EXERCISE - 1 [A]

1. (C)

(a) $NH_3 = 0$ $N = -3$

(b) $O = -2$, $H = +1$ $N = -1$

(c) $N_2H_5 = +1$ $N = -2$

(d) $N = -3$

2. (C)

$+ \overset{+7}{ClO_4^{\ominus}} \xrightarrow{n=6} \overset{+1}{ClO^{\ominus}}$ $\overset{+4}{MnO_2} \xrightarrow{n=2} \overset{+6}{MnO_4^{-2}}$

$ClO_4^{\ominus} + 3MnO_2 + \cancel{6H^+}\ 3H_2O \quad \cancel{+6OH} \quad + 6OH^{\ominus} \longrightarrow ClO^{\ominus} + 3MnO_4^{-2} \cancel{+3H_2O} + 6H^+ + 6OH^{\ominus}$

$ClO_4^{\ominus} + 3MnO_2 + 6OH^{\ominus} \longrightarrow ClO^{\ominus} + 3MnO_4^{-2} + 3H_2O$

$x = 1$, $y = 3$, $z = 6$

3. (A)

ferric oxalate $Fe_2(C_2O_4)_3 \longrightarrow 2Fe^{+3} + 6CO_2 + 6e^{\ominus}$ $n = 6$

ferrous oxalate $FeC_2O_4 \longrightarrow Fe^{+3} + 2CO_2 + 3e^{\ominus}$ $n = 3$

$6 \times$ moles of $Fe_2(C_2O_4)_3 = 5 \times$ moles of $MnO_4^{\ominus}$

$x = \frac{6 \times 1}{5} = \frac{6}{5}$

$3 \times$ moles of $FeC_2O_4 = 5 \times$ moles of $MnO_4^{\ominus}$

$y = \frac{3 \times 1}{5} = 3/5$

$\frac{x}{y} = \frac{2}{1}$

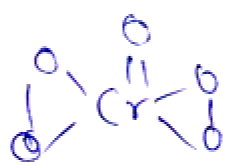
4. (B)

$\overset{+7}{Mn}O_4^{\ominus} \xrightarrow{n=5} Mn^{+2}$

$5 \times$ moles of $KMnO_4 = \cancel{5}\,3 \times$ moles of FeC_2O_4

Ans $= \frac{3}{5}$

5. (B)



$CrO_5 = Cr(O_2)_2O$

$Cr = +6$

6. (B)

$\overset{-2}{N_2}H_4 \longrightarrow 2N^{+y}$

$[y-(-2)] \times 2 = 10$

$y + 2 = 5$

$y = 3$

7. (B)

$$3Pb(N_3)_2 + 22H_2O \longrightarrow Pb_3O_4 + 18NO + 44H^+ + 44e^\ominus$$

So $e^\ominus$ charge per mole $= \frac{44}{3}$

8. (C)

$$\overset{0}{Zn} + 2\overset{\ominus}{O}\underset{+1}{H} \longrightarrow \underset{+2}{Zn}O_2^{-2} + \underset{0}{H_2}$$

$n=2$ $n=2$

Balanced eqn

$$Zn + 2\overset{\ominus}{O}H \longrightarrow ZnO_2^{-2} + H_2$$

9. (B)

$$Zn \xrightarrow{n=2} Zn^{+2} \qquad Na\overset{+5}{N}O_3 \xrightarrow{n=8} \overset{-3}{N}H_3$$

$$4Zn + NaNO_3 + 5H_2O + 10\overset{\ominus}{O}H \longrightarrow 4Na_2ZnO_2 + NH_3 + 10H^+ + 10\overset{\ominus}{O}H$$

$$4Zn + NaNO_3 + 10\overset{\ominus}{O}H \longrightarrow 4Na_2ZnO_2 + NH_3 + 5H_2O$$

10. (B)

CH_3Cl $C = \cancel{+0} -2$

CCl_4 $C = +4$

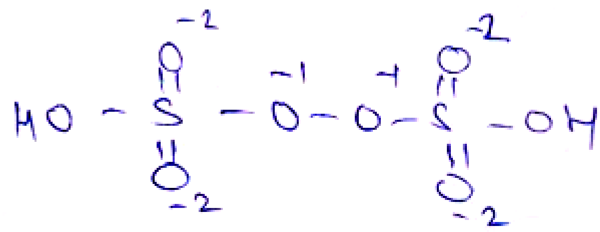
$CHCl_3$ $C = +2$

CH_2Cl_2 $C = 0$

11. (D)

$$\overset{+5}{N_2O_5} \longrightarrow H\overset{+5}{N}O_3$$

12. (C)



Marshall's acid

$$H_2S_2O_6(O_2)$$

$$+2+2x+6(-2)+2(-1)=0$$

$$\underline{x=+6}$$

13. (D)

(a) $MnO_4^{\ominus}$, $Mn=+7$ (b) $[Cr(CN)_6]^{-3}$ $Cr=+3$

(c) $[NiF_6]^{-2}$ $Ni=+4$ (d) CrO_2Cl_2 $Cr=+6$

14. (B)

$$2S_2O_3^{-2} \longrightarrow S_4O_6^{-2} + 2e^{\ominus}$$

oxidised

reduced I_2 to $I^{\ominus}$

so a R.A.

15. (A)

(a) In peroxides $O=-1$

16. (B)

highest ox. states ~~of~~ ~~to~~ are

Mn = +~~6~~7, Cr = +6, Co = +6, Ni = +4

17. (A)

0.1 gm metal gives

= 34.2 ml H_2 gas

$= \frac{34.2}{22400}$ moles of H_2 gas

x gm metal will give

$\frac{34.2}{22400} \times \frac{x}{0.1}$ moles

$= \cancel{34.2}\ \frac{342x}{22400} \times 2 = 1.008$

$x = 32.7$ gm

18. (B)

0.5 gm combining with

(0.79 − 0.5) gm oxygen

= 0.29 gm

x will combine with

$\frac{0.29}{0.5} \times x = 8$

$x = \frac{4}{0.29} = 13.79 \simeq 14$

19. (C)

74.5 gm metal chloride combined with 35.5 gm chlorine

so wt of metal in chloride

$= 74.5 - 35.5 = 39$ gm.

20. (C)

$PV = nRT$

$1 \times 0.1 = \frac{0.72}{M_w} \times 0.0821 \times 273$

$M_w = 7.2 \times 22.4 = 161.28$

moles of chlorine $= \frac{65.5}{100} \times \frac{161.28}{35.5}$

$\simeq 3$

so formula is MCl_3

21. (B)

Eq. wt of chloride $= 4.5 + 35.5$

$= 40$

so valancy $= \frac{80}{40} = 2$

so at. wt $= 2 \times 4.5 = 9$

22. (B)

Metal is M^{+2}

eq of metal 4 sulphate will be same

$$\frac{42.2}{E} = \frac{(100-42.2)}{(96/2)} \qquad SO_4^{-2}$$

$$E \simeq 35.04$$

23. (B)

eq. Wt of chloride = 4 + 35.5 = 39.5

$$\text{valency} = \frac{59.25 \times 2}{39.5} = 3$$

24. (C)

valancy = +3

at. wt of metal = 9 × 3 = 27

25. (C)

eq. of mg = eq of Cu

$$\frac{0.534}{12} = \frac{1.415}{E_{Cu}}$$

$$E_{Cu} = 31.8$$

26. (A)

no. of equivalents will be same

$$\frac{m_1}{E_1} = \frac{m_2}{E_2}$$

$$\therefore E_1 = \frac{m_1}{m_2} \times E_2$$

27. (A)

$$\frac{W}{12} = \frac{0.475}{12+35.5} = \frac{1}{100}$$

$$W = 0.12 \text{ gm}$$

28. (A)

Fe^{+3}

$$E = \frac{56}{3} = 18.6$$

29. (B)

$$\frac{1.5}{E} = \frac{4}{(64/2)} = \frac{4}{32} = 1/8$$

$E = 12$ so at. wt $= 12 \times 2$
$= 24$

30. (A)

$$K\overset{+7}{Mn}O_4 \longrightarrow \overset{+2}{Mn}SO_4$$

$$n = 5$$

$$E = M/5$$

31. (D)

$$\frac{W_1}{E_1} = \frac{W_2}{E_2}$$

$$\frac{W_1}{W_2} = \frac{E_1}{E_2}$$

32. (D)

$$\frac{0.84}{E+1} = \frac{0.042}{1}$$

$E+1$ = eq wt of metal hydride $= 20$

33. (A)

60 gm metal has 40 gm oxygen

so 12 gm " " 8 gm "

so eq. wt = 12 gm

34. (C)

on burning, combustion will take place

let 100 gm metal

so $\frac{100}{E} = \frac{124}{E+8}$

$100E + 800 = 124E$

$24E = 800$

$E = 33.3$

35. (A)

$$\frac{3}{E+8} = \frac{5}{E+35.5}$$

$3E + 106.5 = 5E + 40$

$2E = 66.5 \Rightarrow E = 33.25$

36. (D)

M^{+2} so M^{t} wt = 24

MO M·wt = 24 + 16 = 40

37. (C)

n factor = 3

so eq. Wt = $\frac{98}{3}$ = 32.66.

