Stoichiometry and Redox Reactions

SOLUTIONS

EXERCISE - O

1. **Ans. (D)**

Oxidation number of oxygen is (–1) in peroxide.

2. **Ans. (B)**

(A) Halogens mostly have –1 oxidation state in their compounds. However, Cl, Br & I also show + 1, + 3, +5 & + 7 in some cases.

(C) In OF_2, the oxidation number of F is –1.

(D) Hydrogen mostly has + 1 oxidation number in its compounds, except in metal hydrides (–1).

3. **Ans. (C)**

Let oxidation number of C is x.

Adding oxidation numbers of all atoms & equating to 0,

$x + 2(-2) = 0 \quad \therefore C : +4;$

Similarly, for other compound, $2(+1) + x + 4(-2) = 0 \therefore$ Mn : + 6

The sum of the oxidation states of all the underlined elements is 4 + 6 = 10.

4. **Ans. (C)**

Let oxidation number of P is x.

Adding oxidation numbers of all atoms & equating to 0,

$2(+2) + 2x + 7(-2) = 0$

$\therefore x = +5$

5. **Ans. (A)**

S_8 : Elemental form, so O.N. = 0

$S_2F_2 : 2x + 2(-1) = 0 \therefore x = +1$

6. **Ans. (C)**

$$K\overset{(7\oplus)}{Mn}O_4 > K_2\overset{(6\oplus)}{Mn}O_4 > \overset{(4\oplus)}{Mn}O_2 > \overset{(8/3\oplus)}{Mn_3}O_4$$

7. **Ans. (D)**

$$\overset{+2}{Zn}\,\overset{-2}{S} + H\overset{+5}{N}O_3 \longrightarrow \overset{+2}{Zn}(\overset{+5}{N}O_3)_2 + H_2\overset{+6}{S}O_4 + \overset{+4}{N}O_2$$

8. **Ans. (B)**

Let oxidation state of Fe in (B) compound is x.

Adding oxidation numbers of all atoms & equating to 0,

$(x + 5 \times 0 + 1) - 2 = 0 \quad \Rightarrow \quad x = +1$

9. **Ans. (D)**

S undergoes increase in oxidation number from +2 to +2.5, while I undergo decrease in oxidation number from 0 to –1.

10. **Ans. (D)**

$H_2S_2O_8 = H_2SO_4 > SO_2 > H_2S$

(+6) (+6) (+4) (–2)

$H_2S_2O_8$ (has two O in –1, peroxide) $[2(+1) + 2x + 6(-2) + 2(-1) = 0 ; x = +6]$

11. Ans. (D)

In all reactions, a single reactant decomposes into 2 or more products so all are decomposition reaction.

12. Ans. (D)

In 4th reaction, Cu displaces $Ag^{\oplus}$ from $AgNO_3$. Cu gets oxidised and $Ag^{\oplus}$ gets reduced.

13. Ans. (D)

In 4th reaction, N is oxidised ($-3 \rightarrow 0$) and Cr is reduced ($+6 \rightarrow +3$). So, it is not a disproportionation reaction.

14. Ans. (C)

3rd reaction is a combination reaction but not a redox reaction.

15. Ans. (D)

In 4th reaction, Sn is oxidised ($+2 \rightarrow +4$) and Hg is reduced ($+2 \rightarrow 0$)

16. Ans. (B)

In 2nd reaction, H_2 is oxidised ($0 \rightarrow +1$) and Cl_2 is reduced ($0 \rightarrow -1$)

17. Ans. (C)

In (C) option, Cl goes from +5 to +7 and –1.

18. Ans. (B)

O is removed from H_2O_2. So, reduction of H_2O_2 occurs.

19. Ans. (B)

$Fe^{2\oplus} \rightarrow Fe^{3\oplus} + e^{\ominus}$; loss of electron is oxidation.

20. Ans. (D)

O is removed from ZnO & added to C.

21. Ans. (C)

H is removed from CH_4 & added to O_2.

22. Ans. (D)

Electronegative atom (Cl) is added to Zn & removed from $CuCl_2$.

23. Ans. (D)

Electronegative atom (F) is added to Mg & electropositive atom (Mg) is added to F_2.

24. Ans. (D)

Electronegative atom (N) is added to Mg & electropositive atom (Mg) is added to N_2.

25. Ans. (C)

Electronegative atom (Cl) is added to Fe & electropositive atom (Fe) is added to Cl_2.

26. Ans. (A)

$S_2O_3^{2\ominus}$ gets oxidized

27. Ans. (A)

$$K\overset{(7\oplus)}{Mn}O_4 + K\overset{(1\ominus)}{Cl} + H_2SO_4 \longrightarrow \overset{(2\ominus)}{Mn}SO_4 + K_2SO4 + H_2O + \overset{(0)}{Cl_2}$$

$$K\overset{(7\oplus)}{Mn}O_4 \text{ (oxidant)} \longrightarrow \overset{(2\oplus)}{Mn}SO_4 \text{ (reduction half)}$$

$$K\overset{(1\ominus)}{Cl} \text{ (reductant)} \longrightarrow \overset{(0)}{Cl_2} \text{ (oxidation half)}$$

28. **Ans. (A)**

$$\overset{(2\oplus)}{FeCl_2} + \overset{(1\ominus)}{H_2O_2} + HCl \longrightarrow \overset{(3\oplus)}{FeCl_3} + \overset{(2\ominus)}{H_2O}$$

$$\overset{(2\oplus)}{FeCl_2}\text{ (reductant)} \longrightarrow \overset{(3\oplus)}{Fe\ Cl_3}\text{ (oxidation half)}$$

$$\overset{(1\ominus)}{H_2O_2}\text{ (oxidant)} \longrightarrow \overset{(2\ominus)}{H_2O}\quad\text{(reduction half)}$$

29. **Ans. (D)**

In (A), (B) & (C) reactions, H_2O_2 oxidises others and itself gets reduced to H_2O. So, it acts as oxidising agent (oxidant) in all 3 reactions.

30. **Ans. (B)**

H_2O_2 is getting reduced in reaction (A) and is getting oxidised in reaction (B).

So, H_2O_2 acts as oxidant in reaction (A) and reductant in reaction (B).

31. **Ans. (C)**

$NO_3^{\ominus} + 4H^{\oplus} + 3e^{\ominus} \rightarrow 2H_2O + NO$ (charge balance)

32. **Ans. (D)**

$NO_3^{\ominus} + 7H^{\oplus} + 6e^{\ominus} \rightarrow NH_2OH + 2H_2O$ (on balancing reduction half)

33. **Ans. (C)**

$$\underset{\Delta=1}{\overset{-1}{HI}} + \underset{\Delta=3}{H\overset{+5}{N}O_3} \longrightarrow NO + I_2 + H_2O$$

On exchanging Δ values, x : y = 3 : 1. Here, (C) option has correct ratio.

34. **Ans. (A)**

$$\underset{\Delta=6}{\overset{+6}{Cr_2}O_7^{2\ominus}} + \underset{\Delta=2}{\overset{+3}{C_2}O_4^{2\ominus}} + H^{\oplus} \longrightarrow Cr^{3\oplus} + \overset{+4}{C}O_2 + H_2O$$

∴ Balanced equation : $Cr_2O_7^{2\ominus} + 3C_2O_4^{2\ominus} + 14H^{\oplus} \longrightarrow 2Cr^{3\oplus} + 6CO_2 + 7H_2O$

35. **Ans. (C)**

1

$$\underset{0}{xP_4} + \underset{+5}{yHNO_3} \longrightarrow \underset{+5}{4H_3PO_4} + \underset{+4}{NO_2} + H_2O$$

4 × 5 = 20

∴ (Δ)P_4 : (Δ) HNO_3 = 20 : 1

∴ x = 1 ; y = 20

36. **Ans. (A)**

On balancing all atoms on reactant side, we get x = 2, y = 6 and z = 8.

37. **Ans. (B)**

$X^{\ominus} + XO_3^{\ominus} + H^{\oplus} \longrightarrow X_2 + H_2O$

Δ = 1 Δ = 5

∴ Molar ratio = 5 : 1

38. **Ans. (B)**

$$\overset{0}{P_4} + OH^{\ominus} \rightarrow \underset{\Delta=0-(-3)=3}{\overset{-3}{P}H_3} + \underset{\Delta=1-0=1}{H_2\overset{+1}{P}O_2^{\ominus}}$$

∴ Ratio of coefficients of PH_3 and $H_2PO_2^{\ominus}$ = 1 : 3

39. **Ans. (A)**

Balanced reaction is :

$2KMnO_4 + 5H_2O_2 + 3H_2SO_4 \longrightarrow 2MnSO_4 + 5O_2 + 8H_2O + K_2SO_4$

$\therefore$ Sum of stoichiometric coefficients = 2 + 5 + 3 + 2 + 5 + 8 + 1 = 26

40. **Ans. (A)**

On balancing Na atoms on both sides of reaction, we get :

$y = 6x$.

$\therefore$ $x : y = 1 : 6$ (only 1st option matches).

41. **Ans. (D)**

Equating number of O-atoms on both sides :

$3b = a + b + 2a + c/2$

$\therefore$ $4b = 6a + c$

Also, from charge balance : $c = a + b$

$\therefore$ $a : b : c = 3 : 7 : 10$

42. **Ans. (B)**

In 40 g metal oxide, weight of metal is $\frac{60}{100} \times 40 = 24$g and weight of oxygen is 16 g.

$\because$ 16 g oxygen combines with 24 g metal

$\therefore$ 8 g oxygen combines with 12 g metal

Hence, equivalent weight of metal is 12.

43. **Ans. (B)**

H_3PO_4 is losing $2H^{\oplus}$ ions per molecule in this reaction. Therefore, valence factor of H_3PO_4 is 2

$\Rightarrow$ equivalent mass = $\frac{\text{Molecular weight}}{\text{v.f.}} = \frac{98}{2} = 49$

44. **Ans. (D)**

$Cr_2O_7^{2\ominus} + 14H^{\oplus} + 6e^{\ominus} \longrightarrow 2Cr^{3\oplus} + 7H_2O$.

$\Rightarrow$ v.f. $(Cr_2O_7^{2\ominus}) = 6$

$\Rightarrow$ equivalent weight of $Cr_2O_7^{2\ominus} = \frac{M}{6}$

45. **Ans. (D)**

$Na_2\overset{+2}{S_2}O_3 \rightarrow Na_2\overset{+2.5}{S_4}O_6$

$\Rightarrow$ v.f. $(Na_2S_2O_3) = 2(2.5 - 2) = 1$

$\Rightarrow$ equivalent weight of $Na_2S_2O_3 = \frac{M}{1}$

46. **Ans. (C)**

Here SO_2 act as an oxidising agent, and since it reduces to form S, therefore its valence factor is 4.

$\overset{4\oplus}{S}O_2 \longrightarrow \overset{0}{S}$

$\Rightarrow$ Equivalent mass of $SO_2 = \frac{\text{Moleculare weight}}{\text{v.f.}} = \frac{64}{4} = 16$

47. **Ans. (B)**

The oxidation half reaction is

$4H_2O + 3Fe \longrightarrow Fe_3O_4 + 8H^{\oplus} + 8e^{\ominus}$

Since 3 Fe atoms are losing $8e^{\ominus}$

$\Rightarrow e^{\ominus}$ lost per atom = v.f. of Fe = 8/3

$\Rightarrow$ Equivalent weight of $Fe = \dfrac{\text{Atomic weight}}{\text{v.f.}} = \dfrac{56}{8/3} = 21$

48. **Ans. (A)**

Balanced half reaction is

$FeC_2O_4 \longrightarrow Fe^{3\oplus} + CO_2 + 3e^{\ominus}$

Since v.f. of FeC_2O_4 is 3, hence its equivalent weight is $\dfrac{M}{3}$

49. **Ans. (D)**

Balanced half reaction is

$4H_2O + Cu_2S \longrightarrow 2Cu^{2\oplus} + SO_4^{2\ominus} + 8H^{\oplus} + 10\ e^{\ominus}$

Since $e^{\ominus}$ lost per molecule of Cu_2S is 10,

$\Rightarrow$ v.f. of $Cu_2S = 10$

50. **Ans. (C)**

6.022×10^{23} electrons $\equiv$ 1 equivalent

$\therefore\ \ 6.022 \times 10^{20}$ electrons $= \dfrac{6.022 \times 10^{20}}{6.022 \times 10^{23}} = 0.001$ equivalent

51. **Ans. (C)**

Equivalent weight of $H_2C_2O_4.2H_2O = \dfrac{\text{Molecular weight}}{\text{v.f.}} = \dfrac{126}{2} = 63$

Equivalents $(H_2C_2O_4.2H_2O) = \dfrac{\text{weight}}{\text{Eq.w.t.}}$

$\therefore 0.01 = \dfrac{w}{63}$

$\therefore$ W = 0.63 g

52. **Ans. (C)**

$\overset{2\oplus}{V}O + \overset{3\oplus}{Fe_2}O_3 \longrightarrow \overset{2\oplus}{Fe}O + \overset{5\oplus}{V_2}O_5$

n.f. of $V_2O_5 = 3\times2 = 6$

Eq. Wt. = $\dfrac{M}{6}$

53. **Ans. (C)**

$A^{n_2\ominus} + xe^{\ominus} \longrightarrow A^{n_1\ominus}$

Gain of $e^{\ominus} = -n_2 - (-n_1)$

$x = n_1 - n_2$

54. **Ans. (B)**

(A) $H\overset{5\oplus}{N}O_3 \longrightarrow \overset{0}{N_2}$

$1 \times \text{n.f.} = \dfrac{1}{2} \times 10$

n.f. = 5

(B) $H\overset{5\oplus}{N}O_3 \longrightarrow \overset{1\oplus}{N_2}O$

$1 \times \text{n.f.} = \frac{1}{2} \times 8$

n.f. = 4

(C) $H\overset{5\oplus}{N}O_3 \longrightarrow \overset{4\oplus}{N}O_2$

1 × n.f. = 1 × 1

n.f. = 1

(D) $H\overset{5\oplus}{N}O_3 \longrightarrow \overset{3\ominus}{N}H_3$

1 × n.f. = 1 × 8

55. **Ans. (B)**

(A) $\overset{2\oplus}{Mn}SO_4 \longrightarrow \overset{3\oplus}{Mn_2}O_3$

n.f. = 1

$\text{Eq. Wt.} = \frac{M}{1}$

(B) $\overset{2\oplus}{Mn}SO_4 \longrightarrow \overset{4\oplus}{Mn}O_2$

n.f. = 2

$\text{Eq. Wt.} = \frac{M}{2}$

(C) $\overset{2\oplus}{Mn}SO_4 \longrightarrow \overset{7\oplus}{Mn}O_4^{\ominus}$

n.f. = 5

$\text{Eq. Wt.} = \frac{M}{5}$

(D) $\overset{2\oplus}{Mn}SO_4 \longrightarrow \overset{6\oplus}{Mn}O_4^{2\ominus}$

n.f. = 4

$\text{Eq. Wt.} = \frac{M}{4}$

56. **Ans. (B)**

Oxidation, n-factor = 1

$Cr_2O_7^{2\ominus} + I^{\ominus} + H^{\oplus} \rightarrow Cr^{3\oplus} + I_2 + H_2O$

Reduction, n-factor = 6

Here, reductant is $I^{\ominus}$ so equivalent weight of $I^{\ominus}$ is $\frac{127}{1}$.

57. **Ans. (A)**

$KMnO_4 \longrightarrow Mn^{2\oplus}$

Milliequivalents of $KMnO_4$ = Moles × v.f. × 1000

$$= \frac{1.58}{158} \times 5 \times 1000 = 50$$

58. **Ans. (D)**

Equivalents = Normality × V(in L)

$1 = 0.1 \times V$

$\therefore V = 10$ L

59. **Ans. (C)**

milli equivalent of H_3PO_4 = V(mL) × M × v.f. = 120 × 1.5 × 3 = 540

60. **Ans. (D)**

Valence factor of $KMnO_4 = 5$ ($\because Mn^{7\oplus} \longrightarrow Mn^{2\oplus}$)

$\therefore$ meq of $KMnO_4$ = 0.1 × 20 × 5 = 10

Valence factor of oxalate = 2 ($\because \overset{+3}{C_2}O_4^{2\ominus} \longrightarrow \overset{+4}{C}O_2$)

$\therefore$ meq of oxalate in (D) option = 0.1 × 50 × 2 = 10

Since milliequivalents are equal, (D) option is correct.

61. **Ans. (D)**

$Cr_2O_7^{2\ominus} + 14H^{\oplus} + 6I^{\ominus} \longrightarrow 3I_2 + 2Cr^{3\oplus} + 7H_2O$

(v.f.=3×2=6) (v.f.=2)

Equivalents of $K_2Cr_2O_7$ = equivalents of I_2

1 × 6 = moles of I_2 × 2

$\therefore$ Moles of $I_2 = 3$

62. **Ans. (C)**

$\overset{-2}{N_2}H_4 \longrightarrow 2N^{x\oplus} + 10e^{\ominus}$

$\therefore\ 2x - 2(-2) = 10.$

$\therefore\ 2x = 6$

$\therefore\ x = +3.$

63. **Ans. (D)**

	H_3PO_2	H_3PO_3	H_3PO_4
v.f.	1	2	3
	NaOH	$Ca(OH)_2$	$Al(OH)_3$
v.f.	1	2	3

m.eq. must be equal, $\therefore$ 1 × 1 = x × 1 ; 1 × 2 = y × 2 ; 1 × 3 = z × 3

So, x : y : z = 1 : 1 : 1

64. **Ans. (A)**

$H_2C_2O_4$	NaOH
$M = \frac{63 \times 1000}{126 \times 100}$	$M = \frac{40 \times 1000}{40 \times 100}$
M = 5	M = 10
N = 10	N = 10
V = 125 mL	V = 125 mL
N_1V_1 = 1250 milli equivalent	N_2V_2 = 1250 milli equivalent

so, resulting solution will be neutral.

65. **Ans. (D)**

$H_2C_2O_4$ readily participates in oxidation-reduction and acid-base reactions both (due to 2 acidic H and C in +3 oxidation state which can oxidised to + 4).

66. **Ans. (B)**

meq of $CaCO_3$ + meq of KOH = meq of HCl

$$\left(\frac{10}{100}\right) \times 2 \times 1000 + 2 \times 1 \times v = 1 \times 1 \times 250$$

$(\because\ CO_3^{2\ominus} \longrightarrow H_2CO_3\ (CO_2 + H_2O)\ ;\ \ CO_3^{2\ominus}$ accepts $2H^{\oplus}$ $\therefore$ v.f. = 2)

So, V = 25 mL.

67. **Ans. (B)**

Eq. of MnO_2 = Eq. of $H_2C_2O_4$

Mol × n.f. = N × V

$$\frac{x}{87} \times 2 = 0.16 \times \frac{35}{1000} \Rightarrow x = 0.24 \text{ gm}$$

68. **Ans. (D)**

$\%\frac{w}{w} \rightarrow$ unitless

69. **Ans. (B)**

$$\%\frac{w}{w} = \frac{20}{20 + 80} \times 100 = 20\%$$

70. **Ans. (B)**

$$\%\frac{w}{w} = \frac{20}{80} \times 100 = 25\%$$

71. **Ans. (D)**

58.5% w/w, means 58.8 gm NaCl present in 100 gm solution

$$n_{NaCl} = \frac{58.5}{58.5} = 1$$

72. **Ans. (A)**

$$25 = \frac{W_{glucose}}{200} \times 100$$

$W_{glucose}$ = 50 gm

73. **Ans. (C)**

$$\frac{20}{80} \times 100 = 25\%$$

74. **Ans. (A)**

$$\%\frac{w}{V} = \frac{v \times d}{V} \times 100 = \frac{40 \times 1}{160+40} = 20\%$$

75. **Ans. (B)**

$$\frac{g}{\text{litre}} = \frac{W_{solute}}{V_{solution\ (litre)}}$$

$$20 = \frac{W_{solute}}{500 \times 10^{-3}}$$

W_{solute} = 10 g

$$\text{mole} = \frac{10}{40} = 0.25 \text{ mol}$$

76. **Ans. (C)**

2 mol urea

$wt_{urea} = 2 \times 60 = 120$ g

$\%\frac{w}{V} = \frac{120}{360} \times 100 = 33.33\%$

77. **Ans. (C)**

$\%\frac{w}{V} = 20 = \frac{W_{NaOH}}{1\times10^{3}} \times 100$

$W_{NaOH} = 200$ g

$\text{mole} = \frac{200}{40} = 5$ mole

78. **Ans. (B)**

$\%\frac{v}{V} = \frac{30}{30+70} \times 100$

79. **Ans. (B)**

$\%\frac{v}{V} = \frac{20}{180} \times 100 = 11.11\%$

80. **Ans. (B)**

From the definition of $\%\frac{v}{V}$ 100 ml solution have 70 ml of alcohol.

