CHAPTER

8

REDOX REACTIONS

FACT/DEFINITION TYPE QUESTIONS

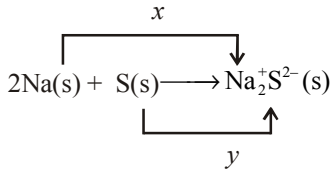
1. Which of the following process takes place in oxidation process?
(a) Addition of oxygen (b) Addition of hydrogen
(c) Removal of oxygen (d) Addition of chlorine

2. Given reaction,
$2K_4[Fe(CN)_6]\ (aq) + H_2O_2\ (aq) \rightarrow 2K_3[Fe(CN)_6](aq) + 2KOH(aq)$
The above given reaction is oxidation reaction due to
(a) removal of a hydrogen from H_2O_2
(b) addition of electropositive potassium to H_2O_2
(c) removal of electropositive element potassium from potassium ferrocyanide ($K_4[Fe(CN)_6]$)
(d) All of the above are the correct reasons.

3. In the reaction given below, identify the species undergoing redox reaction
$2Na(s) + H_2(g) \longrightarrow 2NaH(s)$
(a) Na is reduced and hydrogen is oxidised
(b) Na is oxidised and hydrogen is reduced
(c) Na undergoes oxidation and hydrogen undergoes reduction
(d) Both (b) and (c)

4. The loss of electron is termed as
(a) oxidation (b) reduction
(c) combustion (d) neutralization

5. Which of the following is correct code for *x* and *y* in the following reaction.



(i) *x* = oxidation reaction, *y* = reduction reaction
(ii) *x* = gain of two electrons, *y* = loss of two electrons,
(iii) *x* = reduction reaction, *y* = oxidation reaction
(iv) *x* = loss of two electrons, *y* = gain of two electrons
(a) (i) and (ii) (b) (i) and (iv)
(c) (ii) and (iii) (d) (iii) and (iv)

6. Which of the following involves transfer of five electrons ?
(a) $MnO_4^- \rightarrow Mn^{2+}$ (b) $CrO_4^{2-} \rightarrow Cr^{3+}$
(c) $MnO_4^{2-} \rightarrow MnO_2$ (d) $Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$

7. Which reaction involves neither oxidation nor reduction?
(a) $CrO_4^{2-} \longrightarrow Cr_2O_7^{2-}$ (b) $Cr \longrightarrow CrCl_3$
(c) $Na \longrightarrow Na^+$ (d) $2S_2O_3^{2-} \longrightarrow S_4O_6^{2-}$

8. In the following reaction
$4P + 3KOH + 3H_2O \longrightarrow 3KH_2PO_2 + PH_3$
(a) phosphorus is both oxidised and reduced.
(b) only phosphorus is reduced.
(c) phosphorus is not oxidised
(d) None of these

9. Which one of the following reaction involves oxidation-reduction ?
(a) $H_2 + Br_2 \rightarrow 2HBr$
(b) $NaBr + HCl \rightarrow NaCl + HBr$
(c) $HBr + AgNO_3 \rightarrow AgBr + HNO_3$
(d) $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

10. In reaction, $4Na + O_2 \longrightarrow 2Na_2O$, sodium behaves as
(a) oxidising agent (b) reducing agent
(c) Both (a) and (b) (d) None of these

11. $Zn^{2+}(aq.) + 2e^- \longrightarrow Zn(s)$. This is
(a) oxidation (b) reduction
(c) redox reaction (d) None of the above

12. $Co(s) + Cu^{2+}(aq) \longrightarrow Co^{2+}(aq) + Cu(s)$
The above reaction is
(a) oxidation reaction (b) reduction reaction
(c) redox reaction (d) None of these

13. One mole of N_2H_4 loses 10 moles of electrons to form a new compound, y. Assuming that all nitrogen appear in the new compound, what is the oxidation state of nitrogen in y (There is no change in the oxidation state of hydrogen)
(a) –1 (b) –3
(c) +3 (d) +5

14. When a strip of metallic zinc is placed in an aqueous solution of copper nitrate the blue colour of the solution disappear due to formation of
(a) Cu^{2+} (b) Zn^{2+}
(c) ZnS (d) Cus

15. The correct order of electron releasing tendency of the metals Cu, Zn and Ag is in the order:
(a) Cu > Zn > Ag (b) Zn > Ag > Cu
(c) Ag > Zn > Cu (d) Zn > Cu > Ag

16. What is the oxidation number of elements in the free or in the uncombined state ?
(a) +1 (b) 0
(c) +2 (d) –1

17. In which of the following compounds oxygen has highest oxidation state and in which it has lowest oxidation state?
OF_2, H_2O_2, KO_2, O_2F_2
(a) Highest = KO_2, lowest = H_2O_2
(b) Highest = OF_2, lowest = K_2O_2
(c) Highest = OF_2, lowest = KO_2
(d) Highest = KO_2, lowest = H_2O_2

18. 'Oxidation number of H in NaH, CaH_2 and LiH, respectively is
(a) +1, +1, –1 (b) –1, +1, + 1
(c) +1, + 1, + 1 (d) –1,–1, –1

19. Which of the following is the correct representative of stock notation for auric chloride?
(a) $Au(III)Cl_3$ (b) $Au(II)Cl_2$
(c) $Au(I)Cl_2$ (d) None of these

20. Oxidation number of N in HNO_3 is
(a) –3.5 (b) +3.5
(c) –5 (d) +5

21. In which of the following reactions, there is no change in valency ?
(a) $4\,KClO_3 \longrightarrow 3KClO_4 + KCl$
(b) $SO_2 + 2H_2S \longrightarrow 2H_2O + 3S$
(c) $BaO_2 + H_2SO_4 \longrightarrow BaSO_4 + H_2O_2$
(d) $3\,BaO + O_2 \longrightarrow 2\,BaO_2$.