38. (C)

$16\,Cl^{\ominus} \longrightarrow \cancel{2t\frac{t}{2}} + 5Cl_2 + 6Cl^{\ominus} + 10e^{\ominus}$

n factor = $\frac{10}{16}$ = 5/8

$E = \frac{8M}{5}$

39. (C)

eq of metal = eq of sodium sulphite

n × 50 × 0.1 = 2 × 25 × 0.1

n = 1

so metal will be reduced to +2

40. (A)

eq of $K_2Cr_2O_7$ = eq of $FeSO_4$

$Cr_2O_7^{-2} \rightarrow 2Cr^{+3}$ $\quad$ $Fe^{+2} \rightarrow Fe^{+3}$

$+6 \rightarrow +3$, $n = 6$ $\quad$ $n = 1$

$6 \times M_1V_1 = 1 \times M_2 \times V_2$

41. (B)

$(n\ \text{factor}) \times 3.36 \times 10^{-3} = 6 \times 1.68 \times 10^{-3}$

$n\text{factor} = 3$

so A^{-n} will be oxidized to

A^{-n+3} (A^{3-n})

42. (D)

$n = 2 \times 2 = 4$

$\underset{+3\ \ -2}{As_2S_3} \rightarrow 2H_3\underset{+5}{AsO_4} + 3H_2\underset{+6}{SO_4}$

$n = 8 \times 3 = 24$

$H\overset{+5}{N}O_3 \rightarrow \overset{+2}{N}O$

n factor = $24 + 4 = 28$

$28 \times x = 3 \times 1$

$x = 3/28$

43. (A)

n factor = 2 for reductant

so $2 \times M \times 25 = 5 \times 20 \times 0.01$

$M = 0.02 = \frac{2.52}{M_w}$

$M_w = \frac{2.52}{0.02} = 126$

44. (B)

$H_2O_2 \rightarrow 2H_2O$

$+2H^+$

$+2e^-$

eq of H_2O_2 = eq of Sn^{+2}

$100 \times M \times \cancel{x} = \cancel{2} \times 50 \times 0.2$

$M = 0.1$

if vol strength = x

molarity $= \frac{x}{11.2} = 0.1$

$x = 1.12$

45. (A)

$H_2O_2 + 2I^{\ominus} \longrightarrow H_2O + I_2$

n = 2

n = 2

eq of H_2O_2 = eq of KI = eq of I_2 = eq of hypo

$2 \times 10 \times M = 1 \times 20 \times 0.1$ {n factor for hypo = 1}

$M = 0.1$

vol. strength $= 11.2 \times 0.1$

$= \cancel{2.24}\ 1.12$

46. (C)

$\overset{0}{P} \longrightarrow \overset{+5}{P}O_4^{-3}$

$5 \times \text{moles of } P = 6 \times \text{moles of } Cr_2O_7^{-2}$

$\text{moles of } P = \frac{6 \times 0.2}{5} = \frac{1.2}{5} = 0.24$

47. (A)

$4HCl^{\ominus} \longrightarrow 2Cl^{\ominus} + Cl_2 + 2e^{\ominus}$

n factor $= 2/4 = 1/2$

48. (B)

$2Fe_3O_4 + H_2O \longrightarrow 3Fe_2O_3 + 2H^+ + 2e^{\ominus}$

n factor $= 1$ $\quad E = \frac{M}{1}$

49. (D)

$As_2S_3 + 20H_2O \longrightarrow 2AsO_4^{-3} + 3SO_4^{-2} + 40H^+ + 28e^{\ominus}$

$E = \frac{M}{28}$

50. (B)

HNO_3 itself is getting reduced

$H\overset{+5}{N}O_3$ so final product will have N as +1.

In N_2O $\quad N = +1$

51. (B)

n factor = 2

so $N = 0.1 \times 2 = 0.2$

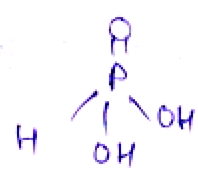
52. (A, C)

3 acidic hydrogens so n factor = 3

$E = M/3$

53. (D)

H_3PO_3



n factor = 2

$N = 0.3 \times 2 = 0.6$

54. (B)

$$\frac{0.52}{E} = 100 \times 10^{-3} \times 0.1$$

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

$E = 52$

55. (D)

$Pb^{+2} + Cr_2O_7^{-2} \longrightarrow PbCrO_4$ yellow ppt

n factor = no. of cationic charge replaced

= 2

So $N = 0.1 \times 2 = 0.2$

56. (A)

$$\frac{3}{E+8} = \frac{5}{E+35.5}$$

$E = 33.25$

57. (A)

Oxalic acid · dihydrate $H_2C_2O_4 \cdot 2H_2O$

$M_{\text{Oxalic acid}}$ moles $= \frac{6.3}{110}$ so molarity $= 0.23$

$2 \times 0.23 \times 10 = 0.1 \times V$

$V = 46$ ml

58. (B)

n factor $= 2$ $E = \frac{98}{2} = 49.$

EXERCISE - 1 [B]

1. (B)

$2 \times \frac{x}{M_w} = 5 \times 0.1 \times 0.02$

$x = 5 \times 10^{-3}$

$1 \times \frac{y}{M_w} = 2 \times 0.1 \times 0.05$

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

$2x = y$

2. (B)

$MnO_4^- \rightarrow Mn^{+2}$, $n = 5$

$Cr_2O_7^{-2} \rightarrow Cr^{+3}$, $n = 6$

$1 \times n_{Fe^{+2}} = 5 \times 1 \times V$

$n_{Fe^{+2}} = 5V$

$1 \times n_{Fe^{+2}} = 6 \times 1 \times V$

$n_{Fe^{+2}} = 6V$

3. (B)

$0.1 \times 1 \times 5 = 2 \times 0.1 \times M_{H_2O_2}$

$M_{H_2O_2} = 5/2 = 2.5$

now $3 \times 1 \times V = 2 \times 2.5 \times 0.1$

$V = 0.5/3$ litre $= 500/3$ ml

4. (A)

$\frac{x}{11.2} \times 10 \times 2 = \frac{16 \times 0.1}{\cancel{0.56}}$

$x = 0.56$

5. (C)

$20 \times x \times 1 = 10 \times 0.1 \times 1 + 5 \times 0.2 \times 2$

$\cancel{x = 1/20}$ $x = 3/20 = 0.15$

6. (C)

$10 \times x \times 1 = 10 \times 0.1 \times 1$

$x = 0.1$

$2 \times x \times 10 = 5 \times 10 \times M_{KMnO_4}$

$M_{KMnO_4} = 2/50 = 0.04$

7. (A)

$Fe_2(C_2O_4)_3 \rightarrow 2Fe^{+3} + 6CO_2 + 6e^-$

$6 \times 1 = 5 \times x$

$x = 6/5$

$FeC_2O_4 \rightarrow Fe^{+3} + 2CO_2 + 3e^-$

$3 \times 1 = 5 \times y$

$y = 3/5$

$\frac{x}{y} = \frac{2}{1}$

8. (A)

moles of sesquicarbonate $= 40 \times 0.05 \times 10^{-3}$

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

$1 \times 2 \times 10^{-3} = 1 \times 0.05 \times x$

$x = \frac{2 \times 10^{-3}}{0.05} = 2/50$

$2 \times 2 \times 10^{-3} + 1 \times 2 \times 10^{-3} = 1 \times 0.05 \times y$

$y = \frac{6 \times 10^{-5}}{0.05} = 6/50$

$y - x = \frac{4}{50}$ litre $= \frac{4}{50} \times 1000 = 80$ ml

9. (A)

$x \times 1 = .5 \times 0.1 \times 2$

$= 1$

$x = 1$ mole fraction $= 1/3$

10. (A)

m.eq of M_2CO_3 = $150 \times 1 - 100 \times 0.5$

$= 100$

$\frac{5.3}{E} = 100 \times 10^{-3} = 0.1$

$E = 53$

11. (D)

$H_3\overset{+1}{P}O_2 \longrightarrow \overset{-3}{P}H_3 + H_3\overset{+3}{P}O_3$

$n = 4$ $n = 2$

$n = \frac{2 \times 4}{2+4}$

$n = 4/3$

$E = 3M/4$

12. (A)

moles of I_2 = $\frac{1}{2} \times 0.1 \times 1 = 0.05$

$\overset{+2}{Cu}SO_4 \longrightarrow Cu^{+1}$

n factor = 1

eq of $CuSO_4$ = eq of I_2

$1 \times$ moles of $CuSO_4 = 2 \times 0.05 = 0.1$

13. (C)

$Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2$

moles   0.05   0.1

—   0.05   0.05   0.05

molarity $= \frac{0.05}{0.1} = 0.5$

14. (A)

$18 \times V = 1 \times 0.9$

$V = 0.9/18 = \frac{1}{20}$ litre $= 50$ ml

15. (D)

$1 \times V \times 0.5 = 2 \times 40 \times 0.05$

$V = \frac{80 \times 0.05}{0.5} = 8$ ml

16. (A)

$M = \frac{150 \times 6 + 250 \times 3}{400} = 4.125$

17. (B)

molarity of oxalic acid $= \frac{0.9/90}{0.1} = 0.1$

$N_{C_2O_4^{-2}} = 0.2$, $N_{HC_2O_4^{\ominus}} = 0.1$

18. (D)

$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

$n_{Cl_2} = \frac{0.1}{2} = \underline{0.05} \Rightarrow n_{MnO_2} = 0.05$

$w_{MnO_2} = 0.05 \times 87 = 4.35$

% purity $= \frac{4.35}{10} \times 100 = 43.5$

19. (A)

$$2 \times \frac{0.106}{106} = 0.04 \times N$$

$$N = \frac{2 \times 10^{-3}}{40 \times 10^{-3}} = 1/20$$

20. (C)

$$5 \times 0.02 \times V = 1 \times 40 \times 0.1$$

$$V = 40 \text{ ml}$$

21. (B)

$$\overset{+4}{SO_3^{-2}} \longrightarrow \overset{+6}{SO_4^{-2}}$$

$n = 2$

$$2 \times 20 \times M = 6 \times 30 \times 0.01$$

$$M = \frac{18\cancel{0} \times 0.01}{4\cancel{0}} = 0.045$$

22. (A)

$$2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$$

$0.15 \quad 0.0112 \quad - \quad -$

$0.15 - 2 \times 0.0112 \quad - \quad 0.0112 \quad 0.0112$

moles of NaOH left $= 0.1276$

$$M = \frac{0.1276}{1} = 0.1276$$

23. (D)