So, 1000 ml (1 litre) have 700 ml of alcohol.

81. **Ans. (A)**

$20\ \%\frac{v}{V}$ H_2SO_4 solution

$V_{H_2SO_4} = 20$ ml

$\text{Density} = 1.8\frac{g}{ml}$

$W_{H_2SO_4} = 20 \times 1.8 = 36$ g

$\text{Mole } H_2SO_4 = \frac{36}{98} = 0.367$

82. **Ans. (A)**

$\%\frac{v}{V} = \frac{15}{15+75} \times 100$

$= \frac{15}{90} \times 100 = 16.66\%$

83. **Ans. (A)**

$\text{ppm} = \frac{0.25}{999.75+0.25} \times 10^{6} = 250$

84. **Ans. (C)**

$2.5 = \frac{\text{volume of } Cl_2}{30000\times10^{3}} \times 10^{6}$

$\Rightarrow$ volume of $Cl_2 = 75$ ml

85. **Ans. (D)**

$n_{NaCl} = \frac{5.85}{58.5} = 0.1$

$\text{Molarity} = \frac{0.1}{500} \times 1000 = 0.2$

86. **Ans. (C)**

1 ml → 1.17 g

Molarity $= \dfrac{1.17 \times 1000}{36.5} \Rightarrow 32.05$ M

87. **Ans. (A)**

$\% \% \dfrac{w}{V} = d \times \% \dfrac{w}{w}$ = 1.2 × 20 = 24%

88. **Ans. (B)**

30 mL, 50% $\dfrac{v}{v}$ solution = $\dfrac{50 \times 30}{100}$ = 15 mL

70 mL, 20% $\dfrac{v}{v}$ solution = $\dfrac{70 \times 20}{100}$ = 14 mL

Total volume of solution is 30 + 70 = 100 mL

Actual HCl = 15 + 14 = 29 mL

89. **Ans. (C)**

Weight of NaOH solution = 100 × $\dfrac{5}{3} = \dfrac{500}{3}$ gm

Weight of NaOH = $\dfrac{40}{100} \times \dfrac{500}{3} = \dfrac{200}{3}$ gm

Moles of NaOH = $\dfrac{200}{3 \times 40} = \dfrac{5}{3}$

Molecules = $\dfrac{5}{3} \times 6 \times 10^{23} = 10 \times 10^{23} = 10^{24}$

90. **Ans. (D)**

Molality $= \dfrac{11.7 \times 1000}{58.5 \times 500} = 0.4$ m

91. **Ans. (D)**

Molality $= \dfrac{18 \times 1000}{180 \times 1000} = 0.1$ m

92. **Ans. (C)**

Molality $= \dfrac{720 \times 1000}{18 \times 720} = 55.5$ m

93. **Ans. (D)**

$\overset{+7}{\text{KMnO}_4} \longrightarrow \overset{+4}{\text{MnO}_2}$

$\Rightarrow \text{v.f.}_{\text{KMnO}_4} = 3$

Normality = Molarity × v.f. ⇒ Molarity $= \dfrac{0.6}{3} = 0.2$M

94. **Ans. (D)**

Basicity of H_3PO_3 is 2 $\Rightarrow \text{v.f.}_{H_3PO_3} = 2$

Normality = Molarity × v.f. = 0.3 × 2 = 0.6 N

95. **Ans. (C)**

(A) Normality of NaOH $= \dfrac{16/40}{200} \times 1000 = 2N$

(C) Valence factor of H_2SO_4 = 2

$\Rightarrow N = M \times 2 = 2 \times 2 = 4\ N$

(D) Valence factor of HCl = 1

$\Rightarrow N = M \times 1 = \dfrac{1.5}{1} \times 1 = 1.5N$

96. **Ans. (C)**

$n_{H_2O} = \dfrac{36}{18} = 2$

$n_{[C_3H_5(OH)_3]} = \dfrac{46}{92} = 0.5$

$X_{[C_3H_5(OH)_3]} = \dfrac{0.5}{2+0.5} = 0.2$

97. **Ans. (B)**

$n_{N_2} = \dfrac{7}{28} n_{O_2} = \dfrac{8}{32}$

$= \dfrac{1}{4} = \dfrac{1}{4}$

$X_{O_2} = \dfrac{\frac{1}{4}}{\frac{1}{4}+\frac{1}{4}} = 0.5$

98. **Ans. (B)**

mass fraction of glucose $= \dfrac{18}{18+162} = \dfrac{18}{180} = 0.1$

99. **Ans. (C)**

13% by mass

$D_{Solution} = 0.98$ g/ml

$W_{Solute} = 13$ g

$V_{Solution} = \dfrac{100}{0.98}$ ml

Molarity $= \dfrac{\frac{13}{98} \times 1000}{\frac{100}{0.98}}$

$= \dfrac{13 \times 1000}{100 \times 100}$

= 1.3 M

100. **Ans. (D)**

$X_{urea} = 0.2 = \dfrac{n_{urea}}{n_{urea}+n_{water}}$

$X_{water} = 1 - 0.2 = 0.8$

$\dfrac{n_{urea}}{n_{water}} = \dfrac{0.2}{0.8} = \dfrac{w_{urea}/60}{w_{water}/18}$

$\dfrac{wt_{urea}}{wt_{water}} = \dfrac{2}{8} \times \dfrac{60}{18} = \dfrac{5}{6}$

Mass % of urea $= \dfrac{w_{urea}}{w_{Solution}} \times 100$

$= \dfrac{5x}{5x+6x} \times 100$

= 45.45

101. Ans. (B)

98% by weight

$W_{Solute} = 98$

$W_{Solution} = 100$

$D_{solution} = 1.8$ g/ml

$$\text{Molarity} = \frac{\frac{98}{98}\times 1000}{\frac{100}{1.8}} = 18\text{ M}$$

102. Ans. (A)

$W_{Solute} = 20$ g

$W_{Solvent} = 80$ g

$$\text{molality} = \frac{\frac{20}{180}\times 1000}{80}$$

$$= \frac{25}{18}\text{ m}$$

103. Ans. (B)

Molarity = 9 M

Molality = 18 M

Density = ?

$$m = \frac{1000M}{1000d - M \times M_w}$$

$$18 = \frac{1000\times 9}{1000\times d - 9\times 50}$$

$(18000\text{ d} - 9 \times 50) \times 18 = 9000$

$$\text{Density} = \frac{9000+8100}{18000}$$

$= 0.95$ g/cc

104. Ans. (B)

$$m = \frac{1000M}{1000d - M \times M_w}$$

$$3 = \frac{1000M}{1000\times 1.12 - M\times 40}$$

$1120 \times 3 - 120\text{ M} = 1000\text{ M}$

$$M = \frac{1120\times 3}{1120} = 3M$$

105. Ans. (D)

millimoles of HCl = 100 × 0.3 = 30

millimoles of H_2SO_4 = 200 × 0.3 = 60

$$\begin{array}{llll} HCl & \rightarrow H^{\oplus} & + & Cl^{\ominus} \\ 30 & & & \\ & \quad 30 & & 30 \end{array}$$

$$\begin{array}{llll} H_2SO_4 & \rightarrow 2H^{\oplus} & + & SO_4^{2\ominus} \\ 60 & & & \\ & \quad 120 & & 120 \end{array}$$

Total millimoles of $H^{\oplus}$ = 120 + 30 = 150

Total Volume = 100 + 200 = 300 ml

$$[H^{\oplus}] = \frac{150}{300} \Rightarrow 0.5\text{ M}$$

106. Ans. (C)

$M_1V_1 = M_2V_2$

$18 \times 50 = M_2 \times (50 + 50)$

$M_2 \Rightarrow \frac{18\times50}{100} = 9M$

107. Ans. (C)

Molarity (M) of solution $= \frac{\text{volume strength}}{11.35} = \frac{10}{11.35}$

$\%\left(\frac{w}{v}\right) = \frac{M \times \text{mol. wt. of solute}}{10} = \frac{10}{11.35} \times \frac{34}{10} = 3\%$

108. Ans. (D)

moles of $H_2O_2 = \frac{1}{24} \times X$

moles of $O_2 = \frac{3}{24} = \frac{1}{8}$

moles of $H_2O_2 = \frac{1}{4} = \frac{X}{24}$

$X = 6$

109. Ans. (A)

$H_2O_2 \rightarrow 34g$

in volume of solution = 1135 ml

moles of $H_2O_2 = \frac{34}{34} = 1$ mole

molarity $= \frac{n}{V} = \frac{1}{1135} \times 1000$

Volume strength = 11.35 × molarity

$= 11.35 \times \frac{1000}{1135}$

$= 10$ V

110. Ans. (C)

$H_2O_2 = 20\text{ V} = C$, Volume, $V_1 = 20$ ml.

Diluted to 80 ml $= V_2$

$C_1V_1 = C_2V_2$

$20\text{ ml} \times 20\text{ V} = 80\text{ ml} \times C_2$

$C_2 = \frac{400}{80} = 5$ V

111. Ans. (B)

$H_2O_2 = 11.35$ V

Molarity $= \frac{V}{11.35} = \frac{11.35}{11.35} = 1$

Strength = molar mass × molarity × 100%

$= \frac{34g}{mol} \times \frac{1\text{ g}}{1000\text{ ml}} \times 100$

$= 3.4\ \%$

112. Ans. (D)

$3BaCl_2 + 2Na_3PO_4 \longrightarrow Ba_3(PO_4)_2 + 6NaCl$

0.5 mol   0.2 mol

L.R.

$2 \text{ mol } Na_3PO_4 \longrightarrow 1 \text{ mol } Ba_3(PO_4)_2$

$0.2 \text{ mol } Na_3PO_4 \longrightarrow \frac{1}{2} \times 0.2 \Rightarrow 0.1 \text{ mol of } Ba_3(PO_4)_2$

113. Ans. (C)

$H_2 \quad + \frac{1}{2}O_2 \longrightarrow H_2O\ (l)$

4g   4g

2 mol $\frac{1}{8}$ mol

L.R.

$\because \frac{1}{2} \text{ mol } O_2 \longrightarrow 1 \text{ mol } H_2O$

$\therefore \frac{1}{8} \text{ mol} \longrightarrow \frac{1}{1/2} \times \frac{1}{8} = \frac{1}{4} \text{ mol}$

Wt. of $H_2O = 18 \times \frac{1}{4} \text{ mol} = 4.5 \text{ g}$

114. Ans. (B)

$A \quad + \quad 2\,B \longrightarrow C$

5   8

L.R.

$2 \text{ mol B} \longrightarrow 1 \text{ mol C}$

$8 \text{ mole B} \longrightarrow \frac{1}{2} \times 8 = 4 \text{ mol of C}$

115. Ans. (C)

	$2H_2S$	$+$	$SO_2 \longrightarrow$	$3S$	$+ \quad 2H_2O$
	1.5×10^{22}			1.6 g	
Mol	$\frac{1.5\times10^{22}}{6\times10^{23}}$			$\frac{1.6}{64}$	
Mol	$\frac{1}{40}$ mol L.R.			$\frac{1}{40}$ mol excess	

116. Ans. (D)

$N_2 \longrightarrow [Cr(NH_3)_x\,Br_2]$

On applying POAC on N atom

$\Rightarrow \quad 2 \times n_{N_2} = x \times n_{[Cr(NH_3)_x\,Br_2]}$

$\Rightarrow \quad 2 \times \frac{6}{28} = x \times \frac{30}{[52+17x+160]}$

$\Rightarrow \quad 52 + 160 + 17x = x \times 30 \times \frac{28}{12}$

$\Rightarrow \quad 212 + 17x = 70\,x$

$\Rightarrow \quad 212 = 53\,x$

$\Rightarrow \quad x = \frac{212}{53} = 4$

117. Ans. (A)

$CaCO_3 \longrightarrow CaO + CO_2$

Pure $CaCO_3 = 10 \times \frac{90}{100} = 9$ g

$n_{CaCO_3} = \frac{9}{100}$

n_{CO_2}produces $= \frac{9}{100}$

Volume of CO_2 at STP $= \frac{9}{100} \times 22.7 = 2.043$ L

118. Ans. (C)

$CaCO_3$	+	2HCl	$\longrightarrow$	CO_2	+	$CaCl_2$	+	H_2O
1 mole				1 mole				
100 g				22.4 L				

Now calculation of $CaCO_3$ for 3.36 L CO_2

22.4 L $CO_2 \longrightarrow$ 100 g $CaCO_3$

1 L $CO_2 \longrightarrow \frac{100}{22.4}$ g $CaCO_3$

3.36 L $\longrightarrow \frac{100}{22.4} \times 3.36 = 15$ g

% Purity $= \frac{15}{20} \times 100 = 75\%$

119. Ans. (D)

$M_T = M_{NH_3} = 17, M_0 = 100$ (given), $n = \frac{4}{2} = 2$

$$\alpha = \frac{M_T - M_0}{(n-1)M_0} = \frac{17-10}{(2-1)10} = \frac{7}{10} = 0.7$$

120. Ans. (D)

$C_4H_8(g) \rightarrow 2C_2H_4\,(g) \qquad n = \frac{2}{1} = 2$

$M_T = M_{C_2H_8} = 56;\ M_0 = 40$

$$\alpha = \frac{M_T - M_0}{(n-1)M_0} = \frac{56-40}{(2-1)40} = \frac{16}{40} = 0.40$$

121. Ans. (C)

	A	→	B
Initial moles	8 moles		
Final	8 – 5		5
	$8\left(1 - \frac{5}{8}\right)$		

$$\alpha = \frac{\text{moles consumed}}{\text{Total moles}} = \frac{5}{8} = 0.625$$

122. Ans. (A)

(a)

	C	+	$\frac{1}{2}O_2$	$\longrightarrow$	CO
t = 0	1mol		5 mol		
	0		5 – 0.5		
	(LR)		4.5 mol		1 mol

[initially use a reaction using lesser amount of oxygen]

Since CO & O_2 are left, CO_2 will also formed.

	CO	+	$\frac{1}{2}O_2$	$\longrightarrow$	CO_2
t = 0	1mol		4.5 mol		
	0		4 mol		1 mol

At end, 1 mole CO_2 & no CO present

(b)

	C	+	$\frac{1}{2}O_2$	$\longrightarrow$	CO
t = 0	10mol		5mol		0
	0		0		10

At end only 10 mol CO present.

(c)

	C	+	$\frac{1}{2}O_2$	$\longrightarrow$	CO
t = 0	6mol		5mol		0
	0		2 mol		6 mol
	(LR)				

	CO	+	$\frac{1}{2}O_2$	$\longrightarrow$	CO_2
t = 0	6mol		2mol		0
	2mol		0 (LR)		4mol

At end (2 mol CO + 4 mol CO_2) left.

123. Ans. (C)

$$C + O_2 \longrightarrow \underset{a\text{ mol}}{CO} + \underset{b\text{ mol}}{CO_2}$$

On applying POAC on 'C' atom

$n_C = a + b$

$a + b = 2$ ...(1)

On applying POAC on 'O' atom

$2n_{O_2} = n_{CO} + 2 \times n_{CO_2}$

$2 \times 1.5 = a + 2b$

$a + 2b = 3$ ...(2)

Equation (2) – Equation (1)

$b = 1$ mol $n_{CO_2} = 1$ mol

$a = 1$ mol $n_{CO} = 1$ mol

124. Ans. (B)

$CuSO_4.5H_2O \xrightarrow{\Delta} CuSO_4 + 5H_2O$

$MgSO_4.7H_2O \xrightarrow{\Delta} MgSO_4 + 7H_2O$

Let, $CuSO_4.5H_2O = x\%$

Then, $MgSO_4.7H_2O = (100 - x)\%$

So, mixture contain, $CuSO_4.5H_2O = 0.05\ xg$

$MgSO_4.7H_2O = (5 - 0.05\ x)g$

Moles of $CuSO_4.5H_2O = \frac{0.05x}{249.5}$

Moles of $MgSO_4.7H_2O = \frac{0.05-0.05x}{246}$

From the reaction, we get

moles of water formed = $\left(5 \times \frac{0.05x}{249.5}\right) + \left(7 \times \frac{(5-0.05x)}{246}\right)$

$= 10^{-3}x + \frac{5.0-0.05x}{35.22}$

Mass of water = 2g

Moles of water = $\frac{2}{18}$

So, $\frac{x}{998} + \frac{35-0.35x}{246} = \frac{2}{18}$

If we solve for 'x' we get x = 74.06 %

125. Ans. (D)

$N_2 = 28$ g/mol, $NO_2 = 46$ g/mol, $N_2O_4 = 92$ g/mol,

moles of $NO_2 = x$, moles of $N_2O_4 = y$, moles of $N_2 = 1 - x - y$

So, mean molar mass = $\frac{\text{Total mass}}{\text{Total moles}}$

$55.4 = \frac{28(1-x-y)+46x+92y}{1}$

$55.4 = 28 - 28x - 28y + 46x + 92y$

$27.4 = 18x + 64y$ ... (1)

Reaction involved :

$\underset{y}{N_2O_4} \longrightarrow \underset{2y}{2NO_2}$

Final moles of $NO_2 = x + 2y$ moles

$N_2O_4 = 0$ moles

Total moles = $1 - x - y + x + 2y = 1 + y$

So, $39.6 = \frac{28(1-x-y)+46(x+2y)}{1+y}$

$39.6(1 + y) = 28 - 28x - 28y + 46x + 92y$

$39.6 + 39.6y = 28 + 18x + 64y$

$39.6 - 28 = 18x + 64y - 39.6y$

$11.6 = 18x + 24.4y$ ... (2)

Subtracting (1) and (2), we get

$27.4 - 11.6 = 64y - 24.4y$

$15.8 = 39.6y$

$\mathbf{y = 0.40}$

Then, x $\Rightarrow$ $11.6 = 18x + 24.4(0.4)$

$11.6 = 18x + 9.76$

$\mathbf{x = 0.1}$

$N_2 = 1 - 0.1 - 0.4 = 0.5$

$\mathbf{N_2 : NO_2 : N_2O_4}$

$\mathbf{0.5 : 0.1 : 0.4}$

126. Ans. (D)

Boiling causes decomposition of $Mg(HCO_3)_2$ & $Ca(HCO_3)_2$ precipitating $Mg^{2\oplus}$ & $Ca^{2\oplus}$ as $Mg(OH)_2$ & $CaCO_3$ respectively. In Clark's method, addition of lime ($Ca(OH)_2$) causes precipitation of $Mg(OH)_2$ & $CaCO_3$ from $Mg(HCO_3)_2$ and $Ca(HCO_3)_2$ containing water sample.