22. The oxidation number of chromium in potassium dichromate is
(a) +6 (b) –5
(c) –2 (d) +2

23. The oxidation number of sulphur in S_8, S_2F_2, H_2S respectively, are
(a) 0, +1 and –2 (b) +2, +1 and –2
(c) 0, +1 and +2 (d) –2, +1 and –2

24. Oxidation number of cobalt in $K[Co(CO)_4]$ is
(a) +1 (b) +3
(c) –1 (d) –3

25. Oxidation number of nitrogen in $(NH_4)_2SO_4$ is
(a) –1/3 (b) –1
(c) +1 (d) –3

26. Oxidation number of carbon in CH_2Cl_2 is
(a) –4 (b) +4
(c) 0 (d) –2

27. In which of the following compounds, iron has lowest oxidation state?
(a) $K_3[Fe(CN)_6]$
(b) $K_4[Fe(CN)_6]$
(c) $FeSO_4.(NH_4)_2SO_4.6H_2O$
(d) $Fe(CO)_5$

28. The oxidation state of osmium (Os) in OsO_4 is
(a) +7 (b) +6
(c) +4 (d) +8

29. Which of the following transition metal has zero oxidation state ?
(a) $[Fe(CO)_5]$ (b) $NH_2.NH_2$
(c) $NOClO_4$ (d) CrO_5

30. In which of the compounds does 'manganese' exhibit highest oxidation number ?
(a) MnO_2 (b) Mn_3O_4
(c) K_2MnO_4 (d) $MnSO_4$

31. Among the following, identify the species with an atom in +6 oxidation state
(a) MnO_4^- (b) $Cr(CN)_6^{3-}$
(c) NiF_6^{2-} (d) CrO_2Cl_2

32. In which of the following compounds the oxidation number of carbon is not zero?
(a) HCHO (b) CH_3COOH
(c) $C_{12}H_{22}O_{11}$ (d) CH_3CHO

33. In which of the following compounds, the oxidation number of iodine is fractional ?
(a) IF_7 (b) I_3^-
(c) IF_5 (d) IF_3

34. A metal ion M^{3+} loses 3 electrons, its oxidation number will be
(a) +3 (b) +6
(c) 0 (d) –3

35. The correct name for NO_2 using stock notation is
(a) nitrogen dioxide (b) nitrogen (iv) oxide
(c) nitrogen per oxide (d) All of these

36. The oxide, which cannot act as a reducing agent, is
(a) NO_2 (b) SO_2
(c) CO_2 (d) ClO_2

37. The oxidation state of Fe in Fe_3O_4 is
(a) +3 (b) 8/3
(c) +6 (d) +2

38. In oxygen difluoride, the oxidation number of oxygen is
(a) –2 (b) –1
(c) +2 (d) +1, –2

39. Oxygen has an oxidation state of +2 in the compound
(a) H_2O_2 (b) CO_2
(c) H_2O (d) F_2O

40. The number of electrons involved in the reduction of one nitrate ion to hydrazine is
(a) 8 (b) 5
(c) 3 (d) 7

41. The average oxidation state of sulphur in $Na_2S_4O_6$ is
(a) +2.5 (b) +2
(c) +3.0 (d) +3.5

42. Which of the following species can function both as oxidizing as well as reducing agent ?
(a) Cl^- (b) ClO_4^-
(c) ClO^- (d) MnO_4^-

43. The oxidation number of an element in a compound is evaluated on the basis of certian rules. Which of the following rules is not correct in this respect?
(a) The oxidation number of hydrogen is always + 1.
(b) The algebraic sum of all the oxidation numbers in a compound is zero.
(c) An element in the free or the uncombined state bears oxidation number zero.
(d) In all its compounds, the oxidation number of fluorine is – 1.

44. Nitric oxide acts as a reducing agent in the reaction
(a) $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$
(b) $2NO + 3I_2 + 4H_2O \rightarrow 2NO_3^- + 6I^- + 8H^+$
(c) $2NO + H_2SO_3 \rightarrow N_2O + H_2SO_4$
(d) $2NO + H_2S \rightarrow N_2O + S + H_2O$

45. In the compounds $KMnO_4$and $K_2Cr_2O_7$ the highest oxidation state is of the element
(a) potassium (b) manganese
(c) chromium (d) oxygen

46. Atomic number of an element is 22. The highest O.S. exhibited by it in its compounds is
(a) 1 (b) 2
(c) 3 (d) 4

47. Why the displacement reactions of chlorine, bromine and iodine using fluorine are not generally carried out in aqueous solution?
(a) chlorine, bromine and iodine reacts with water and displace oxygen of water
(b) Fluorine being very reactive attacks water and displaces oxygen of water
(c) Fluorine does not react with chlorine, bromine and iodine in aqueous media
(d) None of these

48. Which of the following statement is not true ?
(a) Displacement reaction of chlorine with Br^- and I^- form the basis of identifying Br^- and I^- in laboratory using layer test
(b) F_2, Cl_2, Br_2 and I_2 can be recovered by halogen displacement reactions by using their respective halides
(c) F_2 can be recovered from F^- by oxidising it electrolytically.
(d) None of these.

49. Which of the following do not show disproportionation reaction?
ClO_4^-, F_2, Cl_2, ClO_2^-, P_4, S_8, and ClO^-
(a) ClO_2^-, ClO_4^-, and ClO^-
(b) F_2 only
(c) F_2 and ClO_4^-
(d) ClO_4^- only

50. Which one of the following reactions involves disproportionation?
(a) $2H_2SO_4 + Cu \rightarrow CuSO_4 + 2H_2O + SO_2$
(b) $As_2O_3 + 3H_2S \rightarrow As_2S_3 + 3H_2O$
(c) $2KOH + Cl_2 \rightarrow KCl + KOCl + H_2O$
(d) $Ca_3P_2 + 6H_2O \rightarrow 3Ca(OH)_2 + 2PH_3$

51. The following species will not exhibit disproportionation reaction
(a) ClO^- (b) ClO_2^-
(c) ClO_3^- (d) ClO_4^-

52. In the reaction
$3Br_2 + 6CO_3^{2-} + 3H_2O \rightarrow 5Br^- + BrO_3^- + 6HCO_3^-$
(a) Bromine is oxidised and carbonate is reduced.
(b) Bromine is reduced and water is oxidised
(c) Bromine is neither reduced nor oxidised
(d) Bromine is both reduced and oxidised

53. Which of the following elements does not show disproportionation tendency?
(a) Cl (b) Br
(c) F (d) I

54. Phosphorus, sulphur and chlorine undergo disproportion in the ...A... medium.
Here, A refers to
(a) acidic (b) alkaline
(c) neutral (d) Both (a) and (b)

55. The reaction, $\overset{+1\ -2}{2H_2O(l)} \xrightarrow{\Delta} \overset{0}{2H_2(g)} + \overset{0}{O_2(g)}$ is an example of
(a) addition reaction (b) decomposition reaction
(c) displacement reaction (d) None of these

56. How will you balance the total ionic charge of reactant and products if reaction is carried out in acidic solution?
(a) By using H^+ ions
(b) By using OH^- ions
(c) Adding H_2O molecules to the reactant or product
(d) Multiplying by suitable coefficients.