$1 \times \frac{a}{M_w} = 1 \times 0.1 \times 0.2$

$a = 0.02 M_w$

$2\cancel{5} \times \frac{b}{M_w} = 5 \times 0.1 \times 0.2$

$b = 0.05 M_w$

$\frac{a}{b} = 2/5$

24. (C)

$2A + \cancel{2}4B = 5 \times 0.1 \times V$

$2A + 4B = 0.5V$

$3B = 1 \times 0.1 \times V$

$3B = 0.1V$

$2A = 0.5V - \frac{0.4}{3}V$

$= \cancel{12} \; \cancel{\quad} \; 1.1V$

$A = \cancel{0.40} \; 1.1V/6$

$B = 0.1V/3$

25. (D)

$FeCl_3 + 3NaOH \longrightarrow Fe(OH)_3 + 3NaCl$

$n_{Fe(OH)_3} = \frac{1.425}{107} = n_{FeCl_3}$

$M_{FeCl_3} = 0.133$

$N_{FeCl_3} = 0.4$

EXERCISE - 1 [C]

1. i) +1 ii) -1 iii) +2 iv) +2 v) +5
   vi) +6 vii) +6 viii) +5 ix) +5 x) +6

2. i) $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$
   ii) $4Zn + 10HNO_3 \rightarrow 4Zn(NO_3)_2 + N_2O + 5H_2O$
   iii) $8KMnO_4 + 3NH_3 \rightarrow 3KNO_3 + 8MnO_2 + 5KOH + 2H_2O$
   iv) $S + 6HNO_3 \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$

3. i) $3I_2 + 5Cr_2O_7^{2-} + 34H^+ \rightarrow 10Cr^{3+} + 6IO_3^- + 17H_2O$
   ii) $3N_2O_4 + BrO_3^- + 3H_2O \rightarrow 6NO_3^- + Br^- + 6H^+$
   iii) $3Cu_2O + 14H^+ + 2NO_3^- \rightarrow 6Cu^{2+} + 2NO + 7H_2O$
   iv) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$
   v) $3KClO_3 + 3H_2SO_4 \rightarrow 3KHSO_4 + HClO_4 + 2ClO_2 + H_2O$

4. i) $3C_2H_5OH + 2MnO_4^- + OH^- \rightarrow 3C_2H_3O^- + 2MnO_2 + 5H_2O$
   ii) $40HNO_3 + As_2S_5 \rightarrow 5H_2SO_4 + 2H_3AsO_4 + 40NO_2 + 12H_2O$
   iii) $4H_2O_2 + PbS \rightarrow PbSO_4 + 4H_2O$
   iv) $6Fe_3O_4 + 2MnO_4^- + H_2O \rightarrow 9Fe_2O_3 + 2MnO_2 + 2OH^-$
   v) $4S + 6OH^- \rightarrow 2S^{2-} + S_2O_3^{2-} + 3H_2O$

5. (i) 1 (ii) 20 (iii) 8 (iv) 8 (v) 1

(i) $\overset{+5}{H_3PO_4} \longrightarrow NaH_2PO_4$

n factor = 1

(ii) $Fe_2S_3 \longrightarrow 2FeSO_4 + 3SO_2$

+3 −2   +2   +4

n = 2   n = 6 × 3 = 18

n = 20

or

$Fe_2S_3 \longrightarrow 2FeSO_4 + SO_2$

$+16H_2O$ $+26H^+ + 26e^-$

(iii) $\underset{-3}{NH_3} \rightarrow \underset{+5}{NO_3^{\ominus}}$ $n = 8$ (iv) $\underset{-2}{CuS} \rightarrow \overset{+6}{CuSO_4}$ $n = 8$

(v) $2S_2O_3^{-2} \rightarrow S_4O_6^{-2} + 2e^{\ominus}$

$n = 1$

6. 0.125 g

eq of metal = eq of hydrogen

$\frac{W}{2} = 2 \times \frac{0.7}{22.4}$

$W = 0.125\,gm$

7. 9.01 g

$\frac{5}{E} = \frac{9.44}{E+8}$

$5E + 40 = 9.44E$

$E = 9.01\,gm$

8. 56 g, 3.36 L

$\frac{14.7}{(98/2)} = \frac{16.8}{E}$

$E = 56\,g$

eq of H_2 liberated $= \frac{16.8}{56}$

moles of H_2 " $= \frac{16.8}{56} \times \frac{1}{2}$

volume of $H_2 = \frac{16.8}{112} \times 22.4 = 3.36\,L$

9. 49 g

$H_3PO_4 \longrightarrow Na_2HPO_4$

n factor = 2

$E = 98/2 = 49$

10. 108 g

eq of Ag = eq of AgCl

$$\frac{0.501}{E} = \frac{0.6655}{E+35.5}$$

E = 108 gm

11. ≈ 5 Vol

Volume strength of $H_2O_2 = 5.6 \times N$

N_1 of 2.8 vol $H_2O_2 = \frac{2.8}{5.6} = 0.5\text{ N}$

N_2 of 5.6 vol $H_2O_2 = \frac{5.6}{5.6} = 1\text{ N}$

N_3 of 22.4 vol $H_2O_2 = \frac{22.4}{5.6} = 4\text{ N}$

$N_1V_1 + N_2V_2 + N_3V_3 = N_4V_4$ $(V_4 = 300 + 300 = 600\text{ mL})$

$0.5 \times 100 + 1 \times 100 + 4 \times 100 = N_4 \times 600$

$\therefore N_4 = \frac{50+100+400}{600} = \frac{550}{600} = 0.91\text{ N}$

Volume strength $= 5.6 \times 0.91 = 5.09$ vol

12. (3)

In dilute basic medium, MnO_4^- is reduced to MnO_2. (n = 3)

$$NO_2^- \longrightarrow NO_3^- + 2e^- (n = 2)$$

$\therefore$ 2 mol of $MnO_4^- = 3$ mol of NO_2^-

PYQ : JEE Main

1. (C)

$$\overset{(+3)}{Na_2HAsO_3} \longrightarrow \overset{(+5)}{H_3AsO_4} \text{ (oxidation)}$$

Change in O.N. = +2

$$\overset{(+5)}{NaBrO_3} \longrightarrow \overset{(-1)}{NaBr} \text{ (reduction)}$$

Change in O.N. = –6

To balance the change in O.N., we will multiple first half reaction with 3 and add the second half reaction.

$$3Na_2HAsO_3 + NaBrO_3 + 6H^+ \rightarrow 3H_3AsO_4 + NaBr$$

On balancing Cl^- and Na^+

$$3Na_2HAsO_3 + NaBrO_3 + 6H^+ + 6Cl^- \rightarrow 3H_3AsO_4 + NaBr + 6Na^+ + 6Cl^-$$

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

Hence, X = 3, Y = 1 and Z = 6

2. (C)

In SO_3^{2-}

$x + 3(-2) = -2; x = +4$

In $S_2O_4^{2-}$

$2x + 4(-2) = -2; x = +3$

In $S_2O_6^{2-}$

$2x + 6(-2) = -2; x = +5$

Hence the correct order is :

$S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$

3. (A)

If an electronegative element is in its lowest possible oxidation state in a compound. It can function only as reduction agent, e.g., I^-.

4. (C)

The reaction given as

$$Cr_2O_7^{2-} + Fe^{2+} + C_2O_4^{2-} \longrightarrow Cr^{3+} + Fe^{3+} + CO_2$$

$$Cr_2O_7^{2-} \longrightarrow 2Cr^{3+}$$

On balancing

$$14H^+ + Cr_2O_7^{2-} + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O \quad ...(i)$$

$$Fe^{2+} \rightarrow Fe^{3+} + e^-] \times 2 \quad ...(ii)$$

$$C_2O_4^{2-} \longrightarrow 2CO_2 + 2e^-] \times 2 \quad ...(iii)$$

On adding all three equations, we get

$$Cr_2O_7^{2-} + 2Fe^{2+} + 2C_2O_4^{2-} + 14H^+ \longrightarrow 2Cr^{3+} + 2Fe^{3+} + 4CO_2 + 7H_2O$$

Hence the total no. of electrons involved in the reaction = 6

5. (C)

$$H_2\overset{+4}{S}O_3(aq) + Sn^{4+}(aq) + H_2O(l) \longrightarrow Sn^{2+}(aq) + H\overset{+6}{S}O_4^-(aq) + 3H^+$$

Hence H_2SO_3 is the reducing agent because it undergoes oxidation.

6. (D)

CrO_2Cl_2

Let O. No. of Cr = x

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

$\quad x - 4 - 2 = 0;\ x = +6$

7. (A)

Applying law of equivalence

Equivalent of acid = Equivalent of base

Equivalent of acid = Normality × volume = 0.1 × V

Another formula of equivalence = n factor × number of moles

$\therefore$ Equivalent of base = n factor of OH^- × mole of OH^-

= 1 × 0.04

$\Rightarrow \quad 0.1 \times V = 1 \times 0.04$

$V = 0.4\ L = 0.4 \times 1000 = 400\ mL$.

