roast without air}} (B)$

    Which are the correct statements

    a) It is self-reduction

    b) It involves disproportionation

        $Cu_2S \rightarrow Cu + CuS$

    c) (A) is a mixture of CuO and CuS and (B) is a mixture of Cu and SO_2

d) (A) is a mixture of Cu and SO_2 and B is $CuSO_4$

458. Extraction of metal from the ore cassiterite involves
   a) Carbon reduction of an oxide ore
   b) Self-reduction of a sulphide ore
   c) Removal of copper impurity
   d) Removal of iron impurity

459. Following is/are disproportionation reaction(s).
   a) $2CCl_3CHO + NaOH \rightarrow CCl_3COONa + CCl_3CH_2OH$
   b) $NH_4NO_3 \rightarrow N_2O + 2H_2O$
   c) $2KClO_3 \rightarrow 2KCl + 3O_2$
   d) $5Cl_2 + 6OH^- \rightarrow ClO_3^- + 5Cl^- + 3H_2O$

460. The reaction of white phosphorus with aqueous NaOH gives phosphine along with another phosphorus containing compound. The reaction type; the oxidation states of phosphorus in phosphine and the other product are respectively
   a) Redox reaction; -3 and -5
   b) Redox reaction; 3 and +5
   c) Disproportionation reaction; -3 and +5
   d) Disproportionation reaction; -3 and +1

461. 0.1 mole of $NaHC_2O_4$ is
   a) Neutralized by 0.1mole of NaOH
   b) Neutralized by 0.05mole of $Ca(OH)_2$
   c) Oxidized by 0.04 mole of $KMnO_4$ in acidic medium
   d) Oxidized by 0.02 mole of K_2MnO_4 in basic medium

462. Which of the following represent redox reactions?
   a) $Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$
   b) $2CrO_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{2-} + H_2O$
   c) $2MnO_4^- + 3Mn^{2+} + 4OH^- \rightarrow 5MnO_2 + 2H_2O$
   d) $2Cu^+ \rightarrow Cu + Cu^{2+}$

463. All the following species are strong oxidizing agents
   I. $S_2O_8^{2-}$; II. $Cr_2O_7^{2-}$ III. MnO_4^-
   Their strength as oxidizing agents in acidic solution is such that
   a) $I > II > III$
   b) $III > II > I$
   c) $I > III > II$
   d) $III > I > II$

464. Select the correct statements,
   Equivalent weight of $KMnO_4$ (molar mass $= M$) is
   a) $\frac{M}{5}$ in acidic medium
   b) $\frac{M}{3}$ in dilute basic medium
   c) M in strongly alkaline medium
   d) $\frac{M}{2}$ in acidic, basic and neutral media

465. Intramolecular redox reactions are
   a) $PCl_5 \rightarrow PCl_3 + Cl_2$
   b) $2KClO_3 \rightarrow 2KCl + 3O_2$
   c) $\begin{array}{c} CHO \\ | \\ CHO \end{array} + OH^- \longrightarrow \begin{array}{c} COO^- \\ | \\ CH_2OH \end{array}$
   d) $NH_4NO_2 \rightarrow N_2\, 2H_2O$

466. Metals found in free as well as combined states are
   a) Sodium
   b) Gold
   c) Silver
   d) Copper

467. Which is/are intramolecular diproportionation reaction(s)?
   a) $NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$
   b) $3H_3PO_2 \xrightarrow{\Delta} 2H_3PO_3 + PH_3$
   c) $\begin{array}{c} CHO \\ | \\ CHO \end{array} + OH^- \longrightarrow \begin{array}{c} COO^- \\ | \\ CH_2OH \end{array}$
   d) $2CH_3CHO \xrightarrow{Al(OC_2H_5)_3} CH_3COOC_2H_5$

468. Following reaction(s) is/are not involved in thermite process
   a) $3Mn_3O_4 + 8Al \rightarrow 9Mn + 4Al_2O_3$
   b) $Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr$
   c) $2Fe + Al_2O_3 \rightarrow 2Al + Fe_2O_3$
   d) $B_2O_3 + 2Al \rightarrow 2B + Al_2O_3$

469. Select the correct statements(s).
   a) Equivalent weight of $Ca(HC_2O_4)_2$ is $\frac{M}{2}$ when it is a reducing agent
   b) Equivalent weight of $Ca(HC_2O_4)_2$ is M when it behaves as an acid
   c) $Ca(HC_2O_4)_2$ can be estimated by MnO_4^-/H^+

d) $Ca(HC_2O_4)_2$ can be estimated by an acid

470. Which of the following are disproportionation reactions?

a)

b) $4H_3PO_3 \xrightarrow{\Delta} 3H_3PO_4 + PH_3$

c) $NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$

d) $PCl_5 \xrightarrow{\Delta} PCl_3 + Cl_2$
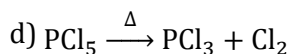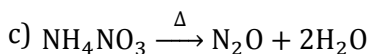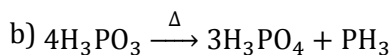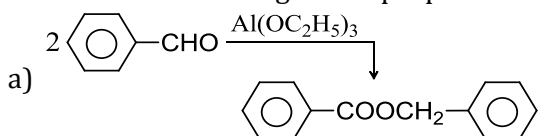
471. Roasting is carried out to

a) Convert sulphide to oxide and sulphate
b) Remove water of hydration
c) Melt the ore
d) Remove arsenic and sulphur impurities

472. 0.1 mole of MnO_4^- (in acidic medium) can oxidize

a) 0.5 mol of Fe^{2+}
b) 0.25 mol of $C_2O_4^{2-}$
c) 0.6 mol of $Cr_2O_7^{2-}$
d) 0.166 mol of FeC_2O_4

473. By which of the following processes, the ore is made porous?

a) Roasting
b) Calcinations
c) Reduction
d) Distillation

474. Following method is not used for extraction of Al

a) Van-Arkel
b) Serpeck
c) Bayer
d) Hall-Heroult

475. Consider the following reaction,

$$\begin{array}{c} CHO \\ | \\ CHO \end{array} + OH^- \longrightarrow \begin{array}{c} COO^- \\ | \\ CH_2OH \end{array}$$
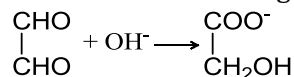
a) It is a disproportionation reaction
b) It is intramolecular redox reaction
c) OH^- is a reducing as well as oxidizing agent
d) $\begin{array}{c} CHO \\ | \\ CHO \end{array}$ is a reducing as well as oxidizing agent

476. The process by which higher earthy particles are free from the heavier particles using water are

a) Leaching
b) Levigation
c) Hydraulic washing
d) Gravity separation

477. Consider the following reaction, $H_3PO_4 + Ca(OH)_2 \rightarrow CaHPO_4 + 2H_2O$ and select the true statements

a) Equivalent weight of H_3PO_4 is 49
b) Resulting mixture is neutralized by 1 mole of KOH
c) $CaHPO_4$ is an acid salt
d) 1 mole of H_3PO_4 can be completely neutralized by 1.5 moles of $Ca(OH)_2$

478. The extraction of metals from oxide ores involves

a) Reduction with carbon
b) Reduction with aluminium
c) Electrolytic reduction
d) Reduction with CO

479. Of the following reduction processes, correct processes are

a) $Fe_2O_3 + C \rightarrow Fe$
b) $ZnO + C \rightarrow Zn$
c) $Ca_3(PO_4)_2 + C \rightarrow P$
d) $PbO + C \rightarrow Pb$

480. Carbon cannot be used in the reduction of Al_2O_3 because

a) It is an expensive proposition
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

481. Out of FeO_4^{2-}, $FeCl_3$, $FeCl_2$ and Fe,

a) Best reducing agent is Fe
b) Best oxidizing agent is FeO_4^{2-}
c) Best oxidizing agent is $FeCl_3$
d) Best reducing agent is FeO_4^{2-}

482. If Cl_2 is passed into hot NaOH solution, oxidation number of chlorine changes from

a) 0 to +5
b) 0 to −1
c) 0 to +1
d) 0 to +7

483. The role of CaF_2 which is added in the electrolytic reduction of alumina dissolved in fused cryolite is/are

a) To make the fused conducting mixture
b) To act as a catalyst
c) To lower the temperature of the melt

d) To decrease the oxidation of carbon at the anode

484. In which of the following isolations to reducing agent is required?
   a) Iron from haematite
   b) Aluminium from bauxite
   c) Mercury from cinnabar
   d) Zinc from zinc blende

485. In the following reaction, $3H_3PO_2 \rightarrow H_3PO_3 + PH_3$
   a) H_3PO_2 undergoes disproportionation reaction
   b) Equivalent weight of H_3PO_2 is 22
   c) Equivalent weight of H_3PO_2 is 49.5
   d) NaH_2PO_2 is an acid salt

Assertion - Reasoning Type

This section contain(s) 0 questions numbered 486 to 485. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

a) Statement 1 is True, Statement 2 is True; Statement 2 **is** correct explanation for Statement 1

b) Statement 1 is True, Statement 2 is True; Statement 2 **is not** correct explanation for Statement 1

c) Statement 1 is True, Statement 2 is False

d) Statement 1 is False, Statement 2 is True

486

Statement 1: Gold occurs in native state

Statement 2: Gold dissolves in aqua-regia

487

Statement 1: The reduction of a metal oxide is easier if the metal formed is in liquid state at the temperature of reduction

Statement 2: The value of entropy change of the reduction process is more on positive side when the metal formed is in liquid state

488

Statement 1: Forth-floatation process is used to Concentrate sulphide ores

Statement 2: There is no difference in the wettability of different minerals

489

Statement 1: In the Hoop's process of purification of aluminium, the fused materials remains in three different layers. These layers remain intact even in electrolytic reduction

Statement 2: All the layers have different densities

490

Statement 1: Alkaline earth metals are not easy to produce by chemical reduction

Statement 2: Their aqueous solutions can not be used for displacing one metal by another

This section contain(s) 0 question(s). Each question contains Statements given in 2 columns which have to be matched. Statements (A, B, C, D) in **columns I** have to be matched with Statements (p, q, r, s) in **columns II**.

491. Match the method in Column I with related reaction in Column II

	Column-I		Column- II
(A)	Mond's process	(1)	$Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr$
(B)	Van-Arkel-de-Boer process	(2)	$TiCl_4 + Mg \xrightarrow{1000-1150°C} Ti + 2MgCl_2$
(C)	Thermite process	(3)	$Ni(CO)_4 \xrightarrow{230°C} Ni + 4CO$
(D)	Kroll process	(4)	$2CuO + CuS \rightarrow 3Cu + SO_2$
(E)	Self reduction	(5)	$ZrI_4 \xrightarrow{\Delta} Zr + 2I_2$

CODES :

	A	B	C	D	E
a)	1	2	3	4	5
b)	3	5	1	2	5
c)	4	1	2	3	5
d)	2	4	5	1	5

492. Match the extraction process in Column I with metals in Column II

	Column-I		Column- II
(A)	Self reduction	(1)	Zirconium
(B)	Carbon reduction	(2)	Silver
(C)	Complex formation and displacement by metal	(3)	Copper
(D)	Decomposition of iodide	(4)	Boron

CODES :

	A	B	C	D
a)	4	2	1	3
b)	2	1	3	4
c)	1	3	4	2
d)	3	4	2	1

493. Match the compounds (in Column I) with their applications/colours (in Column II)

	Column-I		Column- II

	(A)	Pb_3O_4		(1)	White lead

(A) Pb_3O_4 (1) White lead

(B) $(PbCO_3)_2, Pb(OH)_2$ (2) Rust proofing sheets

(C) Ca_2PbO_4 (3) Road signs and markings

(D) $PbCrO_4$ (4) Red lead

CODES :

	A	B	C	D
a)	4	1	2	3
b)	2	3	4	1
c)	3	2	1	4
d)	1	4	3	2

494. Match the reactions taking place in blast furnace (in Column I) with temperature-range of operations (in Column II)

               Column-I   Column- II

(A) $Fe_2O_3 + CO \rightarrow CO_2 + Fe$ (1) 1200°C

(B) $C + CO_2 \rightarrow CO$ (2) 900°C

(C) $C + H_2O \rightarrow CO + H_2$ (3) 600°C

(D) $CaO + SiO_2 \rightarrow CaSiO_3$ (4) 1100°C

CODES :

	A	B	C	D
a)	3	2	1	4
b)	2	4	3	1
c)	1	3	4	2
d)	4	1	2	3

495. Match the different compounds of Mn (in Column I) with oxidation number (in Column II)

               Column-I   Column- II

(A) MnO_3HSO_4 (1) +4

(B) K_2MnO_4 (2) +7

(C) MnO_2 (3) +6

(D) Mn_2O_3 (4) +2

(E) $Mn(HCO_3)_2$ (5) +3

CODES :

	A	B	C	D	E
a)	2	3	1	5	4
b)	2	1	3	5	4
c)	3	2	4	5	4
d)	1	4	2	3	4

496. Match the compounds (in Column I) with the matter (in Column II).

Column-I	Column- II
(A) $H_2S_2O_8$	(1) Peroxy linkage
(B) CrO_5	(2) Oxidation number of the underlined atom 8
(C) H_2SO_5	(3) H_2O_2 is the hydrolysis product
(D) K_2CrO_4	(4) Caro's acid
(E) $(NH_3)_3CrO_4$	(5) Marshall's acid

CODES :

	A	B	C	D
a)	1,2,3,5	1,2	2	1
b)	2	1	1,2,3,5	1,2
c)	1,2,3,5	1,2	1,2,3	1
d)	1,2	1,2,3	1,2,3,5	1

497.