127. Ans. (B)

$$n_{Ca^{2\oplus}} = n_{CaCO_3} = 0.1$$

$$\Rightarrow [Ca^{2\oplus}] = \frac{0.1}{1} = 0.1\ M$$

128. Ans. (B)

$$n_{CaO} = \frac{1}{2} \times n_{CaCO_3} = \frac{1}{2} \times \frac{2}{100} = 0.01$$

$\therefore$ weight of CaO = 0.01 × 56 = 0.56 g

129. Ans. (D)

$$RH_2 + Ca^{2\oplus} \longrightarrow RCa + 2H^{\oplus}$$

$pH = 2 \Rightarrow [H^{\oplus}] = 10^{2\ominus}$ mol/L

$\therefore$ Mole of $H^{\oplus}$ in 1 L = $10^{2\ominus}$

$\therefore$ Mole of $Ca^{2\oplus}$ in 1 L water = $\frac{10^{-2}}{2}$

Mass of $Ca^{2\oplus}$ in 1 L = $\frac{10^{-2}}{2} \times 40 = 0.2g$

$\therefore$ Hardness (in terms of $Ca^{2\oplus}$ ppm) = 0.2 × 1000 = 200 ppm

130. Ans. (D)

Milli equivalents of FeC_2O_4 = 0.1 × 3 × 25 = 7.5 ($\because \overset{+2}{Fe}\overset{+3}{C}_2O_4 \longrightarrow Fe^{3\oplus} + \overset{+4}{C}O_2 \Rightarrow$ v.f. = 1 + 2 (4 – 3) = 3)

From (D) option, m. eq. of $K_2Cr_2O_7$ = 0.1 × 6 × 12.5 = 7.5 ($\because \overset{+6}{Cr}_2O_7^{2\ominus} \longrightarrow Cr^{3\oplus} \Rightarrow$ v.f. = 2 (6 – 3) = 6)

$\therefore$ m. eq. of FeC_2O_4 = m. eq. of $K_2Cr_2O_7$

131. Ans. (A)

$$CI^{\ominus} + MnO_4^{\ominus} \longrightarrow Mn^{2\oplus} + CI_2$$

Eq. of Cl_2 = Eq. of $KMnO_4$

$$[\text{mole of } CI_2] \times 2 = \left[\frac{15.8}{158}\right] \times 5$$

mole of CI_2 = 0.25

$\therefore$ volume of CI_2 at NTP = 0.25 × 22.4 = 5.6 L

132. Ans. (B)

Mole of I_2 = Mole of $Na_3AsO_4 = \frac{1.04}{208}$ (from balanced reaction given in question)

Now, Eq. of I_2 = Eq. of $Na_2S_2O_3$

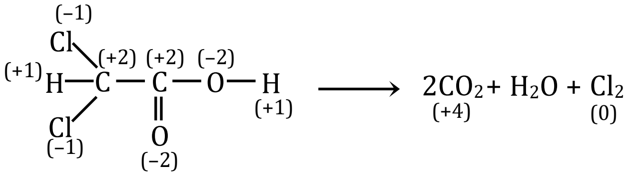
Mole of $Na_2S_2O_3$ = 2 × Mole of I_2

$(\because I_2 \rightarrow I^{\ominus} \Rightarrow$ v.f. = 2 and $Na_2\overset{+2}{S_2}O_3 \rightarrow Na_2\overset{+2.5}{S_4}O_6 \Rightarrow$ v.f. = 2 (2.5 – 2) = 1)

$$0.2 \times \frac{V}{1000} = \frac{2.08}{208}$$

So, V = 50 mL

133. Ans. (B)



∴ v.f. of dichloroacetic acid = 2 (4 – 2) + 2 (0 – (– 1)) = 6

m.eq. of dichloroacetic acid = m.eq. of oxidising agent = 600

∴ m.moles of dichloroacetic acid = $\frac{600}{6} = 100$

$CHCl_2COOH + NH_3 \longrightarrow CHCl_2COONH_4$

From reaction, m.moles of NH_3 = m.moles of dichloroacetic acid = 100

∴ Moles of $NH_3 = \frac{100}{1000} = 0.1$

134. Ans. (A)

$6e^{\ominus} + 10H^{\oplus} + V_2O_5 \longrightarrow 2V^{2\oplus} + 5H_2O$

$(Zn \longrightarrow Zn^{2\oplus} + 2e^{\ominus}) \times 3$

––––––––––––––––––––––––––––––––––––––

$V_2O_5 + 3\,Zn + 10\,H^{\oplus} \longrightarrow 3\,Zn^{2\oplus} + 2V^{2\oplus} + 5H_2O$ ...(A)

Now, $H_2O + V^{2\oplus} \longrightarrow VO^{2\oplus} + 2H^{\oplus} + 2e^{\ominus}$

$2e^{\ominus} + I_2 \longrightarrow 2I^{\ominus}$

––––––––––––––––––––––––––––––––––––––

$V^{2\oplus} + I_2 + H_2O \longrightarrow 2I^{\ominus} + VO^{2\oplus} + 2H^{\oplus}$

so, we have overall 1 mole of V_2O_5 reducing 2 moles of iodine

So, $\left(\frac{9.1}{102+80}\right)$ moles of V_2O_5 will be reduce = $\frac{9.1}{182} \times 2 = 0.1$ moles of I_2

135. Ans. (C)

$K\overset{7\oplus}{Mn}O_4 \xrightarrow{H^{\oplus}} Mn^{2\oplus}$

n.f. = 5

mol × n.f. = N × V

$$\frac{x}{158} \times 5 = 0.05 \times 4$$

x = 6.32 gm

136. **Ans. (A)**

$$\underset{n.f.=1}{Na_2\overset{2\oplus}{S_2}O_3} + \underset{n.f.=5}{\overset{0}{I_2}} \longrightarrow 2NaI^{1\ominus} + Na_2\overset{2.5\oplus}{S_4}O_6$$

E of Na2S_2O_3 = E of I_2

M.V. × n.f. = M.V. × n.f.

$$0.5\times\frac{40}{1000}\times1=M\times\frac{25}{1000}\times2$$

M = 0.4

137. **Ans. (B)**

$M_1V_1 = M_2V_2$

$0.8 \times 20 = M_2 \times 100 \Rightarrow M_2 = \frac{4}{25}M$

2NaOH	+	H_2SO_4	$\longrightarrow$	Na_2SO_4	+	$2H_2O$
M = ?		$M = \frac{4}{25}$				
V = 30 ml		V = 25 ml				

For complete reaction $\frac{2}{1}=\frac{(MV)_{NaOH}}{(MV)_{H_2SO_4}}$

$$\frac{2}{1}=\frac{M\times30}{\frac{4}{25}\times25} \Rightarrow M = \frac{4}{15}$$

138. **Ans. (C)**

$$\underset{n.f.=6}{K_2\overset{6\oplus}{Cr_2}O_7} + KI^{1\ominus} \xrightarrow{H^{\oplus}} Cr^{3\oplus} + \overset{0}{I_2}$$

Eq. of $K_2Cr_2O_7$ = Eq. of KI

$M_2 \times 40 \times 6 = 0.2 \times 15$

$M_2 = \frac{1}{80}M$

$M_1V_1 = M_2V_2$

$M_1 \times 25 = \frac{1}{80}\times200$

$M_1 = 0.1$ M

N = M × n.f.

= 0.1 × 6w

= 0.6

139. **Ans. (D)**

H_2SO_4	+	2NaOH	$\longrightarrow$	Na_2SO_4	+	$2H_2O$
1.5 M, 35 mL		0.6 M, 50 mL				
Mmol = 1.5 × 35		mmol = 0.6 × 50				
52.5		= 30				
E.R.		L.R.				

Remaining moles of H_2SO_4 = 52.5 – 15 = 37.5 mmol

H_2SO_4	+	2KOH	$\longrightarrow$	K_2SO_4	+	H_2O
37.5 mmol		M = ?, 75 mL				

For complete neutralisation

$$\frac{1}{2}=\frac{37.5}{M\times 75}\Rightarrow M=1$$

140. **Ans. (B)**

$$C_2H_6+\frac{7}{2}O_2\rightarrow 2CO_2(g)+3H_2O(\ell)$$

V Ltr. 2V Ltr.

$$C_3H_8+5O_2\rightarrow 3CO_2(g)+4H_2O(\ell)$$

(3–V) 3(3–V)Ltr.

2V + 9 – 3V = 8 Ltr.

V = 1Ltr.

141. **Ans. (D)**

$$C_xH_y+\left(\frac{4x+y}{4}\right)O_2\longrightarrow xCO_2+\frac{y}{2}H_2O$$

10 ml 10 x $\frac{10y}{2}$

10x = 40 $\frac{10y}{2}=50$

x = 4 y = 10

The hydrocarbon is C_4H_{10}

142. **Ans. (B)**

$O_2 \xrightarrow{\Delta}$ No reaction

x ml

$2O_3 \xrightarrow{\Delta} 3O_2$

(20 – x)ml $\frac{3}{2}$(20 – x)ml

On passing from alkaline pyrogallol solution all the O_2 disappears.

$\frac{3}{2}(20-x)+x=29$

60 – 3x + 2x = 58

x = 2

% O_2 in original mixture $=\frac{2}{20}\times 100=10\%$

143. **Ans. (D)**

$$CO(g)+\frac{1}{2}O_2(g)\longrightarrow CO_2(g)$$

x ml $\frac{x}{2}$ml x ml

$$H_2(g)+\frac{1}{2}O_2(g)\longrightarrow H_2O(l)$$

(20 – x)ml $\left(\frac{20-x}{2}\right)$ml —

Volume concentration = 23

$\left(x+\frac{x}{2}+20-x+\frac{20-x}{2}\right)-x=23$

$\left(\frac{3x}{2}+20-x+10-\frac{x}{2}\right)-x=23$

$30 - x = 23$

$x = 7$ ml

$V_{CO} = 7$ ml

$V_{H_2} = 13$ ml

$V_{CO} : V_{H_2} = 7 : 13$

144. Ans. (A)

$C_nH_{2n}(g) + \frac{3n}{2}O_2(g) \longrightarrow nCO_2(g) + nH_2O(g)$

if there no volume changes i.e. $\Delta n_g = 0$

$(n + n) - \left(1+\frac{3n}{2}\right) = 0 \Rightarrow n = 2$

145. Ans. (A,C,D)

Balance the equation by any method

$4Zn + 10HNO_3 \longrightarrow 4Zn(NO_3)_2 + 3H_2O + NH_4NO_3$

$\therefore$ a + b + c = 4 + 3 + 1 = 8

146. Ans. (A,B,D)

$6I^{\ominus} + ClO_3^{\ominus} + 6H_2SO_4 \rightarrow Cl^{\ominus} + 6HSO_4^{\ominus} + 3I_2 + 3H_2O$

Hence, $I^{\ominus}$ is oxidised to I_2

Coefficient of $HSO_4^{\ominus} = 6$

and H_2O is one of the products.

Hence (A), (B), (D)

147. Ans. (A,C,D)

milli equivalent of $KMnO_4 = 25 \times 0.2 = 5$ meq.

(A) $Fe^{2\oplus} \longrightarrow Fe^{3\oplus}$

v.f. = 1

milli equivalent of $FeSO_4 = 25 \times 0.2 \times 1 = 0.2 \times 25 = 5$ (same)

(B) $H_3AsO_3 \longrightarrow H_3AsO_4$

v.f. = 2

milli equivalent of $H_3AsO_3 = 2 \times 50 \times 0.1 = 10$ (not same)

(C) $H_2O_2 \longrightarrow 2H^{\oplus} + O_2$

v.f. = 2

milli equivalent of $H_2O_2 = 25 \times 0.1 \times 2 = 5$ (same)

(D) $Sn^{2\oplus} \longrightarrow Sn^{4\oplus}$

v.f. = 2

milli equivalent of $SnCl_2 = 25 \times 0.2 = 25 \times 0.1 = 5$ (same)

148. Ans. (A,B)

$N_1V_1 = N_2V_2$

$3 \times 5 = N_2 \times 250$

so $N_2 = 0.06$ N,

Now, v.f. of $H_2SO_4 = 2$

so, molarity $= \frac{0.06}{2} = 0.03$ M

149. Ans. (A,B,C,D)

$K_xH_y(C_2O_4)z.nH_2O \quad + \quad NaOH \quad \longrightarrow \quad$ Products

v.f. = y $\qquad$ 27 mL, 0.12 N

$$\frac{9.15\times30\times y}{1000\times M} = 27 \times 0.12 \times 10^{-3} \qquad \text{(M = mol.wt. of salt)} \qquad ...(A)$$

$K_xH_y(C_2O_4)z.nH_2O \quad + \quad KMnO_4 \quad \longrightarrow \quad CO_2$ + Products

v.f. = 2z(4 – 3) = 2z $\qquad$ 36 mL, 0.12 N

$$\frac{9.15\times30\times2z}{1000\times M} = 36 \times 0.12 \times 10^{-3} \qquad ...(B)$$

(B) / (A)

$$\frac{2z}{y} = \frac{4}{3} \text{ or } \frac{z}{y} = \frac{2}{3}$$

From charge balance, $x + y - 2z = 0$

$$\text{or } \frac{x}{y} + 1 = \frac{2z}{y}$$

$$\frac{x}{y} = \frac{4}{3} - 1 = \frac{1}{3} \text{ or } \frac{x}{y} = \frac{1}{3}$$

∴ x : y : z = 1 : 3 : 2

∴ x = 1, y = 3, z = 2

From (A), M = 254

∴ $KH_3(C_2O_4)_2.nH_2O$

M = 39 + 3 + 176 + 18n

or 254 = 218 + 18n

or n = 2

x = 1, y = 3, z = 2, n = 2

150. Ans. (A)

Let oxidation number of N is x.

Adding oxidation numbers of all atoms & equating to 0,

$NaN_3 \Rightarrow 1(+1) + 3(x) = 0 \therefore x = -1/3$

$N_2H_2 \Rightarrow 2(x) + 2(+1) = 0 \therefore x = -1$

$NO \Rightarrow 1(x) + 1(-2) = 0 \therefore x = +2$

$N_2O_5 \Rightarrow 2(x) + 5(-2) = 0 \therefore x = +5$

EXERCISE - S

1. **Ans.** (a) +5 (b) +2 (c) –1 (d) +2
(e) +6 (f) +3 (g) +4/3 (h) –1/3
(i) +8/3 (j) +16/3 (k) 0 (l) +1/2
(m) –1/2 (n) +2

(a) $H_4P_2O_7$
$1 \times 2 + 2 \times x + 7 \times (-2) = 0$
$x = +5$

(b) $S_2O_3^{2-}$
$2x + 3 \times (-2) = -2$
$x = +2$

(c) CaO_2
$2 + 2x = 0$
$x = -1$

(d) ZnO_2^{-2} $x + 2(-2) = -2$
$x = +2$

(e) CrO_2Cl_2
$x + 2(-2) + 2 \times (-1) = 0$
$x = +6$

(f) $Ca(ClO_2)$
$\downarrow$
Ca^{+2} $2(ClO_2)^{-1}$
So in $(ClO_2)^{-1}$
$x + 2(-2) = -1$
$x = +3$

(g) C_3O_2 : $3x + 2 \times (-2) = 0$
$x = \dfrac{4}{3}$
Avg. oxid. No of C = 4/3

(h) KI_3 : $(+1) \times 1 + 3x = 0$
$x = -1/3$
Avg oxid. no of I = –1/3

(i) Fe_3O_4 : $3x + (-2)4 = 0$
$x = 16/3$
Avg. oxid. no of Br = 16/3

(j) Br_3O_8 : $3x + (-2) \times 8 = 0$
$n = 16/3$
Avg oxid. no of Br = 16/3

(k) $CaOCl_2$: $(+2) \times 1 + (-2) \times 1 + 2\ 5\ x = 0$
$x = 0$
Avg. oxid. no of Cl = 0

(l) O_2^2 :- Avg oxid. no of O = +1/2

(m) O_2^- :- Avg. oxid. no of O = – 1/2

(n) CN^- :- $x + (-3) \times 1 = -1$

$x = +2$

oxid. no of C = + 2

2. **Ans.** (a) +3 (b) +3, +6 (c) +2 (d) $+\frac{200}{93}$

(e) +6 (f) +6 (g) +6

(a) $K[Co(C_2O_4)_2(NH_3)_2] \Rightarrow (+1) \times 1 + x \times 1 + (-2)x^2 + 0x^2 = 0$

$\Rightarrow n = +3$

oxid no of C_0 = + 2

(b) $K\underline{Al}(\underline{S}O_4)_2.12H_2O$

$(H) + x + (-2)x^2 + 12 \times 0 = 0 \Rightarrow x = +3$

oxid. no of Al = + 3

(c) $[\underline{Fe}(CN)_6]^{4-}$

$x \times 1 + (-1) \times b = -4$

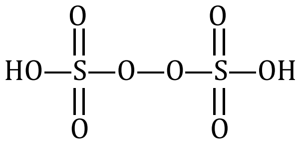
$x = +2$

oxdi. no of Fe = + 2

(d) $\underline{Fe}_{0.93}O : 0.93 \times n + (-2) \times 1 = 0 \Rightarrow x = \frac{2}{0.93}$

* oxid. no of $Fe = \frac{200}{93}$

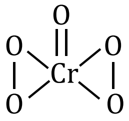
(e) $H_2\underline{S}_2O_8$



$$HO-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-O-O-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-OH$$

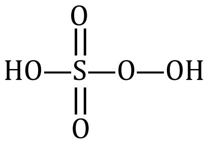
oxid. no of S = + 6

(f) $\underline{Cr}O_5$



oxid. no of Cr = + 6

(g) $H_2\underline{S}O_5$



$$HO-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-O-OH$$

oxid. no of S = + 6

3. **Ans.**(a) Reduction (b) Oxidation (c) Reduction (d) Oxidation

(e) Reduction (f) Oxidation (g) Reduction

(a) 0 → –2

$O_2 \rightarrow OH^-$

so reduction

–1 → – 2

(b) $H_2O_2 \rightarrow O_2$

reduction

(c) +7 → +6

$MnO_4^- \to MnO_4^{-2}$

reduction

(d) $CH_3OH \quad \to \quad CH_2O$

$x + 3 - 2 + 1 = 0 \qquad y + 2 - 2 = 0$

$-2 \longrightarrow 0$

So $\qquad CH_3OH \longrightarrow CH_2O$

So, oxidation

(e) $\overset{+4}{MnO_2}(s) \longrightarrow \overset{+8/3}{Mn_3O_4}(s)$

Gain of e⁻ so reduction

(f) $\overset{+2}{FeO}(s) \longrightarrow \overset{+8/3}{Fe_3O_4}(s)$

Loss of e⁻ so oxidation

(g) $CH_3COOH(aq.) \longrightarrow CH_3CH_2OH(aq)$

$+2 \qquad\qquad -1$

gain of e⁻ so reduction

4. **Ans.** (a) Oxidant : O_2 ; Reductant : Zn

(b) Oxidant : H^+ ; Reductant : Zn

(c) Oxidant : NO_3^- ; Reductant : Zn

(d) Oxidant : SO_2 ; Reductant : H_2S

(e) Oxidant : MnO_4^- ; Reductant : Cl^-

(f) Oxidant : MnO_4^- ; Reductant : H_2O_2

(a) $Zn(s) + \frac{1}{2}O_2(g) \longrightarrow ZnO(s)$

$Zn \longrightarrow Zn^{+2} \qquad O_2 \longrightarrow O^{-2}$

Reductant $\qquad$ oxidant

(b) $Zn(s) + 2H+(aq) \longrightarrow Zn^{2+}(aq) + H_2(g)$

$Zn \longrightarrow Zn^{+2} \qquad H^+ \longrightarrow H_2$

(c) $10H+(aq) + 4Zn(s) + NO_3^-(aq) \longrightarrow 4Zn^{2+}(aq) + NH_4^+(aq) + 3H_2O(\ell)$

$Zn \longrightarrow Zn^{+2} \qquad NO_3^- \longrightarrow NH_4^+$

Reductant $\qquad$ Oxidant

(d) $2H_2S(aq) + SO_2(g) \to 3S(s) + 2H_2O(\ell)$

$H_2S \longrightarrow S \qquad Cl^- \longrightarrow Cl_2$

reductant $\qquad$ oxidant

(e) $2MnO_4^-(aq) + 16H^+(aq) + 10Cl^-(aq.) \longrightarrow 2Mn^{2+}(aq.) + 8H_2O(\ell) + 5O_2(g)$