8. (D)

Oxidation

(A) $\overset{+1}{H}OCl + H_2\overset{-1}{O_2} \rightarrow H_3O^+ + \overset{-1}{Cl^-} + \overset{0}{O_2}$

Reduction

Oxidation

(B) $\overset{0}{I_2} + H_2\overset{-1}{O_2} + 2OH^- \rightarrow 2\overset{-1}{I^-} + 2H_2O + \overset{0}{O_2}$

Reduction

Oxidation

(C) $2\overset{+7}{Mn}O_4^- + 3H_2\overset{-1}{O_2} \rightarrow 2\overset{+4}{Mn}O_2 + 3\overset{0}{O_2} + 2H_2O + 2OH^-$

Reduction

Reduction

(D) $\overset{-2}{\text{PbS}} + 4\text{H}_2\overset{-1}{\text{O}}_2 \rightarrow \text{Pb}\overset{+6}{\text{S}}\text{O}_4 + 4\text{H}_2\overset{-2}{\text{O}}$

Oxidation

Notice that the oxidation of oxygen goes from –1 in the H_2O_2 to –2 in the H_2O means H_2O_2 is being reduced. On the other hand the oxidation state of sulphur is going from –2 in the PbS to +6 in the $PbSO_4$. i.e. Sulphur is being oxidised.

9. (A)

In the reaction

Oxidation

$$\overset{+4}{\text{Xe}}\text{F}_4 + \overset{+1}{\text{O}_2}\text{F}_2 \longrightarrow \overset{+6}{\text{Xe}}\text{F}_6 + \overset{0}{\text{O}_2}$$

Reduction

10. (A)

Reaction involved:

$$\overset{+3}{\text{C}_2}\text{O}_4^{2-} \longrightarrow 2\overset{+4}{\text{C}}\text{O}_2 + 2e^-$$

$\therefore$ The number of electrons involved in producing one mole of CO_2 is 1.

11. (D)

$$\overset{(+1)}{\text{CuBr}} \longrightarrow \overset{(0)}{\text{Cu}} + \overset{(+2)}{\text{Cu}}\text{Br}_2$$

It is an example of disproportionation reaction, as Cu undergoes both oxidation and reduction.

12. (B)

Potassium shows +1 state in all its oxides, superoxides and peroxide.

13. (C)

$$NH_2CONH_2 + 2NaOH \longrightarrow Na_2CO_3 + 2NH_3$$

1 mol of urea $\equiv$ 2 mol of NH_3

60 g of urea $\equiv$ 2 mol of NH_3

0.6 g of urea $= \frac{2}{60} \times 0.6\ \text{mol} = 0.02\ \text{mol of}\ NH_3$

For neutralisation: mol of NH_3 = mol of HCl in option (C), no. of moles of HCl = 0.1 × 0.2 = 0.02

14. (A)

In H_3PO_4 oxidation state of P is +5, which cannot be oxidised further to a higher oxidation state. Hence, it cannot act as reducing agent.

15. (A)

In BrO_4^-, Br is in highest oxidation state (+7). So it cannot oxidise further and hence, it cannot show disproportionation reaction.

16. (A)

In disproportionation reaction one oxidation state is simultaneously oxidised and reduced.

Reduction

$$3\overset{+6}{Mn}O_4^{2-} + 4H^+ \rightarrow 2\overset{+7}{Mn}O_4^- + \overset{+4}{Mn}O_2 + 2H_2O$$

Oxidation

17. (C)

In a disproportionation reaction, an element in one oxidation state is simultaneously oxidised and reduced.

$$\underset{-1}{2H_2O_2} \longrightarrow \underset{-2}{2H_2O} + \underset{0}{O_2} \quad \text{(Disproportionation reaction)}$$

- $\underset{+4}{2NO_2} + H_2O \longrightarrow \underset{+5}{HNO_3} + \underset{+3}{HNO_2}$ (Disproportionation reaction)
- $\underset{+7}{MnO_4^-} + 4H^+ + 3e^- \longrightarrow \underset{+4}{MnO_2} + 2H_2O$ (Reduction reaction)
- $\underset{+6}{MnO_4^{2-}} + 4H^+ \longrightarrow \underset{+7}{2MnO_4^-} + \underset{+4}{MnO_2} + 2H_2O$ (Disproportionation reaction)

18. (50)

M. eq. of $K_2Cr_2O_7$ = M.eq. of FeC_2O_4

$$\overset{(+2)}{Fe}\,\overset{(+3)}{C_2}O_4 + \overset{(+6)}{Cr_2}\,O_7^{2-} \longrightarrow Fe^{3+} + \overset{(+4)}{C}O_2 + Cr^{3+}$$

n-factor of $K_2Cr_2O_7 = 2(6-3) = 6$

n-factor of $FeC_2O_4 = 1(3-2) + 2(4-3) = 3$

By law of equivalence,

n-factor of $K_2Cr_2O_7 \times$ no. of moles

= n-factor of $FeC_2O_4 \times$ no. of moles

$$\Rightarrow \frac{V}{1000} \times 0.02 \times 6 = \frac{0.288}{144} \times 3 \Rightarrow V = 50 \text{ mL}$$

19. (19)

	Compound	**Oxidation state of transition element**
(i)	$K_2Cr_2O_7$	$x = +6$
(ii)	$KMnO_4$	$y = +7$
(iii)	K_2FeO_4	$z = +6$

So, $(x + y + z) = 6 + 7 + 6 = 19$.

20. (19)

$$2Fe^{2+} + H_2O_2 \longrightarrow 2Fe^{3+} + 2OH^-$$

$$2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$$

$\because\ x = 2,\ y = 2,\ x' = 2,\ y' = 8,\ z' = 5$

$\therefore\ x + y + x' + y' + z' = 19$

21. (18)

Milli-equivalent of Fe^{2+} = milli-equivalent of $K_2Cr_2O_7 \Rightarrow$ millimoles $\times\, n$-factor of Fe^{2+} = millimoles $\times$ n-factor of $K_2Cr_2O_7$.

$$x \times 10 \times 1 = 0.02 \times 15 \times 6$$

$$x = 0.18 = 18 \times 10^{-2}\ M$$

22. (16)

Writing the half reaction,
Oxidation half reaction,

$$MnO_4^- \longrightarrow Mn^{2+}$$

Balancing oxygen,

$$MnO_4^- \rightarrow Mn^{2+} + 4H_2O$$

Balancing hydrogen,

$$MnO_4^- + 8H^+ \longrightarrow Mn^{2+} + 4H_2O$$

Balancing charge,

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$$

Reducing half reaction,

$$C_2O_4^{2-} \longrightarrow CO_2$$

Balancing carbon and charge,

$$C_2O_4^{2-} \longrightarrow 2CO_2 + 2e^-$$

Balancing charge in both oxidation and reduction reaction,

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O] \times 2$$

$$C_2O_4^{2-} \longrightarrow 2CO_2 + 2e^-] \times 5$$

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

So, we get
$b = 5;\ c = 16;\ x = 2;\ y = 10;\ z = 8$

23. (12)

$$16e^- + S_8 \longrightarrow 8S^{2-}$$

$$24OH^- + S_8 \longrightarrow 4S_2O_3^{2-} + 12H_2O + 16e^-$$

$$2S_8 + 24OH^- \longrightarrow 8S^{2-} + 4S_2O_3^{2-} + 12H_2O$$

$\Rightarrow S_8 + 12OH^- \longrightarrow 4S^{2-} + 2S_2O_3^{2-} + 6H_2O$

24. (3)

Acid (A) + Base $\longrightarrow$ Salt + H_2O

0.1 M (M(OH)₂)
10 ml 0.05 M
30 ml

At equivalence point, equivalent of acid = equivalent of base

$0.1 \times 10 \times n = 30 \times 0.05 \times 2 \Rightarrow n = 3.$

EXERCISE - 2 [A]

1. (B)

eq. of NH_3 = eq. of acid used

$= 10^{-3}\left[150 \times \frac{1}{5} - 20 \times 1\right]$

$1 \times$ moles of $NH_3 = 10^{-2}$

$W_{NH_3} = 10^{-2} \times 17 = 0.17$ gm

% of $NH_3 = \frac{0.17}{0.5} \times 100 = \frac{17}{0.5} = 34\%$

2. (B)

eq of Na_2CO_3 = eq of H_2SO_4

In PH indicator n factor of $Na_2CO_3 = 1$

$1 \times n_{Na_2CO_3} = \cancel{2 \times n_{H_2SO_4}}\ 20 \times 10^{-3} \times 0.1$

$n_{Na_2CO_3} = 2 \times 10^{-3} \Rightarrow w_{Na_2CO_3} = 2 \times 10^{-3} \times 106$
$= 0.212$ gm

So in 2.25 gm mixture $w_{Na_2CO_3} = 2.12$ gm

3. (A)

$$M_{HCl} = \frac{109.5}{36.5} = 3$$

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

$$n_{Na_2CO_3} = \frac{1}{2} \times n_{HCl} = \frac{1}{2} \times \frac{32.9}{1000} \times 3$$

$$M_{Na_2CO_3} = \frac{3 \times 32.9}{2\cancel{000}} \times \frac{\cancel{1000}}{25} = 1.974$$

125 gm = 100 ml

$$1.974 \times 100 \times 10^{-3} = \left(\frac{0.84}{2}\right) \times V$$

$$V = \frac{197.4}{0.42} \times 10^{-3} \text{ litre}$$

$$= 470 \text{ ml}$$

4. (B)

eq of KOH + eq of $Ca(OH)_2$ = eq of acid

$$\frac{x}{56} + \frac{4.2 - x}{74} \times 2 = 0.1$$

$$\frac{x}{56} + \frac{4.2 - x}{37} = 0.1$$

$$x = 1.47 \text{ gm}$$

$$\% \text{ KOH} = \frac{1.47}{4.2} \times 100$$

$$= 35\%$$

5. (B)