57. Consider the following reaction occuring in basic medium
$2MnO_4^-(aq) + Br^-(aq) \longrightarrow 2MnO_2(s) + BrO_3^-(aq)$
How the above reaction can be balanced further?
(a) By adding 2 OH^- ions on right side
(b) By adding one H_2O molecule to left side
(c) By adding $2H^+$ ions on right side
(d) Both (a) and (b)

58. For the reaction : $NH_3 + OCl^- \longrightarrow N_2H_4 + Cl^-$ in basic medium, the coefficients of NH_3, OCl^- and N_2H_4 for the balanced equation are respectively
(a) 2, 2, 2 (b) 2, 2, 1
(c) 2, 1, 1 (d) 4, 4, 2

59. $C_2H_6(g) + nO_2(g) \rightarrow CO_2(g) + H_2O(l)$
In this equation, the ratio of the coefficients of CO_2 and H_2O is
(a) 1 : 1 (b) 2 : 3
(c) 3 : 2 (d) 1 : 3

60. $2MnO_4^- + 5H_2O_2 + 6H^+ \rightarrow 2\ Z + 5O_2 + 8H_2O$. In this reaction Z is
(a) Mn^{+2} (b) Mn^{+4}
(c) MnO_2 (d) Mn

61. In the redox reaction,
$xKMnO_4 + NH_3 \longrightarrow yKNO_3 + MnO_2 + KOH + H_2O$
(a) $x = 4, y = 6$ (b) $x = 3, y = 8$
(c) $x = 8, y = 6$ (d) $x = 8, y = 3$

62. What is 'A' in the following reaction
$2Fe^{3+}(aq) + Sn^{2+}(aq) \rightarrow 2Fe^{2+}(aq) + A$
(a) $Sn^{3+}(aq)$ (b) $Sn^{4+}(aq)$
(c) $Sn^{2+}(aq)$ (d) Sn

63. Given :
$X\ Na_2HAsO_3 + Y\ NaBrO_3 + Z\ HCl \rightarrow NaBr + H_3AsO_4 + NaCl$
The values of X, Y and Z in the above redox reaction are respectively
(a) 2, 1, 2 (b) 2, 1, 3
(c) 3, 1, 6 (d) 3, 1, 4

64. The values of x and y in the following redox reaction

$x\ Cl_2 + 6OH^- \longrightarrow ClO_3^- + y\ Cl^- + 3H_2O$ are
(a) x = 5, y = 3 (b) x = 2, y = 4
(c) x = 3, y = 5 (d) x = 4, y = 2

65. A negative E° means that redox couple is a ___A___ than the H^+/H_2 couple
A positive E° means that the redox couple is a ____B___ than H^+/H_2 couple
(a) A = stronger reducing agent
B = weaker reducing agent
(b) A = stronger oxidising agent
B = weaker oxidising agent
(c) A = weaker oxidising agent
B = stronger oxidising agent
(d) Both (a) and (c)

66. Given E^Θ
(i) $Mg^{2+}/Mg(s)$, $E^\Theta = -2.36$
(ii) $Ag^+/Ag(s)$, $E^\Theta = 0.80$
(iii) $Al^{3+}/Al(s)$, $E^\Theta = -1.66$
(iv) $Cu^{2+}/Cu(s)$, $E^\Theta = 0.52$
Out of the above given elements which is the strongest oxidising agent and which is the weakest oxidising agent ?
(a) (iv) is the strong whereas (ii) is the weakest oxidising agent
(b) (ii) is the strongest whereas (i) is the weakest oxidising agent
(c) (i) is the strongest whereas (ii) is the weakest oxidising agent
(d) (ii) is the strongest whereas (iii) is the weakest oxidising agent

67. Stronger is oxidising agent, more is
(a) standard reduction potential of that species
(b) the tendency to get it self oxidised
(c) the tendency to lose electrons by that species
(d) standard oxidation potential of that species

68. Standard reduction potentials of the half reactions are given below :
$F_2(g) + 2e^- \rightarrow 2F^-(aq)$; $E^\circ = +2.85$ V
$Cl_2(g) + 2e^- \rightarrow 2Cl^-(aq)$; $E^\circ = +1.36$ V
$Br_2(l) + 2e^- \rightarrow 2Br^-(aq)$; $E^\circ = +1.06$ V
$I_2(s) + 2e^- \rightarrow 2I^-(aq)$; $E^\circ = +0.53$ V
The strongest oxidising and reducing agents respectively are :
(a) F_2 and I^- (b) Br_2 and Cl^-
(c) Cl_2 and Br^- (d) Cl_2 and I_2

69. Standard electrode potentials of redox couples A^{2+}/A, B^{2+}/B, C/C^{2+} and D^{2+}/D are 0.3V, – 0.5V, – 0.75V and 0.9V respectively. Which of these is best oxidising agent and reducing agent respectively –
(a) D^{2+}/D and B^{2+}/B (b) B^{2+}/B and D^{2+}/D
(c) D^{2+}/D and C^{2+}/C (d) C^{2+}/C and D^{2+}/D

70. The standard reduction potentials at 298K for the following half reactions are given against each
$Zn^{2+}(aq) + 2e \rightleftharpoons Zn(s)$; –0.762 V
$Cr^{3+}(aq) + 3e \rightleftharpoons Cr(s)$; –0.740 V
$2H^+(aq) + 2e \rightleftharpoons H_2(g)$; 0.00 V
$Fe^{3+}(aq) + e \rightleftharpoons Fe^{2+}(aq)$; 0.770 V
Which is the strongest reducing agent?
(a) Zn (s) (b) Cr (s)
(c) H_2(g) (d) Fe^{3+} (aq)

71. Electrode potential data are given below :
$Fe^{+3}_{(aq)} + e^- \longrightarrow Fe^{+2}_{(aq)}$; $E^\circ = +0.77$ V
$Al^{3+}_{(aq)} + 3e^- \longrightarrow Al_{(s)}$; $E^\circ = -1.66$ V
$Br_{2\ (aq)} + 2e^- \longrightarrow 2Br^-_{(aq)}$; $E^\circ = +1.08$V
Based on the data, the reducing power of Fe^{2+}, Al and Br^- will increase in the order
(a) $Br^- < Fe^{2+} < Al$ (b) $Fe^{2+} < Al < Br^-$
(c) $Al < Br^- < Fe^{2+}$ (d) $Al < Fe^{2+} < Br^-$

72. The standard reduction potentials for Cu^{2+}/Cu; Zn^{2+}/Zn; Li^+/Li; Ag^+/Ag and H^+/H_2 are + 0.34 V, – 0.762 V, – 3.05 V, + 0.80 V and 0.00 V respectively. Choose the strongest reducing agent among the following
(a) Zn (b) H_2
(c) Ag (d) Li

73. Given :

$E^{o}_{\frac{1}{2}Cl_2/Cl^-} = 1.36\,V,\ E^{o}_{Cr^{3+}/Cr} = -0.74\,V,$

$E^{o}_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\,V,\ E^{o}_{MnO_4^-/Mn^{2+}} = 1.51\,V$

The correct order of reducing power of the species (Cr, Cr^{3+}, Mn^{2+} and Cl^-) will be

(a) $Mn^{2+} < Cl^- < Cr^{3+} < Cr$
(b) $Mn^{2+} < Cl^{3+} < Cl^- < Cr$
(c) $Cr^{3+} < Cl^- < Mn^{2+} < Cr$
(d) $Cr^{3+} < Cl^- < Cr < Mn^{2+}$

74. $E^{\ominus}$ Values of some redox couples are given below. On the basis of these values choose the correct option.