Column-I	Column- II
(A) $Cl^- \rightarrow ClO_4^-$	(1) 2
(B) $Cr^{3+} \rightarrow CrO_5$	(2) 8
(C) $H_2O_2 \rightarrow O_2$	(3) 0
(D) $CrO_2^{2+} \rightarrow CrO_4^{2-}$	(4) 3

CODES :

	A	B	C	D
a)	1	2	3	4
b)	2	4	1	3
c)	3	4	1	2
d)	2	1	3	4

498. Match List I with List II and select the correct answer using the codes given below the list

	Column-I		Column- II
(A)	Ti	(p)	Bauxite
(B)	Si	(q)	Cerussite
(C)	Al	(r)	van-Arkel method
(D)	Pb	(s)	Zone refining

CODES :

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

499. Match ores in Column I with metals in Column II

	Column-I		Column- II
(A)	Carnallite	(1)	Zinc
(B)	Calamine	(2)	Titanium
(C)	Ilmenit	(3)	Magnesium
(D)	Chalcopyrite	(4)	Copper

CODES :

	A	B	C	D
a)	3	1	2	4
b)	1	2	4	3
c)	2	3	1	4
d)	4	1	3	2

500. Match process (in Column I) with electrolytes (in Column II)

	Column-I		Column- II
(A)	Downs cell	(1)	Fused $MgCl_2$
(B)	Dow sea-water process	(2)	Fused $(Al_2O_3 + Na_2AlF_6)$
(C)	Hall-Heroult	(3)	Fused KHF_2
(D)	Moissan	(4)	Fused $(40\% \ NaCl + 60\% \ CaCl_2)$

CODES :

	A	B	C	D
a)	2	3	1	4
b)	1	2	3	4
c)	4	1	2	3
d)	3	2	4	1

<div align="center">

Linked Comprehension Type

</div>

This section contain(s) 18 paragraph(s) and based upon each paragraph, multiple choice questions have to be answered. Each question has atleast 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 501 to -501

Metallurgy is the process of extraction of metals form the substances in which these are found in nature. It involves a series of process like ore dressing, conversion of concentrated ore to oxide, reduction and refining of metal

In one of the refining processes, the molten impure metal is stirred with green logs of wood. These wood release some gases by which the impurities are reduced and thus, removed

501. The metal which is purified by the method discussed above is
   a) Sodium   b) Copper   c) Iron   d) Manganese

Paragraph for Question Nos. 502 to - 502

Metallic gold is frequency 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 reaching the gold complex with zinc, which is converted to $[Zn(CN)_4]^{2-}$. Gold in nature is frequency alloyed with silver which is also oxidized by aerated sodium cyanide solution

502. The precipitating agent used in the hydrometallurgy of silver and gold is
   a) Mercury   b) Magnesium   c) Aluminium   d) Zinc

Paragraph for Question Nos. 503 to - 503

Following passage describes extraction of zinc from zinc sulphide. Answer the questions at the end of it
The chief ore of zinc is the sulphide, ZnS. The ore is concentrated by floatation process and then heated in air, which convert the ZnS to ZnO

$$2ZnS + 3O_2 \xrightarrow{90.6\%} 2ZnO + 2SO_2 \quad ...(i)$$
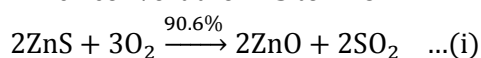
The ZnO is then treated with dilute H_2SO_4

$$ZnO + H_2SO_4 \xrightarrow{100\%} ZnSO_4 + H_2O \quad ...(ii)$$
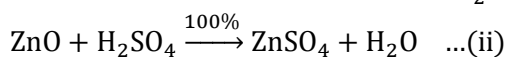
To produce $ZnSO_4$(aq.) which produces Zn metal on electrolysis

$$2ZnSO_4 + 2H_2O \xrightarrow{98.2\%} 2Zn + 2H_2SO_4 + O_2 \quad ...(iii)$$
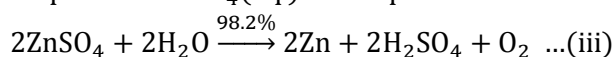
503. What mass of Zn will be obtained from an ore containing 225 kg of ZnS? Efficiencies of the process have been indicated above the arrow mark. $(Zn = 65, S = 32, O = 16, H = 1)$

a) 134 kg　　　　　b) 112 kg　　　　　c) 102 kg　　　　　d) 130 kg

Paragraph for Question Nos. 504 to - 504

Questions given below are based on the following sequence of reactions

At high temperature carbon reacts with water to produce a mixture of carbon monoxide, CO and hydrogen, H_2

$C + H_2O \xrightarrow{\text{red heat}} CO + H_2$
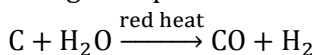
CO is separated from H_2 and then used to separate nickel from cobalt by forming a volatile compound, nickel tetracarbonyl, $Ni(CO_4)$

$Ni + 4CO \rightarrow Ni(CO)_4$
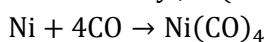
504. How many moles of $Ni(CO)_4$ could be obtained from the CO produced by the reaction of 75.0 g of carbon? Assume 100% reaction and 100% recovery in both steps

a) 6.25　　　　　b) 1.563　　　　　c) 3.125　　　　　d) 25.0

Paragraph for Question Nos. 505 to - 505

$FeCr_2O_4$ (chromite) is a good source of chromium and its compounds like $Na_2CrO_4, Na_2Cr_2O_7$

Questions are based on the following reactions

$P: FeCr_2O_4 + NaOH + air \rightarrow A + Fe_2O_3$

$Q: A + B \rightarrow Na_2Cr_2O_7$

$R: Na_2Cr_2O_7 + X \xrightarrow{\Delta} Cr_2O_3$

$S: Cr_2O_3 + Y \rightarrow Cr$
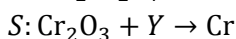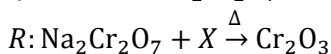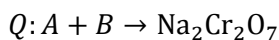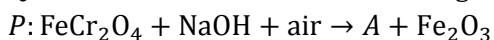
505. Compound (A) and (B) are

a) Na_2CrO_4, H_2SO_4　　　b) $Na_2Cr_2O_7, HCl$　　　c) Na_2CrO_5, H_2SO_4　　　d) $Na_4[Fe(OH)_6], H_2SO_4$

Paragraph for Question Nos. 506 to - 507

Copper is the most noble 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 partia roasting, removal of iron and self-reduction

506. Partial roasting of chalcopyrite produces

a) Cu_2S and FeO　　　b) Cu_2O and FeO　　　c) CuS and Fe_2O_3　　　d) Cu_2O and Fe_2O_3

Paragraph for Question Nos. 507 to - 508

Read the following cyclic process of recovery of copper from a copper wire and answer the questions at the end of it

The following "cycle of copper" experiment is performed in some general chemistry laboratories. The series of

reactions starts with copper and ends with metallic copper. The steps are as follows: (1) A piece of copper wire of known mass is allowed to react with concentrated nitric acid [the products are copper (II) nitrate, nitrogen dioxide, and water]. (2) The copper (II) nitrate is treated with a sodium hydroxide solution to form copper (II) hydroxide precipitate. (3) On heating copper (II) hydroxide decomposes to yield copper (II) oxide. (4) The copper (II) oxide is reacted with concentrated sulphuric acid to yield copper (II) sulphate. (5) Copper (II) sulphate is treated with an excess of zinc metal to form metallic copper. (6) The remaining zinc metal is removed by treatment with hydrochloric acid and metallic copper is filtered, dried, and weighted

507. Assuming that a student started with 65.6 g of copper, calculate the theoretical yield of copper sulphate
    a) 165 g   b) 82.4 g   c) 90 g   d) 100.2 g

Paragraph for Question Nos. 508 to - 509

Questions given below are based on the given diagram for extractive metallurgy
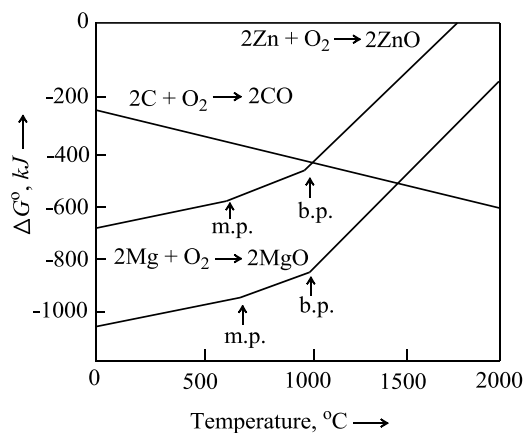
The points noted by arrows are the melting and boiling points of the metals zinc and magnesium. $\Delta G°$ as a function of temperature for some reactions of extractive metallurgy

508. At what approximate temperature, zinc and carbon have equal affinity for oxygen?
    a) 1000°C   b) 1500°C   c) 500°C   d) 1200°C

Paragraph for Question Nos. 509 to - 510

The Ellingham diagram for a number of metallic sulphides is reproduced below
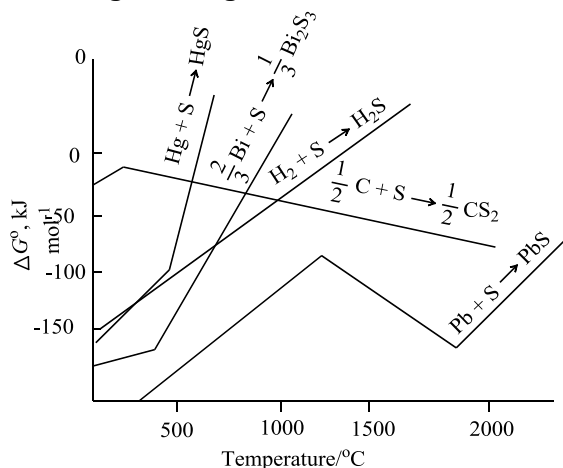
Answer the questions given

509. Formation of which of the sulphides is most spontaneous?

   a) HgS   b) Bi_2S_3 c) PbS   d) CS_2

Paragraph for Question Nos. 510 to - 511

From the following flow-sheet for the extraction of pure metal, answer the questions at the end of it

Sulphide → A → Oxide → B → Impure metal → C → Pure metal
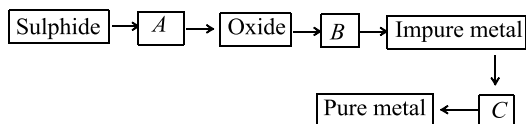
510. Step A is

   a) Roasting   b) Smelting   c) Calcination   d) Bessemerisation

Paragraph for Question Nos. 511 to - 512

Given flow-sheet is for the extraction of copper. Based on this, answer the questions given at the end

$CuFeS_2$ → froth Floatation → Roasting → SO_2 → $Cu_2S + FeO$ → Smelting (with SiO_2 → $FeSiO_3$) → Matte → Bessemerisation → Blister Cu → Electrolysis → Pure Cu
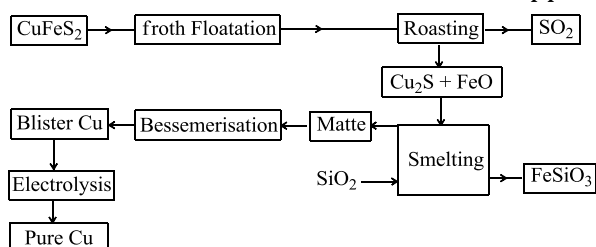
511. Froth-floatation process can be made more effective by

   a) Use of pine oil which produces stable froth
   b) Use of sodium ethyl xanthate as a collector that coats the particles of ore
   c) Both (a) and (b)
   d) None of the above

Paragraph for Question Nos. 512 to - 513

Following few lines are based on the household bleach. Answer the questions at the end of it
Aqueous solution of sodium hypochlorite (NaOCl) is a household bleach and is a strong oxidizing agent that reacts with chromite ion $[Cr(OH)_4^-]$ in basic solution to yield chromate (CrO_4^{2-}) and chloride ion

512. Select the correct statements(s)

   a) OCl^- has been oxidized and $Cr(OH)_4^-$ has been reduced
   b) OCl^- has been reduced and $Cr(OH)_4^-$ has been oxidized
   c) It is simply a neutralization reaction
   d) It is simply a displacement reaction

Paragraph for Question Nos. 513 to - 514

Following experiment is given to determine the oxidation state of vanadium and different stages
When ammonium vanadate is heated with oxalic acid solution, a compound Z is formed. A sample of Z was titrated with $KMnO_4$ solution is hot acidic solution. The resulting liquid was reduced with SO_2, the excess

SO_2 boiled off, and the liquid again titrated with $KMnO_4$. The ratio of the volumes of $KMnO_4$ used in the two titrations was $5:1$ $KMnO_4$ oxidizes all oxidation state of vanadium to vanadium (+V) and SO_2 reduces vanadium (+V) to vanadium (+IV)

Read the above experiment and answer the following questions

513. What is the oxidation state of vanadium in the compound Z?
    a) +2   b) +1   c) 0   d) −1

Paragraph for Question Nos. 514 to - 515

Read the following experimental facts and answer the questions at the end of it
"$KMnO_4$ and $K_2Cr_2O_7$ are widely used as volumetric reagents for analytical estimation of iron, hydrogen peroxide, iodide, ozone, sulphite, nitrite, etc. Reaction is carried out in acidic medium"

514. Equivalents of MnO_4^- and $Cr_2O_7^{2-}$ per mole of the ion in acidic medium are in the ratio of
    a) $1:1$ b) $1:5$ c) $6:1$ d) $5:6$

Paragraph for Question Nos. 515 to - 515

Consider the following Redox Predominance Diagram for iron in different oxidation state

Oxidation state	Half-reaction	$E°/V$
+6	$FeO_4^{2-} + 8H^+ + 3e^- \rightleftharpoons Fe^{3+} + 4H_2O$	+2.20 V
+3	$Fe^{3+} + e^- \longrightarrow Fe^{2+}$	+0.77 V
+2	$Fe^{2+} + 2e^- \rightleftharpoons Fe$	−0.44 V

Answer the following questions

515. Select the best oxidizing and reducing agent
    a) Fe, Fe^{2+} b) FeO_4^{2-}, Fe^{3+} c) FeO_4^{2-}, Fe^{2+} d) FeO_4^{2-}, Fe

Paragraph for Question Nos. 516 to - 516

Every disproportionation reaction is a redox reaction but every redox reaction may not be disproportionation. Disproportionation reaction may be intramolecular if same species is oxidized and reduced
Based on the above statement answer the following questions

516. A : $2C_6H_5CHO + KOH \rightarrow C_6H_5COOK + C_6H_5CH_2OH$
    B : $3Cl_2 + 6KOH \rightarrow 5KCl + KClO_3 + 3H_2O$
    Select the correct statement
    a) Bothe are correct statement
    b) Both are disproportionation reactions
    c) A is a disproportionation and B is a redox reaction
    d) A is a redox reaction, B is a disproportionation reaction

517. What is the oxidation number of Cr in $(NH_3)_3Cr(O_2)_2$?

518. Al_2O_3 is converted to AlN on heating with carbon in the atmosphere of N_2. How much carbon is required to convert 23 g of Al_2O_3 into AlN?