$\underset{\text{Oxidant}}{MnO_4^-} \longrightarrow Mn^{+2} \qquad \underset{\text{Reductant}}{Cl^-} \longrightarrow Cl_2$

(f) $2MnO_4^-(aq) + 6H^+(aq) + 5H_2O_2(aq.) \longrightarrow 2Mn^{2+}(aq.) + 8H_2O(\ell) + 5O_2(g)$

$\underset{\text{Oxidant}}{MnO_4^-} \longrightarrow Mn^{+2} \qquad \underset{\text{reductant}}{H_2O_2} \longrightarrow O_2$

5. **Ans.** (Theoretical)

(i) $H_2S \to S + 2H^{\oplus} + 2e^{\ominus}$

(ii) $SO_3^{2\ominus} + 6H^{\oplus} + 6e^{\ominus} \longrightarrow S^{2\ominus} + 3H_2O$

(iii) $H_2O_2(aq.) \longrightarrow O_2 + 2H^{\oplus} + 2e$

(iv) $Cl_2 + 2e^{\ominus} \longrightarrow 2Cl^{\ominus}$

(v) $MnO_4^{\ominus} + 8H^{\oplus} + 5e^{\ominus} \longrightarrow Mn^{2\oplus} + 4H_2O$ (vi) $NH_3 + H_2O \longrightarrow NO + 5H^{\oplus} + 5e^{\ominus}$

(vii) $C_2O_4^{2\ominus} \rightarrow 2CO_2 + 2e$ (viii) $2S_2O_3^{2\ominus} \rightarrow S_4O_6^{2\ominus} + 2e$

(ix) $Cr_2O_7^{2\ominus} + 14H^{\oplus} + 6e^{\ominus} \rightarrow 2Cr^{3\oplus} + 7H_2O$ (x) $MnO_4^{\ominus} + 4H^{\oplus} + 3e^{\ominus} \rightarrow MnO_2 + 2H_2O$

6. **Ans.** (Theoretical)

(i) $3N_2H_4 + 4ClO_3^{\ominus} \rightarrow 6NO + 4Cl^{\ominus} + 6H_2O$

(ii) $Cl_2O_7 + 4H_2O_2 \rightarrow 2ClO_2^{\ominus} + 4O_2 + 3H_2O + 2H^{\oplus}$

(iii) $Cr_2O_7^{2\ominus} + 3SO_3^{2\ominus} + 8H^{\oplus} \rightarrow 2Cr^{3\oplus} + 3SO_4^{2\ominus} + 4H_2O$

(iv) $2MnO_4^{\ominus} + Br^{\ominus} + H_2O \rightarrow 2MnO_2 + BrO_3^{\ominus} + 2OH^{\ominus}$

(v) $H_2S + Cl_2 \rightarrow 2HCl + S$

(vi) $3Fe_3O_4 + 8Al \rightarrow 9Fe + 4Al_2O_3$

(vii) $I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$

7. **Ans.** (Theoretical)

(i) $Cr_2O_7^{2\ominus} + 6Fe^{2\oplus} + 14H^{\oplus} \rightarrow 2Cr^{3\oplus} + 6Fe^{3\oplus} + 7H_2O$

(ii) $XeO_6^{4\ominus} + 2F^{\ominus} + 6H^{\oplus} \rightarrow XeO_3 + 3H_2O + F_2$

(iii) $2CuSO_4 + 4KI \rightarrow Cu_2I_2 + I_2 + 2K_2SO_4$

(iv) $NO_3^{\ominus} + 4Mg + 6H_2O \rightarrow NH_3 + OH^{\ominus} + 4Mg(OH)_2$

(v) $4AgNO_3 + 2H_2O + H_3PO_2 \rightarrow 4Ag + H_3PO_4 + 4HNO_3$

(vi) $Sn^{2\oplus} + 2Fe^{3\oplus} \rightarrow Sn^{4\oplus} + 2Fe^{2\oplus}$

(vii) $Sn^{4\oplus} + H_2SO_3 + H_2O \rightarrow Sn^{2\oplus} + HSO_4^{\ominus} + 3H^{\oplus}$

8. **Ans. (20.1)**

Mass of $Cl_2 = \dfrac{1.12}{22.4} \times 71 = 3.55$ g

3.55 g Cl ≡ (5.56 – 3.55) g metal

35.5 g Cl ≡ 20.1 g metal (equivalent mass of metal)

9. **Ans. (72.61)**

$$\underset{(0.98\ g)}{\text{Metal sulphate (aq)}} \xrightarrow{+ BaCl_2} \underset{(0.95\ g)}{BaSO_4 \downarrow}$$

Now, 233 g $BaSO_4 \equiv 96$ g $SO_4^{2\ominus}$

$\therefore$ 0.95 g $BaSO_4 \equiv \dfrac{96}{233} \times 0.95$ or 0.39 g $SO_4^{2\ominus}$

$\therefore$ Mass of metal in metal sulphate = 0.98 – 0.39 = 0.59 g

Now, $eq_{metal} = eq_{SO_4^{2\ominus}}$

$$\frac{0.59}{E_{metal}} = \frac{0.39}{96/2}$$

$E_{metal} = 72.61$

10. **Ans. (1) 1 (2) 1 (3) 1 (4) 1 (5) 2**

(1) $NaOH + \underline{H_3PO_4} \longrightarrow NaH_2PO_4 + H_2O$

$n_f = 1$

(2) $NaOH + \underline{H_2SO_4} \longrightarrow NaHSO_4 + H_2O$

$n_f = 1$

(3) $\underline{Ca(OH)_2} + HCl \longrightarrow Ca(OH)Cl + H_2O$

$n_f = 1$

(4) $\underline{Na_2CO_3} + HCl \longrightarrow NaHCO_3 + NaCl$

$n_f = 1$

(5) $\underline{Na_2CO_3} + HCl \longrightarrow NaCl + H_2O + CO_2$

$n_f = 2$

11. **(21)**

n_f of $HNO_3 = 3$

Eq. wt of $HNO_3 = \frac{63}{3} = 21$

12. **(i) 13.91 or 13.92** **(ii) 5.66 or 5.67**

(i) $\underline{ClO_3^-} + Fe^{2+} + H^+ \longrightarrow Cl^- + Fe^{3+} + H_2O$

$n_f = 6$ Eq. wt of $ClO_3^- = 13.91$

(ii) $CuO + \underline{NH_3} \longrightarrow Cu + N_2 + H_2O$

$n_f = 3$ Eq. wt of $NH_3 = \frac{17}{3} = 5.66$

13. **Ans. (5)**

$$I_2 \xrightarrow{OH^-} IO_3^- + I^-$$

$\downarrow$

n_f of $IO_3^- = 5$

14. **Ans. (1.4)**

100 g solution → 98 g H_2SO_4 is present

$d = \frac{M}{V}$

$1.8 = \frac{100}{V}$

$V = \frac{100}{1.8}$ ml

$[H_2SO_4] = \frac{98 \times 1.8 \times 1000}{98 \times 100} = 18M$

After dilution

$M_1V_1 = M_2V_2$

$18 \times V_1 = 2 \times 12.6$

$V_1 = 1.4$ Litre

15. **Ans. (5.55 or 5.56)**

$AlCl_3 = 0.8$ M, Volume $= V_1$

$CaCl_2 = 0.2$ M, Volume = 50 ml

Total volume = (V + 50 ml)

moles of Cl ions from $AlCl_3 = 3 \times 0.8 \times V_1$

moles of Cl ions from $CaCl_2$ = 0.2 × 2 × 50 m moles

= 20 m moles

Final molarity of Cl ions = 0.6 = $\frac{\text{total moles}}{\text{total volume}}$

$$0.6 = \frac{(3\times0.8\times V_1)+(20\text{mmoles})}{V_1+50}$$

$0.6\,V_1 + 30 = 2.4\,V_1 + 20$

30 – 20 = (2.4 – 0.6) V

$10 = 1.8\,V_1$

$V_1 = \frac{10}{1.8}\text{ml} = 5.55 \text{ or } 5.56$

16. **Ans. (1.5)**

NaCl solution, $M_1 = 2M$

$V_1 = 500$ ml

NaCl, $M_2 = \frac{1}{4}M, V_2 = 200\text{ml}$

V_T = 500 + 200 = 700 ml

Final concentration = $\frac{M_1V_1+M_2V_2}{V_1+V_2}$

$$= \frac{(2\times500)+50}{700} = \frac{1050}{700}$$

Final concentration of NaCl = 1.5 M

17. **Ans. (0.15)**

$$M_{\text{resultant}} = \frac{(0.5\times200)+\left(\frac{9.5\times1000}{95\times50}\right)\times2\times50}{(200+50)\times8}$$

$$= \frac{100+200}{2000}$$

= 0.15 M

18. **Ans. (0.80)**

$Ca(OH)_2 + 2HCl \longrightarrow CaCl_2 + 2H_2O$

let a moles ↓

2a moles

$Al(OH)_3 + 3HCl \longrightarrow AlCl_3 + 3H_2O$

let a moles ↓

3a moles

Total HCl = 5a moles

5a = 0.5 × 4 ⇒ a = 0.4 moles

Total moles of the mixture = 0.4 + 0.4 = 0.8 moles

19. **Ans. (0.20)**

2.2M H_2SO_4(Vml) + 10Vml H_2O

Final volume should be = 11V ml but

due to volume contraction: $V_{\text{final}} = \left(\frac{98}{100} \times 11V\right)$ml

Now $M_1V_1 = M_2V_2$

$2.2 \times V = M_2 \times 11V \times \frac{98}{100} \Rightarrow = 0.20$ M

20. **Ans. (33.33)**

$$\underset{\text{a mol}}{CH_4} + \underset{\text{b mol}}{C_2H_4} + \underset{\text{excess}}{O_2} \longrightarrow CO_2 + H_2O$$

On applying POAC on 'C' atom

$\Rightarrow \quad 1 \times n_{CH_4} + 2 \times n_{C_2H_4} = 1 \times n_{CO_2}$

$\Rightarrow \quad a + 2b = 1 \times \frac{44}{3 \times 44}$

$\Rightarrow \quad a + 2b = \frac{1}{3}$ ...(1)

5 gm mixture

16a + 28b = 5

$4a + 7b = \frac{5}{4}$ ...(2)

$\Rightarrow$ (4 × eqn. (1) – eqn. (2))

$\Rightarrow \quad b = \frac{4}{3} - \frac{5}{4} = \frac{1}{12} \Rightarrow \boxed{b = \frac{1}{12}}$

From eqn. (1)

$a = \frac{1}{3} - \frac{1}{6} = \frac{1}{6} \Rightarrow \boxed{a = \frac{1}{6}}$

mole % $C_2H_4 = \frac{b}{a+b} \times 100$

$= \frac{\frac{1}{12}}{\frac{1}{6}+\frac{1}{12}} \times 100$

$= \frac{1}{3} \times 100 = 33.33\%$

21. **Ans. (2352)**

$S_8 \longrightarrow H_2SO_4$

On applying POAC on 'S' atom

$8 \times n_{S_8} = 1 \times n_{H_2SO_4}$

$8 \times 3 = \frac{Wt}{98}$

$Wt_{H_2SO_4} = 2352$ gm

22. **Ans. (5.28)**

$KH_3(C_2O_4)_2.2H_2O \xrightarrow{\text{C–atoms converted}} CO_2$

7.62 gm ↓

$\frac{7.62}{254}$ moles let: W gm

$\frac{W}{44}$ moles

0.03 moles

Apply POAC for C.

4 × moles of $KH_3(C_2O_4)$. $2H_2O$ = 1 × moles of CO_2

$4 \times 0.03 = 1 \times \frac{W}{44} \Rightarrow W = 5.28$ gm

23. **Ans. (66.67)**

$KClO_3 \longrightarrow KCl + \frac{3}{2}O_2$

$n_{KClO_3} = \frac{245}{122.5} = 2$ mole

$n_{O_2} = \frac{64}{32} = 2$ mole

n_{O_2} produce from 2 moles of $KClO_3$ if yield is 100% is 3 moles.

% yield $= \frac{2}{3} \times 100 = 66.67\%$

24. **Ans. (1600)**

$CaCO_3 \longrightarrow CaO + CO_2$

Pure $CaCO_3 = 2000 \times \frac{80}{100} = 1600$ gm

25. **Ans. (50)**

$KClO_3 \longrightarrow KCl + \frac{3}{2}O_2$

Let the weight of impure sample be x

$x \times \frac{60}{100} = 30$

x = 50 gm

26. **Ans. (0.12)**

$2KO_2 + H_2O \longrightarrow 2KOH + \frac{3}{2}O_2$

0.158 mol 0.10 mol

L.R.

$2 \text{ mol } KO_2 \longrightarrow \frac{3}{2}O_2$

$0.158\ KO_2 \longrightarrow \frac{3}{2} \times \frac{1}{2} \times 0.158 = 0.12$ mol

27. **Ans (27.60)**

$3NO_2 + H_2O \rightarrow 2HNO_3 + NO$

$\downarrow$

25.2 gm

$= \frac{25.2}{63}$ moles

= 0.4 moles

moles of NO_2 required = $\frac{3}{2} \times 0.4 = 0.6$ moles

weight of NO_2 = 0.6 × 46 = 27.6 gm

28. **Ans. (0.63)**

$2NH_4NO_3(s) \rightarrow 2N_2(g) + O_2(g) + 4H_2O(g)$

16 gm

$\downarrow \quad \downarrow \quad \downarrow$

$= \frac{16}{80}$ moles

= 0.2 moles

moles = 0.2 0.1 0.4

PV = nRT

$V = \frac{nRT}{P}$

$= \frac{0.7 \times 0.0821 \times 900}{82.1} = 0.63$

29. **Ans. (58.80)**

$2H_3PO_4 \longrightarrow H_4P_2O_7 + H_2O$

$\downarrow \qquad \downarrow$

$\underbrace{2 \times 0.3}_{0.6 \text{ moles}}$ 53.4 gm

Mass = .6 × 98 $= \frac{53.4}{178}$ moles

= 58.80 = 0.3 moles

30. **Ans. (6.41 or 6.42)**

			↓L.R		
	C	+	$2\,Cl_2$	$\longrightarrow$	CCl_4
	36 gm		142 gm		↓
	3 mole		2 mole		
left =	2 mole		0 mole		1 mole
	(24 gm)				(154 gm)

$$\frac{y}{1}=\frac{154}{24}=\frac{6.416}{1}$$

31. **Ans. (0.25)**

$6\,LiH$	+	$8BF_3$	$\rightarrow$	$6LiBF_4 + B_2H_6$
2 moles		2 moles		↓
		↑		
		L.R.		$\left(\frac{2}{8}\text{mole}\right)=0.25\text{mole}$

32. **Ans. (0.02)**

$CaCO_3 = 5g, M_{CaCO_3} = 100$ g/mol,

$$\text{moles, } n = \frac{5\text{ g}}{100\text{ g/mol}} = 0.05 \text{ moles}$$

	$CaCO_3(s)$	$\rightarrow$	$CaO(s)$	+	$CO_2(g)$
Initial moles	0.05 moles				
After time	$0.05(1-\alpha)$		$0.05\,\alpha$		$0.05\,\alpha$

Moles of CO_2 formed = $0.05\,\alpha = 0.05 \times 0.40$ moles

$n = 0.02$ moles

33. **Ans. (0.2)**

	HI	$\rightarrow$	$\frac{1}{2}H_2$	+	$\frac{1}{2}I_2$
	$(1-\alpha)$		$\frac{\alpha}{2}$		$\frac{\alpha}{2}$
at time t					0.1 mole

$$\text{given, } \frac{\alpha}{2} = 0.1 \Rightarrow \alpha = 0.2$$

34. **Ans. (539)**

$$\text{Moles of PbS} = \frac{1320}{240} = 5.5 \text{ mol}$$

Moles of SO_2 = 5.5 mol = moles of H_2SO_4

Mass of H_2SO_4 = 5.5 × 98 = 539 g

[When amount of only one reactant is given generally other is assumed in excess.]

35. **Ans. (4)**

	A	$\longrightarrow$	2B	+	C
	3 moles				
Final	—		6 moles		3 moles
	3B	$\longrightarrow$	2D		
	6 moles				
Final	—		$\frac{2}{3} \times 6$ moles = 4 moles		

Hence, starting with 3moles of A, moles of D formed = 4 moles.

36. **Ans. (4.5)**

$E_{Produced}$ = 6 moles

So, we have,

3C	$\longrightarrow$	2E
		6 moles

So, $C = \frac{3}{2} \times 6 = 9$ moles

Also,	2A	+	3B	$\longrightarrow$	4C	+ D
	excess				9 moles	

So, $A = \frac{2}{4} \times 9 = 4.5$ moles

Hence, initially 4.5 moles of A were taken.

37. **Ans. (6.40)**

S_8 taken = 1 mole

	S_8	+ $8O_2(g)$	$\longrightarrow$	$8SO_2$ (g)
Initial	1 mole			
Final	—	—		8 moles
	$2SO_2(g)$	+ $O_2(g)$	$\longrightarrow$	$2SO_3$ (g)
Initial	8 moles			
Final	—	—		$8 \times \frac{2}{2} = 8$ moles

Moles of SO_3 formed, n = 8 moles

Molar mass of SO_3, M = 80 g/mol

Mass of SO_3 formed, W = n × M = 8 × 80 = 640 g

$$\frac{W}{100} = \frac{640}{100} = 6.40$$

38. **Ans. (3.04)**

$$CH_4 + \frac{3}{2} O_2 \longrightarrow CO + 2H_2O$$

$$4CH_4 + 8O_2 \longrightarrow 4CO_2 + 8H_2O$$

$CO : CO_2 \Rightarrow 1 : 4$ Molar ratio given

Mole of $O_2 = \frac{3}{2} + 8 = \frac{19}{2}$ mol

Wt. of $O_2 = \frac{19}{2} \times 32 = 304$ g

$$\frac{W}{100} = 3.04$$

39. **Ans. (80)**

$$3Fe_2O_3\,(s) \longrightarrow 2Fe_3O_4 \;+\; \frac{1}{2}O_2$$

3×160 $\qquad\qquad$ $\frac{1}{2} \times 32$

$= 480$ gm $\qquad\qquad$ $=16$ gm

loss of 16 gm → 480 gm Fe_2O_3

loss of 0.04 gm → $0.04 \times \frac{480}{16} = 1.2$ gm Fe_2O_3

% by mass $= \frac{1.2}{1.5} \times 100 =$ **80%**

40. **Ans. (44.21)**

$Na_2CO_3 \xrightarrow{\Delta}$ No decomposition

$2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + CO_2 + H_2O$

$n_{CO_2} = \frac{2.2}{44} = 0.05$

$n_{NaHCO_3} = 2 \times 0.05 = 0.1$

Wt. of $NaHCO_3 = 0.1 \times 84 = 8.4$ gm

$\%NaHCO_3$ in sample $= \frac{8.4}{19} \times 100 =$ **44.21**

41. **Ans. (28.4)**

Let the mass of mixture be 100 gm, x is the mass of $CaCO_3$ and 100 – x is mass of $MgCO_3$.

$$CaCO_3 \longrightarrow CaO + CO_2$$

Moles $\frac{x}{100}$

$$MgCO_3 \longrightarrow MgO + CO_2$$

$\frac{100-x}{84}$

[CaO & MgO] → Mass = 50 gm

Let CaO mass be 'y'

MgO mass be '50 – y'

$\frac{x}{100} = \frac{y}{56}$ ...(1)

$\frac{100-x}{84} = \frac{50-y}{40}$ ...(2)

From equation (1) and (2)

x = 28.40

% of $CaCO_3$ in sample $= \frac{28.40}{100} \times 100 =$ **28.40**

% of $MgCO_3$ in sample = 100 – 28.40 **= 71.59**

42. **Ans. (24)**

Final No. of eq. of $H_2SO_4 = 0.2 \times 30 \times 10^{-3}$

$= 6 \times 10^{-3}$

Initial No. of eq. of $H_2SO_4 = 1 \times 30 \times 10^{-3}$

$= 30 \times 10^{-3}$

No. of reacted eq. of $H_2SO_4 = 24 \times 10^{-3}$

So, No. of equivalent of $NH_3 = 24 \times 10^{-3}$

No. of mole of $NH_3 = 24 \times 10^{-3}$ ($\because$ v.f. = 1)

No. of millimole of $NH_3 = 24$

43. **Ans. (3.48)**

Let moles of MnO_2 in 5 gram sample is x.