$E^{\ominus}$ values : $Br_2/Br^- = +1.90$; $Ag^+/Ag(s) = +0.80$
$Cu^{2+}/Cu(s) = +0.34$; $I_2(s)/I^- = 0.54$

(a) Cu will reduce Br^- (b) Cu will reduce Ag
(c) Cu will reduce I^- (d) Cu will reduce Br_2

75. Arrange the following in the order of their decreasing electrode potentials : Mg, K, Ba and Ca

(a) K, Ca, Ba, Mg (b) Ba, Ca, K, Mg
(c) Ca, Mg, K, Ba (d) Mg, Ca, Ba, K

76. The standard electrode potentials of four elements A, B, C and D are –3.05, –1.66, –0.40 and +0.80. The highest chemical reactivity will be exhibited by

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

STATEMENT TYPE QUESTIONS

77. Which of the following statement(s) is/are correct for the given reaction?

$2HgCl_2\,(aq) + SnCl_2(aq) \rightarrow Hg_2Cl_2(s) + SnCl_4(aq)$

(i) Mercuric chloride is reduced to Hg_2Cl_2
(ii) Stannous chloride is oxidised to stannic chloride
(iii) $HgCl_2$ is oxidised to Hg_2Cl_2
(iv) It is an example of redox reaction

(a) (i), (ii) and (iv) (b) (i) and (ii)
(c) (iii) and (iv) (d) (iii) only

78. Which of the following sequences of T and F is correct for given statements. Here T stands for true and F stands for false statements

(i) Reducing agents lower the oxidation number of an element in a given substance. These reagents are also called as reductants
(ii) Reducing agents are acceptor of electrons
(iii) Loss of electron(s) by any species is called oxidation reaction
(iv) Oxidation and reduction always occur simultaneously.

(a) TTTT (b) TFTT
(c) TFFT (d) FTTT

79. If aqueous solution of H_2O_2 is made acidic. For this which of the following statement(s) is/are correct ?

(i) This aqueous solution oxidizes I^-
(ii) This aqueous solution oxidizes F^-

(a) Both statements (i) and (ii) are correct.
(b) Statement (i) is correct and (ii) is incorrect.
(c) Statement (ii) is correct and (i) is incorrect.
(d) Both statements (i) and (ii) are incorrect.

80. Which of the following statement(s) is/are correct ?

(i) All alkali metals and some alkaline earth metals (Ca, Sr and Ba) displace hydrogen from cold water.
(ii) Magnesium and iron react with steam as well as acids to produce hydrogen gas.
(iii) Cadmium and tin do not react with steam but displace hydrogen from acids.

(a) (i) and (ii) (b) (ii) only
(c) (i) and (iii) (d) (i), (ii) and (iii)

81. Which of the following statements are correct concerning redox properties?

(i) A metal M for which E° for the half life reaction $M^{n+} + ne^- \rightleftharpoons M$ is very negative will be a good reducing agent.
(ii) The oxidizing power of the halogens decreases from chlorine to iodine.
(iii) The reducing power of hydrogen halides increases from hydrogen chloride to hydrogen iodide

(a) (i), (ii) and (iii) (b) (i) and (ii)
(c) (i) only (d) (ii) and (iii)

82 Which of the following statement(s) is/are correct ?

(i) A negative value of E^- means that the redox couple is a weaker reducing agent than the H^+/H_2 couple.
(ii) A positive E^- means that the redox couple is weaker reducing agent than the H^+/H_2.

Which of the following code is incorrect regarding above statements?

(a) Only (i) (b) only (ii)
(c) Both (i) and (ii) (d) Neither (i) nor (ii)

83. Which of the following statement(s) is/are correct ?

(i) Oxidation state of carbon in C_3H_4 is –(4/3).
(ii) Electrons are never shared in fraction.

(a) (i) and (ii) (b) Only (i)
(c) Only (ii) (d) Neither (i) nor (ii)

MATCHING TYPE QUESTIONS

84. Match the columns

Column-I	Column-II
(A) Addition of electronegative element	(p) Oxidation reaction
(B) Removal of hydrogen	(q) Reduction reaction
(C) Addition of electropositive element	
(D) Removal of oxygen	

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

85. Match the columns

Column-I	Column-II
(A) $2Mg + O_2 \longrightarrow 2MgO$	(p) Removal of hydrogen
(B) $Mg + Cl_2 \longrightarrow MgCl_2$	(q) Removal of electropositive element
(C) $2H_2S + O_2 \longrightarrow 2S + 2H_2O$	(r) Addition of oxygen
(D) $2KI + H_2O + O_3 \longrightarrow 2KOH + I_2 + O_2$	(s) Addition of electronegative element, chlorine

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

86. Match Column-I (compound) with Column-II (oxidation state of underlined element) and choose the correct option.

Column - I	Column - II
(A) $\underline{Cu}O$	(p) 4
(B) $\underline{Mn}O_2$	(q) 3
(C) $H\underline{Au}Cl_4$	(r) 2
(D) $\underline{Tl}_2O$	(s) 1

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

87. Match the columns

Column-I	Column-II
(A) $V_2O_5(s) + 5\,Ca(s) \rightarrow 2V(s) + 5\,CaO(s)$	(p) Disproportionation reaction
(B) $CH_4(g) + 2O_2(g) \xrightarrow{\Delta} CO_2(g) + 2\,H_2O(l)$	(q) Decomposition reaction
(C) $P_4(s) + 3OH^-(aq) + 3H_2O(l) \rightarrow PH_3(g) + 3H_2PO_2^-(aq)$	(r) Combination reaction
(D) $2\,KClO_3(s) \xrightarrow{\Delta} 2KCl(s) + 3O_2(g)$	(s) Displacement reaction

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

ASSERTION-REASON TYPE QUESTIONS

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

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

88. **Assertion :** In the reaction $2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$ sodium is oxidised.
Reason : Sodium acts as an oxidising agent in given reaction.

89. **Assertion :** $HClO_4$ is a stronger acid than $HClO_3$.
Reason : Oxidation state of Cl in $HClO_4$ is +VII and in $HClO_3$ +V.

90. **Assertion :** The reaction :
$CaCO_3(s) \xrightarrow{\Delta} CaO(s) + CO_2(g)$ is an example of decomposition reaction
Reason : Above reaction is not a redox reaction.

91. **Assertion :** In a reaction
$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$
Zn is a reductant but itself get oxidized.
Reason : In a redox reaction, oxidant is reduced by accepting electrons and reductant is oxidized by losing electrons.