519. Which of the following behave as oxidizing agent as well as reducing agent? $HNO_2, H_3PO_2, H_2O_2, N_2H_4, HNO_3, MnO_2$

520. Total number of atoms in one unit of chalcopyrites are......

521. $Al(OH)_3$ is soluble in alkaline solution of pH 8.3010. Thus, $[NaOH] = y \times 10^{-6}$ what is the value of y?

522. $S_2O_3^{2-}$ has two types of sulphur. What is the difference in oxidation states of two types of sulphur?

523. In oxysalt of Mn, equivalent mass is one-fifth of ionic mass of oxysalt. What is the oxidation number of Mn in oxysalt?

524. For the following reaction, $N_2 + 3H_2 \rightarrow 2NH_3$ equivalent mass of $N_2 = \frac{\text{molar mass of } N_2}{x}$ what is the value of x?

525. One unit formula of azurite contains..... copper atoms

526. In the following reaction slag $CaSiO_3$ is formed
$Ca_3(PO_4)_2 + C + SiO_2 \rightarrow P_4 + CaSiO_3 + CO$
If one mole of P_4 is formed, then $CaSiO_3$ formed is..... moles

527. The difference in the oxidation numbers of the two types of sulphur atoms in $Na_2S_4O_6$ is

528. Difference in oxidation number of two Cl atoms in bleaching powder is x. What is the value of x?

529. How many moles of $KMnO_4$ are required to oxidize 10 moles of iron (II) sulphate (IV) in acidic medium?

530. What is the maximum oxidation state of nitrogen in its compounds?

531. How many of the following underlined atoms have oxidation number of $(+6)$?
$H_2S_2O_3, H_2SO_5, H_2S_2O_8, H_2S_2O_7, H_2Cr_2O_7, K_2MnO_4, CrO_3, CrO_5$

532. Among the following, the number of elements showing only one non-zero oxidation state is O, Cl, F, N, P, Sn, Tl, Na, Ti.

533. How many of the following underlined atoms have different oxidation number?
$H_2S_2O_3, H_2S_4O_6, CaOCl_2, CrO_5, CrO_3, [Fe_2(CN)_6]^-, CrO_2Cl_2$

534. One unit of corundum has.......oxygen atoms

535. 2.68×10^{-3} moles of A^{n+} is oxidised to AO_3^- by 1.61×10^{-3} moles of MnO_4^- which is reduced to Mn^{2+} in acidic medium. What is the value of x?

536. Mineral $CuFeS_2$ is 50% pure

537. In the following half-reaction $Cr_2O_7^{2-} \rightarrow Cr^{3+}$ molar mass of $Cr_2O_7^{2-} = x \times$ equivalent mass. What is the value of x?

538. When one mole of Ag_2CO_3 is strongly heated, residue is.....mole(s)

539. In the ring test of NO_3^-, following complex appears as ring $[Fe(H_2O)_5NO]^{2+}$.
What is the oxidation state of Fe?

540. E_{red}° values are

	E°
$Ag^+ + e^- \rightarrow Ag$	+0.80 V
$Zn^{2+} + 2e^- \rightarrow Zn$	−0.76 V
$Fe^{2+} + 2e^- \rightarrow Fe$	−0.44 V
$Cu^{2+} + 2e^- \rightarrow Cu$	+0.34 V
$Hg^{2+} + 2e^- \rightarrow Hg$	+0.79 V
$Mg^{2+} + 2e^- \rightarrow Mg$	−2.37 V
$Al^{3+} + 3e^- \rightarrow Al$	−1.66 V

How many of the metals can displace Cu from $CuSO_4$ solution?

541. Epsomite is $MgSO_4 \cdot xH_2O$, where $y =$......

542. Phosphate rock is represented as $Pb_{10}(PO_4)_xCl_2$ what is the value of x?

543. How many of the following ores can be enriched by FFP?

Dolomite, cerussite, argentite, pyrites, anhydrite, cinnabar, chalcopyrite, galena, greenockite, chalcocite

544. How many of the following species have more than one oxidation state (except zero)?
$Cu, Zn, Cr, Mn, Cl, O, P, Sn, Al, Tl$

545. If reduction of Cu^{2+} by Al is possible then E°_{cell} will be ...... volt
$$3Cu^{2+} + 2Al \rightarrow 2Al^{3+} + 3Cu$$

546. Bauxite is $Al_2O_3 \cdot xH_2O$, where $x =$.....

547. How many peroxy linkages are present in CrO_5?

548. Gold is found to be 37.5% pure. What is its grading in terms of carrat?

549. What is the basicity of oxyacid of phosphorus with oxidation number +5?

550. In the electrolysis of $AgNO_3$ solution, 97.2 g of Ag is deposited on passing current for 9650 s. What is the value of current in amperes?

: ANSWER KEY :

1)	c	2)	b	3)	b	4)	b	189)	d	190)	b	191)	c	192)	b
5)	b	6)	c	7)	d	8)	d	193)	a	194)	b	195)	a	196)	a
9)	a	10)	d	11)	a	12)	c	197)	d	198)	c	199)	a	200)	c
13)	c	14)	d	15)	a	16)	c	201)	b	202)	b	203)	c	204)	a
17)	b	18)	d	19)	a	20)	a	205)	b	206)	d	207)	c	208)	c
21)	b	22)	a	23)	b	24)	d	209)	d	210)	a	211)	d	212)	d
25)	c	26)	c	27)	b	28)	a	213)	c	214)	b	215)	a	216)	b
29)	c	30)	b	31)	b	32)	c	217)	a	218)	a	219)	a	220)	c
33)	c	34)	b	35)	b	36)	b	221)	c	222)	a	223)	c	224)	c
37)	d	38)	a	39)	d	40)	d	225)	c	226)	a	227)	c	228)	d
41)	b	42)	d	43)	b	44)	c	229)	a	230)	b	231)	c	232)	b
45)	d	46)	b	47)	c	48)	c	233)	c	234)	b	235)	c	236)	d
49)	c	50)	c	51)	d	52)	b	237)	b	238)	c	239)	c	240)	b
53)	c	54)	c	55)	d	56)	b	241)	d	242)	b	243)	a	244)	d
57)	c	58)	d	59)	a	60)	a	245)	d	246)	b	247)	d	248)	b
61)	d	62)	d	63)	a	64)	d	249)	c	250)	a	251)	c	252)	d
65)	c	66)	d	67)	c	68)	a	253)	b	254)	a	255)	a	256)	d
69)	c	70)	c	71)	c	72)	c	257)	a	258)	a	259)	c	260)	a
73)	d	74)	b	75)	a	76)	d	261)	a	262)	c	263)	a	264)	c
77)	a	78)	b	79)	d	80)	b	265)	d	266)	d	267)	b	268)	c
81)	a	82)	b	83)	a	84)	b	269)	b	270)	d	271)	d	272)	b
85)	c	86)	b	87)	a	88)	c	273)	d	274)	a	275)	a	276)	a
89)	c	90)	b	91)	a	92)	d	277)	c	278)	c	279)	d	280)	b
93)	c	94)	c	95)	c	96)	a	281)	b	282)	c	283)	b	284)	a
97)	c	98)	a	99)	d	100)	c	285)	c	286)	b	287)	b	288)	a
101)	d	102)	b	103)	a	104)	d	289)	c	290)	b	291)	b	292)	a
105)	b	106)	c	107)	b	108)	a	293)	b	294)	a	295)	b	296)	c
109)	b	110)	c	111)	d	112)	a	297)	c	298)	a	299)	a	300)	d
113)	b	114)	a	115)	b	116)	b	301)	c	302)	c	303)	a	304)	a
117)	b	118)	b	119)	c	120)	d	305)	a	306)	d	307)	b	308)	a
121)	d	122)	c	123)	a	124)	b	309)	a	310)	a	311)	a	312)	c
125)	d	126)	c	127)	c	128)	c	313)	b	314)	b	315)	d	316)	c
129)	c	130)	b	131)	c	132)	d	317)	c	318)	b	319)	b	320)	b
133)	d	134)	d	135)	b	136)	a	321)	b	322)	b	323)	c	324)	c
137)	c	138)	b	139)	d	140)	b	325)	b	326)	d	327)	b	328)	d
141)	d	142)	c	143)	d	144)	a	329)	c	330)	c	331)	d	332)	b
145)	b	146)	b	147)	c	148)	b	333)	b	334)	a	335)	c	336)	c
149)	a	150)	d	151)	d	152)	b	337)	d	338)	a	339)	d	340)	b
153)	b	154)	d	155)	c	156)	a	341)	b	342)	c	343)	a	344)	b
157)	b	158)	a	159)	c	160)	b	345)	b	346)	b	347)	d	348)	c
161)	b	162)	d	163)	b	164)	c	349)	b	350)	a	351)	b	352)	a
165)	d	166)	d	167)	c	168)	b	353)	c	354)	a	355)	a	356)	b
169)	a	170)	c	171)	a	172)	a	357)	b	358)	d	359)	b	360)	d
173)	a	174)	c	175)	a	176)	b	361)	b	362)	b	363)	a	364)	b
177)	d	178)	c	179)	c	180)	c	365)	b	366)	c	367)	a	368)	c
181)	c	182)	c	183)	d	184)	b	369)	c	370)	d	371)	d	372)	c
185)	c	186)	d	187)	b	188)	d	373)	c	374)	c	375)	b	376)	a

377) b	378) d	379) c	380) a	33) 3		34) 9	
381) c	382) d	383) c	384) b				
385) a	386) c	387) c	388) c				
389) d	390) d	391) b	392) a				
393) a	394) a	395) d	396) a				
397) b	398) c	399) d	400) d				
401) a	402) d	403) b	404) c				
405) d	406) a	407) b	408) a				
409) d	410) d	411) d	412) b				
413) c	414) c	415) c	416) b				
417) c	418) d	419) d	420) c				
421) b	422) a	423) b	424) c				
425) a	426) d	427) a	428) d				
429) b	430) c	431) b	432) b				
433) b	434) a	435) b	436) a				
437) c	438) a	439) a	440) c				
441) d	442) c	443) d	444) c				
445) c	446) c	447) d	448) a				
449) a	450) d	1) a,c	2) a,c,d				
	3) b,c	4) d					
5) c,d	6) a,b,d	7) a,c,d	8) a,d				
9) a,d	10) b	11) a,b,c	12) c,d				
13) c	14) a,b,c	15) a,b,c,d	16) b, c				
17) c	18) c	19) a,b,c	20) a,b				
21) a,c,d	22) a,b,d	23) a, b	24) a				
25) b,d	26) b,c,d	27) a,b,c,d	28) a,b,c,d				
29) a,b,c,d	30) d	31) a,b	32) a,b				
33) a, c	34) c	35) a,c	1) b				
2) a	3) b	4) a					
5) b	1) b	2) d	3) a				
4) b							
5) a	6) c	7) b	8) d				
9) a	10) c	1) b	2) d				
3) a	4) b						
5) a	6) b	7) a	8) a				
9) c	10) a	11) c	12) b				
13) c	14) d	15) d	16) a				
1) 4	2) 9	3) 4	4) 4				
5) 2	6) 8	7) 7	8) 6				
9) 3	10) 6	11) 5	12) 2				
13) 6	14) 5	15) 7	16) 2				
17) 5	18) 3	19) 2	20) 1				
21) 6	22) 2	23) 1	24) 4				
25) 7	26) 6	27) 7	28) 8				
29) 2	30) 2	31) 2	32) 9				

: HINTS AND SOLUTIONS :

1 **(c)**
The fact that impurities are more soluble in the molten state than in the solid state of the metal is used in zone refining. Zone refining is also called fractional crystallization

2 **(b)**
Oxides of the metal are converted into metal if they are above Hg in activity series
Cu, Hg, Ag
$Ag_2O \xrightarrow{\Delta} Ag$
$HgO \xrightarrow{\Delta} Hg$
$CuO \xrightarrow{\Delta} No\ effect$

5 **(b)**
H_3PO_4 (1 equivalent) $\equiv$ 1 equivalent NaOH

$\equiv$ 1 equivalent $Ca(OH)_2$

$\equiv$ 1 equivalnet $Al(OH)_3$

In terms of moles

1 equivalent NaOH $\equiv$ 1 mol NaOH

1 equivalent $Ca(OH)_2$ = 0.5 mol $Ca(OH)_2$

1 equivalent $Al(OH)_3 \equiv \frac{1}{3}$ mol $Al(OH)_3$

Thus, molar ratio is $1 : \frac{1}{2} : \frac{1}{3}$

10 **(d)**
$Na_2CO_3 + H_2O \rightarrow 2NaOH + H_2CO_3$

$H_2CO_3 \rightarrow H_2O + CO_2$

$6NaOH + Br_2 \rightarrow 5NaBr + NaBrO_3 + 3H_2O$

By reduction by oxidation

11 **(a)**
Liquation process is the refining method used to obtain pure tin metal. The pure tin metal obtained by this method is called pig tin

13 **(c)**
After bessemerisation of the concentrated ore, Cu obtained is 98% pure, it is called blister Cu

15 **(a)**
I. CaF_2 (fluorspar) and Na_3AlF_6 (cryolite) reduce melting point of the mixture CaF_2 improves electrical conductivity of the melting as compared

to molten Al_2O_3
II. Aqueous solution of Al^{3+} cannot be taken since H_2 gas is formed in preference to Al
III. Molten $AlCl_3$ being covalent is poor conductor. It sublimes at melting point. Hence, cannot be taken
IV. Hall's process is adopted for the extraction of Al from bauxite
Thus, III incorrect