$MnO_2 + HCl \rightarrow MnCl_2 + Cl_2 + H_2O$

v.f. = 2 v.f. = 2

no. of eq. of MnO_2 = no. of eq. of Cl_2

$x \times 2 = n_{(Cl_2)} \times 2$

$x = n_{(Cl_2)}$

evolved Cl_2 passes through KI that released I_2

$Cl_2 + 2\,KI \rightarrow I_2 + 2KCl$

x moles x moles

So $n_{(I_2)} = n_{(Cl_2)} = x$

Evolved I_2 required 40 mL, $\frac{N}{10}$ $Na_2S_3O_3$

$I_2 + Na_2S_2O_3 \rightarrow NaI + Na_2S_4O_6$

v.f. = 2 v.f. = 1

no. of equivalent of I_2 = no. of equivalent of hypo

$$x \times 2 = \frac{1}{10} \times 40 \times 10^{-3}$$

$x = 2 \times 10^{-3}$ moles

$$\% \, MnO_2 = \frac{wt.(MnO_2)}{total wt.} \times 100$$

$$= \frac{x \times 87}{5} \times 100 = \frac{2 \times 10^{-3} \times 87}{5} \times 100$$

= 3.48 %

44. **Ans. (80)**

Let mmole of $CuSO_4$ present in 250 mL solution is x.

$\Rightarrow$ mmole of $CuSO_4$ in 25 mL sample is x/10

Reaction involved

$Cu^{2\oplus} + I^{\ominus} \longrightarrow CuI + I_2$

v.f. = 1

$I_2 + 2Na_2S_2O_3 \longrightarrow Na_2S_4O_6 + 2NaI$

v.f. = 1

meq. $(Cu^{2\oplus})$ = meq. $(Na_2S_2O_3)$

$$\frac{x}{10} \times 1 = 40 \times 1 \times 1 \Rightarrow x = 400 \text{ gm}$$

$\therefore$ Weight of $CuSO_4$ in original sample $= \left(\frac{400}{1000}\right) \times 160 = 64$ g

% purity of $CuSO_4$ solution $= \frac{64}{80} \times 100 = 80\%$

45. **Ans. (50)**

Let molarity of $KMnO_4$ = x

$\Rightarrow x \times 5 = 1.25 \Rightarrow x = 0.25$

Let moles of Mn_3O_4 in sample is y.

$\Rightarrow$ moles of $Mn^{2\oplus}$ formed are 3y

$MnO_4^{\ominus} \quad + \quad Mn^{2\oplus} \quad \rightarrow \quad Mn^{3\oplus}$

v.f. = 4 v.f. = 1

equivalents ($MnO_4^{\ominus}$) = equivalents ($Mn^{2\oplus}$)

$3 \times 0.25 \times 4 = 3y \times 1$

$\Rightarrow y = 1 \Rightarrow$ wt. of Mn_3O_4 = 229 g

$\therefore$ % of Mn_3O_4 in sample = $\frac{229}{458} \times 100 = 50\%$

46. **Ans. (85)**

$AgNO_3 \quad + \quad KI \quad \longrightarrow \quad AgI \quad + \quad KNO_3$ ...(A)

1 g (impure) 50 mL

$2KI + KIO_3 + 6HCl \longrightarrow 3ICl + 3KCl + 3H_2O$ ...(B)

(left over)

Let molarity of KI solution be M

By given information, in reaction 2,

Moles of KI used = 2 × moles of KIO_3

$M \times 20 = 2 \times 30 \times \frac{1}{10}$

M = 0.3

Millimoles of KI taken = 50 × 0.3 = 15

Millimoles of KI used in reaction 2 = $2 \times 50 \times \frac{1}{10} = 10$

$\therefore$ millimoles of KI used in reaction (A) = 15 – 10 = 5 mmol

= mmol of $AgNO_3$ in the sample

$\therefore$ $AgNO_3$ = 5 mmol

$= 5 \times 10^{-3} \times 170$ g = 0.85 g

% of pure $AgNO_3$ = $\frac{0.85}{1} \times 100 = 85\%$

47. **Ans. (12.50)**

$NaOH + HCl \longrightarrow NaCl + H_2O$

n_{factor} (1) (1)

$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$

n_{factor} (1) (2)

equivalent of HCl + equivalent of H_2SO_4

$(0.4 \times 1) \times V = 1 \times 1 + 2 \times 2$

V = 12.5 Lt

48. **Ans.** (3.00)

$2HCl + Na_2CO_3 \longrightarrow 2NaCl + CO_2 + H_2O$

n_{factor} (1) (2)

$$HCl + NaHCO_3 \longrightarrow NaCl + CO_2 + H_2O$$

n_{factor} (1) (1)

moles of Na_2CO_3 = moles of $NaHCO_3$

wt = x gm wt = 19 – x gm

$$\frac{x}{106} = \frac{19-x}{84}$$

x = 10.6 gm

So,

Equivalent of HCl = equivalent of Na_2CO_3 + equivalent of $NaHCO_3$

$$0.1 \times V = \left(\frac{10.6}{106}\right)\times 2 + \left(\frac{19-10.6}{84}\right)\times 1$$

V = 3Lt

49. **Ans.** (200)

$$NaOH + NaH_2PO_4 \longrightarrow Na_3PO_4 + H_2O$$

n_{factor} (1) (2)

equivalent of NaOH

= equivalent of NaH_2PO_4

$$(1 \times V) \times 1 = \left[\frac{12}{23+2+31+64}\right]\times 2$$

u = 0.2 Lt

= 200 mL

50. **Ans. (4)**

$$K_2\overset{+6}{Cr_2}O_7 + Sn \xrightarrow{HCl} Cr^{+3} + \overset{+6}{Sn}Cl_4$$

n.f = |3 – 6| × 2 n.f = |4 – 0|

= 4

$\boxed{\text{decinormal} = \frac{1}{10}N}$, dichromate solution = $K_2Cr_2O_7$

equivalent of O.A = equivalent of R.A.

equivalent of $K_2Cr_2O_7$ = equivalent of S_n

N × v = moles × n.f

$$\frac{1}{10}\times v = \frac{11.9}{119}\times 4$$

v = 4 lt

51. **Ans. (3)**

$BrO_3^- + Br^- \longrightarrow Br_2$ $n_f = \frac{5}{3}$, n millimole

Eq. of BrO_3^- = Eq. of Br_2

$$10 \times 10^{-3} \times 0.1 \times 5 = (n \times 10^{-3}) \times \frac{5}{3}$$

n = millimoles of Br_2 = 3

produced.

52. **Ans. (200)**

$Na_2S_2O_3 + I_2 \longrightarrow Na_2S_4O_6 + I^-$

Eq. of $Na_2S_2O_3$ = Eq. of I_2

$$0.5 \times V \times 10^{-3} \times 1 = \frac{12.7}{254} \times 2$$

$V(Na_2S_2O_3) = 200ml$

53. **Ans. (2.50)**

Eq. of NaOH = Eq. of H_2SO_4 + Eq. of HCl

$30 \times 10^{-3} \times 3 \times 1 = 20 \times 10^{-3} \times 2 \times 2 + 4 \times v \times 10^{-3} \times 1$

Volume of HCl = V = 2.5 ml

required

54. **Ans. (2.50)**

$KMnO_4 + KI \longrightarrow I_2 + Mn^{+2}$

Eq. of $KMnO_4$ = Eq. of I_2

$25 \times 10^{-3} \times 0.4 \times 5 = n(I_2) \times 2$

no. of moles of I_2 produced = 25×10^{-3} mol

$I_2 + Na_2S_2O_3 \longrightarrow I^- + Na_2S_2O_7$

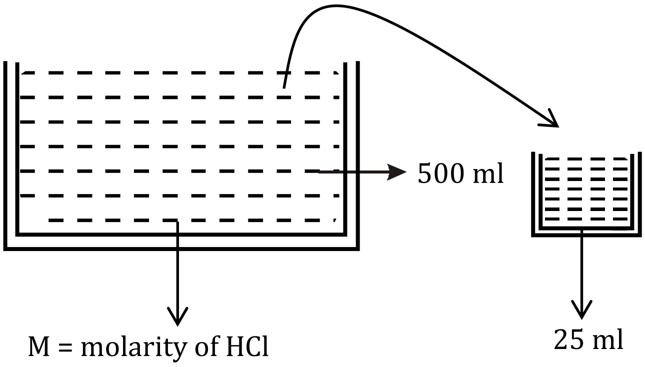
Eq. of I_2 = Eq. of $Na_2S_2O_3$

$25 \times 10^{-3} \times 2 = 20 \times 10^{-3} \times 1 \times M$

molarity of $Na_2S_2O_3(M)$ = 2.5 M

55. **Ans. (39.42)**

NaOH	+	HCl	⇒
4.00 gm		100 ml	
0.1 m HCl		Assume x moles	



M = molarity of HCl
in final solution
M' = (x-0.1) = 2 (n-0.1)
1/2

$HCl + Na_2CO_3 \longrightarrow NaCl + H_2O + CO_2$

Eq. of HCl = Eq. of Na_2CO_3

$2(n.0.1) \times 25 \times 10^{-3} \times 1 = 10 \times 10^{-3} \times 0.02 \times 2$

moles of HCl in = 0.108

original 100 ml solution

conc. of HCl in = $\frac{0.108 \times 36.5}{0.1} = 39.42 g/L$

original solution

56. Ans. (250)

$$\underset{n_f=\frac{5}{3}}{3I_2}+\underset{n_f=\frac{5}{6}}{6NaOH}\longrightarrow NaIO_3+5NaI+3H_2O$$

Eq. of $I_2=\frac{12.7}{254}\times\frac{5}{3}=\frac{1}{12}$ eq.

Eq. of NaOH = $200 \times 10^{-3} \times 1.5 \times \frac{5}{6}=\frac{1}{4}$ eq.

Eq. of NaOH left = $\frac{1}{4}-\frac{1}{12}=\frac{1}{6}$ eq.

moles of NaOH left = $\frac{1/6}{5/6}=\frac{1}{5}$ mol

final molarity of NaOh = $\frac{1/5}{200\times10^{-3}}=1M$

finally $NaOH + HCl \rightarrow NaCl + H_2O$

Eq. of NaOH = Eq. of HCl

$1 \times 200 \times 10-3 \times 1 = 0.8 \times (v \times 10^{-3}) \times 1$

volume of HCl required = 250 ml

57. Ans. (6)

$$C_xH_y+\left(x+\frac{y}{4}\right)O_2 \longrightarrow xCO_2(g)+\frac{y}{2}H_2O\ (l)$$

$$\begin{array}{lll} V & \left(x+\frac{y}{4}\right)V & \\ — & — & Vx \end{array}$$

Volume contraction = $V_i - V_f$

$V_i = V + V\left(x+\frac{y}{4}\right)$

$V_f = Vx$

$2.5\,V = V\left(1+\frac{y}{4}\right)$

$y = 6$

Number of H-atom in 1 molecule of hydrocarbon is 6.

58. Ans. (140)

$$C_2H_6+\frac{7}{2}O_2 \longrightarrow 2CO_2+3H_2O$$

40 ml $\downarrow$

required = $\frac{7}{2}\times 40 = 140$ ml

59. Ans. (30.00)

air is 25 ml but only 20% of it is O_2 vol. of O_2 in air = $\frac{20}{100}\times 25 = 5ml$

remaining air = $20m\ell$

$$\begin{array}{llllll} CO & + & \frac{1}{2}O_2 & \longrightarrow & CO_2 & \text{final volume} \\ 10\text{ ml} & & 5\text{ ml} & & \downarrow & = 10 + 20 = 30 \\ X & & X & & 10ml & \downarrow \quad \downarrow \\ & & & & & CO_2\ \text{remaining air} \end{array}$$

60. **Ans. (70.00)**

(40%) (60%)

$$\underbrace{\underset{\substack{\downarrow\\ 20ml}}{C_2H_4} + \underset{\substack{\downarrow\\ 30ml}}{CH_4}}_{50ml} + O_2 \longrightarrow CO_2$$

$$\underset{20\ ml}{C_2H_4} + 3O_2 \longrightarrow \underset{\substack{\downarrow\\ 40\ ml}}{2CO_2} + 2H_2O$$

$$\underset{30ml}{CH_4} + 2O_2 \longrightarrow \underset{\substack{\downarrow\\ 30\ ml}}{CO_2} + 2H_2O$$

Total = 40 + 30 = 70 ml

CO_2

61. **Ans. (10.00)**

$$\underbrace{\underset{\text{let x mole}}{CO} + \underset{\text{(10-x) mole}}{CH_4}}_{10\ mole} + \underset{22\ mole}{O_2}$$

$$\underset{x}{CO} + \underset{\text{used} = \frac{x}{2}}{\frac{1}{2}O_2} \longrightarrow \underset{\substack{\downarrow\\ x}}{CO_2}$$

$$\underset{(10-x)}{CH_4} + \underset{\text{used} = 2(10-x)}{2O_2} \longrightarrow \underset{\substack{\downarrow\\ (10-x)}}{CO_2} + 2H_2O$$

Total CO_2 after the reaction = x + 10 – x = 10

moles of CO_2 absorbed by KOH = 10

62. **Ans. (73.33)**

$$\underbrace{\underset{\text{let xml}}{N_2O} + \underset{(60-x)ml}{NO}}_{60ml} + \underset{(excess)}{H_2} \longrightarrow \underset{38ml}{N_2} \text{ is formed}$$

all 'N' in reactants is converted to N_2

let's apply POAC for N : 2x + (60 – x) = 2 × 38

x = 16

$$\%\text{ vol. of NO} = \frac{(60-16)}{60} \times 100 = 73.33\%$$

63. **Ans. (10.00)**

The volume contraction is due to absorption of O_3

So in 100 ml mixture : O_3 = 20 ml

$$\text{When mixture is heated: } \underset{20\ ml}{O_3} \rightarrow \underset{\substack{\downarrow\\ \frac{3}{2} \times 20 = 30\ ml}}{\frac{3}{2}O_2}$$

So increase in vol. = 10 ml.

64. **Ans. (5.00)**

$$\underbrace{\underset{\text{let}\quad\text{Vml}}{C_2H_4} + \underset{(20\text{-}V)\text{ml}}{C_2H_2}}_{20\text{ml}} + \underset{\text{just sufficient}}{O_2}$$

C_2H_4 + $3O_2$ → $2CO_2 + 2H_2O(liq)$

V req. 3V $\downarrow$

2V X

C_2H_2 + $2.5\ O_2$ → $2CO_2 + H_2O(liq)$

(20 – V) req = 2.5 (20 –V) $\downarrow$

2(20 × V) X

{mixture + O_2}

V_i = 20 + 3V + 2.5 (20 – V)

V_f = 2V + 2(20 – V) ⇒ V_f = 40 ml

$V_i - V_f$ = 37.5

V = 15 ml. C_2H_5 = 20 – 15 = 5ml.

65. **Ans. (11.20)**

$Ca(HCO_3)_2$ = 324 ppm

10^6g hard water contains 324g $Ca(HCO_3)_2$

1g hard water contains $\frac{324}{10^6}$ g $Ca(HCO_3)_2$

10^5 g or 100 by or 1002 H_2O contains = 32.4 g $Ca(HCO_3)_2$

moles of $Ca(HCO_3)_2$ = $\frac{32.4}{162}$ = 0.2 moles

$Ca(HCO_3)_2 + 2CaO \longrightarrow Ca(OH)_2 + 2CaCO_3\downarrow$

0.2 mol

* moles of CaO required 0.2 mole or 11.2 g

66. **Ans. (100)**

Eq. of $CaCO_3$ = Eq. of $Mg(HCO_3)_2$

$$\frac{\text{wt of } CaCO_3}{100}\times 2=\frac{7.3}{50\times(24+2\times 61)}\times 2$$

wt of $CaCO_3$ = $\frac{7.3}{50\times 146}\times 100=0.1g$

in 1 L water

PPM strength = $\frac{0.1}{1000}\times 10^6=100ppm$

of $CaCO_3$

67. **Ans. (a) 50 milimoles, (b) 12 milimoles, (c) 450 milimoles, (d) 5 milimoles, 0.05 M**

(a) Milimoles of H_2SO_4 = $\frac{4.9}{98}\times 10^3=50\,\text{milimoles}$

(b) Milimoles of Na^+ = (50 × 0.2) + (20 × 0.1) = 10 + 2 = 12 milimoles

(c) Milimoles of H^+ = $\left(\frac{3.65}{36.5}+\frac{9.8}{98}\times 2+\frac{4.9}{98}\times 3\right)$ × 10^3 = 450 milimoles

(d) Molimoles of OH^- = (0.1 × 10) + (0.2 × 10 × 2) = 5 milimoles

Molarity = $\frac{5}{100}$ × 10^{-3} = 0.05 M

68. Ans. (a) 0.50 M, (b) 0.50 M, (c) 0.20 M

(a) $M=\frac{n_{NaOH}}{V}=\frac{4/40}{\frac{200}{1000}}=0.5M$

(b) $M=\frac{n_{Na_2CO_3}}{V}=\frac{5.3/106}{\frac{100}{1000}}=0.5M$

(c) $M=\frac{n_{HCl}}{V}=\frac{0.365/36.5}{\frac{50}{1000}}= 0.20\ M$

69. Ans. (16.66 or 16.67)

mass% = $\frac{w}{w}\%=\frac{\text{wt. of solute}}{\text{wt. of solution}}\times100$

wt. of solution = V × d = 100 × 0.9 = 90 gm

$\frac{w}{w}\%=\frac{15}{90}\times100 = 16.67\%$

70. Ans. (1.40)

$$M=\frac{\frac{w}{w}\%\times10\times d}{M_{solute}}\Rightarrow 7=\frac{28\times10\times d}{56}$$

$d = \frac{7}{5} = 1.4$ gm

71. Ans. (2.50)

10^6 gm solution contains 405 gm $Ca(HCO_3)_2$

vol. of solution $\frac{10^6}{1}ml=1000L$

moles of solute = $\frac{405}{162} = 2.5$

$M = \frac{2.5}{1000} = 2.5 \times 10^{-3}$ M

72. Ans. (0.66 or 0.67)

$$m=\frac{1000\times M}{1000\times d-M\times M_{solute}}\Rightarrow m=\frac{2\times1000}{1000\times3.107-\ 2\times53.5}$$

$m=\frac{2}{3}=0.667$

$$\begin{array}{ccc} NH_4Cl\rightarrow & NH_4^+ & +\ Cl^- \\ \frac{2}{3}m & \downarrow & \downarrow \\ & \frac{2}{3}m & \frac{2}{3}m \end{array}$$

73. **Ans. (1.40)**

$M_1V_1 = M_2V_2 \Rightarrow \left(\frac{98\times10\times1.8}{98}\right)\times V_1 = 2\times12.6$

$V_1 = 1.4$ litre

74. **Ans. (45.40 V)**

$H_2O_2 \longrightarrow H_2O + \frac{1}{2}O_2$

2 mole $\downarrow$ $\downarrow$

2 mole 1 mole

$M = \frac{2}{0.5} = 4\ :\ M_{H_2O_2} = \frac{V}{11.35}$

$V = 4 \times 11.35 = 45.4$

75. **Ans. (56.00 V)**

$H_2O_2 \longrightarrow H_2O + \frac{1}{2}O_2$

moles of $H_2O_2 = \frac{2\times5.6}{22.7}$ 5.6 l (1 has, 0°C)

$\frac{5.6}{22.7}$ moles

$n_{H_2O_2} = M_{H_2O_2}\times \text{vol.}$

$\frac{2\times5.6}{22.7} = M_{H_2O_2}\times0.1 \Rightarrow M_{H_2O_2} = \frac{56}{11.35} = \frac{V}{11.35}$

EXERCISE - JEE (Main) PYQ

1. **Ans. (3)**

$5 = \dfrac{125}{M_A+2M_B}$

$M_A + 2M_B = 25$ ... (A)

$10 = \dfrac{300}{2M_A+2M_B}$

$2M_A + 2M_B = 30$ ... (B)

Solving (A) & (B)

$M_A = 5$ g/mol $= 5 \times 10^{-3}$ Kg/mole

$M_B = 10$ g/mol $= 10 \times 10^{-3}$ Kg/mole

2. **Ans. (3)**

Disproportionate reaction is one in which 1 atom of a given compound oxidises & Reduces both in a redox reaction.