CRITICAL THINKING TYPE QUESTIONS

92. Among NH_3, HNO_3, NaN_3 and Mg_3N_2 the number of molecules having nitrogen in negative oxidation state is
(a) 1 (b) 2
(c) 3 (d) 4

93. Fill up the table from the given choice.

Element	Oxidation number
Oxygen	–2 in most compounds __(i)__ in H_2O_2 and __(ii)__ in OF_2
Halogen	–1 for __(iii)__ in all its compounds
Hydrogen	__(iv)__ in most of its compounds __(v)__ in binary metallic hydrides
Sulphur	__(vi)__ in all sulphides

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
(a)	+1	+1	Cl	+1	–1	+2
(b)	–1	+2	F	+1	–1	–2
(c)	–1	+1	F	+1	+2	+2
(d)	+1	+2	Cl	+1	+1	+6

94. The correct decreasing order of oxidation number of oxygen in compounds BaF_2, O_3, KO_2 and OF_2 is
(a) $BaO_2 > KO_2 > O_3 > OF_2$
(b) $OF_2 > O_3 > KO_2 > BaO_2$
(c) $KO_2 > OF_2 > O_3 > BaO_2$
(d) $BaO_2 > O_3 > OF_2 > KO_2$

95. Oxidation numbers of P in PO_4^{3-}, of S in SO_4^{2-} and that of Cr in $Cr_2O_7^{2-}$ are respectively
(a) +3, +6 and +5 (b) +5, +3 and +6
(c) –3, +6 and +6 (d) +5, +6 and +6

96. When Cl_2 gas reacts with hot and concentrated sodium hydroxide solution, the oxidation number of chlorine changes from
(a) zero to +1 and zero to –5
(b) zero to –1 and zero to +5
(c) zero to –1 and zero to +3
(d) zero to +1 and zero to –3

97. Which of the following arrangements represent increasing oxidation number of the central atom?

(a) $CrO_2^-, ClO_3^-, CrO_4^{2-}, MnO_4^-$

(b) $ClO_3^-, CrO_4^{2-}, MnO_4^-, CrO_2^-$

(c) $CrO_2^-, ClO_3^-, MnO_4^-, CrO_4^{2-}$

(d) $CrO_4^{2-}, MnO_4^-, CrO_2^-, ClO_3^-$

98. Which of the following act as reducing agents ?

(i) PO_4^{3-} (ii) SO_3

(iii) PO_3^{2-} (iv) NH_3

(a) (i), (ii) and (iii) (b) Only (iii)
(c) (i), (iii) and (iv) (d) (iii) and (iv)

99. In the reaction shown below, oxidation state of the carbon in reactant and product are (*i*) and (*ii*) respectively? Is the given reaction a redox reaction?

$Na_2CO_3(aq) + HCl(aq)$

$\longrightarrow Na^{\oplus}(aq) + Cl^-(aq) + H_2O(\ell) + CO_2(g)$

(a) (i) 6, (ii) 4, yes (b) (i) 6, (ii) 6, No
(c) (i) 4, (ii) 4, No (d) (i) 4, (ii) 4, yes

100. What products are expected from the disproportionation reaction of hypochlorous acid?

(a) HCl and Cl_2O (b) HCl and $HClO_3$
(c) $HClO_3$ and Cl_2O (d) $HClO_2$ and $HClO_4$

101. In the disproportionation reaction

$3\,HClO_3 \rightarrow HClO_4 + Cl_2 + 2O_2 + H_2O$, the equivalent mass of the oxidizing agent is (molar mass of $HClO_3 = 84.45$)

(a) 16.89 (b) 32.22
(c) 84.45 (d) 28.15

102. Consider the following reaction :

$$xMNO_4^- + yC_2O_4^{2-} + zH^+ \rightarrow xMn^{2+} + 2yCO_2 + \frac{z}{2}H_2O$$

The value's 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

103. In the balanced chemical reaction

$IO_3^- + aI^- + bH^+ \longrightarrow cH_2O + dI_2$

a, b, c and d respectively corresponds to

(a) 5, 6, 3, 3 (b) 5, 3, 6, 3
(c) 3, 5, 3, 6 (d) 5, 6, 5, 5

104. If equal volume of reactants are used, than no. moles of $KMnO_4$ (moles per liter) used in acidic medium required to completely oxidises the 0.5 M $FeSO_3$?

(a) 0.3 (b) 0.1
(c) 0.2 (d) 0.4

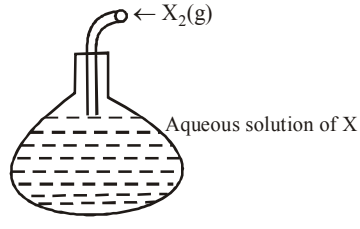
105. Acidic medium used in $KMnO_4$ can be made from which of the following acids?

(a) HCl (b) H_2SO_4
(c) HI (d) HBr

106. If rod of a metal (x) is put in a metal ion solution which is blue in colour , solution turn colorless. The metal rod and solution respectively are?

(a) Zinc and Cu(II) (b) Zinc and Ni(II)
(c) Aluminium and Cu(II) (d) Both (a) and (c)

107. What could be the X^- in the system, Where X signifies halogen ; formation of shown below X_2 takes place, when F_2 is purge into aqueous solution of X^-?



(a) Br^- (b) Cl^-
(c) I^- (d) All of these

HINTS AND SOLUTIONS

FACT/DEFINITION TYPE QUESTIONS

1. (a) Addition of oxygen takes place in oxidation.

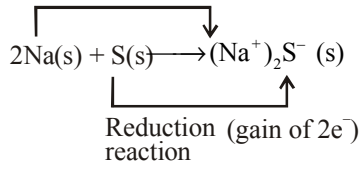
2. (c) Given reaction is oxidation reaction due to removal of electropositive element potassium from potassium ferrocyanide.

3. (d) $2Na(s) + H_2(g) \xrightarrow{\Delta} 2NaH(s)$

With the careful application of the concept of electronegativity only S we can find that sodium is oxidised and hydrogen is reduced.

4. (a) Losing of electron is called oxidation.

5. (b) Oxidation reaction (loss of $2e^-$)



6. (a) O.N. of Mn in MnO_4^- is +7 and in Mn^{2+} it is +2. The difference is of 5 electrons.

7. (a) Ox. no. of Cr on both side is + 6.

8. (a) $4P + 3KOH + 3H_2O \rightarrow KH_2PO_2 + PH_3$

O.N of P = 0, In KH_2PO_2 it is + 1, In PH_3 it is –3.
Hence P is oxidised and reduced.

9. (a) In a redox reaction, one molecule is oxidised and other molecule is reduced i.e. oxidation number of reactants are changed.

$\overset{0}{H_2} + \overset{0}{Br_2} \longrightarrow 2\overset{+1\,-1}{HBr}$

Here H_2 is oxidised and Br_2 is reduced, thus it is oxidation-reduction reaction.

10. (b) $4Na + O_2 \longrightarrow \overset{+}{2Na}_2O$

Loss of electrons (oxidation)

In this reaction, Na converts into ion (Na^+) and Na donates electrons to oxygen atoms, So, Na behaves as reducing agent.