16 **(c)**
$3Fe + C \rightarrow Fe_3C(s)$
　　　　Cementite

19 **(a)**
$Fe_2(C_2O_4)_3 \rightleftharpoons 2Fe^{3+} + C_2O_4^{2-}$

MnO_4^- is reduced to $Mn^{2+}C_2O_4^{2-}$ is oxidized to CO_2

Fe^{3+} is not affected, hence does not appear in net ionic reaction

20 **(a)**
During smelting of roasted copper pyrites, ferrous oxide is produced which combines with silica (flux) to form fusible slag
$FeO\ +\ SiO_2\ \rightarrow\ FeSiO_3$
Ferrous Silica　　Ferrous silicate
Oxide　(Flux)　(Fusible slag)
The molten material obtained after roasting and smelting of copper ore from the blast furnace consists of sulphides of Cu^+, Fe^{+2}, coke and sand which is called matte

22 **(a)**
When oil, water and air are mixed up, they produce froth. Hence, pine oil is used as foaming agent

23 **(b)**
Pyrolusite $-$ MnO_2
Malachite $-$ $CuCO_3.Cu(OH)_2$
Diaspore $-$ $Al_2O_3.H_2O$
Cassiterite $-$ SnO_2
Hence, malachite is the only carbonate ore in the given options

24 **(d)**

Combustion zone	2000 K
Fusion zone	1500 K
Slag zone	1500 K
Reduction zone	900 K

26 **(c)**

$$FeO \cdot CrO_3 + C \rightarrow \underbrace{Fe + Cr}_{\text{terrochrome}} + CO$$

27 (b)

$$2Cr(OH)_3 + 3H_2O_2 + 4OH^- \rightarrow 2CrO_4^{2-} + 8H_2O$$

$$\quad\uparrow \qquad\quad \uparrow \qquad\qquad \uparrow \qquad \uparrow$$

$$(+3) \qquad\quad (-1) \qquad\qquad +6 \qquad (-2)$$

(green ppt)   (yellow)

I: True

II: True
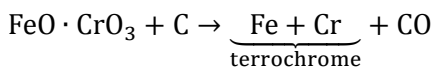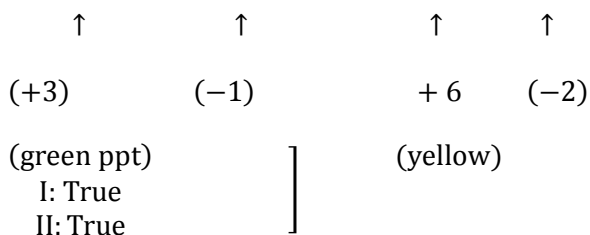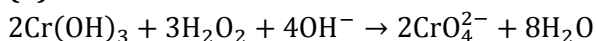
III. False as O.N. of O in H_2O_2 changes from (-1) to (-2)

28 (a)

Strongest acid is that which has maximum value of O.N. of the central atom

$HBrO_4$ O.N. of Br $= +7$

$HOCl$ O.N. of Cl $= +1$

HNO_2 O.N. of N $= +3$

H_3PO_3 O.N. of P $= +3$
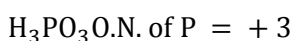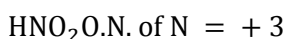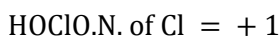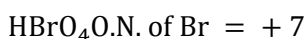
33 (c)

The various steps involved in the extraction of pure metals from their ores are as follows:
i. Concentration of an ore/ore benefaction/ore dressing
ii. Extraction of crude metal from concentrated ore (either by conversion of ores into oxides or other desired compounds or by reduction of ores)
iii. Purification or refining of the metal

36 (b)

NH_3 is oxidized to N_2 by O_2. Thus, O_2 is the oxidizing agent

In (a), (c) and (d), oxygen is a reducing agent

37 (d)

In order to separate two sulphide ores by froth floatation process, proportion of oil to water is adjusted or certain depressant like NaCN is added

41 (b)

$$Al_2O_3 + 2OH^- + 3H_2O \rightarrow 2[Al(OH)_4]^-$$
$$\text{Soluble}$$
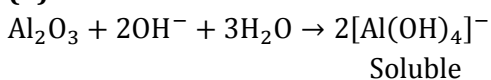
(a) and (c) are sulphides ores and concentrated by froth-floatation process
(d) is concentrated by magnetic separator

44 (c)

$$Al_2O_3 + C \xrightarrow[\Delta]{Cl_2} AlCl_3 + CO \uparrow$$

45 (d)

(d) $H_2O_2 + Mn O_2 \longrightarrow Mn O_4^- + 2H_2O$

$$-2 \qquad +4 \qquad\qquad +7 \qquad\qquad -4$$

$-3e^-$

$+2e^-$

(ox. no. of two O atoms taken)

Balancing of O.N.

$$3H_2O_2 + 2MnO_2 \rightarrow MnO_4^- + 6H_2O$$

Thus, $H_2O_2 : MnO_2 = 3 : 2$

46 (b)

(b) $Mn^{3+} + Mn^{3+} \longrightarrow Mn^{2+} + Mn O_2$

$$+3 \qquad +3 \qquad\qquad +2 \qquad +4$$

red

oxid
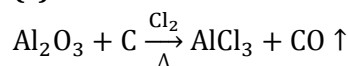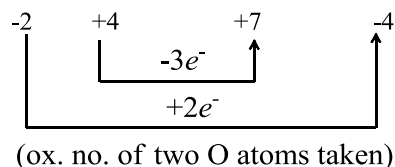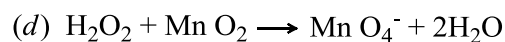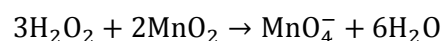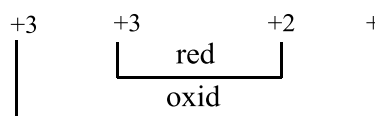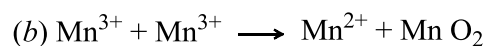
Mn^{3+} disproportionates to Mn^{2+} and $Mn O_2$

Thus, equivalent mass of $Mn^{3+} = \frac{2 \text{ units of } Mn^{3+}}{2}$

$$= \frac{M}{1} = 55$$

48 (c)

(a) SO_2 is formed during roasting and autoreduction
$$SO_2 \rightarrow SO_3 \xrightarrow{H_2O} H_2SO_4$$
Thus, correct
(b) Gold, silver and platinum are recovered from anode mud of electrolytic refining thus, correct
(c) $FeSO_4$ is never formed thus is not the by-product
(d) $FeSO_4$ (slag) is also formed
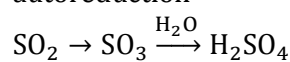
51 (d)

$$KCl \rightarrow KClO_4$$

$$\quad\uparrow \qquad \uparrow$$

$$-1 \qquad +7$$
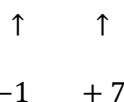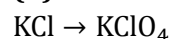
Change $= 7 - (-1) = 8$

52 (b)

Wrought iron contains least percentage of carbon $< 0.2\%$ and is the purest form of iron

53 (c)

Zone refining is employed for preparing extremely pure metals especially metalloids for the preparation of semiconductors. Gallium arsenide is a semiconductor and hence zone refining is used for its purification

54 **(c)**

$$Fe^{2+} + e^- \to Fe^+$$

$$NO \to NO^+ + e^-$$
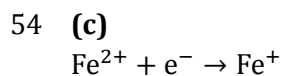
Based on magnetic properties of the complex, it is found that iron has three unpaired electrons thus it is as Fe^+ formed by reduction of Fe^{2+} by NO which is oxidized to NO^+

55 **(d)**

(a) Oxidation of   Reduction of

N from   Cr from

-3 (in NH_4^+) $+6$ (in $Cr_2O_7^{2-}$)

To 0 (in N_2)   to $+3$ (in Cr_2O_3)

(b) N from   N from

-3 (in NH_4^+) $+5$ (in NO_3^-)

To $+1$ (in N_2O)   to $+1$ (in N_2O)

(c) O from   Cl from

-2 (in ClO_3^-) $+5$ (in ClO_3^-)

To 0 (in O_2)   to -1 (in Cl^-)
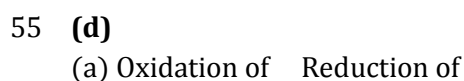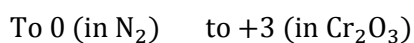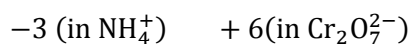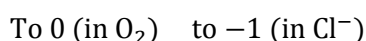
All redox reactions occur within molecule hence all are intramolecular redox reactions

56 **(b)**
Noble metals like gold, platinum, etc., being unreactive, are found in free state

57 **(c)**
$$Fe_2O_3 + 2Al \to 2Fe + Al_2O_3$$

58 **(d)**
$$Al_2O_3 \to Al$$
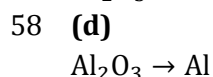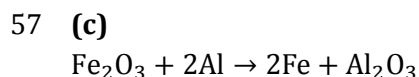
59 **(a)**
Magnetite is Fe_3O_4

60 **(a)**
From Ellingham diagram, it can be deduced that any metal can reduce the oxide of other metal which appears above it in the diagram

62 **(d)**
Purification of aluminium done by electrolytic refining is known as Hoop's process. Serpeck's

process, Hall's process and Baeyer's process are the processes used for leaching of alumina from bauxite

66 **(d)**
It is called silver-mirror test for reducing sugar

$$C_5H_{11}O_5CHO \to C_5H_{11}O_5 \cdot COOH$$
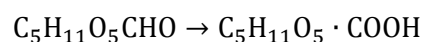
   Glucose   gluconic acid

$$Ag^+ \to Ag$$
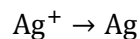
Silver mirror

Thus, (a), (b), (c) true

68 **(a)**
$$Cl_2 + OH^- \to Cl^- + ClO^-$$

$$\frac{1}{2}Cl_2 \to Cl^- \text{ reduction}$$

   0   -1   change $= 1$
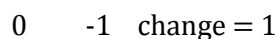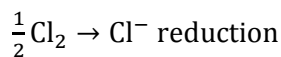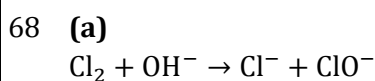
Equivalent mass of Cl_2 in reduction half-reaction

$$= \frac{1/2\ Cl_2}{1} = \frac{M}{2}$$

$$\frac{1}{2}Cl_2 \to ClO^- \text{ oxidation}$$

   0   +1   change $= 1$
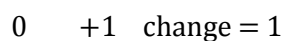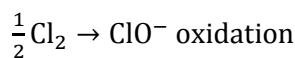
Equivalent mass of Cl_2 in oxidation half-reaction

$$= \frac{\frac{1}{2}Cl_2}{1} = \frac{M}{2}$$

Thus, equivalent mass in overall reaction $= \frac{M}{2} + \frac{M}{2} = M$

69 **(c)**
MnO_4^- oxidizes $Fe^{2+} \to Fe^{3+}$

$$H_2O_2 \to H_2O$$

$$SO_3^{2-} \to SO_4^{2-}$$
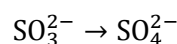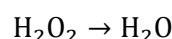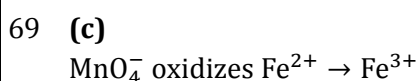
72 **(c)**
Among cuprite [Cu_2O], Copper glance [Cu_2S], chalcopyrite [$CuFeS_2$] and malachite [$Cu(OH)_2 \cdot CuCO_3$], only chalcopyrite is an ore which contains both Fe and Cu

73 **(d)**
Depending on the nature of impurities present in the ore, flux of suitable choice is used for their

removal

e.g. When acidic impurities are present basic flux is used and vice-versa

74 **(b)**
$$Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O$$

$\quad$ 1mol $\qquad$ 1 mol

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

$\quad$ 1 mol $\quad$ 2mol

Thus, 0.05 mol $Ca(OH)_2 \equiv 0.05$ mol H_2SO_4

$\equiv 0.10$ mol NaOH

78 **(b)**
$$Ni + 4CO \xrightarrow{330-350\ K} Ni(CO)_4$$
$$\qquad\qquad\qquad\text{Volatile}$$
Nickel when heated with carbon monoxide forms nickel tetra carbonyl complex which is highly volatile

79 **(d)**
$$Cu_3P \rightarrow H_3PO_4$$

$\quad\quad \uparrow \qquad\quad \uparrow$

$\quad\quad -3 \qquad\quad +5$

Change in oxidation number $= 8$ units of phosphorus

$\therefore$Equivalent weight of $H_3PO_4 = \frac{M}{8}$

80 **(b)**
$NH_4^+; x + 4 = +1$

$x = -3$

$NO_2^-; x - 4 = -1$

$x = +3$

$N_2; x = 0$

$NH_4^+ + NO_2^- \rightarrow N_2$

$\quad$ -3 $\quad\quad$ +3 $\quad\quad$ 0

$NH_4^+ + NO_2^- \longrightarrow N_2$
$\quad$ -3 $\quad\quad$ +3 $\qquad$ 0

81 **(a)**
In froth floatation, finely divided ore is used. In Wilfley's table method and magnetic separation method powdered ore is whereas in leaching process the ore is converted into soluble compound

82 **(b)**

(*b*) $Ca^{2+} \begin{cases} Cl^- \\ ClO^- \end{cases}$

$Cl^-, \qquad\qquad x = -1$

$ClO^-, ClO^-, \qquad x - 2 = -1$

$\qquad\qquad\qquad\qquad x = +1$

87 **(a)**
$$MnO_4^- + 5Fe^{2+} \xrightarrow{H^+} 5Fe^{3+} + Mn^{2+}$$

$$2MnO_4^- + 5C_2O_4^{2-} \xrightarrow{H^+} 10CO_2 + 2Mn^{2+}$$

Net : $3MnO_4^- + 5FeC_2O_4 \xrightarrow{H^+} 5Fe^{3+} + 3Mn^{2+} + 10CO_2$

Both Fe^{2+} and $C_2O_4^{2-}$ are oxidized by MnO_4^-

$5FeC_2O_4 = 3MnO_4^-$

$1FeC_2O_4 = \frac{3}{5}MnO_4^- = 0.6$ mol

89 **(c)**
$CuFeS_2$

93 **(c)**
Pyrolusite $- MnO_2$
Malachite $- CuCO_3 . Cu(OH)_2$
Diaspore $- Al_2O_3 . H_2O$
Cassiterite $- SnO_2$
Hence, malachite is the only carbonate ore in the given options