(1) $K\overset{+7}{Mn}\overset{-2}{O_4} \longrightarrow K_2\overset{+6}{Mn}O_4 + \overset{+4}{Mn}O_4 + \overset{0}{O_2}$ only reduction of Mn & oxidation of oxygen.

(2) $2\overset{+7}{Mn}O_4^{\ominus} + 10\overset{-1}{I}^{\ominus} + 16H^{\oplus} \longrightarrow 2\overset{+2}{Mn}^{2\oplus} + 5\overset{o}{I}_2 + 8H_2O$

Reduction of Mn & oxidation of Iodine

+1 +2

(3) $2\overset{+1}{Cu}Br \longrightarrow \overset{+2}{Cu}Br_2 + \overset{o}{Cu}$

Both oxidation & reduction of copper hence disproportionate

(4) $2Na\overset{-1}{Br} + \overset{0}{Cl_2} \longrightarrow 2NaCl^{1\ominus} + \overset{0}{Br_2}$

oxidation of Br & Reduction of chlorine

3. **Ans. (1)**

$H_2C_2O_4 + 2NaOH \longrightarrow Na_2C_2O_4 + 2H_2O$

m_{eq} of $H_2C_2O_4 = m_{eq}$ NaOH

$50 \times 0.5 \times 2 = 25 \times M_{NaOH} \times 1$

$\therefore$ $M_{NaOH} = 2$ M

Now 1000 ml solution = 2 × 40 gram NaOH

$\therefore$ 50 ml solution = 4 gram NaOH

4. **Ans. (2)**

$n_{eq.}$ $KMnO_4 = n_{eq.}[FeC_2O_4 + Fe_2(C_2O_4)_3 + FeSO_4]$

or $n \times 5 = 1 \times 3 + 1 \times 6 + 1 \times 1$

$\therefore n = 2$

Correct option : (2)

5. **Ans. (4)**

By taking Aq. NaOH in burette & Ag. $H_2C_2O_4$ in conical flask with phenophthlin as indicator will give pink colour of equivalent point.

6. **Ans. (10)**

Molar mass of $Na_2CO_3 \cdot xH_2O$

$\Rightarrow$ 23 × 2 + 12 + 48 + 18x

$\Rightarrow$ 46 + 12 + 48 + 18x

$\Rightarrow$ (106 + 18x)

$\text{Eqwt} = \frac{M}{2} = (53 + 9x)$

As n_{factor} in dissolution will be determined from net cationic or anionic charge; which is 2 so

$\text{Eqwt} = \frac{M}{2} = 53 + 9x$

$\text{Gmeq} = \frac{\text{wt}}{\text{Eqwt}} = \frac{1.43}{53+9x}$

$\text{Normality} = \frac{\text{gmeq}}{V_{\text{litre}}}$

$\text{Normality} = 0.1 = \frac{\frac{1.43}{53+9x}}{0.1}$

As volume = 100 ml

= 0.1 Litre

$\text{So, } 10^{-2} = \frac{1.43}{53+9x}$

53 + 9x = 143

9x = 90

x = 10.00

7. **Ans. (2)**

Volume strength of H_2O_2 is asked.

$M_{H_2O_2} = \frac{5.6}{11.35}$

$M_{H_2O_2} = \frac{5.6}{11.35} = 0.49 \text{ M}$

Assuming 1 litre solution mass of solution = 1000 mL × 1 g/mL = 1000 g

Mass of solute = moles × molar mass

= 0.5 mol × 34 g/mol

$\Rightarrow \text{mass\%} = \frac{17}{100} \times 100$

= 1.7 %

8. **Ans. (8)**

$$C_xH_y \quad + \quad \left(\frac{x+y}{4}\right)O_2 \longrightarrow xCO_2 \quad + \frac{y}{2}H_2O$$

$$\text{VmL} \qquad \left(x+\frac{y}{4}\right)V \qquad xV = 4V$$

x = 4

Given that $\left(x+\frac{y}{4}\right)V = 6V$

$4 + \frac{y}{4} = 6$

y = 8

So the formula of Hydrocarbon is C_4H_8

9. Ans. (3)

$$\begin{array}{lllll} C_xH_yO_z \ + & O_2 & \longrightarrow & CO_2 & + \quad H_2O \\ & & & 2.64g & \quad 1.08g \\ & & & 0.06mol & \quad 0.06mol \end{array}$$

n_{CO_2} = 0.06 ml $\Rightarrow$ n_C = 0.06 mol = 0.06 × 12g = 0.72g

n_{H_2O} = 0.06 mol $\Rightarrow$ n_H = 0.12 mol = 0.12 × 1 g = 0.12g

mass of O in Organic Compound = 1.80 – 0.72 – 0.12
= 0.96 gm

% of O in Organic Compound = $\frac{0.96}{1.8} \times 100$ = 53.33%

10. Ans. (5)

Mass of solution = 1.2 × 1000 = 1200gm
Mass of water = 1000 gm
Mass of NaoH = 200 gm

moles of NaOH = 5 mole

molality = $\frac{5}{1}$ = 5m

11. Ans. (3)

$$m = \frac{M \times 1000}{1000d_{gm/ml} - M \times (Mwt)_{solute}}$$

$$3.3 = \frac{M \times 1000}{1000 \times 1.2 - m \times 74.5}$$

3960 = 1245.85M

$$M = \frac{3960}{1245.85} = 3.17 \approx 3M$$

12. Ans. (20)

$$\text{Molarity} = \frac{\frac{6.3}{126}}{250 \times 10^{-3}} = 20 \times 10^{-2}$$

13. Ans. (13)

$$\begin{array}{llllll} & Na_2O & + & H_2O & \longrightarrow & 2NaOH \\ & 20gm & & 500\ mL & & 500\ mL \\ \text{moles} & \frac{20}{62} & & \frac{500}{18} & & \frac{40}{62} \end{array}$$

$$\text{Molarity} = \frac{\frac{40}{62}}{0.5} = 1.29$$

1.3M

= 13 × 10^{-1}

14. Ans. (64)

m_{wt} $CuSO_4 \cdot 5H_2O$ = 249.5

$$M = \frac{\frac{80}{249.5}}{5} = 0.064 = 64 \times 10^{-3}$$

15. **Ans. (3)**

Let n(SO_2Cl_2) = x moles

∴ n(H_2SO_4) = x, n(HCl) = 2x

⇒ n($H^{\oplus}$) = 4x

For Neutralisation

⇒ n($H^{\oplus}$) = n($OH^{\ominus}$)

⇒ 4x = 16

⇒ **x =** 4

16. **Ans. (3)**

$2H_2\overset{-1}{O_2} \longrightarrow 2H_2\overset{2-}{O} + \overset{0}{O_2}$: Disproportionation

$2\overset{+4}{N}O_2 + H_2O \longrightarrow H\overset{+5}{N}O_3 + H\overset{+3}{N}O_2$: Disproportionation

$MnO_4^{\ominus} + 4H^{\oplus} + 3e^{\ominus} \longrightarrow MnO_2 + 2H_2O$: reduction

$3\overset{+6}{Mn}O_4^{2\ominus} + 4H^{\oplus} \longrightarrow 2\overset{+7}{Mn}O_4^{\ominus} + \overset{+4}{Mn}O_2 + 2H_2O$: Disproportionation

17. **Ans. (2)**

$C_6H_{12}O_6 \to$ Glucose

We know: $\dfrac{\text{mass of C}}{\text{mass of glucose}} = \dfrac{72}{180}$

Given: %C = 10.8 = $\dfrac{\text{mass of C}}{\text{mass of solution}} \times 100$

$\dfrac{10.8 \times 250}{100} = \text{mass of C} \Rightarrow$ Mass of C = 27 gm

∴ mass of glucose = 67.5 gm

∴ moles of glucose = 0.375 moles

Mass of solvent = 250 – 67.5 gm = 182.5 gm

∴ Molality = $\dfrac{0.375}{0.1825} = 2.055 \approx 2.06$

18. **Ans. (56)**

Moles of $CO_2 = \dfrac{0.22}{44} = \dfrac{1}{200}$

∴ Moles of carbon

= (Moles of CO_2) × 1

= $\dfrac{1}{200}$

∴ wt. of C = $\dfrac{1}{200} \times 12 = 0.06$

% of C = $\dfrac{0.06}{W} \times 100 = 24$

(W = Wt. of Organic Compound)

W = 0.25

Moles of $H_2O = \dfrac{0.126}{18} = 0.007$

∴ Moles of H atom = 2 × 0.007= 0.014

% of Hydrogen = $\frac{0.014\times1}{W}\times100$

$= \frac{0.014\times1}{0.25}\times100$

= 5.6

= 56 × 10^{-1}

19. **Ans. (12)**

millimole of NaOH = 0.24 × 25

∴ millimole of acid = 0.24 × 25

⇒ mass of acid = 0.24 × 25 × 24.2 mg

for pure acid,

$$V=\frac{w}{d};(d=1.21\text{ kg}/L\ \ =1.21\ \ g/ml)$$

$$\therefore\ \ V=\frac{0.24\times25\times24.2}{1.12}\times10^{-3}$$

= 120 × 10^{-3} ml

= 12 × 10^{-2} ml

20. **Ans. (1)**

Reaction with HCl

$$Ca(OH)_2+2HCl\rightarrow CaCl_2+2H_2O$$

Volume of $Ca(OH)_2=10\,ml$

Volume of HCl = 20 ml

Concentration of HCl = 0.5 M.

No. of milli moles of HCl= 10

No. of milli moles of $Ca(OH)_2=5$.

i.e. $M_{Ca(OH)_2}=\frac{\text{no. of milli moles}}{V(ml)}=\frac{5}{10}$

= 0.5 M.

Reaction with H_2SO_4

$$Ca(OH)_2+H_2SO_4\rightarrow CaSO_4+2H_2O.$$

No. of milli moles of $Ca(OH)_2=20\times0.5$

= 10

i.e. no. of milli moles of $H_2SO_4=10$

$$\Rightarrow M_{H_2SO_4}=\frac{\text{no. of millimoles}}{V(ml)}$$

$$=\frac{10}{10}$$

= 1 M

EXERCISE - JEE (Advanced) PYQ

1. **Ans. (C)**

Mass of solution $\Rightarrow$ 120 + 1000 = 1120 g

Volume = $\frac{\text{mass}}{\text{Density}} = \frac{1120}{1.15}$ ml

density of solution $\Rightarrow$ 1.15 g/ml

n_{urea} = 120/60 = 2

molarity $\Rightarrow \frac{2\times1.15\times1000}{1120}$ = 2.05 m

2. **Ans. (8)**

$$M = \frac{\%w/w \times d \times 10}{(Mw)}$$

$$= \frac{29.2\times1.25\times10}{36.5} = 10$$

$M_1V_1 = M_2V_2$

$10 \times V_1 = 0.4 \times 200$

$V_1 = 8$ mL

3. **Ans. (B)**

Compound	**Oxidation state of N**
HNO_3	+5
NO	+2
NH_4Cl	+3
N_2	0

NH_4Cl is compound of ions $NH_4^{\oplus}$ and $Cl^{\ominus}$. Let oxidation number of nitrogen

= x in $NH_4^{\oplus}$ x + 4(+1) = + 1

x = – 3

4. **Ans. (8.00)**

Since, upon dissolution no change in vol. occurs hence, volume of solution Vol. of solvent.

Let us assume 1*l*(1000 m*l*) solution

moles of H_2 × = 3.2

wt. of solvent = 1000 × 0.4 = 400 gm

molality = $\frac{3.2}{\frac{400}{1000}} = 8$

5. **Ans. (A,B,D)**

$$6I^{\ominus} + 1ClO_3^{\ominus} + 6H_2SO_4 \longrightarrow 1Cl^{\ominus} + 6HSO_4^{\ominus} + 3I_2 + 3H_2O$$

6. **Ans. (9)**

1 mole solution has 0.1 mole solute and 0.9 mole solvent

Let M_1 = Molar mass solute

M_2 = Molar mass solvent

Molality, m = $\frac{0.1}{0.9M_2} \times 1000$ ... (1)

Molarity, $M = \dfrac{0.1}{0.1M_1 + 0.9M_2} \times 2 \times 1000$ ... (2)

$\because$ m = M

$\Rightarrow \dfrac{0.1 \times 1000}{0.9M_2} = \dfrac{200}{0.1M_1 + 0.9M_2}$

$\Rightarrow \dfrac{M_1}{M_2} = 9$

Alternate solution :

$\because$ M = m

$\Rightarrow$ volume of solution = mass of solvent

$\Rightarrow \dfrac{W_{solute} + W_{solvent}}{2} = W_{solvent}$

$W_{solute} = W_{solvent}$

$0.1 \times M_{solute} = 0.9 \times M_{solvent}$

$\dfrac{M_{solute}}{M_{solvent}} = 9$

7. **Ans. (6)**

In neutral/faintly alkaline medium $MnO_4^{\ominus}$ converts to MnO_2.

Since $MnO_4^{\ominus}$ is strong oxidizing agent it will oxiding sulphur to its highest oxidation state +6.

$$\overset{+7}{Mn}O_4^{\ominus} + \overset{+2}{S_2}O_3^{2\ominus} \longrightarrow \overset{+4}{Mn}O_2 + S^{6\oplus}$$

$n_f = 3$ $\qquad\qquad n_f = +4$

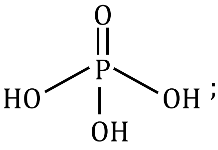
equivalents of $MnO_4^{\ominus}$ = equivalents of $S^{6\oplus}$

8 × 3 = x(+4)

n = 6 moles

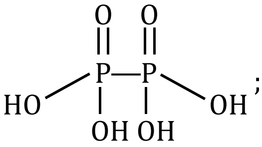
8. **Ans. (A)**

H_3PO_4 →



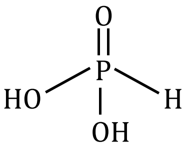
; oxidation state of P = +5

$H_4P_2O_6$ →



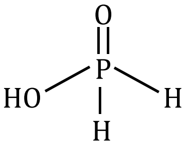
; oxidation state of P = +4

H_3PO_4 →



; oxidation state of P = +3

H_3PO_2 →



; oxidation state of P = +1

Hence Ans (A)

9. **Ans. (2992)**

$$\underset{\substack{1584\text{g} \\ =12\text{ mol}}}{(NH_4)_2SO_4} + Ca(OH)_2 \longrightarrow \underset{\substack{\text{gypsum (M=172)} \\ 12\text{ mol}}}{CaSO_4.2H_2O} + \underset{24\text{mole}}{2NH_3}$$

$$\underset{952\text{g} = 4\text{ mol}}{NiCl_2\cdot 6H_2O} + \underset{24\text{mol}}{6NH_3} \longrightarrow \underset{\substack{(M=232) \\ 4\text{ mol}}}{[Ni(NH_3)_6]Cl_2} + 6H_2O$$

Total mass = 12 (172) + 4(232) = 2992 g

10. **Ans. (6.47)**

$PbS + O_2 \longrightarrow Pb + SO_2$

mol of Pb = mol of O_2

$$= \frac{1000}{32}\text{ mol}$$

$$\therefore \quad \text{mass of Pb} = \frac{1000}{32} \times 207\text{ gm}$$

$$= \frac{207}{32}\text{ kg} = 6.47\text{ kg}$$

11. **Ans. (126)**

$MnCl_2 + K_2S_2O_8 + H_2O \rightarrow KMnO_4 + H_2SO_4 + HCl$

$KMnO_4 + H_2C_2O_4 \rightarrow Mn^{2\oplus} + CO_2$

first reaction eq. of $MnCl_2$ = eq of $KMnO_4$

II^{nd} reaction eq. of $KMnO_4$ = eq of $H_2C_2O_4$

So, eq. of $MnCl_2$ = eq of $H_2C_2O_4$

$$\frac{x}{126} \times 5 = \frac{225}{90} \times 10^{-3} \times 2$$

$x = 126 \times 10^{-3}$

$\boxed{x = 126}$ mg

12. **Ans. (288)**

$$\underset{1\text{ mole}}{S_8} + HNO_3 \longrightarrow SO_4^{2\ominus} + NO_2$$

$$(32H_2O + S_8 \longrightarrow 8SO_4^{2\ominus} + 64H^{\oplus} + 48e^{\ominus}) \times 1$$

$$(e^{\ominus} + H^{\oplus} + HNO_3 \longrightarrow NO_2 + H_2O) \times 48$$

$$\overline{S_8 + 48HNO_3 \longrightarrow 48NO_2 + 8SO_4^{2\ominus} + 16H_2O + 6H^{\oplus}}$$

1 mole of rhombic sulphur (S_8) produces 16 moles of H_2O = 288 g of H_2O

13. **Ans. (2.98)**

$$X_{urea} = 0.05 = \frac{n}{n+50}$$

19n = 50

n = 2.6315

$$\text{Volume} = \frac{\text{mass}}{\text{density}}$$

$$V_{sol} = \frac{(2.6315\times60+900)}{1.2} = 881.5789 \text{ ml}$$

$$\text{Molarity} = \frac{2.6315\times1000}{881.5789} = 2.9849$$

Molarity = 2.98M

14. **Ans. (0.11)**

Volume of NaOH consumed = 9N

$$\underset{5\text{ml, }0.10\text{M}}{H_2C_2OH} + \underset{(9\text{m}\ell,\text{xM})}{NaOH} \longrightarrow Na_2C_2O_4 + H_2O$$

Eq. of $H_2C_2O_4$ = Eq. of NaOH

$5 \times 10^{-3} \times 0.1 \times 2 = 9 \times 10^{-3} \times x \times 1$

$x = \frac{1}{9} = 0.11$ molar

molarity of NaOH = 0.11 molar

15. **Ans. (6)**

$$\underset{(n_f=3)}{MnO_4^{\ominus}} + I^{\ominus} \longrightarrow MnO_2 + \underset{(n_f=2)}{I_2}$$

Equivalents of $MnO_4^{\ominus}$ = Equivalents of I_2

$\Rightarrow 4 \times 3 = nI_2 \times 2$

$\Rightarrow nI_2 = \frac{12}{2} = 6$

16. **Ans. (1.875)**

$$Fe^{2\oplus} + MnO_4^{\ominus} \longrightarrow Mn^{2\oplus} + Fe^{3\oplus}$$

$(\text{v.f.})_{KMnO_4} = 5$

$(\text{v.f.})_{Fe^{2\oplus}} = 1$

For 25 ml

meq of $Fe^{2\oplus}$ = meq of $KMnO_4$

$= 0.03 \times 5 \times 12.5$

For 250 ml

$$\text{meq of } Fe^{2\oplus} = \frac{0.03\times5\times12.5}{25}\times250$$

$$(\text{mole})_{Fe^{2\oplus}} \times 1 \times 1000 = \frac{0.03\times5\times12.5\times250}{25}$$

$$(\text{mole})_{Fe^{2\oplus}} = \frac{18.75}{1000} = 1.875 \times 10^{-2} = \text{mole of Fe}$$

Ans. 1.875

17. **Ans. (18.75)**

$$\text{Weight of Fe} = \frac{18.75}{1000} \times 56 = 1.05 \text{ gram}$$

$$\text{\% by weight of Fe} = \frac{W_{Fe}}{W_{sample}}\times100 = \frac{1.05}{5.6}\times100 = 18.75\ \%$$

18. Ans. (2.38 / 2.39)

Mole of $P_4 = \frac{1.24}{31 \times 4} = 0.01$

$P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$

0.01 mole 0.01 mole

$2PH_3 + 3CuSO_4 \rightarrow Cu_3P_2 + 3H_2SO_4$

$0.01 \quad \frac{3}{2} \times 0.01$

$= \frac{0.03}{2}$ moles

$W_{CuSO_4} = \frac{0.03}{2} \times 159 = 2.385$ gm

Ans. = 2.38 or 2.39

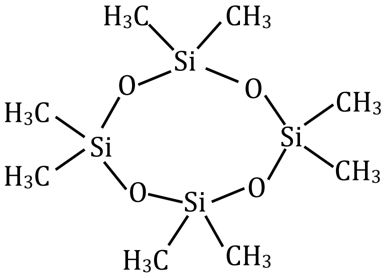
19. Ans. (222)

$$4(CH_3)_2SiCl_2 + 4H_2O \xrightarrow{75\%} \underset{(X)}{(CH_3)_8Si_4O_4} + 8HCl$$

$w = 516\,g$

$\underset{(moles)}{n} = \frac{516}{129}$

$= 4$



weight = 296 g

% yield = 75

The weight of X (in gram) $= 296 \times \frac{75}{100} = 222\,g$

20. Ans. (18)

$$2K\overset{+7}{Mn}O_4 + 5H_2S + 3H_2SO_4 \rightarrow K_2SO_4 + 2\overset{+2}{Mn}SO_4 + 5S + 8H_2O$$

x = 8 (moles of H_2O produced)

y = 14 – 4 = 10 (number of electrons involved)

x + y = 10 + 8 = 18

JEE (Main) Practice Paper

SECTION–A

1. **Ans. (2)**

$MnO_4^{\ominus}$; x + 4(–2) = – 1 or x = + 7 (Maximum possible for Mn);

CrO_2Cl_2 ; x + 2(–2) + 2(–1) = 0 or x = +6 (Maximum possible for Cr).