Vol. of O_2 liberated $= 10 \times 100 = 1000\,ml$

$$Ca + \tfrac{1}{2}O_2 \rightarrow CaO$$

$$n_{CaO} = 2 \times \text{moles of } O_2 = 2 \times \frac{1}{22.4} = \frac{1}{11.2}$$

$$CaO + H_2SO_4 \rightarrow CaSO_4 + H_2O$$

$$n_{H_2SO_4} = n_{CaO} = 1/11.2$$

$$M_{H_2SO_4} = \frac{1}{[illegible]} \times 20 = 1.79\,M$$

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6. (B)

only $NaHCO_3$ will give CO_2

$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$

let $n_{NaHCO_3} = \alpha$, $n_{Na_2CO_3} = \beta$

$\cancel{1 \times y = \frac{x}{100}}$ $\quad 1 \times \beta = \frac{x}{1000} \times 1$

& $\quad 1 \times \alpha + 2\beta = \frac{y}{1000}$

so, $\quad \alpha = \frac{y - 2x}{1000}$

so moles of $CO_2 = \frac{1}{2} \times \frac{y-2x}{1000} = \frac{y-2x}{2000}$

7. (C)

$$\frac{0.4}{96} \times n = \frac{0.5}{40}$$

$n = 3$ $\quad$ so H_3A

At mass of A = 93

8. (B)

$$\overset{+5}{BrO_3^{\ominus}} \xrightarrow[n=6]{} \overset{-1}{Br^{\ominus}}$$

$$6 \times \frac{0.1262}{167} = \text{eq of hypo}$$

$$= 1 \times 0.045 \times M$$

$$M_{hypo} = 0.1$$

9. (C)

$$1 \times 25 \times M_{FeSO_4} = 20 \times 1/10$$

$$M_{FeSO_4} = 2/25$$

mass of $FeSO_4 \cdot 7H_2O$ in 1 litre $= \frac{2}{25} \times 278$

$= 22.24$ gm

$$\% \text{ of } FeSO_4 \cdot 7H_2O = \frac{22.24}{25} \times 100$$

$$= 89\%$$

10. (B)

$$\underset{x}{} Fe + O_2 \rightarrow \underset{x}{FeO} + \underset{y}{Fe_2O_3}$$

$$1 = x + 2y$$

$$2 \times 0.65 = x + 3y = 1.3 \quad \Rightarrow \quad y = 0.3$$

$$x = 0.4$$

11. (B)

$N_1 \times 25 + N_2 \times 25 = 10 \times 1$

$N_1 + N_2 = 2/5$

$N_1 \times 20 \times 10^{-3} = \frac{0.1435}{143.5} = 10^{-3}$

$N_1 = 1/20 = 0.05$

$N_2 = 7/20 = 0.35$

12. (A)

$(NH_4)_2SO_4 + 2NaOH \longrightarrow 2NH_3 + 2H_2O + Na_2SO_4$

eq of NaOH reacted with H_2SO_4

$= 10 \times 10^{-3} \times 0.1 = 1 \times 10^{-3}$

So in 250 ml, eq of NaOH remaining $= 10 \times 10^{-3}$

total eq of NaOH $= 0.1 \times 0.2 = 0.02 = 20 \times 10^{-3}$

So moles of NaOH = eq of NaOH reacted $= 10 \times 10^{-3} = 10^{-2}$

moles of $(NH_4)_2SO_4$ reacted $= \frac{10^{-2}}{2}$

mass $= 10^{-2}/2 \times 132 = 0.66$ gm

% purity $= \frac{0.66}{0.7} \times 100 = 94\%$

13. (A)

$$KOH + Na_2CO_3$$
$$\underset{w_1}{\downarrow} \qquad \underset{w_2}{\downarrow}$$

$$\frac{w_1}{56} \times 1 + \frac{w_2}{106} \times 1 = \frac{1}{20} \times 15 \times 10^{-3} = 0.75 \times 10^{-3} \quad -(1)$$

$$\frac{w_1}{56} \times 1 + \frac{w_2}{106} \times 2 = \frac{1}{20} \times 25 \times 10^{-3} = 1.25 \times 10^{-3} \quad -(2)$$

(2) − (1)

$$\frac{w_2}{106} = 0.5 \times 10^{-3}$$

$$\frac{w_1}{56} = 0.25 \times 10^{-3}$$

$$w_1 = 14 \times 10^{-3} = 0.014 \text{ gm}$$

14. (D)

(A) The purple colour of $KMnO_4$ is decolourised due to the reduction of MnO_4^- to Mn^{2+} and $C_2O_4^{2-}$ is oxidised to CO_2 in acidic medium.

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

Reduction (oxidising agent)

(B) $Br_2 + 2I^- \rightarrow 2Br^- + I_2$

Oxident (reducing agent)

(C) $2S_2O_3^{2-} \longrightarrow S_4O_6^{2-}$

$4x - 12 = -4$ $\qquad$ $4x - 12 = -2$

$4x = 8$ $\qquad$ $4x = 10$

$10 - 8 = 2$

Change in oxidation number of each $S = \frac{2}{4} = 0.5$

(D) $\underline{C}H_4 : x + 4 = 0,\ x = -4$

$\underline{C}O_2 : x - 4 = 0,\ x = 4$

15. (A)

(A) An element in the lowest oxidation state can only attain higher oxidation state. So it is a reductant and undergoes oxidation.

(B) An element in the highest oxidation state can only attain lower oxidation state. So it is an oxidant and undergoes reduction.

(C) The oxidation state of Rb and K is +1 (first group element)

$$\overset{+1\times4}{Rb_4}\,\overset{+1}{K}[HV_{10}O_{28}]^{-5}$$

$$HV_{10}O_{28}^{-5} = 1+10x-2\times28=-5 \Rightarrow x=5$$

$\therefore$ Oxidation state of $V=5$

(D) Calomel is $\overset{+1\times2}{Hg_2}\,\overset{-1\times2}{Cl_2}$

The oxidation number of Hg is +1 and valency is 2.

16. (A)

(A) **Wrong:** The algebraic sum of the oxidation numbers of all the atoms in an ion equals the charge present on the ion.

(B) True statement

(C) True $(2Cl^- \longrightarrow Cl_2 + 2e^-)$ (oxidation)

(D) True

17. (C)

(A) **Disproportionation reaction:**

$\overset{0}{Br_2} \longrightarrow 2\overset{-1}{Br^-}$ (Oxidation state of Br_2 decreases from 0 to –1)

$\overset{0}{Br_2} \longrightarrow BrO_3^-$

$x-6=-1$

$x=5$

(Oxidation state of Br_2 increases from 0 to +5)

(B) **Disproportionation reaction:**

$\overset{+1}{Cu_2O} \rightarrow \overset{0}{Cu}$ (Oxidation state of Cu decreases from + 1 to 0)

$\hookrightarrow Cu^{2+}$ (Oxidation state of Cu increases from + 1 to + 2)

(C) **Oxidation:**

$$\overset{+2}{CN^-} \longrightarrow \overset{+4}{CO_3^{2-}} + 2e^-$$

$x-3=-1$ $\quad$ $x-6=-2$

$x=2$ $\quad$ $x=4$

$$CN^- \longrightarrow NO_3^- + 8e^-$$

(Oxidation state of N = –3) $x - 6 = -1$

$x = 5$

Both are oxidation.

(D) **Disproportionation reaction:**

$(CN)_2$ gets simultaneously oxidised to CNO^- and reduced to CN^-.

EXERCISE - 2 [B]

MULTIPLE ANSWER(S) CORRECT TYPE:

1. (C, D)

(A) $\overset{+6}{Cr}O_3$ (Maximum oxidation state, cannot be oxidised further)

(B) $\overset{+3}{Al_2}O_3$ (Maximum oxidation state, cannot be oxidised further)

(C) $\overset{+4}{S}O_2 \longrightarrow \overset{+6}{S}O_4^{2-}$ (Can be oxidised further)

(D) $\overset{+6}{Mn}O_3 \longrightarrow \overset{+7}{Mn}O_4^-$ (Can be oxidised further)

2. (A, B, C, D)

All are correct.

3. (A, B, C)

(A) Oxidation state of K is +1 in both reactant and product.

In (B), oxidation state of Cr (+6) does not change.

In (C), oxidation states of Ca, C and O do not change.

In (D), the H_2O_2 which disproportionates is both oxidising and reducing agent.

4. (A, C, D)

$$4H_2O + \overset{+1\times3}{Cu_3}\ \overset{-3}{P} \longrightarrow 3Cu^{2+} + H_3PO_4 + 11e^- + 5H^+]\times 6$$

$$6e^- + 14H^+ + Cr_2O_7^{2-} \longrightarrow 2Cr^{3+} + 7H_2O]\times 11$$

$$6Cu_3P + 124H^+ + 11Cr_2O_7^{2-} \longrightarrow 18Cu^{2+} + 6H_3PO_4 + 22Cr^{3+} + 53H_2O$$

5. (A, B, C)

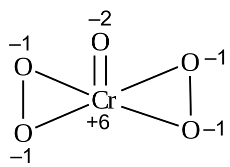
(A) Cu_2O is reduced.

Cu_2S is oxidised.

6. (B, C)

(A) $Fe^{+2}(Cr_2O_4)^{2-}$: Oxidation state of Cr = +3

(B) $K^+[CrO_3Cl]^-$: Oxidation state of Cr = +6

(C)  Oxidation state of Cr = +6. (Two peroxo linkage)

(D) $[Cr(OH)_4]^-$: Oxidation sate of Cr = +3

7. (A, B, C, D)
(A) $CH_2O : x+2-2=0 \Rightarrow x=0$
(B) $CH_2Cl_2 : x+2-2=0 \Rightarrow x=0$.
(C) $C_6H_{12}O_6 : 6x+12-12=0 \Rightarrow x=0$
(D) $C_{12}H_{22}O_{11} : 12x+22-22=0 \Rightarrow x=0$

8. (B, C, D)
A is not a disproportionation reactions.