94 **(c)**
Among cuprite $[Cu_2O]$, chalcocite $[Cu_2S]$, chalcopyrite $[CuFeS_2]$ and malachite $[Cu(OH)_2 . CuCO_3]$; only chalcopyrite is an ore which contains both Fe and Cu

99 **(d)**
During the smelting of iron in blast furnace all the processes viz., oxidation (coke burns to give carbon monoxide), reduction (oxide ore is reduced to metal) and decomposition (limestone which acts as a flux, first gets decomposed to CaO and CO_2). However, it does not involve process of sublimation

100 **(c)**
Chemical separation or Leaching

In this powdered ore is treated with a suitable reagent which can dissolve the ore but not the impurities

111 (d)

	Reaction	Change in O.N.	Number of equivalent
(a)	$VO^{2+}(aq) \rightarrow V^{3+}(aq)$ ↑↑ ↑ $x-2 = +2$ $+3$ $x = +4$	1 unit	1
(b)	$NO_3^-(aq) \rightarrow NO_2(g)$ ↑ ↑ $+5$ $+4$	1 unit	1
(c)	$VO_4^{3-}(aq) \rightarrow V^{2+}(aq)$ ↑ ↑ $+5$ $+2$	3 units	3
(d)	$IO_3^-(aq) \rightarrow I_3^-(aq)$ ↑ ↑ $+5$ $-\dfrac{1}{3}$	$\dfrac{16}{3}$	$\dfrac{16}{3}$

116 (b)

$HNO_3 + 4e^- \rightarrow$ product has O.N. $= 1$

  ↑

$+5$

In N_2O oxidation number of $N = +1$. Thus, 0.5 mole of N_2O are formed by reduction of 1 mole of HNO_3 by 4 moles of electrons

118 (b)

$HNO_3 = +5$

$NO = +2$

$N_2 = 0$

$NH_4^+ = -3$

119 (c)

O_3 can be estimated iodometrically in acidic and basic medium both

I^- is oxidized to I_2

122 (c)

In NH_4NO_3, there are two different N-atoms (NH_4^+, NO_3^-) with different oxidation numbers, thus reaction is not disproportionation

123 (a)

K_3CrO_8 has $[Cr(O_2)_4]^{3-}$ with four peroxy linkage

$\therefore [Cr(O_2)_4]^{3-}$

105 (b)

$Ni -$ Mond's process; $Cu -$ Electrolysis
$Zr -$ van-Arkel process; $Ga -$ Zone refining

  ↑

$x - 8 = -3$

$x = +5$

124 (b)

$(b)\ Cu\ +\ SO_4^{2-}\ \longrightarrow\ Cu^{2+} + SO_2$
    0 $+6$ $+2$ $+4$
             oxidation
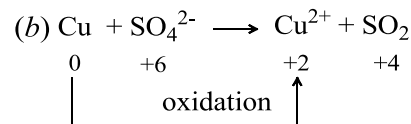
Cu is oxidized by SO_4^{2-}

125 (d)

Fe_2O_3, Fe_3O_4

126 (c)

Auto reduction: Reduction of an oxide ore of a metal by its own sulphide

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

133 (d)
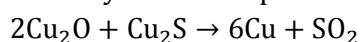
$(d)\ H_2SO_5$ (preoxy sulphuric acid)
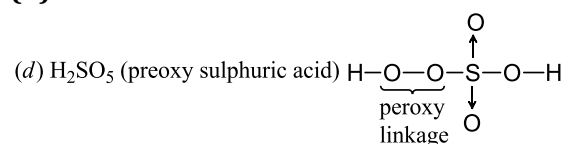
$H_2S_2O_8$ (peroxy disulphuric acid)
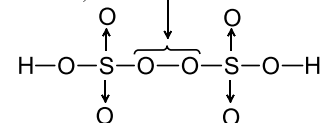
All of the above have O.N. $= 6$ in sulphur, peroxy linkage $(-O-O-)$ has -1 O.N. for oxygen, CrO_5 has two peroxy linkage, thus O.N. of $Cr = +6$
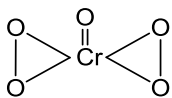
$K_2Cr_2O_7$ and CrO_4^{2-} both has +6 oxidation number forCr

135 **(b)**
CuS (black ppt) on boiling with HNO_3 results in the formation of colloidal S and blue coloured solution of $Cu(NO_3)_2$

136 **(a)**
$V_2O_5 \rightarrow V^{2+} \rightarrow VO^{2+}$

$V_2O_5 \rightarrow 2V^{2+}$

20 g

0.11 mol 0.22 mol

$V^{2+} + l_2 \rightarrow VO^{2+} + 2l^-$

+2 0 +4 -2

Thus, $V_2O_5 \equiv 2V^{2+} - 2VO^{2+} \equiv 2l_2$

0.11 mol 0.22 mol

137 **(c)**
$K[CrO](O_2)(OH)]$

↑ ↑ ↑ ↑ ↑

$+1 + x - 2 - 2 - 1 = 0$

$\therefore x = 4$

$K_3[Cr(O_2)_4]$

↑ ↑ ↑

$3 + y - 8 = 0, y = 5$

$(NH_3)_3[Cr(O_2)_2]$

 ↑   ↑ ↑

 0 $+ z$ $- 4 = 0$ thus, $z = 4$

CrO_2Cl_2

↑
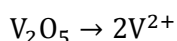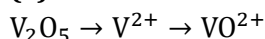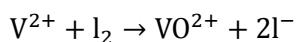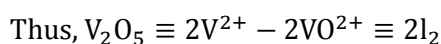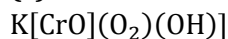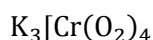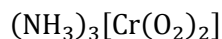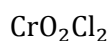
$w - 4 - 2 = 0, w = 6$

139 **(d)**
Autoreduction involves roasting and then reduction in a convertor

Sulphide ore is roasted by oxide ore and also reduction takes place

140 **(b)**
$Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O$
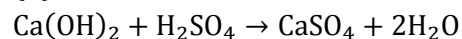
0.05 mol

Thus, 1 mol $Ca(OH)_2 \equiv 1$ mol H_2SO_4

Hence, 0.05 mol $Ca(OH)_2 \equiv 0.05$ mol H_2SO_4

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$
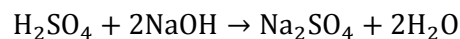
0.05   0.10 mol

143 **(d)**
(I) $Zn + 2H^+ \rightarrow H_2$ changes

      +1   0

(II) $Zn + H^+ + SO_4^{2-} \rightarrow Zn^{2+} + SO_2 + H_2O$ no change

              ↑   ↑

              +1   +1

(III) $Zn + H^+ + NO_3^- \rightarrow Zn^{2+} + NH_4^+ + H_2O$ no change

              ↑   ↑   ↑

              +1   +1   +1

Thus, in (I) only

144 **(a)**
$PbS + O_2 \xrightarrow{\Delta} PbO + PbSO_4 + SO_2$
$PbS + 2PbO \xrightarrow{\Delta} Pb + SO_2$
$SnO_2 + C \xrightarrow{\Delta} Sn + CO$

147 **(c)**
$(NH_4)_2Cr_2O_7 \rightarrow Cr_2O_3$

          ↑   ↑
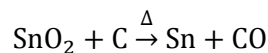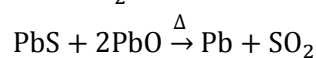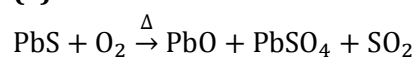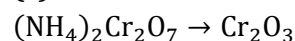
          +6   + 3

148 **(b)**
Tin (melting point: 504.8 K) and lead (melting point: 600.4 K) have lower melting point as compared to the melting point of impurities present in their respective ores. Hence, liquation process is used

153 **(b)**
$\Delta G°(net) = \Delta G_1° + \Delta G_2°$

$$-6FE_3^\circ = -FE_1^\circ - 5E_2^\circ$$

$$\therefore E_3^\circ = \frac{E_1^\circ + 5E_2^\circ}{6}$$

Except H^+ all other species $= 1$ M

$$\therefore E = E_3^\circ - \frac{0.0591}{6}\log\left(\frac{1}{H^+}\right)^8$$

$$= \frac{E_1^\circ + 5E_2^\circ}{6} - \frac{0.0591}{6} \times 8\log\left(\frac{1}{H^+}\right)$$

$$= \frac{E_1^\circ + 5E_2^\circ}{6} - 0.08\ \text{pH}$$

155 **(c)**

$[Cr(O_2)(NH_3)_4(H_2O)]Cl_2$

↓ ↓   ↓   ↓   ↓
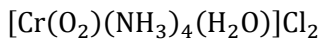
+3 + x   + 0   + 0 − 2 = 0

∴ x = −1

Thus, (O_2) exists as O_2^- (superoxide ion)

156 **(a)**

If acid is weak, its conjugate base is strong. Greater the O.N. of Cl, stronger the acid and thus weaker the conjugate base

HClO HClO$_2$ HClO$_3$ HClO$_4$
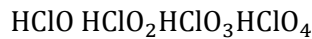
O.N. of Cl   +1   +3   +5   +7

Acid strength ——————————→

Conjugate base ClO⁻ ClO$_2^-$ ClO$_3^-$ ClO$_4^-$

Base strength ←——————————

157 **(b)**

$Ag_2S + NaCN + O_2 \rightarrow Na[Ag(CN)_2]$

158 **(a)**

$H_3PO_2 \equiv HPO_2^- + 2H^+$
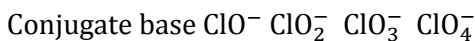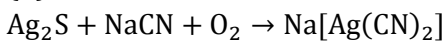
But H_3PO_2 is a monobasic acid, hence, false

(b) $H_3PO_2 \rightarrow H_3PO_3$

        ↑   ↑
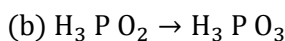
O.N. +1   +3

∴ Equivalent weight $= \frac{M}{2}$

159 **(c)**

$H_2PO_2^-, 2 + x - 4 = -1$

x = +1

161 **(b)**

$Ni + CO \rightarrow Ni(CO)_4 \xrightarrow{\Delta} Ni + CO \uparrow$
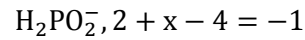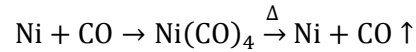
162 **(d)**

Smelting is done after concentration of the ore

164 **(c)**

$Sn^{2+} \rightarrow Sn^{4+} + 2e^-$ increase in O.N. = 2

$Ce^{4+} + ne^- \rightarrow Ce^{(4-n)}$ decrease in O.N. $= n$

To balance

$nSn^{2+} + 2Ce^{4+} \rightarrow nSn^{4+} + 2Ce^{(4-n)}$
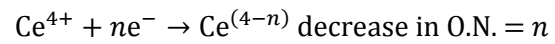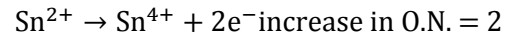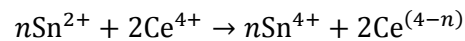
Millimoles of $Sn^{2+} = 100 \times 0.1 = 10$

Millimoles of $Ce^{4+} = 50 \times 0.4 = 20$

Thus, $\frac{n}{2} = \frac{10}{20}$

∴ $n = 1$

Thus, oxidation state of cerium in the reduced product $= (Ce^{4-1} = Ce^{3+}) = +3$

165 **(d)**

$6Fe^{2+} + Cr_2O_7^{2-} + 14H^+$
$$\rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$$

167 **(c)**

$FeC_2O_4 \rightleftharpoons Fe^{2+} + C_2O_4^{2-}$
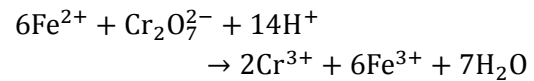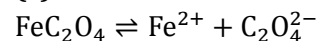
Fe^{2+} is oxidized to Fe^{3+} and $C_2O_4^{2-}$ to CO_2 by $Cr_2O_7^{2-}$

$Fe^{2+} \rightarrow Fe^{3+} + e^-] \times 6$

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$
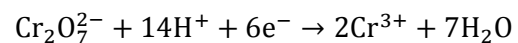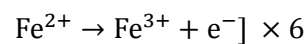
Thus, $6Fe^{2+} \equiv 1\ Cr_2O_7^{2-}$

$1\ Fe^{2+} \equiv \frac{1}{6}Cr_2O_7^{2-}$

$C_2O_7^{2-} \rightarrow 2CO_2 \times 2e^-] \times 3$

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

$3C_2O_4^{2-} \rightarrow Cr_2O_7^{2-}$

$1C_2O_4^{2-} \rightarrow \frac{1}{3}Cr_2O_7^{2-}$
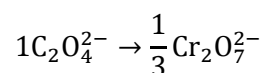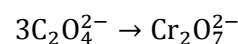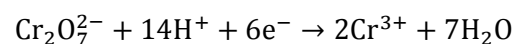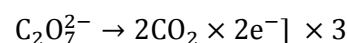
Thus, total $Cr_2O_7^{2-}$ required $= \frac{1}{6} + \frac{1}{3} = \frac{1}{2} = 0.5$ mol

169 (a)

$Fe^{III}[Fe^{II}(CN)_6$

   ↑   ↑   ↑
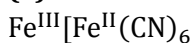
  $+3$ $+2$ $-6 = -1$

170 (c)

In van Arkel method, the impure metal is heated in a vessel with little iodine to form iodide of metal which is covalent and volatile

171 (a)

Liquation process for refining of crude metal is used when the metal has lower melting point and impurity has higher melting point

178 (c)

Cassiterite (SnO_2), Magnetite (Fe_3O_4), Haematite (Fe_2O_3), Limonite ($Fe_2O_3 . 3H_2O$)

180 (c)

Impurities of SiO_2 (acidic) is present in the iron ore, so basic flux limestone ($CaCO_3$) is added during the extraction of iron

182 (c)

$Cr_2O_7^{2-} + 6l^- + 14H^+ \rightarrow 3l_2 + 2Cr^{3+} + 7H_2O$
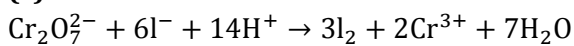
l^- and l_2 are not balanced

183 (d)

Copper pyrite $CuFeS_2$ (Chalopyrite)

185 (c)

Calcination of an ore requires absence of air or a limited supply of air

186 (d)