Oxidation states of the first-row (3d) transition metals
(The most common ones are in bold types)

Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
	+2	+2	+2	**+2**	**+2**	**+2**	**+2**	+1	**+2**
+3	+3	+3	**+3**	+3	**+3**	**+3**	+3	**+2**	
	+4	+4	+4	+4	+4	+4	+4		
		+5	+5	+5					
			+6	+6	+6				
				+7					

2. **Ans. (4)**

In the reactions (b) and (d), H_2O_2 is oxidized and acts as reducing agent.

In the reactions (a) and (c), H_2O_2 is reduced and acts as oxidizing agent.

(a) $H_2O_2 + 2H^{\oplus} + 2e \rightarrow 2H_2O$ A molecule of H_2O_2 loses an O atom and is reduced.

(b) $H_2O_2 - 2e \rightarrow O_2 + 2H^{\oplus}$ A molecule of H_2O_2 loses 2 electrons and is oxidized.

(c) $H_2O_2 + 2e \rightarrow 2(OH^{\ominus})$ A molecule of H_2O_2 gains 2 electrons and is reduced.

(d) $H_2O_2 + 2OH^{\ominus} - 2e \rightarrow O_2 + 2H_2O$ A molecule of H_2O_2 loses hydrogen and is oxidized.

3. **Ans. (2)**

$MnO_4^{\ominus} + 5e^{\ominus} + 8\,H^{\oplus} \longrightarrow Mn^{2\oplus} + 4\,H_2O$

⇒ 1 mole of $MnO_4^{\ominus}$ accepts 5 mole of $e^{\ominus}$

1/5 mole of $MnO_4^{\ominus}$ accepts 1 mole of $e^{\ominus}$

⇒ 0.2 mole of $MnO_4^{\ominus}$ accepts 1 mole of $e^{\ominus}$

⇒ 0.6 mole of $MnO_4^{\ominus}$ accepts 3 mole of $e^{\ominus}$

$Fe^{2\oplus} \longrightarrow Fe^{3\oplus} + e^{\ominus}$

⇒ 1 mole of $Fe^{2\oplus}$ will liberate 1 mole of $e^{\ominus}$

$Cr_2O_7^{2\ominus} + 6e^{\ominus} + 14\,H^{\oplus} \longrightarrow 2Cr^{3\oplus} + 7H_2O$

⇒ 1 mole of $Cr_2O_7^{2\ominus}$ will accept 6 moles of $e^{\ominus}$

1 mole of $FeC_2O_4 \longrightarrow Fe^{3\oplus} + CO_2 + 3\,e^{\ominus}$

⇒ 1 moles of ferrous oxalate gives 3 moles of $e^{\ominus}$

⇒ 0.2 moles of $KMnO_4$ = 1/5 moles of $KMnO_4$ oxidises 1 mole of $Fe^{2\oplus}$ ion. (Tallies with statement A)

0.6 moles of $KMnO_4$ = 3/5 moles of $KMnO_4$ will oxidise 1 mole of ferrous oxalate (Tallies with statement C)

1 mole of $K_2Cr_2O_7$ will oxidise 2 moles of ferrous oxalate. (Tallies with statement D)

Hence, (1), (3), (4) are correct while (2) is incorrect.

4. **Ans. (2)**

Normality of a mixture (N) = $\frac{N_1V_1 + N_2V_2}{V_1 + V_2}$

Normality(N_1) of H_2SO_4 = molarity × basicity = 0.2 × 2 = 0.4 N

$N_2 = 0.2 \times 1 = 0.2$ N

$V_1 = 100$ mL, $V_2 = 200$ mL

$$N = \frac{0.4\times100+0.2\times200}{100+200} = \frac{40+40}{300} = \frac{80}{300} = 0.2670 \text{ N}$$

5. **Ans. (4)**

$$\begin{array}{llll} MgCO_3 & + \; NaHCO_3 & \Rightarrow & MgCO_3 \quad + \quad NaHCO_3 \\ x \text{ mole} & \; y \text{ mole} & & (84x \text{ gm} \quad 84y \text{ gm}) \end{array}$$

$$\begin{array}{lll} MgCO_3 & \longrightarrow & MgO + CO_2 \\ \downarrow & & \qquad\;\; \downarrow \\ x \text{ mole} & & \qquad x \text{ mole} \end{array}$$

$$\begin{array}{llll} 2NaHCO_3 \longrightarrow Na_2CO_3 & + \; CO_2 & + & H_2O \\ y \text{ mol} & \quad \downarrow & & \downarrow \\ & \frac{y}{2}\text{mole} & & \frac{y}{2}\text{mole} \end{array}$$

$$\frac{n_{CO_2}}{n_{H_2O}} = \frac{3}{1} \Rightarrow \frac{\left(x+\frac{y}{2}\right)}{\frac{y}{2}} = \frac{3}{1} \Rightarrow x = y$$

$$\% \; NaHCO_3 = \frac{84y \text{ gm}}{(84x+84y)} \times 100 = 50\%$$

6. **Ans. (3)**

$$5H_2SO_4 + 8NaI \xrightarrow{8e^{\ominus}} 4Na_2SO_4 + 4I_2 + H_2S + 4H_2O$$

$$n_f = \frac{8}{5}$$

Eq. weight of $H_2SO_4 = \frac{M}{n_f} = \frac{98}{\left(\frac{8}{5}\right)} = 61.25\text{g/eq.}$

7. **Ans. (4)**

$2K_2CrO_4 + 2HNO_3 \longrightarrow K_2Cr_2O_7 + 2KNO_3 + H_2O.$

The oxidation state of chromium in $K_2Cr_2O_7$ is +6, whereas the oxidation state of nitrogen in HNO_3 is +5.

Since the maximum oxidation state of nitrogen is +5, so it won't get oxidize further. Rather it will react to from dichromate ion and a water molecule ($Cr_2O_7^{2\ominus}$ and H_2O).

The equation involved is :

$2K_2CrO_4 + 2HNO_3 \rightarrow K_2Cr_2O_7 + 2KNO_3 + H_2O$

Therefore, when potassium chromate solution is treated with an excess of dilute nitric acid, $Cr_2O_7^{2\ominus}$ and H_2O are formed.

8. **Ans. (2)**

$eq_{acid} = eq_{base}$ (n-factor = 1)

$CHCl_2COOH + NH_3 \longrightarrow CHCl_2COONH_4$

From reaction, m.moles of NH_3 = m.moles of dichloroacetic acid = 100

$\therefore$ Moles of $NH_3 = \frac{100}{1000} = 0.1$

9. **Ans. (1)**

Since, minimum mass of reactant is asked so let us assume reactants to be in stoichiometric ratio. {So that no reactant is left}

$$5A_2 + 2B_4 \longrightarrow 2AB_2 + 4A_2B$$

let 5n moles, 2n moles

$2AB_2 \downarrow$ 2n moles = (2n × 250)gm = (500 n) gm

$4A_2B \downarrow$ 4n moles (4n × 140) gm (560 n) gm

Since, at least 1000 gm (1 kg) of each product is formed, let us keep the lesser product amount equal to 1000. So automatically the other product will exceed 1000 gm. We can exceed 1000 gm but not less than that

So. put. 500 n = 1000

n = 2

A_2 = 5n = 10 moles = (10 × 20)gm = 200 gm

B_4 = 2n = 4 mole = (4 × 480)gm = 1920 gm

Total weight of reactants = 2120 gm

10. **Ans. (2)**

Total mole of mixture = 1.25 mole

$$\underbrace{\underset{x\text{ mole}}{C_2H_6} + \underset{(1.25-x)\text{mole}}{C_2H_4}}_{28\ell\text{ at }1\text{atm},0^{\circ}C} + \underset{128\text{gm}}{O_2}$$

let us write the reaction separately

$$C_2H_6 + \frac{7}{2}O_2 \longrightarrow 2CO_2 + 3H_2O$$

x mole $\frac{7x}{2}$mole

$$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$$

(1.25 – x) 3(1.25 –x)

$$\frac{7x}{2} + 3(1.25 - x) = 4 \Rightarrow \quad x = 0.5$$

Mole fraction of $C_2H_6 = \frac{\text{moles of } C_2H_6}{\text{total moles}} = \frac{0.5}{1.25} = 0.4$

11. **Ans. (1)**

	$2KClO_3$	$\rightarrow$	$2KCl + 3O_2$	...(i)
let:	n moles		$\downarrow$ n moles	
	$4KCl_3$	$\rightarrow$	$KCl + 3KClO_4$	...(ii)
	n moles		$\downarrow$ $\frac{n}{4}$ moles	

$$\frac{(KCl)i}{(KCl)ii} = \frac{n}{n/4} = 4$$

12. **Ans. (4)**

	M = 56		M=28
	$C_4H_8(g)$	$\longrightarrow$	$2C_2H_4(g)$
let: t = 0	1 mole		$\downarrow$
t = t	(1 – x) moles		2x mole

$V.D_{mix} = 20$

$$M_{mix} = 40 = \frac{n_1M_1 + n_2M_2}{n_1 + n_2}$$

$$40 = \frac{(1-x)\times 56 + 2x\times 28}{1-x+2x} \Rightarrow 40 = \frac{56}{1+x}$$

x = 0.4

$$\frac{\text{Degree of dissociation}(\alpha)}{\{\text{for reac tan ts}\}} = \frac{\text{moles dissociated}}{\text{initial moles taken}} = \frac{x}{1} = 0.4$$

% α = 40%

13. **Ans. (1)**

	SO_3	$\longrightarrow$	SO_2	+	$\frac{1}{2}O_2$
Ret t = 0	1 mole				
	(1 – x) moles		x		$\frac{x}{2}$
d_{mix} = 2.5 gm/l					

$$P = \frac{dRT}{M}$$

$$M_{mix} = \frac{d_{mix}RT}{P} = 56$$

$$M_{mix} = \frac{n_1M_1 + n_2M_2 + n_3M_3}{(n_1 + n_2 + n_3)}$$

$$M_{mix} = \frac{80}{1 - x + \frac{x}{2} + x} = 56$$

$$1 + \frac{x}{2} = \frac{80}{56} = \frac{10}{7} \Rightarrow \frac{x}{2} = \frac{3}{7} \Rightarrow x = \frac{6}{7}$$

$$\alpha = \frac{x}{1} = \frac{6}{7}$$

14. Ans. (2)

$$\begin{array}{lcl}
CaC_2 + H_2O & \rightarrow & CaO + C_2H_2 \\
\dfrac{20\times1000}{64}\text{moles} & & \dfrac{20\times1000}{64}\text{moles} \\
C_2H_2 + H_2 & \rightarrow & C_2H_4 \\
\dfrac{20\times1000}{64}\text{moles} & & \dfrac{20\times1000}{64}\text{moles} \\
nC_2H_4 & \rightarrow & (C_2H_4)_n \\
\dfrac{20\times1000}{64}\text{moles} & & \left(\dfrac{1}{n}\times\dfrac{20\times1000}{64}\right)\text{moles}
\end{array}$$

$$\text{wt} = \frac{1}{n}\times\frac{20\times1000}{64}\times28n\,\text{gm} = 8.75\text{ kg}$$

15. Ans. (2)

$$\begin{array}{lllll}
Ag_2SO_4 & + \ 2NaCl & \longrightarrow & 2AgCl\downarrow & + \ Na_2SO_4 \\
2M, 2\ell & \ \ \ 1M, 4\ell & & \quad\downarrow & \qquad\downarrow \\
4\text{ moles} & \ \ \ 4\text{ moles} & & 4\text{ moles} & \ \ 2\text{ moles} \\
2\text{ moles left} & \qquad\uparrow & & & \\
 & \qquad\text{L.R} & & &
\end{array}$$

AgCl is a precipitate and will not break into ions.

Ag_2SO_4 left is 2mole: $\begin{cases} Ag^{\oplus} = 2\times2 = 4\text{ mole} \\ SO_4^{2\ominus} = 1\times2 = 2\text{mole} \end{cases}$

Na_2SO_4 left is 2 mole: $\begin{cases} Na^{\oplus} = 2\times2 = 4\text{mole} \\ SO_4^{2\ominus} = 1\times2 = 2\text{mole} \end{cases}$

Total moles of ions = 4 + 2 + 4 + 2 = 12

$$[\text{ions}] = \frac{12}{(2+4)} = 2M$$

16. Ans. (2)

	NaCl	KCl
	W_{gm}	W_{gm}
Mole	$\dfrac{W}{58.5}$	$\dfrac{W}{74.5}$

$$\text{Molarity} = \frac{\frac{W}{58.5}}{V} > \frac{\frac{W}{74.5}}{V}$$

17. Ans. (2)

Here in the question the solvent is ammonia mole fraction of solute = X_A

Let : mole fraction of solute + mole fraction of solvent = 1

So Mole fraction of solute = X_A

Mole fraction of solvent = $(1 - X_A)$

Weight of solvent = $(1 - X_A) \times 17$ gm

$$\text{molality} = \frac{X_A}{\frac{(1-X_A)\times17}{1000}} = \frac{58.82X_A}{(1-X_A)}$$

18. **Ans. (1)**

$$M=\frac{\frac{w}{w}\%\times10\times d}{M_{solute}}=\frac{95\times10\times1.834}{98}\approx17.8M$$

19. **Ans. (1)**

$XeF_4 + KI \rightarrow Xe + I_2 + KF$

gm equivalent pf XeF_4 = gm equivalent of I_2

$(x \times 10^{-2}) \times 4$ = moles of $I_2 \times 2$

moles of I_2= $2x \times 10^{-3}$

I_2 + HyPO $\rightarrow Na_2S_4O_6 + I^{\ominus}$

20ml, 0.1 N

Eq. of I_2 = Eq. of HyPO ($Na_2S_2O_3$)

$(2x \times 10^{-3}) \times 2 = 20 \times 10^{-3} \times 0.1$

$x = 0.5$

20. **Ans. (3)**

Since, equal volumes are mixed, let us assume 100 ml of each.

$10\%\frac{w}{V}HCl$ + $10\%\frac{w}{V}NaOH$

100 ml will contain 10 gm HCl | 100 ml will contain 10 gm NaOH

$n_{HCl}=\frac{10}{36.5}$ | $n_{NaOH}=\frac{10}{40}$

HCl	+	NaOH	$\rightarrow$	NaCl +	H_2O
$\frac{10}{36.5}$moles		$\frac{10}{40}$moles			
(excess)		L.R.			

Final solution will be Acidic.

SECTION-B

1. **Ans. (1)**

Lets mole of $FeSO_4$ = x

Now, $KMnO_4$ oxidises only $FeSO_4$

($\because$ $Fe_2(SO_4)_3$ has Fe & S in their maximum oxidation state, +3 & +6 respectively)

equivalent of $FeSO_4$ = equivalent of $KMnO_4$

$x \times 1 = \frac{100}{1000} \times 2 \times 5 \Rightarrow x = 1$

2. **Ans. (3)**

Necessary equations :

$KBrO_3 + KI \longrightarrow I_2 + Br^{\ominus}$

$I_2 + Na_2S_2O_3 \longrightarrow Na_2S_4O_6 + NaI$

equivalent of I_2 = equivalent of $KBrO_3$ = 12×10^{-2}

equivalent of $Na_2S_2O_3$ = equivalent of I_2

$M \times 1 \times \frac{40}{1000} = 12 \times 10^{-2}$

so, molarity = 3 M.