11. (b) $Zn^{2+} + 2e^- \rightarrow Zn(s)$
Here electrons are reducing from Zn^{2+} to Zn.

12. (c) $Co(s) + Cu^{2+}(aq) \longrightarrow Co^{2+}(aq) + Cu(s)$
This reaction is a redox reaction as Co undergoes oxidation whereas Cu^{+2} undergoes reduction.

13. (c) $N_2^{-4}H_4^{+4} \xrightarrow[N]{\text{loss of } 10e^-} N_2^{+6}Y;$
O.N.of N changes from – 2 to +3

14. (b) Blue colour of the solution disappear due to formation of Zn^{2+}.

15. (d) Correct order is Zn > Cu > Ag.

16. (b) For elements, in the free or the uncombined state, each atom bears an oxidation number of zero.

17. (c) Oxidation number of oxygen in OF_2 = + 2.

$$\text{In } KO_2 = \frac{-1}{2}$$

18. (d) Oxidation number of hydrogen when it is bonded to metals in binary compounds is –1

19. (a) Auric Chloride = $Au(III)Cl_3$

20. (d) Let the oxidation no. of N in $HNO_3 = x$

$\therefore\ 1 + x + (3 \times -2) = 0$
$\therefore\ x = +5$

21. (c) $\overset{+2\ -1}{Ba\,O_2} + \overset{+1}{H_2}\,\overset{+6\ -2}{S\,O_4} \longrightarrow \overset{+2\ +6\ -2}{Ba\ S\ O_4} + \overset{+1\ -1}{H_2\,O_2}$

In this reaction, none of the elements undergoes a change in oxidation number or valency.

22. (a) Let x = oxidation no. of Cr in $K_2Cr_2O_7$.
$\therefore (2 \times 1) + (2 \times x) + 7(-2) = 0$
or $2 + 2x - 14 = 0$ or $x = +6$.

23. (a) (i) Oxidation state of element in its free state is zero.
(ii) Sum of oxidation states of all atoms in compound is zero.
O.N. of S in $S_8 = 0$; O.N. of S in $S_2F_2 = +1$;
O.N. of S in $H_2S = -2$;

24. (c) $K[Co(CO)_4]$
Let O.N. of Co be x then

$$\underset{\text{for K}}{1 \times (+1)} + \underset{\text{for Co}}{x} + \underset{\text{for CO}}{4 \times} (0) = 0$$

$\therefore$ O.N. of Co is = –1

25. (d) $(NH_4)_2SO_4$ is split into ions. NH_4^+. Let O.N. of N be x then, $1 \times (x) + 4 \times (+1) = 1 \quad \therefore x = -3$

26. (c) $\overset{+1}{H}-\overset{H^{+1}}{\underset{Cl^{-1}}{\overset{|}{\underset{|}{C}}}}\overset{2-}{\underset{2+}{}}-Cl^{-1}$ O.N. of C is zero

27. (d) O.N. of Fe in (a), (b), (c) and (d) respectively are : +3, +2, +2 and 0.

28. (d) OsO_4
Let O.N. of Os be x then $1 \times (x) + 4(-2) = 0$
$\therefore\ x = 8$

29. **(a)** $Fe(CO)_5$ is metal carbonyl, hence O.N. of Fe is zero.

30. **(c)** O.N. of Mn in K_2MnO_4 is +6

31. **(d)** MnO_4^- (O.S. of Mn +7); $Cr(CN)_6^{3-}$ (O.S. of Cr +3), NiF_6^{2-} (O.S. of Ni +4) and CrO_2Cl_2 (O.S. of Cr +6)

32. **(d)** O.N. of carbon in CH_3CHO is –1; in other cases it is zero.

33. **(b)** O.N. of iodine in I_3^- is –1/3

34. **(b)** M^{3+} on losing 3 elections will become M^{+6} and O.N. = + 6.

35. **(b)** The method of representing oxidation number by a Roman numeral within the paranthesis represents Stock notation.

36. **(c)** Carbon has the maximum oxidation state of + 4, therefore carbon dioxide (CO_2) cannot act as a reducing agent.

37. **(b)** Let the oxidation no. of Fe in $Fe_3O_4 = x$

$\therefore \; 3x + (-2 \times 4) = 0$ or $\quad 3x = 8$

$\therefore \; x = \frac{8}{3}$

38. **(c)** Let oxidation state of oxygen in $OF_2 = x$

$\therefore \; x + (-1 \times 2) = 0$

$\therefore \; x = +2$

39. **(d)** In $H_2O_2 : \Rightarrow 2 \times (+1) + 2 \times x = 0 \; \Rightarrow x = -1$

In $CO_2 : \Rightarrow 4 + 2x = 0 \Rightarrow x = -2$

In $H_2O : \Rightarrow 2 \times (+1) + x = 0 \Rightarrow x = -2$

In $F_2O : \Rightarrow 2 \times (-1) + x = 0 \Rightarrow x = +2$

40. **(d)** $\underset{+5}{NO_3^-} \longrightarrow \underset{-2}{N_2H_4}$ So, for reduction of 1 mole of NO_3^- number of electrons required is 7.

41. **(a)** Let the oxidation state of S be x.

$S_4O_6^{2-} \Rightarrow 4x - 12 = -2 \Rightarrow 4x = 10 \Rightarrow x = 10/4 = 2.5$

42. **(c)**

Species	**O.N.**
Cl^-	– 1
$\underline{Cl}O_4^-$	+ 7
$\underline{Cl}O^-$	+ 1
$\underline{Mn}O_4^-$	+ 7

In ClO^- chlorine is in +1 oxidation state which can be increased or decreased thus it acts as an oxidising or reducing agent.

In other given species the underlined elements are either in their minimum or maximum oxidation state.

43. **(a)**

44. **(b)** O.N. of N changes from + 2 to + 5 hence NO is reducing.

45. **(b)** In $KMnO_4$: Let O.N. of Mn be x

$\Rightarrow +1 + x + 4(-2) = 0 \Rightarrow x = +7$

In $K_2Cr_2O_7$: Let O.N. of Cr be x

$\Rightarrow 2(1) + 2x + 7(-2) = 0 \Rightarrow x = +6$

46. **(d)** The element is Ti (At. no. 22). Electronic configuration is $1s^2, 2s^2p^6, 3s^2p^6d^2, 4s^2$. the energy level of 3d and 4s is very close. It can have Ti^{4+} O.S.

47. **(b)** Fluorine is so reactive that it attacks water and displaces the oxygen of water :

$$\underset{2H_2O(I)}{\overset{+1-2}{}} + \underset{2F_2(g)}{\overset{0}{}} \rightarrow \underset{4HF(aq)}{\overset{+1-1}{}} + \underset{O_2(g)}{\overset{0}{}}$$

48. **(b)** As fluorine is the strongest oxidising agent; there is no way to convert F^- ions to F_2 by chemical means. The only way to achieve F_2 from F^- is to oxidise it electrolytically.