Pig iron is the most impure form of iron and contains highest proportion of carbon ($2.5 - 4\%$) while the rest in the options are ores

Malachite $\rightarrow Cu(OH)_2 . CuCO_3$

Zinc blende $\rightarrow ZnS$

Bauxite $\rightarrow Al_2O_3 . 2H_2O$

189 (d)

Calcination process involves decomposition of carbonate ores to their respective metal oxides and carbon dioxide. Hence, the reaction D is an example of calcination process

192 (b)

Oxides of some metals are difficult to reduce by carbon. In such cases, alumino thermite process is used. Alumino thermite process involves reduction of oxides such as Fe_2O_3, Mn_3O_4, Cr_2O_3, etc., to metals with aluminium

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

193 (a)

(a) $VO_3^{2-} + MnO_4^- \longrightarrow Mn^{2+} + VO_4^{3-}$

   ↑   ↑   ↑   ↑

  $+4$ $+7$ $+2$ $+5$

            5 unit

           1 unit

Thus, $5VO_3^{2-} + MnO_4^- \rightarrow Mn^{2+} + 5VO_4^{3-}$

5 mol $VO_3^{2-} \equiv 1$ mol MnO_4^-

1 mol $VO_3^{2-} \equiv 0.2$ mol MnO_4^-
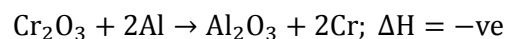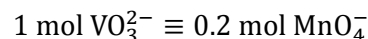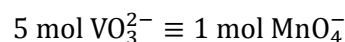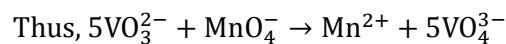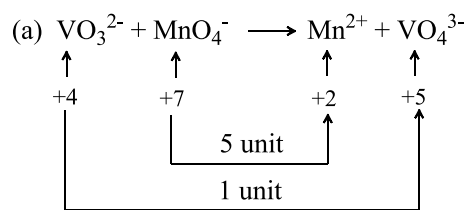
194 (b)

Ag^+ is reduced hence, it is oxidant. Hydroquinone is oxidized hence, it is reductant

196 (a)

Blister copper is 99% pure copper and mainly contains impurities of Ag and Au. It is further refined to 99.99% purity by carrying out electrolysis

197 (d)

(d) $Mn^{2+} + \quad NO_3^- \quad + OH^- \rightarrow MnO_4^{2-} + NO$

   $+2$ Oxidising agent $+6$
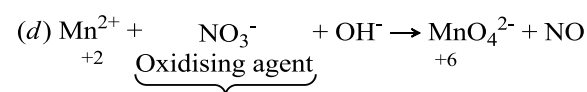
Change $= 6 - 2 = 4$

200 (c)

I: Mond's process for Ni

II: Self-reduction process for Cu

III. Electrolysis of fused NaCl for Na

Thus, $III - Na, I - Ni, II - Cu$

201 (b)

$ZnS \xrightarrow{\Delta} ZnC \xrightarrow{C} Zn$
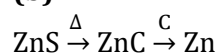
204 (a)

Silica is an acidic flux used to remove basic impurities

207 (c)

Sulphide ore is concentrated by froth-floatation process

208 (c)

SiO_2 is an acidic flux

209 (d)

$Be_3Al_2Si_6O_{18}$ is beryl

215 (a)

At the equivalent point, all species are in unit concentration and

$\Delta G^\circ(\text{net}) = \Delta G_1^\circ + \Delta G_2^\circ$

Total electrons exchanged $= (a + b)$

$\therefore \Delta G^\circ = -nFE^\circ$

$-(a + b)nFE_3^\circ = -aFE_1^\circ - bFE_2^\circ$

$\therefore E_3^\circ = \dfrac{aE_1^\circ + bE_2^\circ}{a + b}$

216 (b)

Al_2O_3

218 (a)

In the roasting process of zinc ore, zinc sulphate may get formed as follows:

$ZnS + O_2 \xrightarrow[1200\,K]{\Delta} ZnSO_4$
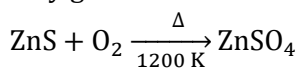
In order to decompose this $ZnSO_4$, care is taken to complete the roasting at 1200 K

$2ZnSO_4 \xrightarrow{1200\,K} 2ZnO + 2SO_2 + O_2 \uparrow$
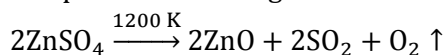
219 (a)

In the extraction of iron, limestone is used as a flux. Calcium oxide obtained by the decomposition of limestone combines with silica impurity to give calcium silicate which is a slag

$CaO \quad + \quad SiO_2 \quad \rightarrow \quad CaSiO_3$

Calcium   Silica   Calcium silicate

Oxide   (Slag)
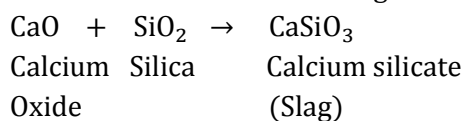
221 (c)

Bauxite $- Al_2O_3 . 2H_2O$

Epsom salt $- MgSO_4 . 7H_2O$

Cryolite $- Na_3AlF_6$

Dolomite $- MgCO_3, CaCO_3$

222 (a)

1 equivalent of an acid $\equiv$ 1 equivalent of a base

0.05 equivalent of $H_3PO_4 \equiv$ 0.05 equivalent of NaOH (or any base)

227 (c)

Pig iron: 95% Fe

4% C and varying quantities of other impurities

228 (d)

$S_4O_6^{2-}\,S_2O_7^{2-}\,S_2O_3^{2-}\,S_8$

+5   +6   +4   0

$H_2SO_4\,SO_2H_2S \quad H_2S_2O_8$

+6   +4   −2   +6

$SO_2^{2+}\,SO_4^{2-}\,SO_3^{2-}\,HSO_4^-$

+6   +6   +4   +6

$H_2SO_5\,H_2SO_3\,S_2Cl_2\,H_2S$

+6   +4   +2   −2

229 (a)

$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

   ↑   ↑

  −3   + 2
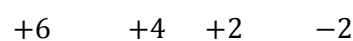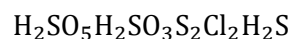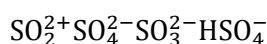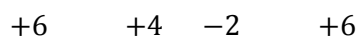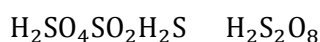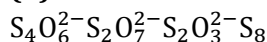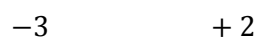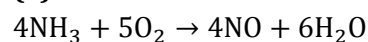
1 mole O_2 oxidises $= \dfrac{4}{5}$ mol of NH_3

$= \dfrac{4}{5} \times 5$ equivalent of NH_3

$= 4$

235 (c)

Sapphire (blue colour) contains Al_2O_3, Fe_2O_3 and Tio_2

236 (d)

(a) $ZnO(s) \xrightarrow{\Delta} Zn(s) + O_2(g)$
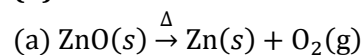
Due to the formation of gaseous products

$\Delta S > 0$

(b) It absorbs heat thus $\Delta H > 0$

(c) $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$

If $T\Delta S^\circ > \Delta H^\circ$

Then, $\Delta G^\circ < 0$

238 (c)

Magnesite is $MgCO_3$

239 (c)

$CaCO_3 \xrightarrow{calcination} CaO + CO_2$

240 (b)

$HCHO + OH^- \rightarrow HCOO^- + (A)$

   ↑   ↑

   0   + 2

$HCHO \xrightarrow{Oxidn} HCOO^-$
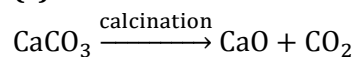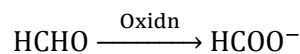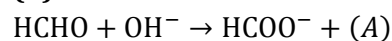
Equivalent mass of $HCHO = \dfrac{M}{2} = \dfrac{30}{2} = 15$

$HCHO \xrightarrow{Redn} A$
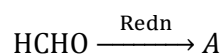
Equivalent mass of $HCHO = 30 - 15 = 15$

In reduction part equivalent mass is also 15

This is only when change in O.N. = 2 units

Thus, CH_3OH

242 (b)

$Bi^{3+} \rightarrow BiO_3^-$

  $+3 \qquad +5$
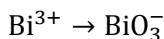
Change in oxidation number = 2 units

Thus, number of equivalents in one mole $Bi^{3+} = 2$

243 (a)
$2[M(CN)_2]^- + Zn \rightarrow (Zn(CN)_4^{2-}) + M(M =$ Au or Ag)
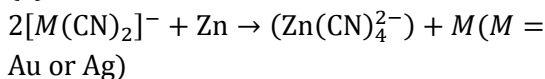
244 (d)
$SnO_2 -$ Cassiterite

247 (d)
$Cr_2O_7^{2-} + Fe^{2+} \rightarrow Fe^{3+} + Cr^{3+}$

Balance Cr : $Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$

O.N. of two $+12 \qquad +6$
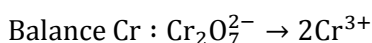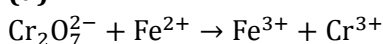
Cr-atoms

Change in O.N.] 6 units

$Fe^{2+} \rightarrow Fe^{3+}$

O.N. of Fe] $+2 \qquad +3$
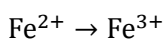
Change in O.N.] 1 unit

By cross-multiplication

$Cr_2O_7^{2-} + 6Fe^{2+} \rightarrow 6Fe^{3+} + 2Cr^{3+}$

1 mol $Cr_2O_7^{2-} = 6$ mol Fe^{2+}
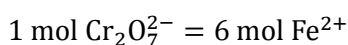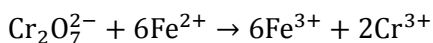
248 (b)
Method II is better than I as I emits CO which causes pollution

250 (a)
Reaction is balanced

Thus, $4x = -4$

$\therefore x = -1$

Thus,O_2^{x-} is O_2^- (Superoxide ion)

251 (c)
Modern vertical process is used carry out smelting (i.e., it involves reduction)
$$ZnO + C \xrightarrow[1673\ K]{\Delta} Zn + CO$$
Zinc   Zinc
Oxide   (Spelter)
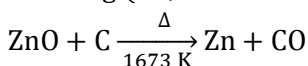
252 (d)
$Cu_2O \rightarrow Cu + Cu^{2+}$

  $\uparrow \qquad \uparrow \qquad \uparrow$

  $+1 \qquad 0 \qquad +2$
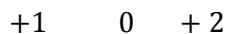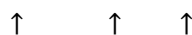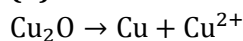
253 (b)
Carnallite: $MgCl_2 \cdot KCl \cdot 6H_2O$

256 (d)
Zr and Ti are refined by van Arkel method, Ge is refined by zone refining and Ni is refined by Mond process
In this process, nickel is heated in a stream of carbon monoxide forming a volatile complex, nickel tetracarbonyl
$$Ni + 4CO \xrightarrow{330-350\ K} Ni(CO)_4$$
(Impure)   Nickel tetracarbonyl
                                    (Volatile)
The nickel carbonyl complex is subjected to higher temperature so that it is decomposed giving the pure metal
$$Ni(CO)_4 \xrightarrow{450-470\ K} Ni + 4CO$$
Nickel   (Pure)
Carbonyl
complex
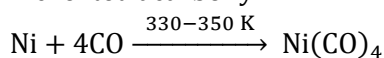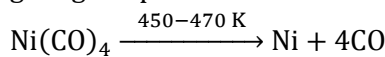
258 (a)
Ethyl part is hydrophobic and it prefers to stay in air. Xanthate part is hydrophilic and it prefers to stay in water
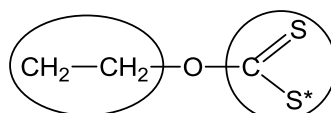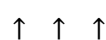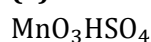

hydrophobic   hydrophilic

261 (a)
Metals like bismuth (m.p. of Bi: 544.3 K), lead (m.p. of Pb: 600.4 K), mercury (m.p. of Hg: 234.6 K), etc. are separated from their crude form by liquation

264 (c)
$CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons 2H^+$

$2CrO_4^{2-} + 2H^+ \rightarrow H_2O + Cr_2O_7^{2-}$
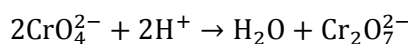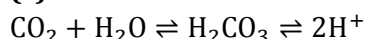
Yellow   orange

270 (d)
$NaHC_2O_4 + NaOH \rightarrow Na_2C_2O_4 + H_2O$
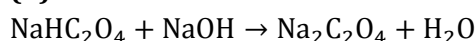
$NaHC_2O_4$ behaves as an acid and $1H^+ \equiv 1\ OH^-$

Thus, equivalent weight of $NaHC_2O_4 = M$

$5\ HC_2O_4^- + 2MnO_4^- \rightarrow 2Mn^{2+} + 10CO_2$
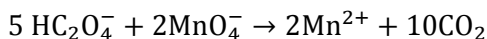
$HC_2O_4^-$ is oxidized to CO_2 and thus change in oxidation number $= +2$ units

Equivalent mass $= \frac{M}{2}$

271 (d)

0.025 equivalent of NaOH $\equiv 1.575$ g acid

1 equivalent of NaOH $\equiv 63$ g acid

Molar mass of acid $=$ basicity $\times$ equivalent mass

$= 126$ g mol^{-1}

273 (d)

Mond's process is for Ni

274 (a)

Zinc spelter contains cadmium, lead and iron as impurities

277 (c)

Levigation or gravity separation is used when the ore particles are heavier than the earthy or rocky gangue particles

278 (c)

Copper obtained has blistered appearance due to evolution of SO_2 thus, called blister copper

279 (d)

Argentite – Ag_2S, Cuprite $-Cu_2O$

280 (b)

$PbS + HNO_3 \rightarrow Pb(NO_3)_2 + S + NO + H_2O$
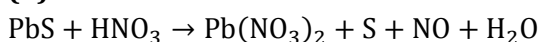
282 (c)

In the blast furnace, cone enables the uniform distribution of charge and cup prevents the loss of gases. Introduction of pre-heated air into the furnace is done through tuyers

284 (a)

In electrolytic refining, anode is made up of impure metal and cathode is made up of strip of the same metal in the pure form. Anode and cathode are suspended in a suitable electrolytic bath containing soluble salt of the same metal