9. (A, B, C, D)
The element in a molecule having its oxidation state in the middle (i.e., greater than minimum and less than maximum) can be used as an oxidising agent and a reducing agent both.

10. (B, C, D)
(B) $3H_2O+\overset{0}{P_4}+3\bar{O}H \longrightarrow \overset{-3}{P}H_3+3H_2\overset{+1}{P}O_2^-$
(C) $\overset{0}{S_8}+12\bar{O}H \longrightarrow 4S^{2-}+2\overset{+2}{S_2}O_3^{2-}+6H_2O$
(D) $\overset{0}{Br_2}+2\bar{O}H \longrightarrow \overset{+1}{Br}O^-+\overset{-1}{Br^-}+H_2O$

11. (B, C, D)
(B), (C) and (D) are redox reactions.
In (A), there is no change in the oxidation state (+6) of Cr.

12. (B, D)
Since, $Cr_2O_7^{2-}$ is reduced to Cr^{3+}, so H_2O_2 must be oxidised to O_2.
Oxidation number of Cr in $Cr_2O_7^{2-}$ is +6 and +3 in Cr^{3+}.
So, change in oxidation number = 3. Hence statements (B) and (D) are wrong.

13. (A, B, C)
(A) $MnO_4^-+8H^++5e^- \longrightarrow Mn^{2-}+4H_2O$
(0.1 mol)
mEq of $MnO_4^- = 0.1\times5 = 0.5$
$Fe^{2+} \longrightarrow Fe^{3+}+e^-$
(0.5 mol)

$\Rightarrow$ mEq of $Fe^{2+} = 0.5$

(B) $FeC_2O_4 \longrightarrow Fe^{3+} + 2CO_2 + 3e^-$

(0.166 mol)

$\Rightarrow$ mEq of $FeC_2Ol4 = 0.166 \times 3 = 0.5$

(C) $C_2O_4^{2-} \longrightarrow 2CO_2 + 2e^-$

(0.25 mol)

$\Rightarrow$ mEq of $C_2O_4^{2-} = 0.25 \times 2 = 0.5$

(D) $Cr_2O_7^{2-}$ cannot be oxidised.

14. (A, B, C, D)

(A) 1.7% = 1 N
6.8% = 4 N

(B) $M = \frac{4\,N}{2} = 2\,M$

(C) 1.7% = 5.6 'V'
6.8% = 22.4 'V'

(D) Volume strength $= 5.6 \times N = 5.6 \times 2 \times M = 11.2 \times M$

15. (B, C, D)

pOH = 1, strong basic medium

$\Rightarrow$ $MnO_4^- \longrightarrow MnO_4^{2-}$ (n-factor = 1)

$2\bar{O}H + H_2O_2 \longrightarrow O_2 + 2H_2O + 2e^-$

mEq of H_2O_2 = mEq of MnO_4^-

$\frac{x}{34/2} \times 1000 = 100 \times \left(\frac{1}{5} \times 1\right)$

$x = 0.34\text{ g}$

16. (A, B, D)

i. mEq $H_2O_2 \equiv$ mEq of $Cr_2O_7^{2-}$
(n = 2) (n = 6)

$20\text{ mL} \times N_1 = 40\text{ mL} \times N_2$ ...(i)

(A) mEq of $Cr_2O_7^{2-} \equiv$ mEq of $C_2O_4^{2-}$
(n = 2)

$2.0 \times N_2 \equiv 5.0 \times 1.0 \times 2$

$N_2(Cr_2O_7^{2-}) = 5$ ...(ii)

Therefore, substituting the N_2 in Eq. (i)

$20\text{ mL} \times N_1 = 40\text{ mL} \times 5$

$N_1(H_2O_2) = 10$

$M_1(H_2O_2) = \frac{10}{2} = 5\,M$

(B) 1 N H_2O_2 = 5.6 V

$\therefore 10$ N $H_2O_2 = 56$ V

(D) $N_1V_1 + N_2V_2 = N_3V_3$ ($V_3 = 10 + 40 = 50$ mL)

$10 \times 10 + 40 \times \frac{5}{8} \times 2 = N_3 \times 50$

N_3 (final) $H_2O_2 = 3$ N

The volume strength of $H_2O_2 = 5.6 \times 3 = 16.8$ V

COMPREHENSION TYPE :

1. (D)

only $1H^+$ replaced

n factor = 1

$E = \frac{98}{1} = 98$

2. (C)

$3Zn + 2K_4[Fe(CN)_6] \rightarrow K_2Zn_3[Fe(CN)_6]_2 + 6K$

per mole 3 K^+ is replaced so n factor = 3

$E = M/3$

3. (D)

$2FeS_2 + \frac{11}{2}O_2 \longrightarrow Fe_2O_3 + 4SO_2$

or $4FeS_2 + 11O_2 \longrightarrow 2Fe_2O_3 + 8SO_2$

4. (D)

Q.4

Fe^{-1}_{-1}

$$2\overset{+2}{Fe}\overset{-1}{S_2} \longrightarrow \overset{+3}{Fe_2O_3} + 4\overset{+4}{SO_2}$$

$n = 2 \times 1 = 2$

$4 \times 5 = 20$

n factor $= 22$

n factor per mole $= \frac{22}{2} = 11$

$E = M/11$

5. (A)

$$S^{-1} \longrightarrow \overset{+4}{SO_2}$$

$n = 5$

$E = M/5$

6. (D)

$$2\,Fe_{0.95}O \longrightarrow 0.95\,Fe_2O_3$$

$+\ 0.85\,H_2O \qquad + 1.7\,H^+$

$+ 1.7\,e^-$

n factor $= 1.7/2 = 0.85$

$E = M/0.85$

7. (D)

$$K_4[Fe(CN)_6] + 36H_2O \rightarrow 4K^+ + Fe^{+3} + 6CO_3^{-2} + 6NO_3^{\ominus} + 72H^+ + 61e^{\ominus}$$

n factor for $Ba(MnO_4)_2$ = ~~10~~ $2 \times 5 = 10$

eq of $KMnO_4$ = eq of $Ba(MnO_4)_2$

$61 \times 1 = 10 \times x$

$x = 6.1$

8. (B)

$CuSO_4$ will convert into Cu_2I_2

$Cu^{+2} \longrightarrow Cu^{+1}$ $\qquad 2I^{\ominus} \longrightarrow I_2 + 2e^{\ominus}$

n factor = 1

$\underset{+2}{S_2O_3^{-2}} \longrightarrow \underset{+6}{SO_4^{-2}}$

n factor = 8

eq of hypo = eq of I_2 = eq of $CuSO_4$

$8 \times 50 \times 10^{-3} \times 1 = 1 \times$ moles of $CuSO_4$

moles of $CuSO_4$ = 0.4

mass of $CuSO_4$ = 63.8 gm

% purity = $63.8/79.75 \times 100$ = 80%

9. (D)

$$IO_3^{\ominus} + 5I^{\ominus} + 6H^+ \longrightarrow 3I_2 + 3H_2O$$

$$n_{IO_3^{\ominus}} = n_{KIO_3} = \frac{214}{214} = 1, \quad n_{I_2} \text{ produced} = 3$$

eq of I_2 = eq of hypo

$$2 \times 3 = 8 \times 1 \times V$$

$$V = 6/8 \text{ litre} = 750 \text{ ml}$$

10. (D)

$$\overset{}{I^{\ominus}} + \overset{+5}{IO_3^{\ominus}} \longrightarrow I^+ + I^+$$

$n = 4$

$n = 2$

$$2I^{\ominus} + IO_3^{\ominus} + 6H^+ \rightarrow 3I^+ + 3H_2O$$

$$2KI + KIO_3 + 6HCl \longrightarrow 3ICl + 3H_2O + 3KCl$$

$$n_{KI} = \frac{1.66}{166} = 0.01$$

$$n_{KIO_3} = \frac{0.01}{2} = 0.005, \quad n_{ICl} = \frac{0.03}{2} = 0.015$$

11. (D)

$O_3 + 2I^{\ominus} + 2H^+ \rightarrow I_2 + O_2 + H_2O$

eq of I_2 = eq of hypo = $1 \times 0.2 \times 0.1$
$= 0.02$

moles of $I_2 = \frac{0.02}{2} = 0.01$

moles of $O_3 = 0.01$

volume of $O_3 = 0.01 \times 22.4 = 0.224$ litre

% of $O_3 = \frac{0.224}{22.4} \times 100 = \underline{1\%}$

12. (D)

molarity of $H_2O_2 = \frac{x}{11.2}$

if x = vol. strength

$M = \frac{10}{11.2}$

strength $= \frac{10}{11.2} \times 34 = 30.3$ gm/litre

% strength = 3.03

13. (D)

$$Ba(MnO_4)_2 \xrightarrow[n=10]{} 2Mn^{+2}$$

$$10 \times \text{moles of } Ba(MnO_4)_2 = 2 \times 0.1 \times \frac{56}{11.2}$$

$$\text{moles of } Ba(MnO_4)_2 = 0.1$$

$$\text{mass of } " = 0.1 \times 375 = 37.5$$

$$\%\ \text{purity} = \frac{37.5}{55} \times 100 = 68.18\%$$

14. (C)

$$S_2O_3^{-2} \xrightarrow[n\ \text{factor}=8]{} SO_4^{-2}$$

eq of H_2O_2 = eq of I_2 = eq of hypo

$$2 \times 0.1 \times M = 8 \times 0.025 \times 1$$

$M = 1$ so vol. strength $= 11.2$

15. (D)

eq of H_2O_2 = eq of I_2

$$2 \times 0.1 \times M = 2 \times \frac{25.4}{254}$$

$$= 0.2$$

$M = 1$ vol. $= 11.2$

16. (D)