3. Ans. (20)

Moles of $CaCl_2 = \dfrac{11.1\times10^{-3}}{111} = 10^{-4} \Rightarrow$ equivalent moles of $CaCO_3 = 10^{-4}$

Moles of $MgCl_2 = \dfrac{9.5\times10^{-3}}{95} = 10^{-4} \Rightarrow$ equivalent moles of $CaCO_3 = 10^{-4}$

$\therefore$ Total moles of $CaCO_3 = 2 \times 10^{-4} \Rightarrow$ Weight of $CaCO_3 = 2 \times 10^{-4} \times 100 = 2 \times 10^{-2}$ g

Also, weight of solution = 1000 g

$$\therefore \text{ ppm of } CaCO_3 = \frac{\text{weight of } CaCO_3}{\text{weight of solution}} \times 10^{6} = \frac{2\times10^{-2}}{1000}\times10^{-6} = 20 \text{ ppm}$$

4. Ans. (3.00)

10^6 gm solution has 2.1 gm $Li^{\oplus}$ ions approx. 10^6 gm solvent (1000 kg) has 2.1 gm $Li^{\oplus}$

$$m = \alpha = \frac{2.1/7}{1000} = 3\times10^{-4}\,m$$

5. Ans. (125)

For same solution: $\dfrac{w}{w}\% \times d = \dfrac{w}{V}\%$

$8 \times d = 10$

$d = \dfrac{10}{8} = 1.25$ gm/ml

$x = 1.25$

$100\,x = 125$

6. Ans. (13.00)

$$\text{Molarity of HCl} = \frac{\dfrac{1.825}{36.5}}{\dfrac{100}{1000}} = 0.5$$

$$[Cl^{\ominus}] = 0.5 \left\{\begin{array}{llll} \text{As}: & HCl & \rightarrow & H^{\oplus} + Cl^{\ominus} \\ & 0.5 & & \quad\downarrow \\ & & & \quad 0.5 \end{array}\right\} \text{we want same } [Cl^{\ominus}] \text{ concentration from } BaCl_2 \text{ solution}$$

$$\begin{array}{lllll} & BaCl_2 & \rightarrow & Ba^{2\oplus} & + \quad 2Cl^{\ominus} \\ \text{let:} & xM & & & \quad\downarrow \\ & & & & 2x = 0.5 \Rightarrow x = \dfrac{0.5}{2} \end{array}$$

$$M_{BaCl_2} = \frac{0.5}{2} = \frac{n_{BaCl_2}}{V} \Rightarrow 0.25 = \frac{n_{BaCl_2}}{0.25}$$

$$n_{BaCl_2} = 0.25\times0.25$$

mass = $(0.25 \times 0.25 \times 208) = 13$ gm

7. Ans. (5)

$$\boxed{\begin{array}{l}\text{500 gm solution}\\ x_{urea} = 0.2\\ x_{H_2O} = 0.8\end{array}} \xrightarrow[\text{H}_2\text{O is added}]{\text{1000 gm}} \boxed{\begin{array}{c}\text{1500 gm}\\ \text{solution}\end{array}}$$

Let moles of urea = x (60 x gm)

Moles of waters = y (18 y gm)

$$0.2 = \frac{x}{x+y}$$

0.2 x + 0.2 y = x

$$\boxed{y = 4x}$$

60x + 18y = 500

$$x = \frac{500}{132} \text{ and } y = \frac{2000}{132}$$

urea moles = x

$$\text{water moles} = y + \frac{1000}{18}$$

$$x_{urea}(\text{new}) = \frac{x}{x+y+\frac{1000}{18}}$$

$$= \frac{\frac{500}{132}}{\frac{500}{132}+\frac{2000}{132}+\frac{1000}{18}}$$

= 0.05

= 5×10^{-2}

8. Ans. (75)

$$\underbrace{CaCl_2 + NaCl}_{2.22gm} \xrightarrow[\text{is precipitated}]{\text{All Ca}} \underset{0.84gm}{CaO}$$

$CaCl_2 \longrightarrow CaCO_3 \longrightarrow CaO$. {All Ca in $CaCl_2$ converted}

$\downarrow$ W gm $\qquad$ $\downarrow$ $\frac{W}{111}$ moles

$\frac{W}{111}$ moles

$$\frac{W}{111} \times 56 = 0.84$$

W = 1.665 gm

$$\text{Mass fraction of } CaCl_2 = \frac{1.665}{2.22} = 0.75$$

= 75×10^{-2}

9. Ans. (2)

$$2CH_3COCH_3 + 6CaOCl_2 \xrightarrow{\%\text{ yield} = 58\%} Ca(CH_3COO)_2 + 2CHCl_3 + 3CaCl_2 + 2Ca(OH)_2$$

$\downarrow$ W gm

$$\text{moles} = \frac{W}{58} \text{ moles}$$

$\downarrow$

$$\left(\frac{W}{58} \times \frac{58}{100}\right) \text{moles}$$

$$= \frac{W}{100} \text{moles}$$

$$= \frac{W}{100} \times 119.5\text{gm} = \frac{239}{1000}\text{gm}$$

W = 0.2 gm

= 2×10^{-1}

10. Ans. (1)

	NaH_2PO_4	$\xrightarrow{\text{finally converted}}$	$Mg_2P_2O_7$
Let :	W gm		1.11 gm
	$\frac{W}{120}$ moles		$\frac{1.11}{222}$ moles
POAC for:	'P' atm		0.005 moles

1 × moles of NaH_2PO_4 = 2 × moles of $Mg_2P_2O_7$

$$1 \times \frac{w}{120} = 2 \times 0.005 \Rightarrow w = 1.20 \text{ gm}$$

w = 1 (nearest integer)

JEE (Advanced) Practice Paper

1. Ans. (54.00)

$$\underbrace{\text{Fe} + \text{other impurities}}_{0.70\text{g}} \quad \text{all Fe converted to} \quad \underset{0.541\text{ gm}}{Fe_2O_3}$$

$$\longrightarrow \quad \longrightarrow \longrightarrow$$

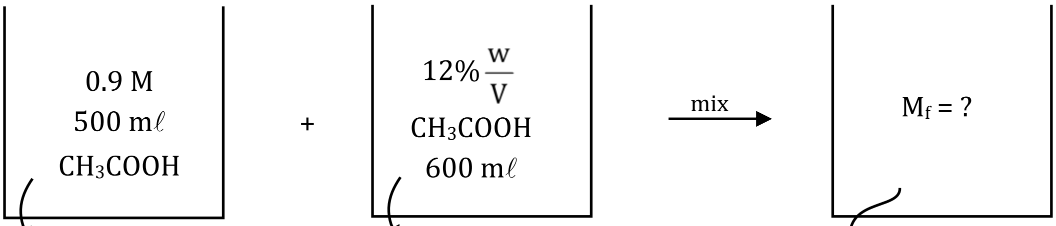
$$\text{Moles of } Fe_2O_3 = \frac{0.541}{160}$$

$$\text{Mole of Fe} = \frac{0.541}{160} \times 2 = \frac{1.082}{160}$$

$$\text{Weight of Fe} = \frac{1.082}{160} \times 56 = 0.3787\text{gm}$$

$$\% \text{ Fe} = \frac{0.3787}{0.7} \times 100 = 54\%$$

2. Ans. (1.50)



$M_1 = 0.9$

$V_1 = 500$ mℓ

$M_2 = \frac{12'10}{60} = 2$

$V_2 = 600$ mℓ

$$M_f = \frac{M_1V_1 + M_2V_2}{V_1 + V_2}$$

$$M_f = \frac{0.9'500 + 2'600}{500 + 600}$$

$M_f = 1.5$ M

3. Ans. (0.02)

let 'V' litre of $\left(\frac{5}{51}\right)$M $Al(SO_4)_3$ be required

$$Al_2(SO_4)_3 \quad + \quad 3Ca(NO_3)_2 \longrightarrow 2Al(NO_3)_3 \quad + \quad 3CaSO_4$$

$$\frac{5V}{51}\text{moles}$$

$$\downarrow \qquad\qquad \downarrow$$

$$\frac{10V}{51}\text{moles} \qquad \frac{15V}{51}\text{moles}$$

$$\left(\frac{10V}{51}\times 213\right)\text{gm} \qquad \left(\frac{15V}{51}\times 136\right)\text{gm}$$

$$\left(\frac{2130V}{51}\right)\text{gm} \qquad \left(\frac{2040}{7}\right)\text{gm}$$

Since, minimum 1 gm of each product must be produced, so if we put the lesser amount to be equal to 1 gm, automatically the products will be produced at least 1 gm.

So: $\frac{2040\times V}{51}=1$

$$V=\frac{51}{2040}=0.025\ell$$

4. **Ans. (21.60)**

$$x\%\frac{w}{w}\ \ (d = 0.6\ gm/ml) \xrightarrow{\text{diluted}} 12\%\ \frac{w}{w}\left(d=0.9\frac{gm}{ml}\right)$$

$V_1 = 60ml$ $\qquad$ $V_2 = 200ml$

$$M_1=\frac{x\times 10\times 0.6}{M_{solute}} \qquad M_2=\frac{12\times 10\times 0.9}{M_{solute}}$$

$M_1V_1 = M_2V_2$

$$\frac{x\times 10\times 0.6}{M_{solute}}\times 60=\frac{12+10\times 0.9}{M_{solute}}\times 200$$

$x = 60$

initial sample was: $\quad 60\%\frac{w}{w}\left(d=\frac{0.6gm}{ml}\right)$

60 ml

mass of solution = 36 gm

mass of alcohol = $\frac{60}{100}\times 36=21.6gm$

5. **Ans. (0.17 or 0.18)**

$$50\ ml \xrightarrow{\text{diluted}} V = ?$$

conc. $HNO_3\left(70\%\frac{w}{V}\right)$ $\qquad$ $20\%\frac{w}{V}$

$V_1 = 50ml$ $\qquad$ $V_2 = Vml$

$$M_1=\frac{70\times 10}{63} \qquad M_2=\frac{20\times 10}{63}$$

{Mol. wt. HNO_3 = 63}

$M_1V_1 = M_2V_2$

$$\frac{70\times 10}{63}\times 50=\frac{20\times 10}{63}\times V$$

V = 175 ml = 0.175*l*

6. **Ans. (35)**

$$\boxed{\begin{array}{ll} \text{KOH}+\text{Ca(OH)}_2 & \\ \text{x(g)} & (4.2-\text{x})\text{g} \end{array}}$$

Eq. of acid = Eq. of KOH + Eq. of $Ca(OH)_2$

$$0.11 = \frac{x}{56}\times 1+\left(\frac{4.2-x}{74}\right)\times 2$$

x = mass of KOH = 1.47 g

mass of $Ca(OH)_2$ = 2.73g

$$\% \text{ mass of KOH} = \frac{1.47}{4.2}\times 100 \approx 35\%$$

7. **Ans. (16.67)**

$$\boxed{\begin{array}{lll} Fe_2O_3 & \& & FeO \\ (520-x) & & x(g) \end{array}}$$

$KMnO_4 + FeO \xrightarrow{H^{\oplus}} Fe^{3\oplus} + Mn^{2\oplus}$

$n_f = 5$ $\qquad\qquad\qquad$ $n_f = 1$

Eq. of $kMnO_4$ = Eq. of FeO

$$\frac{158}{158}\times 5=\frac{x}{72}\times 1$$

x = mass of FeO = 360 g

in mixture

mass of Fe_2O_3 = 160g

n(FeO) = 5 mole; n(Fe_2O_3) = 1 mol

$$\% \text{ mole of } Fe_2O_3 = \frac{1}{6}\times 100=16.67\%$$

8. **Ans. (0.42)**

$KMnO_4 + KI \longrightarrow Mn^{2\oplus} + I_2$

$K_2Cr_2O_7 + KI \longrightarrow Cr^{3\oplus} + I_2$

Eq. of KI = Eq. of $KMnO_4$ + Eq. of $K_2Cr_2O_7$

$40 \times 10^{-3} \times M \times 1 = 50 \times 10^{-3} \times 0.02 \times 5 + 20 \times 10^{-3} \times 0.1 \times 6$

$$\text{Molarity of KI} = M = \frac{17}{40} = 0.42\ M$$

9. **Ans. (A,B,C)**

$$\begin{array}{cccccccc} 3CaCO_3 & + & 2H_3PO_4 & \rightarrow & Ca_3(PO_4)_2 & + & 3H_2O & + \ 3CO_2 \\ 50\text{ gm} & & 68.6\text{ gm} & & \downarrow & & \downarrow & \downarrow \\ 0.5\text{ mole} & & 0.7\text{ mole} & & \frac{0.5}{3}\text{mole} & & 0.5\text{ mole} & 0.5\text{mole} \\ \uparrow & & & & & & & \\ \text{L.R.} & & \multicolumn{6}{l}{\text{left} = \left(0.7-\frac{2}{3}\times 0.5\text{ mole}\right)} \end{array}$$

moles of $Ca_3(PO_4)_2$ = $\frac{0.5}{3}$; wt of $Ca_3(PO_4)_2$ = $\left(\frac{0.5}{3}\times 310\right)$gm

10. Ans. (B,D)

$2ZnS$	+	$3O_2$	$\xrightarrow{80\%}$	$2ZnO$	+	$2SO_2$		
15				$15 \times 0.8 = 12$ mole ZnO				
ZnO	+	H_2SO_4	$\xrightarrow{75\%}$	$ZnSO_4$	+	H_2O		
12				$12 \times 0.75 = 9$ mole $ZnSO_4$				
$2ZnSO_4$	+	$2H_2O$	$\xrightarrow{50\%}$	$2Zn$	+	$2H_2SO_4$	+	O_2
9				9×0.5 $= 4.5$		9×0.5 $= 4.5$		4.5×0.5 $= 2.25$

11. Ans. (A,C,D)

$M = 10^{-5}$ (d = 1gm/ml)

10^{-5} mole HCl is present in 1000 m*l* (1*l*) solution 10^{-5} mole HCl present in 1000 gm (V × d) solution.

(10^{-5} × 36.5)gm HCl in 1000 gm solution 36.5 × 10^{-5} gm HCl is very less, hence, almost all solution

wt = wt. of solvent (i.e. water) $x_{HCl} = \dfrac{10^{-5}}{10^{-5} + \dfrac{1000}{18}} \simeq 1.8 \times 10^{-7}$

{Since, solution very dilute m $\approx$ M}

ppm = $\dfrac{36.5 \times 10^{-5}}{1000} \times 10^{6} = 0.365\,\text{ppm}$

12. Ans. (A,C)

				(do not dissociate into ions)		
		$\downarrow$ L.R		$\uparrow$		
$Ca_2(NO_3)_2$	$\rightarrow$	$Na_2C_2O_4$	$\rightarrow$	$CaC_2O_4\downarrow$	+	$2NaNO_3$
initial millimoles = 6		3		$\downarrow$		$\downarrow$
final : 3 m. mole		0		3 milli = 0.003 mole		6 mili mole

$[Ca^{2\oplus}]_{final} = \dfrac{3}{150} = 0.02$ M

$[C_2O_4^{2\ominus}]_{final} = 0$

13. Ans. (B, D)

	$6Cl_2$	+	$12OH^{\ominus}$	$\rightarrow$	$ClO_3^{\ominus}$	+	$10Cl^{\ominus}$	+	$6H_2O$
t = 0	0.2 mole		500 ml, 12M = 0.6 mol				0		0
t'	0		0.6 – 0.4 = 0.2 mol		$\dfrac{0.2}{3}$mole		$\left\|\dfrac{1}{3}\text{mole}\right\|$		0.2 mole

$[ClO_3^{\ominus}]_{final} = \dfrac{0.2/3}{1/2} = 0.133M$

$[Cl^{\ominus}]_{final} = \dfrac{1/3}{1/2} = \dfrac{2}{3} = 0.67M$

14. **Ans. (B)**

Eq. of $KMnO_4$ used = $100 \times 10^{-3} \times 0.4 \times 5 = 0.2$ eq

We need at least 0.2 equivalents of reducing agent

(A) $K_2Cr_2O_7$ is not a reducing agent

(B) $H_2O_2 \rightarrow O_2$

eq. of $H_2O_2 = 300 \times 10^{-3} \times 0.5 \times 2 = 0.3$ eq.

(C) Eq. of KI = $100 \times 10^{-3} \times 0.8 = 0.08$ eq.

(D) Eq. of $H_2C_2O_4 = 75 \times 10^{-3} \times 1.4 = 0.105$ eq.

15. **Ans. (A)**

(P) L.R.

$$\begin{array}{lclcl} 2H_2 & + & O_2 & \rightarrow & 2H_2O \\ 1\text{gm} & & 1\text{gm} & & \\ \frac{1}{32}\text{mol} & & & & \frac{2}{1}\times\frac{1}{32}\times 18\text{ gm } = 1.125\text{ gm} \\ \downarrow & & & & \\ \text{L.R.} & & & & \end{array}$$

(Q)

$$\begin{array}{lclcl} 3H_2 & + & N_2 & \rightarrow & 2NH_3 \\ 1\text{gm} & & 1\text{gm} & & \\ \frac{1}{2}\text{mol} & & \frac{1}{28}\text{mol} & & \frac{2}{1}\times\frac{1}{28}\times 17\ = 1.214\text{ gm} \end{array}$$

(R)

$$\begin{array}{lclcl} H_2 & + & Cl_2 & \rightarrow & 2HCl \\ 1\text{g} & & 1\text{gm} & & \\ \frac{1}{2}\text{mol} & & \frac{1}{71}\text{mol} & & \frac{2}{1}\times\frac{1}{71}\times 36.5 = 1.028\text{g} \end{array}$$

(S)

$$\begin{array}{lclcl} 2H_2 & + & C & \rightarrow & CH_4 \\ 1\text{g} & & 1\text{g} & & \\ \text{mol}\frac{1}{2} & & \frac{1}{12} & & \frac{1}{1}\times\frac{1}{12}\times 16\ = 1.333\text{gm} \end{array}$$

16. **Ans. (A)**

(A) 2M aq. NaOH solution (d = 1.2 gm/ml)

2 moles NaOH present in 1*l*(1000 m*l*) solution

or 2 moles NaOH(80 gm) in 1200 gm solution

1000 m*l* solution $\longrightarrow$ 80 gm NaOH

100 ml solution $\longrightarrow$ 8 gm NaOH

1200 gm solution $\longrightarrow$ 80 gm

240 gm solution $\longrightarrow \frac{80}{1200}\times 240 = 16$ gm NaOH

(B) 8% $\frac{w}{V}$ aq. KOH (d = 1.2 gm/mol)

8 gm KOH in 100 ml solution

8 gm KOH in 120 gm solution

16 gm KOH in 240 gm solution

(C) $25\%\left(\frac{w}{w}\right)CaCO_3$ solution (d = 1.2 gm/ml)

100 gm solution contains 25 gm $CaCO_3$

400 gm solution $\longrightarrow$ 100 gm (1 mole) $CaCO_3$

240 gm solution $\longrightarrow \frac{25}{100}\times240$ = 60 gm $CaCO_3$

$\frac{100}{1.2}$ ml solution $\longrightarrow$ 25 gm $CaCO_3$

(D) $X_{C_3H_7OH} = \frac{1}{11} = \frac{1}{1+10}$: i.e., 1 mole C_3H_7OH + 10 mole H_2O

$\downarrow \qquad \downarrow$

240 gm solution = 200 ml solution $\quad \underbrace{60\text{gm} \qquad 180\text{gm}}_{\text{240m solution}}$

17. Ans. (C)

(A) 120 gm (2 mole) $CH_3COOH \rightarrow$ mol. wt. = 60

in 1 litre : $M = \frac{2}{1} = 2 = \frac{\frac{w}{V}\%\times10}{60}$

$$\frac{w}{V}\% = 12\%$$

$$m = \frac{1000\times M}{1000\times d - M(M)_{solute}}$$

$$m = \frac{1000\times2}{1000\times1.2-2\times60} = 1.85$$

For same solution : % w/w × d = %w/v

$$\frac{w}{w}\%\times1.2 = 12$$

$$\frac{w}{w}\% = 10\%$$

(B) 120gm glucose ($C_6H_{12}O_6$ mol wt = 180) in 1 litre solution.

d = 1.2 gm/mol : $M = \frac{\frac{120}{180}}{1}$ = 0.66 or $\frac{2}{3}M$

$\frac{2}{3} = \frac{\frac{w}{V}\%\times10}{180} : \Rightarrow \frac{w}{V}\% = 12\%$

For same solution: $\frac{w}{w}\%\times d = \frac{w}{V}\%$

$$\frac{w}{w}\%\times1.2 = 12$$

$$\frac{w}{w}\% = 10$$

$$\frac{m = 1000\times\frac{2}{3}}{1000\times1.2-\frac{2}{3}\times180} = 0.617 : B \rightarrow Q,R,T$$

(C) $x_{NH_2CONH_2} = \frac{1}{31} = \frac{1}{1+30}$: let : n_{urea} + n_{H_2O}

$\downarrow$ $\downarrow$

30

(60 gm) (540 gm)

$$\frac{w}{w}\% = \frac{60}{600} \times 100 = 10\%$$

$$m = \frac{1}{540} \times 1000 = 1.85 \ : C \Rightarrow Q, S$$

(D) $M = \frac{19.6 \times 10}{98} = 2$: $\frac{w}{w}\% \times 1.2 = 19.6$

$$m = \frac{1000 \times 2}{1000 \times 1.2 - 2 \times 98} = 1.99$$

$D \rightarrow P$

18. **Ans. (B)**

(A) $\underline{P_2H_4} \longrightarrow PH_3 + H_4PO_2$

$n_f = \frac{2 \times 3}{5}$ Equation wt. of $P_2O_4 = \frac{5M}{6}$

$= \frac{6}{5}$

(B) $\underline{I_2} \longrightarrow I^{\ominus} + IO_3^{\ominus}$

$n_f = \frac{2 \times 10}{12} = \frac{5}{3}$ Eq. wt of $I_2 = \frac{3M}{5}$

(C) $MnO_4^{\ominus} + Mn^{2\oplus} + H_2O \longrightarrow \underline{Mn_3O_4} + H^{\oplus}$

$$n_f = \frac{13 \times 2}{15} = \frac{26}{15}$$

Eq. wt of $Mn_3O_4 = \frac{15M}{26}$

(D) $\underline{H_3PO_2} \longrightarrow PH_3 + H_3PO_3$

$n_f = \frac{4 \times 2}{6} = \frac{4}{3}$ Eq. wt of $H_3PO_2 = \frac{3M}{4}$