285 (c)

(a) $3H_2 \equiv 2NH_3$
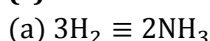
$1\ H \equiv \dfrac{NH_3}{3}$

$\therefore$ Equivalent weight of $NH_3 = \frac{M}{3}$

(b) $4NH_3 \equiv 5O_2$
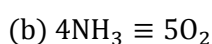
$\equiv 10(O)$ atoms taking weight as 16

$\equiv 20(O)$ atoms taking weight as 8

Thus, $1(O) \equiv \frac{1}{5}NH_3$

$\therefore$ Equivalent weight of $NH_3 = \frac{M}{5}$

(c) $2NH_3 \equiv H_2$
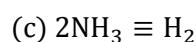
$\therefore 1\ H \equiv 1\ NH_3$

Equivalent weight of $NH_3 = M$

288 (a)

Metals like bismuth (m.p. of Bi: 544.3 K), lead (m.p. of Pb: 600.4 K), mercury (m.p. of Hg: 234.6 K), etc., are separated from their crude form by liquation (i.e., by placing the impure metal on sloping hearth of a reverberatory furnace and heating that above its melting point in absence of air)

290 (b)

Magnetite (Fe_3O_4) and cassiterite (containing wolframite which is a magnetic component) are concentrated by magnetic separation process

292 (a)

MnO_3HSO_4

$\quad \uparrow \ \ \uparrow \ \ \uparrow$

$x - 6 - 1 = 0$

$x = +7$

293 (b)

$$O \leftarrow (-2)$$

$$\|$$

$$H - C - H$$

$$\uparrow \quad \uparrow \quad \uparrow$$

$$+1x \quad +1$$

Thus, $x = 0$

$$O \leftarrow (-2)$$

$$\|$$

$$H - C - O - H$$

$$\uparrow \quad \uparrow \quad \uparrow \quad \uparrow$$

$$+1 \quad x \quad (-2) + 1$$
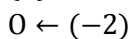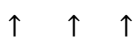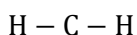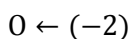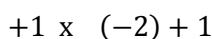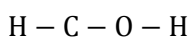
Thus, $x = +2$

295 (b)

PbS changes to PbO which is further reduced to Pb by PbS itself in self reduction process

298 (a)

During smelting of copper pyrites, the roasted ore is mixed with powdered coke and sand (charge) and it is then heated strongly in the blast furnace

304 (a)

$$2H_2S(g) + SO_2(g) \rightarrow 3S(s) + 2H_2O(l)$$

$$\qquad \uparrow \qquad \uparrow \qquad\qquad \uparrow$$

$$\qquad -2 \quad +4 \qquad\qquad 0$$
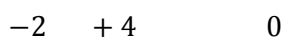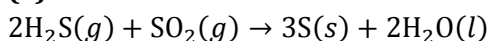
Change in oxidation number $= 4$ units

Thus, number of equivalent of $SO_2 = 4$

306 (d)

$Cu(OH)_2 \cdot CuCO_3$ − Malachite (green)

307 (b)
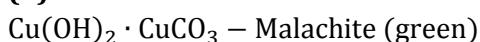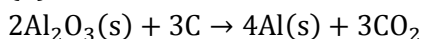
$$2Al_2O_3(s) + 3C \rightarrow 4Al(s) + 3CO_2$$
$$\Delta G° = 3\Delta G°_f(CO_2) - 2\Delta G°(Al_2O_3)$$
$$= -3 \times 394 - 2(-1520)$$
$$= -1182 + 3040 = +1858 \text{ kJ}$$
$$\Delta G° = -nFE°$$
$$1858 \times 1000 = -12 \times 96500 \times E°$$
$$\therefore E° = -1.60 \text{ V}$$
Thus, voltage requires $= 1.60$ V

309 (a)

310 (?)

$$6CO_2 + 12H_2O \xrightarrow{\text{Sun light}} C_6H_{12}O_6 + 6O_2$$
$$+ 6H_2O$$

$$6CO_2 \equiv C_6H_{12}O_6 \equiv 6O_2 \equiv 192 \text{ g(O)}$$

Thus, $8 \text{ g (O)} \equiv \frac{6 \times 44 \times 8}{192} CO_2 = 11 \text{ g } CO_2$

$$\equiv \frac{180 \times 8}{192} \text{ g } C_6H_{12}O_6$$

$$= 7.5 \text{ g } C_6H_{12}O_6$$

311 (a)

$$N_2 \equiv 3H_2 \equiv 6H$$

$$1 \text{ H} \equiv \frac{N_2}{6} = \frac{28}{6}$$

$$= 4.67$$
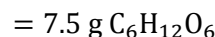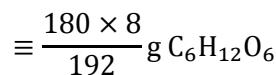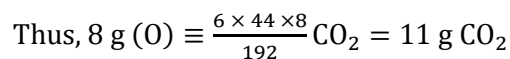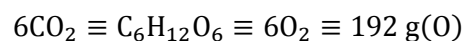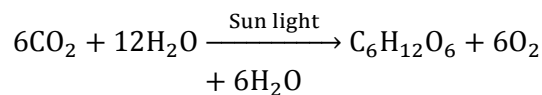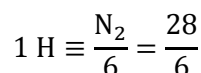
313 (b)

(a, d) no change

(b) reduction, (c) oxidation

315 (d)

In metallurgy of iron, the flux used is $CaCO_3$

317 (c)

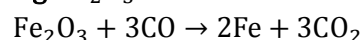$$N_2H_4 \quad \rightarrow \quad N_2(- - -) + 10e^-$$

$$\uparrow \qquad\qquad\qquad \uparrow$$
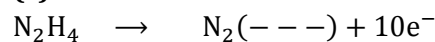
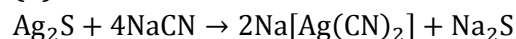O.N. two N-atoms of $= -4$ O.N. of two N-atoms in oxidizing species

$$= -4 + 10 = +6$$
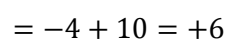
Thus, oxidation state of N in new compound $= +3$

322 (b)

Smelting is a process of reducing metal oxide to metal by means of coke or CO
e.g. $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$
$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

325 (b)
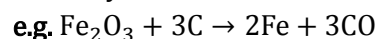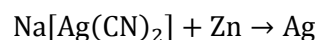
$$Ag_2S + 4NaCN \rightarrow 2Na[Ag(CN)_2] + Na_2S$$
$$\qquad\qquad\qquad\qquad\qquad A$$
$$Na[Ag(CN)_2] + Zn \rightarrow Ag$$
$$\qquad\qquad\qquad\qquad B$$

326 (d)

Corundum (Al_2O_3) is a mineral of aluminium whereas malachite $(Cu(OH)_2 . CuCO_3)$, cuprite (Cu_2O) and azurite $(Cu(OH)_2 . 2CuCO_3)$ are minerals of copper

327 (b)

Refractory materials are the substances which can withstand very high temperature without melting or becoming soft

331 **(d)**
From Ellingham diagram, it can be deduced that any metal can reduce the oxide of other metal which appears above it in the diagram. Also the graph of formation of silver oxide is at the upper part of diagram indicating positive $\Delta G°$ value and possible decomposition at moderate temperature. Thus, if the newly discovered metal 'M' is found to have its graph of formation of oxide above the graph line of silver, then it can be reduced by silver and also it can be easily decomposed at moderate temperature

333 **(b)**
$Zn \rightarrow Zn^{2+}$
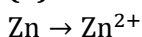
Zn is oxidized hence, it is a reducing agent (reductant)

$NO_3^- \rightarrow NH_4^+$

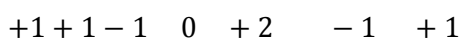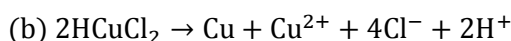$\quad +5 \quad -3$
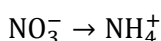
NO_3^- is reduced hence, it is oxidizing agent (oxidant)

340 **(b)**
Slag is a light material and forms separate layer above molten metal

344 **(b)**
$\quad\quad -2 \quad\quad\quad -2$

$\quad\quad \downarrow \quad -2 \quad \downarrow$

(a) $Ca\, CO_3 \rightarrow CaO + CO_2$

$\quad \uparrow \uparrow \quad\quad \uparrow \quad\quad \uparrow$

$\quad +2 +4 \quad +2 \quad\quad +4$

No change

(b) $2HCuCl_2 \rightarrow Cu + Cu^{2+} + 4Cl^- + 2H^+$

$\quad \uparrow \uparrow \, \uparrow \quad\quad \uparrow \quad\quad \uparrow \quad\quad \uparrow \quad\quad \uparrow$

$\quad +1 +1 -1 \quad 0 \quad +2 \quad\quad -1 \quad +1$
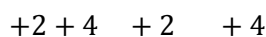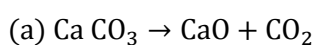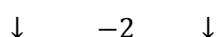
Thus, Cu^+ disproportionate to Cu and Cu^{2+}

345 **(b)**
Limestone is a flux used to remove acidic impurities in metallurgical process

346 **(b)**
Roasting is a process used to convert sulphide ores into their corresponding oxides. Among the given options, only zinc blende is the sulphide ore. So, zinc blende is subjected to roasting

348 **(c)**
Corundum (Al_2O_3) is an ore of Al

349 **(b)**
In column chromatography, the mixture whose different components are to be separated is dissolved in suitable liquid or gaseous solvent (called moving/mobile phase) and then it is moved through the stationary phase [alumina (Al_2O_3) or silica (SiO_2)] and eluted out using eluents

351 **(b)**
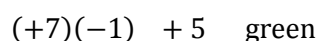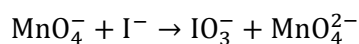(a) Intramolecular Cannizzaro
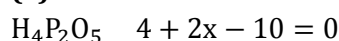
(b) Disproportionation thus, true

362 **(b)**
Self-reduction process taking in a Bessemer converter. Copper obtained is 98% and is called blister copper
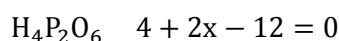
364 **(b)**
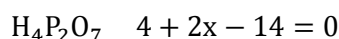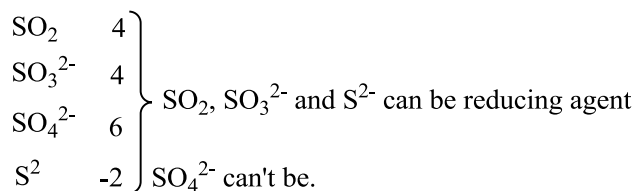MnO_4^- oxidizes I^- to IO_3^- in strongly basic medium and itself reduced to MnO_4^{2-}

$MnO_4^- + I^- \rightarrow IO_3^- + MnO_4^{2-}$

$(+7)(-1) \quad +5 \quad\quad green$

$\quad\quad\quad\quad\quad\quad\quad +6$

367 **(a)**
$H_4P_2O_5 \quad 4 + 2x - 10 = 0$

$x = 3$

$H_4P_2O_6 \quad 4 + 2x - 12 = 0$
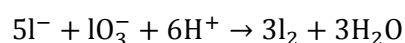
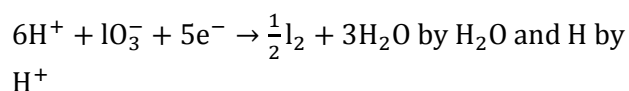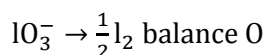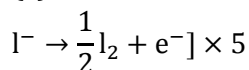$x = +4$

$H_4P_2O_7 \quad 4 + 2x - 14 = 0$

$x = +5$

368 **(c)**
If the species is a reducing agent, it means it can be oxidized easily thus it should have an O.N. less than maximum values of O.N
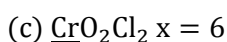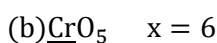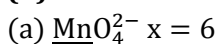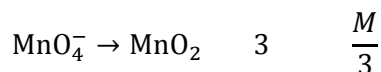
O.N

$$\left.\begin{array}{ll} SO_2 & 4 \\ SO_3^{2-} & 4 \\ SO_4^{2-} & 6 \\ S^2 & -2 \end{array}\right\} \begin{array}{l} SO_2, SO_3^{2-} \text{ and } S^{2-} \text{ can be reducing agent} \\ SO_4^{2-} \text{ can't be.} \end{array}$$

369 **(c)**

$$l^- \rightarrow \frac{1}{2}l_2 + e^-] \times 5$$

$$lO_3^- \rightarrow \frac{1}{2}l_2 \text{ balance O}$$

$$6H^+ + lO_3^- + 5e^- \rightarrow \frac{1}{2}l_2 + 3H_2O \text{ by } H_2O \text{ and H by } H^+$$

_____

$$5l^- + lO_3^- + 6H^+ \rightarrow 3l_2 + 3H_2O$$

_____

370 **(d)**

(a) $\underline{Mn}O_4^{2-}$ x = 6

(b) $\underline{Cr}O_5$ x = 6

(c) $\underline{Cr}O_2Cl_2$ x = 6

372 **(c)**

Change   Equiv. mass

$MnO_4^- \rightarrow Mn^{2+}$ 5 $\dfrac{M}{5}$

   +7   +2

$MnO_4^- \rightarrow MnO_4^{2-}$ 1 M

   +7   +6

$MnO_4^- \rightarrow MnO_2$ 3 $\dfrac{M}{3}$

 +7   +4
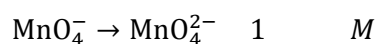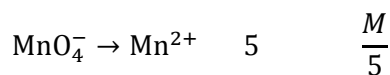
374 **(c)**

Aluminium is strongly electropositive metal and can reduce oxides like Cr_2O_3, Mn_3O_4, etc., which are not easily reduced by carbon or carbon monoxide. The process is called alumino-thermite process

376 **(a)**

Dolomite ($MgCO_3. CaCO_3$) is the mineral of magnesium whereas magnetite (Fe_3O_4), haematite (Fe_2O_3) and limonite ($2Fe_2O_3. 3H_2O$) are the minerals of iron

379 **(c)**

Flux is added during smelting. It combines with infusible gangue in the ore to form a fusible mass known as slag