22.4 Vol.

$\Rightarrow$ 1 ml H_2O_2 can liberate 22.4 ml O_2

so for 2240 ml O_2 we need 100 ml H_2O_2

17. (C)

$$Al(MnO_4)_3 \xrightarrow[n=15]{} Mn^{+2}$$

eq of H_2O_2 = eq of $Al(MnO_4)_3$

$$2 \times 0.84 \times \frac{\cancel{V}}{11.2} = 15 \times M \times \cancel{V} \times 10^{-3}$$

$M = 10$

18. (D)

$$2 \times 20 \times M = 5 \times 10 \times 0.1$$

$$M = 5/40 = 1/8$$

So initial molarity $= \frac{400}{100} \times M = 4M = \frac{1}{2}$

Vol. strength $= \frac{1}{2} \times 11.2 = 5.6$

19. (D)

118% oleum means 100 g of oleum requires 18 g of H_2O to form 118 g of H_2SO_4.

$$\underset{\substack{1\,\text{mol} \\ (80\,\text{g})}}{SO_3} + \underset{\substack{1\,\text{mol} \\ (18\,\text{g})}}{H_2O} \longrightarrow H_2SO_4$$

$$\therefore \text{ \% of free } SO_3 = \frac{80}{100} \times 100 = 80\%$$

20. (B)

% of free $SO_3 = 20\%$

i.e., 20 g SO_3 is present in 100 g oleum.

$\because$ 80 g SO_3 required 18 g H_2O.

$\therefore$ 20 g SO_3 required 4.5 g H_2O.

$\therefore$ % of labelling of oleum = 100 + 4.5 = 104.5%

21. (D)

147% oleum sample implies 100 g oleum sample on addition of 47 g H_2O will form 147 g H_2SO_4.

Equivalent of $H_2SO_4 = \frac{147}{49} = 3$

$\therefore$ mEq of H_2SO_4 = mEq of NaOH

$3 \times 10^3 = 500\,\text{mL} \times x \times 1$

$x = \frac{3000}{500} = 6$ M

MATRIX MATCH :

1. A – 2 ; B – 1; C – 4 ; D – 3

① $2CrI_3 + \cancel{31}H_2O \longrightarrow Cr_2O_7^{-2} + 6IO_4^{\ominus} + \cancel{62H^+}\ 62H^+ \cancel{+33e^{\ominus}}\ 54e^{\ominus}$

n factor = 54/2 = 27

E = M/27

② $Fe(SCN)_2 + 20H_2O \longrightarrow Fe^{+3} + 2SO_4^{-2} + 2CO_3^{-2} + 2NO_3^{\ominus} + 40H^+ + 33e^{\ominus}$

E = M/33

(3) $NH_4SCN + 13H_2O \longrightarrow SO_4^{-2} + CO_3^{-2} + 2NO_3^{\ominus} + 30H^+ + 24e^{\ominus}$

$E = M/24$

(4) $K_4[Fe(CN)_6] + 36H_2O \longrightarrow 4K^+ + Fe^{+3} + 6CO_3^{-2} + 6NO_3^{\ominus} + 72H^+ + 61e^{\ominus}$

$E = M/61$

2. A – 4 ; B – 2; C – 3 ; D – 1

(A) $\underset{-2}{P_2H_4} \longrightarrow \underset{-3}{PH_3} + \underset{-1/2}{P_4H_2}$

$n = 2 \times (3/2) = 3$

$n = 2$

$\frac{1}{n} = \frac{1}{2} + \frac{1}{3} = \frac{5}{6}$ $n = 6/5$ $\Rightarrow E = \frac{5M}{6}$

(B) $I_2 \longrightarrow I^{\ominus} + IO_3^{\ominus}$

$\cancel{n=2}$

$2e + I_2 \rightarrow 2I^{\ominus}$ | $I_2 + 6H_2O \longrightarrow 2IO_3^{\ominus} + 12H^+ + 10e^{\ominus}$

$n\text{ factor} = \frac{10}{6} = 5/3$

$E = 3M/5$

(C)
$$\overset{+8/3}{Mn_3O_4} \longrightarrow Mn^{+2} + \overset{+7}{MnO_4^{\ominus}}$$

$n = 3\times\left[\frac{8}{3}-2\right] = 2$

$n = 3\left[7-\frac{8}{3}\right] = 13$

$$n = \frac{n_1 n_2}{n_1+n_2} = \frac{26}{15} \qquad E = \frac{15M}{26}$$

(D)
$$H_3\overset{+1}{P}O_2 \longrightarrow \overset{-3}{P}H_3 + H_3\overset{+3}{P}O_3$$

$n = 4$ $\qquad$ $n = 2$

$$n = \frac{2\times4}{2+4} = \frac{8}{6} = 4/3$$

$$E = 3M/4$$

3. A – 4 ; B – 1; C – 2 ; D – 3

Q(3)

$$Br_2 \longrightarrow Br^{\ominus} + BrO_3^{\ominus}$$

$$(2e^{\ominus} + Br_2 \longrightarrow 2Br^{\ominus}) \times 5$$

$$Br_2 + 6H_2O \longrightarrow 2BrO_3^{\ominus} + 12H^+ + 10e^{\ominus}$$

$$6Br_2 + 6H_2O \longrightarrow 10Br^{\ominus} + 2BrO_3^{\ominus} + 12H^+$$
$$+12\overset{\ominus}{O}H \qquad +12\overset{\ominus}{O}H$$

$$6Br_2 + 12\overset{\ominus}{O}H \longrightarrow 10Br^{\ominus} + 2BrO_3^{\ominus} + 6H_2O$$

EXERCISE - 2 [C]

1. 31.5 g

$$\frac{5}{32.5} = \frac{4.846}{E_{Cu}}$$

$$E_{Cu} = 31.5 \text{ gm}$$

2. 2

let x acidic hydrogens are present

$$x \times \frac{1}{146} = \frac{0.768}{56}$$

$$x = 2$$

3. 2.5 ml

eq of $KMnO_4$ = eq of $FeSO_4$

$$\underset{+7}{MnO_4^-} \xrightarrow{n=5} Mn^{+2}$$

$$5 \times 0.2 \times V = 1 \times 0.05 \times 50$$

$$V = 2.5 \text{ ml}$$

$$FeSO_4 \xrightarrow{n=1} Fe_2(SO_4)_3$$

4. 1.28 %

m.eq of HCl used $= 10 \times 0.5 - 0.2 \times 10$

$= 3$

let x gm $Ba(OH)_2$ is present

$$\frac{x}{(171/2)} = 3 \times 10^{-3}$$

$$x = 256.5 \times 10^{-3} \text{ gm}$$

$$\% = \frac{256.5 \times 10^{-3}}{20} \times 100 = 1.28\%$$

5. 0.267 M

n factor as an acid = 3

$$m = \frac{0.2}{3} = \frac{0.2}{3}$$

as R.A.

$$\underbrace{\overset{+3}{C_2O_4^{-2}} \longrightarrow \overset{+4}{CO_2}}_{n=2}$$

so n factor (total) = 4

$$N = 4\left(0.2/3\right)\frac{1}{1} = \frac{0.8}{3} = 0.267 \text{ M}$$

6. 0.063 M

$$KIO_3 + KI \longrightarrow I_2$$

$$\underset{+5}{IO_3^{\ominus}} + I^{\ominus} \longrightarrow \tfrac{1}{2}\underset{0}{I_2} + \tfrac{1}{2}I_2$$

$n = 1$

$n = 5$

$IO_3^{\ominus} + 5I^{\ominus} + 6H^+ \rightarrow 3I_2 + 3H_2O$

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

$\frac{n_{IO_3^{\ominus}}}{n_{I_2}} = \frac{1}{3}$

$\frac{n_{I_2}}{n_{hypo}} = \frac{1}{2}$

$\frac{n_{IO_3^{\ominus}}}{n_{hypo}} = \frac{1}{6}$

$\frac{0.1/214}{M \times 0.045} = \frac{1}{6} \Rightarrow M = 0.063$

7. 57.4 %

$CuS = x$ gm $\quad Cu_2S = (10-x)$ gm

eq of CuS + eq of Cu_2S = eq of $K_2Cr_2O_7$ used.

meq of Fe^{+2} = meq of $KMnO_4$

$1 \times 25 \times M = 5 \times 0.875 \times 20$

$M = 3.5$

So eq of $K_2Cr_2O_7$ used in first rxn

$= 6 \times 100 \times 10^{-3} \times 1.25 - 50 \times 10^{-3} \times 3.5$

$= 575 \times 10^{-3} = 0.575$

$\underset{-2}{CuS} \rightarrow Cu^{+2} + SO_2 \quad n = 6$

$Cu_2\overset{-2}{S} \rightarrow Cu^{+2} + \overset{+4}{SO_2} \quad n = 2, \; n = 6$

$n = 8$

$6 \times \frac{x}{95.5} + \frac{8 \times (10-x)}{159} = 0.575$

$x = 5.74$ gm

% of CuS = 57.4 %

8. $FeC_2O_4 = 10^{-2}$ M, $FeSO_4 = 3 \times 10^{-2}$ M

let molarity of

$FeC_2O_4 = M_1$, $FeSO_4 = M_2$

$FeC_2O_4 \rightarrow Fe^{+3} + 2CO_2 + 3e^{\ominus}$ $n = 3$

$\overset{+2}{Fe}SO_4 \rightarrow Fe^{+3}$ $n = 1$

meq of FeC_2O_4 + meq of $FeSO_4$ = meq of $KMnO_4$

$3 \times (100 \times M_1) + 100 \times M_2 \times 1 = 5 \times 60 \times 0.02$

$3M_1 + M_2 = 0.06$ .. (1)