49. **(c)** F_2 being most electronegative element cannot exhibit any positive oxidation state.

In ClO_4^- chlorine is present in its highest oxidation state i.e + 7. Therefore it does not show disproportionation reaction.

50. **(c)** A reaction, in which a substance undergoes simultaneous oxidation and reduction, is called disproportionation reaction. In these reactions, the same substance simultaneously acts as an oxidising agent and as a reducing agent. Here Cl undergoes simultaneous oxidation and reduction.

$$\underset{0}{2KOH + Cl_2} \rightarrow \underset{-1}{KCl} + \underset{+1}{KOCl} + H_2O.$$

51. **(d)** In disproportionation reaction, one element of a compound will simultaneously get reduced and oxidised. In ClO_4^-, oxidation number of Cl is + 7 and it can not increase it further. So, ClO_4^- will not get oxidised and so will not undergo disporportionation reaction.

52. **(d)** $3Br_2 + 6CO_3^{2-} + 3H_2O \rightarrow 5Br^- + BrO_3^- + 6HCO_3^-$

O.N. of Br_2 changes from 0 to –1 and +5 hence it is reduced as well as oxidised.

53. **(c)**

54. **(b)** Phosphorus, sulphur and chlorine disproportionate in the alkaline medium.

55. **(b)** $2H_2O \xrightarrow{\Delta} 2H_2 + O_2$

There is decomposition of H_2O molecule into H_2 and O_2.

56. **(a)** H^+ ions are added to the expression on the appropriate side so that the total ionic charges of reactants and products become equal.

57. **(d)** Since reaction is occuring in basic medium therefore $2OH^-$ are added on right side.

$$2MnO_4^-(aq) + Br^-(aq) \longrightarrow 2MnO_2(s) + BrO_3^-(aq) + 2OH^-(aq)$$

Now, hydrogen atoms balanced by adding one H_2O molecule to the left side

$$2MnO_4^-(aq) + Br^-(aq) + H_2O(\ell) \longrightarrow 2MnO_2(s) + BrO_3^-(aq) + 2OH^-(aq)$$

58. **(c)** The balanced equation :

$$2NH_3 + OCl^- \longrightarrow N_2H_4 + Cl^- + H_2O$$

59. **(b)** The balanced equation is

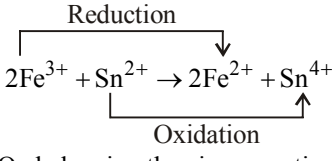
$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O.$$

Ratio of the coefficients of CO_2 and H_2O is 4 : 6 or 2 : 3.

60. **(a)** $2MnO_4^- + 5H_2O_2 + 6H^+ \rightarrow 2Mn^{2+} + 5O_2 + 8H_2O.$

61. **(d)** $8KMnO_4 + 3NH_3 \longrightarrow 8MnO_2 + 3KNO_3 + 5KOH + 2H_2O$

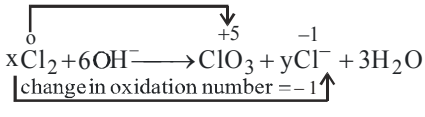
62. **(b)**



63. **(c)** On balancing the given reaction, we find

$$3Na_2HAsO_3 + NaBrO_3 + 6HCl \longrightarrow 6NaCl + 3H_3AsO_4 + NaBr$$

64. **(c)**



on balancing the eq we get

$$3Cl_2 + 6OH^- \longrightarrow ClO_3^- + 5Cl^- + 3H_2O$$

65. **(d)** Negative $E^{\Theta} \Rightarrow$ Stronger reducing agent or weaker oxidising agent

Positive $E^{\Theta} \Rightarrow$ Weaker reducing agent or stronger oxidising agent.

66. **(b)** Strongest oxidising agent = $Ag^+/Ag(s)$

Weakest oxidising agent = $Mg^{2+}/Mg(s)$

67. **(a)** More is E°_{RP}, more is the tendency to get itself reduced or more is oxidising power.

68. **(a)** Higher the value of reduction potential higher will be the oxidising power whereas the lower the value of reduction potential higher will be the reducing power.

69. **(c)** The redox couple with maximum reduction potential will be best oxidising agent and with minimum reduction potential will be best reducing agent.

70. **(a)** Since oxidation potential of Zn is highest hence strongest reducing agent.

71. **(a)**

Fe	Al	Br	
0.77	–1.66	1.08	E°_{Red}
–0.77	1.66	–1.08	E°_{Oxi}

Hence, reducing power $Al > Fe^{2+} > Br^-$

72. **(d)** More the negative reduction potential, more is the tendency to lose electron. The reducing power increases as the standard reduction potential becomes more and more negative.

Thus, Li is the strongest reducing agent as the standard reduction potential of Li^+/Li is most negative, –3.05 V.

73. **(a)** Lower the value of reduction potential higher will be reducing power hence the correct order will be $Mn^{2+} < Cl^- < Cr^{3+} < Cr$

74. **(d)**

75. **(d)** Order of decreasing electrode potentials of Mg, K, Ba and Ca is

Mg > Ca > Ba > K

It can be explained by their standard reduction potentials.

$$E^{\circ}_{K^+|K} = -2.925$$

$$E^{\circ}_{Ba^{2+}|Ba} = -2.90$$

$$E^{\circ}_{Ca^{2+}|Ca} = -2.87$$

$$E^{\circ}_{Mg^{2+}|Mg} = -2.37$$

Highly negative value of E°_{red} shows the least value of electrode potential.

76. **(a)** Standard electrode potential i.e. reduction potential of A is minimum (–3.05V) i.e. its oxidation potential is maximum which implies 'A' is most reactive chemically.

STATEMENT TYPE QUESTIONS

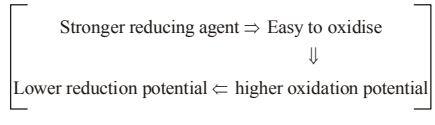
77. **(a)** For statement (iii), $HgCl_2$ is reduced to Hg_2Cl_2

78. **(b)** For statement (ii) reducing agents are donor of electrons.

79. **(b)** H_2O_2 is strong oxidizing than I_2, reduction potential of H_2O_2 is greater than that of I_2.

80. **(d)** All the given statements are correct.

81. **(a)** (i) $M^{n+} + ne^- \rightleftharpoons M$, for this reaction, high negative value of E° indicates lower reduction potential, that means M will be a good reducing agent.



(ii)

Element	F	Cl	Br	I
Reduction potential (E° volt)	+2.87	+1.36	+1.06	+0.54

As reduction potential decreases from fluorine to iodine, oxidising nature also decreases from fluorine to iodine.