Flux + Gangue → Slag

380 **(a)**

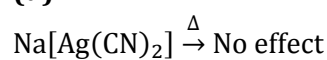$$\overset{II\ \ III}{Fe[Fe(CN)_6]}$$
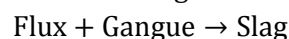
$$+2 + 3 - 6 = -1$$

384 **(b)**

Conversion of ferrous oxide (FeO) to ferric oxide (Fe_2O_3) occurs during roasting and not during extraction of iron in blast furnace
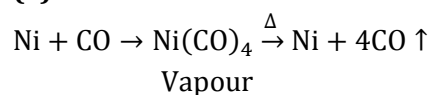
390 **(d)**

$$Na[Ag(CN)_2] \overset{\Delta}{\rightarrow} \text{No effect}$$

391 **(b)**

It is magnetic in nature

392 **(a)**

$$Ni + CO \rightarrow Ni(CO)_4 \overset{\Delta}{\rightarrow} Ni + 4CO \uparrow$$
$$\text{Vapour}$$

394 **(a)**

After bessemerization, as the molten copper solidifies, SO_2 (sulphur dioxide) escapes and leaves blisters on the surface. The solid metal thus obtained is called as blister copper

395 **(d)**

$$CN^- \rightarrow CNO^-$$
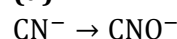
O.N. of nitrogen $4 + x = -1$ $4 + x - 2 = -1$

$x = -5$ $x = -3$

CN^- is thus oxidized. Thus, two electrons are lost

397 **(b)**

Gold is a native element. It is unreactive and found in the free state whereas metals like copper, silver and mercury occur partly in free state

399 **(d)**

$$HgS \overset{\Delta}{\rightarrow} HgO \overset{\Delta}{\rightarrow} Hg$$
$$Ag_2S \overset{\Delta}{\rightarrow} Ag_2O \rightarrow Ag$$

400 (d)

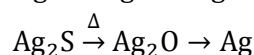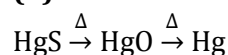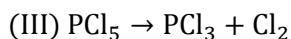During roasting of concentrated zinc sulphide (ZnS) ore at about 1200 K and in the presence of excess of air, zinc oxide (ZnO) and some amount of zinc sulphate ($ZnSO_4$) may also get formed

$3Zns + 3O_2 \xrightarrow{1200\ K} 2ZnO + SO_{2(g)} \uparrow$

$ZnS + O_2 \xrightarrow[1200\ K]{\Delta} ZnSO_4$

401 (a)

MnO_4^- will only oxidize oxalate ($C_2O_4^{2-}$),ferric is already in oxidized state

$2MnO_4^- + 5C_2O_4^- \rightarrow 10CO_2 + 2MnO_4^-$

$Fe_2(C_2O_4)_3 \rightleftharpoons 2Fe^{3+} + 3C_2O_4^{2-}$

$\therefore$ 2 moles of MnO_4^- oxidises = 5 moles of $C_2O_4^{2-}$

1 mole of MnO_4^- oxidises = $\frac{5}{2}$ mol of $C_2O_4^{2-}$

$= \frac{5}{6}$ mol of $Fe_2(C_2O_4)_3$

403 (b)

$OH^- \rightarrow H_2$

↑   ↑   ↑

$-2 + 1\ 0$

Thus, $OH^-$is reduced to H_2

404 (c)

H_2Schanges to S

Thus, change in oxidation number = 2 units

Thus, one equivalents $H_2S = 2$

$2H_2S + \quad SO_2 \rightarrow 3S + 2H_2O$

2 mol   1 mol   3 mol

4 equivalent 1 mol

1 equivalent of H_2Swill reduce 0.25 mole of SO_2

408 (a)

For the formation of metal oxide, $\Delta G°$ increases with the increase in temperature
$2M_{(s)} + O_{2(g)} \rightarrow 2MO_{(s)}$
Here, $\Delta G = \Delta H - T\Delta S$
$\Delta H = -ve$ (since all combustion reactions are exothermic)
$\Delta S = -ve$ (gaseous reactant converted into solid

product i.e., $O_{2(g)}$ converted to $MO_{(s)}$)
At low temperature ΔG may be negative but it becomes positive with the increase in temperature

410 (d)

$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$
$CaO + P_2O_5 \rightarrow Ca_3(PO_4)_2$

412 (b)

$CuFeS_2 -$ Chalcopyrite

414 (c)

ZnO is reduced by carbon

415 (c)

Let sulphur be as $(S_n)^x$

X = charge

n = number of sulphur atoms

$(S_n)^x + 12OH^- \rightarrow 4S^{2-} + 2S_2O_3^{2-} + 3H_2O$

Charge-balanced : $x + (-12) = -8 - 4$

$\therefore x = 0$

Sulphur-balanced $x = 4 + 4$

$\therefore S = 8$

Thus, (S_8)

416 (b)

$2Cu^{2+} + N_2H_4 \rightarrow Cu + N_2 + 4H^+$

$\qquad\qquad ↑ \qquad\qquad ↑$

$+2 \quad -4 \quad\ 0 \quad 0$

$\therefore$ Thus, 1 mole $N_2H_4 \equiv 2$ mol Cu^{2+}

418 (d)

(*d*) (I) $NH_4^+ + NO_3^- \longrightarrow N_2O + 2H_2O$

It is a redox but not disproportionation since, different N-species are involved

(II) $NH_4^+ + NO_2^- \rightarrow N_2$

↑   ↑   ↑

$-3 \quad +3 \quad\ 0$

Same as (I)

(III) $PCl_5 \rightarrow PCl_3 + Cl_2$

$\uparrow\uparrow\quad\uparrow\uparrow\quad\uparrow$
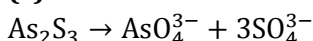
$+5 - 1 + 3 - 1\ 0$

P^{5+} is reduced to P^{3+}

Cl^- is oxidized to Cl_2

Thus, different species are involved. Thus, it is also not a disproportionation reaction

420 (c)

$As_2S_3 \rightarrow AsO_4^{3-} + 3SO_4^{3-}$

O.N. 2As $= +6\ 2 \times 5\ 3 \times 6$

3S = -6 $= 10 = 18$

Net = 0 Total = 28 Net change = 28

Thus, equivalent mass of $As_2S_3 = \frac{M}{28}$

421 (b)

A water soluble complex of silver with a dilute aqueous solution of NaCN is sodium argentocyanide, in the cyanide process, the native from is crushed and treated with 0.1-0.2% solution of NaCN and aerated

$4Ag + 8NaCN + 2H_2O + O_2$
$\rightarrow 4Na[Ag(CN)_2] + 4NaOH$
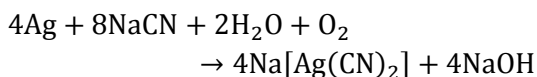
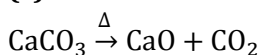Argentocyanide is soluble metal is recovered from the complex by reduction with zinc

422 (a)

Galena is PbS (a sulphide ore). Cassiterite is SnO_2 (oxide ore). Magnetite is Fe_3O_4 (Oxide ore) and Malachite is $Cu(OH)_2 \cdot CuCO_3$ (Carbonate ore). The froth floatation process is used to concentrate sulphide ores, based on preferential wetting properties with frothing agent and water

423 (b)

Zinc blende is roasted and then treated with coke for the reduction

$3ZnS + 3O_0 \xrightarrow{\Delta} 2ZnO + 2SO_2 \uparrow$

$ZnO + C \xrightarrow{\Delta} Zn + CO \uparrow$

424 (c)

$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$
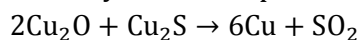
426 (d)

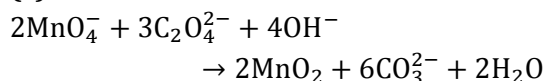$Ca^{2+}(ClO^-)(Cl^-)$
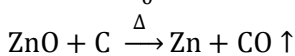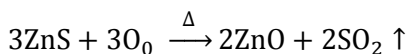
429 (b)

II. Magnetic impurities should be separated before gravity separation as it involves H_2O

433 (b)
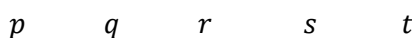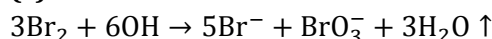
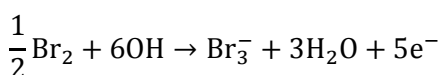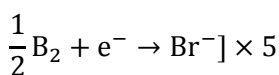Auto reduction: Reduction of an oxide ore of a metal by its own sulphide

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

440 (c)

$2MnO_4^- + 3C_2O_4^{2-} + 4OH^-$
$\rightarrow 2MnO_2 + 6CO_3^{2-} + 2H_2O$

442 (c)

$3Br_2 + 6OH \rightarrow 5Br^- + BrO_3^- + 3H_2O \uparrow$

$\uparrow\qquad\uparrow\qquad\uparrow\qquad\uparrow\qquad\uparrow$

$p\qquad q\qquad r\qquad s\qquad t$

Br_2 disproportionates to Br^- and BrO_3^- when treated with hot alkali solution

$\frac{1}{2}B_2 + e^- \rightarrow Br^-] \times 5$

$\frac{1}{2}Br_2 + 6OH \rightarrow Br_3^- + 3H_2O + 5e^-$

_____

$3\ Br_2 + 6OH \rightarrow 5Br^- + BrO_3^- + 3H_2O$

_____

443 (d)

Kieserite: $MgSO_4 \cdot 7H_2O$

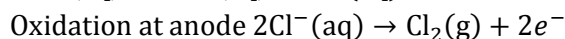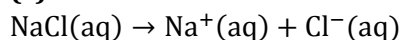**444 (c)**

$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$
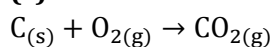
Here, $\Delta G = \Delta H - T\Delta S$ .....(i)

For this reaction, ΔH is –ve

and $\Delta S \approx 0$

$\therefore T\Delta S$ in equation (i) becomes zero, thus ΔG does not vary much with the temperature

446 (c)

$NaCl(aq) \rightarrow Na^+(aq) + Cl^-(aq)$

Oxidation at anode $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$

Reduction at cathode $2Na^+(aq) + 2e^- \rightarrow 2Na$

$2Na + 2H_2O \rightarrow 2NaOH + H_2$
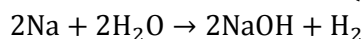
Thus, (a) is incorrect (b)is incorrect only (c) is correct since $\Delta G° < 0$ implies reaction is spontaneous

447 (d)

$Fe_2O_3 \xrightarrow{\text{through different stages}} Fe$

448 (a)

$$4Au_{(s)} + 8CN^-_{(aq)} + 2H_2O_{(aq)} + O_2$$
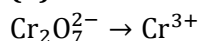$$\rightarrow 4[Au(CN)_2]^-_{(aq)} + 4OH^-_{(aq)}$$
$$\text{'X'}$$

$$2[Au(CN)_2]^-_{(aq)} + Zn_{(s)} \rightarrow [Zn(CN)_4]^{2-} + 2Au_{(s)}$$
$$\text{'Y'}$$

449 (a)

Hall's process

450 (d)

$$Cr_2O_7^{2-} \rightarrow Cr^{3+}$$

Green

$$Fe^{2+} \rightarrow Fe^{3+} + e^-$$

$$\left.\begin{array}{l} SO_2 \\ SO_3^{2-} \end{array}\right\} \longrightarrow SO_4^{2-} + 2e^-$$
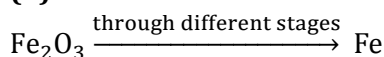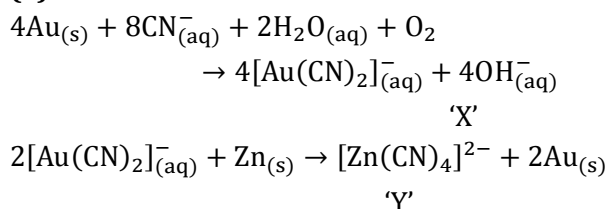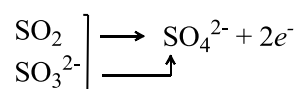
$Fe^{2+}SO_2/SO_3^{2-}$ reduce $Cr_2O_7^{2-}/H^+$ to Cr^{3+}(green)

466 (b, c)

Gold and silver occurs in free as well as in combined states in nature

473 (a, b)

Both roasting and calcinations make the ore porous

476 (b,c,d)

Gravity separation levigation or hydraulic washing separate lighter gangue particles from the heavier ore particles using the steam of water

478 (a,b,c,d)

All the given processes are used to reduce metal oxides into their respective metals

483 (a, c)

The fluorspar is an ionic compound. It ionises to give ions and thus, increases the number of ions in the electrolyte and as impurity decreases the melting point of Al_2O_3

486 (b)

Being less reactive, gold occurs in native state. All metals including gold dissolve in aqua-regia

488 (b)

Forth-flotation process is used to concentrate sulphide ores. This process is based upon the wettability of differen minerals

489 (a)

Upper most layer of pure molten aluminium, middle layer of molten fluorides of Na^+, Ba^{2+} and Al^{3+} and lower layer of molten impure aluminium have different densities

490 (b)

Alkaline earth metals are strong reducing agents so they cann't be produced by reduction method. Aqueous solution of alkaline earth metals cann't be used for displacing one metal by another
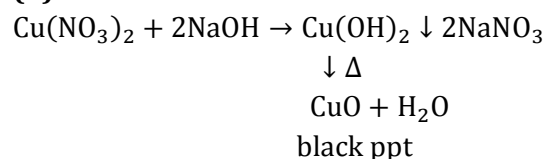
498 (d)

Ti- van-Arkel method
Si- Zone refining method
Al– Bauxite (Al_2O_3)
Pb– Cerussite ($PbCO_3$)

501 (b)

$$Cu(NO_3)_2 + 2NaOH \rightarrow Cu(OH)_2 \downarrow 2NaNO_3$$
$$\downarrow \Delta$$
$$CuO + H_2O$$
$$\text{black ppt}$$

502 (d)

$$Zn + 2K[Ag(CN)_2] \rightarrow K_2[Zn(CH)_4] + 2Ag \downarrow$$
$$Zn + 2K[Ag(CN)_2] \rightarrow K_2[Zn(CH)_4] + 2Au \downarrow$$

DCAM classes
Dynamic Classes for Academic Mastery