(iii) The size of halide ions increases from F^- to I^-. The bigger ion can loose electron easily. Hence the reducing nature increases from HF to HI.

82. **(a)**

83. (a) –(4/3) is the average oxidation state of C in C_3H_4.

MATCHING TYPE QUESTIONS

84. (b) Oxidation is addition of electronegative or removal of electroposition element to a substance or removal of hydrogen from a substance.
Reduction is addition of electropositive or removal of electropositive element or removal of oxygen from a substance.

85. (b)

86. (a) $\underline{Cu}O \Rightarrow +2$
$\underline{Mn}O_2 \Rightarrow +4$
$H\underline{Au}Cl_4 \Rightarrow +3$
$\underline{Tl}_2O \Rightarrow +1$

87. (b)

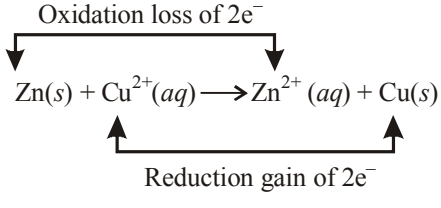
ASSERTION-REASON TYPE QUESTIONS

88. (c) In reaction $2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$ sodium is oxidised by loss of electrons and acts as a reducing agent (donor of electrons).

89. (b) Both Assertion and Reason are true but reason is not the correct explanation of assertion. Greater the number of negative atoms present in the oxy-acid make the acid stronger. In general, the strengths of acids that have general formula $(HO)_m ZO_n$ can be related to the value of n. As the value of n increases, acidic character also increases. The negative atoms draw electrons away from the Z-atom and make it more positive. The Z-atom, therefore, becomes more effective in withdrawing electron density away from the oxygen atom that bonded to hydrogen. In turn, the electrons of H – O bond are drawn more strongly away from the H-atom. The net effect makes it easier from the proton release and increases the acid a strength.

90. (b) Decomposition of calcium carbonate is not a redox reaction.

91. (a)



CRITICAL THINKING TYPE QUESTIONS

92. (c) Calculating the oxidation state of nitrogen in given molecules;
Oxidation state of N in NH_3 is
$x + 3 \times (+1) = 0$ or $x = -3$
Oxidation state on N in $NaNO_3$ is
$1 + x + 3 \times (-2) = 0$ or $x = +5$
Oxidation state of N in NaN_3 is
$+1 + 3x = 0$ or $x = -\frac{1}{3}$
Oxidation state of N in Mg_3N_2 is
$3 \times 2 + 2x = 0$ or $x = -3$
Thus 3 molecules (i.e. NH_3, NaN_3 and Mg_3N_2 have nitrogen in negative oxidation state.

93. (b)

94. (b) Oxidation no. of O are + 2, 0, – 1/2 and – 1 respectively

95. (d) $PO_4^{3-} = x + 4(-2) = -3;\ x - 8 = -3;\ x = +5$

$SO_4^{2-} = x + 4(-2) = -2;\ x - 8 = -2;\ x = +6$

$Cr_2O_7^{2-} = 2x + 7(-2) = -2;\ 2x - 14 = -2;$
$2x = 12;\ x = +6$

96. (b) On reaction with hot and concentrated alkali a mixture of chloride and chlorate is formed

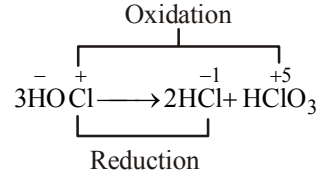
$$3Cl_2 + 3\,NaOH_{(excess)} \xrightarrow{Hot} \overset{-1}{5NaCl} + \overset{+5}{NaClO_3} + 3H_2O$$

97. (a)

98. (d) In (i) and (ii) both P and S are in highest oxidation state. In (iii) and (iv) ; P has oxidation state of +4 which can be oxidized to +5 state, while in case of NH_3 nitrogen has oxidation state of –3 which can be oxidised.

99. (c) The redox reaction involve loss or gain of electron(s) i.e. change in oxidation state. Given reaction is not a redox reaction as this reaction involves no change in oxidation state of reactant or product.

100. (b) During disproportionation same compound undergo simultaneous oxidation reduction.



101. (a) $ClO_3^- \longrightarrow Cl_2^0$
$x - 6 = -1 \quad x = 0$
$x = +5 \quad x = 0$ (x = oxidation number)

$$\text{Equivalent mass} = \frac{\text{Molecular mass}}{\text{Oxidation number}} = \frac{84.45}{5} = 16.89$$

102. (c) On balancing the given equations, we get

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{++} + 10CO_2 + 8H_2O$$

So, $x = 2, y = 5$ & $z = 16$

103. (a) Given reaction is

$IO_3^- + aI^- + bH^+ \longrightarrow cH_2O + dI_2$

I[st] half reaction

$I^- \longrightarrow I_2$ ...(i)

$-1 \quad 0$ (oxidation)

II[nd] half reaction

$IO_3^- \longrightarrow I_2$ ...(ii)

$+5 \quad 0$ (reduction)

On balancing equation (ii) we have

$10e^- + 2IO_3^- + 12H^+ \longrightarrow I_2 + 6H_2O$ ...(iii)

Now, balance equation (i)

$2I^- \longrightarrow I_2 + 2e^-$ ....(iv)

Multiply eqn (iv) by 5 and add it to eqn (iii), we get

$2IO_3^- + 10I^- + 12H^+ \longrightarrow 6I_2 + 6H_2O$

or, $IO_3^- + 5I^- + 6H^+ \longrightarrow 3I_2 + 3H_2O$

Hence a = 5, b = 6, c = 3, d = 3

104. (a) Both Fe(ii) and S(iv) in SO_3^{2-} can be oxidised to Fe(iii) and $(SO_4)^{2-}$ respectively hence (3/5)×0.5 =0.3 moles / litre.

$\left[MnO_4^- + 5e^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O\right] \times \frac{3}{5}$

$Fe^{2+} \longrightarrow Fe^{3+} + 1e^-$

$SO_3^{2-} \longrightarrow SO_4^{2-} + 2e^-$

$$\frac{8}{5}MnO_4^- + \frac{24}{5}H^+ + Fe^{2+} + SO_3^{2-} \longrightarrow 3Mn^{2+} + 4H_2O + Fe^{3+} + SO_4^{2-}$$

105. (b) If one uses HCl, HBr or HI, to make acidic medium for $KMnO_4$ than all the halide ion can be oxidized as the reduction potential of $KMnO_4$ is very high in acidic medium, while in case of H_2SO_4, sulphur is already in its highest oxidation state cannot be further oxidized.

106. (d) Reduction potential of Cu(II) is greater than that of Zn(II) and Al(III) thus can be easily replaced by these ions. Moreover solution of copper is blue in color.

107. (d) F_2 is strongest oxididing agent among halogens thus X^- can be possibly Br^-, Cl^- or I^-.