By Zn + dil HCl

all Fe^{+3} convert into Fe^{+2}

now all Fe^{+2} will converted into Fe^{+3}

by $KMnO_4$

$1 \times M_1 \times 100 + 1 \times M_2 \times 100 = 40 \times 0.02 \times 5$

$M_1 + M_2 = 0.04$ - (2)

(1) - (2)

$2M_1 = 0.02$

$M_1 = 0.01$

$M_2 = 0.03$

9. 0.68 g

$$AgNO_3 + KI \rightarrow AgI + KNO_3$$

$$I^{\ominus} + IO_3^{\ominus} \rightarrow I^{+} + I^{+}$$

$+5$; $n=2$; $n=4$

$$2I^{\ominus} + IO_3^{\ominus} + 6H^{+} \rightarrow 3I^{+} + 3H_2O$$

So $\dfrac{n_{I^{\ominus}}}{n_{IO_3^{\ominus}}} = \dfrac{2}{1}$ let molarity of KI = M

$$\frac{25\times10^{-3}\times M}{30\times10^{-3}\times 1/10} = \frac{2}{1} \Rightarrow M = 6/25$$

So remaining KI :

$$\frac{6/25 \times V}{50\times10^{-3}\times 1/10} = \frac{2}{1} \Rightarrow V = \frac{250}{6}\text{ ml}$$

$$V = 125/3\text{ ml}$$

So vol. of KI used with $AgNO_3$

$$50 - 125/3 = 25/3\text{ ml}$$

moles of KI used $= 6/25 \times 25/3 \times 10^{-3} = 2\times10^{-3}$

So ~~ann~~ moles of $AgNO_3$ should be taken $= 2\times10^{-3}$

since sample is 50% pure

so moles taken $= 4\times10^{-3}$

mass taken $= 4\times10^{-3}\times170$

$= 0.68$ gm

10. 12.5 %

$\overset{\ominus}{S}CN + 4H_2O \rightarrow SO_4^{-2} + HCN + \cancel{8}7H^+ + 6e^\ominus$

n factor for $\overset{\ominus}{S}CN = 6$

I_2 used with hypo

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

$n_{hypo} = 20 \times 0.1 \times 10^{-3}$
$= 2 \times 10^{-3}$

So moles of I_2 used $= 1 \times 10^{-3}$

So moles of I_2 used with $\overset{\ominus}{S}CN$

$= \cancel{2}50 \times 10^{-3} \times \frac{0.1}{2} - 1 \times 10^{-3}$

$= \frac{3}{2}\cancel{8} \times 10^{-3}$

So

eq of I_2 = eq of $\overset{\ominus}{S}CN$

$2 \times \frac{3}{2} \times 10^{-3} = 6 \times$ moles of $\overset{\ominus}{S}CN$

moles of $\overset{\ominus}{S}CN = \cancel{\frac{18 \times 10^{-3}}{42}}\ \frac{1}{2} \times 10^{-3}$

So moles of $Ba(SCN)_2 = \cancel{\frac{3}{2} \times 10^{-3}}\ \frac{1}{4} \times 10^{-3}$

mass of $Ba(SCN)_2 = \cancel{\frac{3}{2} \times 10^{-3}} \times$

$= \frac{1}{4} \times 10^{-3} \times 253$

$= 0.06325$ gm

% purity $= \frac{0.06325}{0.506} \times 100 = 12.5\%$

11. N = 2.94, Volume strength = 16.464, w_{KMnO_4} = 9.29 g

$(H_2O_2 \rightarrow O_2 + 2H^+ + 2e^-) \times 5$

$(MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{+2} + 4H_2O) \times 2$

$5H_2O_2 + 2MnO_4^- + 6H^+ \rightarrow 5O_2 + 2Mn^{+2} + 8H_2O$

moles of $O_2 = \frac{3.294}{22.4} = 0.147$

so moles of $H_2O_2 = 0.147$

molarity of $H_2O_2 = \frac{0.147}{100 \times 10^{-3}} = 1.47$

vol. strength of H_2O_2 = $\cancel{1.47 \times 34}$ 1.47×11.2
$= 16.464$

Normality of $H_2O_2 = 2 \times 1.47 = 2.94$

moles of $KMnO_4 = \frac{2}{5} \times 0.147$

mass of $KMnO_4 = \frac{2}{5} \times 0.147 \times 158$

$= 9.29$ gm

12. 0.1 M

let molarity of $H_2O_2 = M_1$

" " $KMnO_4 = M_2$

so

$2 \times 20 \times M_1 = 5 \times 20 \times M_2$

$2M_1 = 5M_2$

now

$\overset{+7}{MnO_4^{\ominus}} + Mn^{+2} \longrightarrow \overset{+4}{MnO_2} + \overset{+4}{MnO_2}$

n = 3, n = 2

$2MnO_4^{\ominus} + 3Mn^{+2} + 2H_2O \longrightarrow 5MnO_2 + 4H^+$

$\overset{+4}{MnO_2} + C_2O_4^{-2} \longrightarrow Mn^{+2} + 2CO_2$

n = 2, n = 2

eq of MnO_2 = eq of ~~Mn^{+2}~~ $C_2O_4^{-2}$

$\cancel{2} \times$ moles of $MnO_2 = \cancel{2} \times 10 \times 10^{-3} \times 0.2$

moles of $MnO_2 = 2 \times 10^{-3}$

hence moles of $MnO_4^{\ominus} = \frac{2}{5} \times 2 \times 10^{-3} = \frac{4}{5} \times 10^{-3}$

molarity of $KMnO_4 = M_2 = \frac{\frac{4}{5} \times 10^{-3}}{20 \times 10^{-3}} = 0.04$

so $M_1 = \frac{5}{2} \times 0.04 = \underline{0.1}$

13. (a) 34.4 ml (b) 55.8 ml (c) 21.3 ml

moles of NaOH = $1/40$

" " $Na_2CO_3 = 1/106$

" " $NaHCO_3 = 1/84$

(a) only PH indicator

eq of Na_2CO_3 + eq of NaOH = eq of HCl

$1 \times \frac{1}{106} + 1 \times \frac{1}{40} = 1 \times V$

$V = 34.4$ ml

(b) only me. o as indicator

eq of Na_2CO_3 + eq of NaOH + eq of $NaHCO_3$ = eq of HCl

$2 \times \frac{1}{106} + 1 \times \frac{1}{40} + 1 \times \frac{1}{84} = 1 \times V$

$V = 55.8$ ml

(C) now no NaOH is left

& all Na_2CO_3 is converted to $NaHCO_3$

moles of converted $NaHCO_3$ = $1/106$

moles of HCl = moles of $NaHCO_3$

(already present + converted)

$$1 \times V = \frac{1}{106} + \frac{1}{84}$$

V = 21.3 ml

---

14. Na_2CO_3 = 42.4 g, NaOH = 16 g

In PH

n factor of $Na_2CO_3 = 1$

eq of Na_2CO_3 + eq of NaOH = eq of H_2SO_4

$$1 \times \frac{w_1}{106} + 1 \times \frac{w_2}{40} = 2 \times 1 \times 10 \times 10^{-3}$$

$$\frac{w_1}{106} + \frac{w_2}{40} = 0.02 \quad -(1)$$

In me.o.

n factor for $Na_2CO_3 = 2$

$$2 \times \frac{w_1}{106} + 1 \times \frac{w_2}{40} = 2 \times 1 \times 15 \times 10^{-3}$$

$$\frac{2w_1}{106} + \frac{w_2}{40} = 0.03 \quad -(2)$$

② – ①

$$\frac{w_1}{106} = 0.01 \Rightarrow w_1 = 1.06 \text{ gm}$$

hence $w_2 = 0.4$ gm

Hence in 1 dm^3 = 1 litre soln.

$$w_{Na_2CO_3} = \frac{1.06}{25} \times 1000 = 42.4 \text{ gm}$$

$$w_{NaOH} = \frac{0.4}{25} \times 1000 = \cancel{40}\ 16 \text{ gm}$$

15. Na_2CO_3 = 4.24 g/l, NaHCO3 = 5.04 g/l

let in 10ml soln.

mass of $Na_2CO_3 = w_1$

" " $NaHCO_3 = w_2$

In Phe. only Na_2CO_3 will react till $NaHCO_3$

$$1 \times \frac{w_1}{106} = 2 \times 0.1 \times 2 \times 10^{-3}$$

$$w_1 = 42.4 \times 10^{-3} \text{ gm}$$

after MeO· is added it will react
with $NaHCO_3$ already present & converted both

$$1 \times \frac{W_1}{106} + 1 \times \frac{W_2}{84} = 2 \times 0.2 \times 2.5 \times 10^{-3}$$

$$6.4 \times 10^{-3} + \frac{W_2}{84} = 1 \times 10^{-3}$$

$$W_2 = 50.4 \times 10^{-3} \text{ gm}$$

so strengths are

$$Na_2CO_3 = \frac{42.4 \times 10^{-3}}{10} \times 1000 = 4.24 \text{ gm/litre}$$

$$NaHCO_3 = \frac{50.4 \times 10^{-3}}{10} \times 1000 = 5.04 \text{ gm/Litre}$$

16. $\frac{5}{6}, 2$

(a) It is a redox reaction:

$$6e^- + Cr_2O_7^{2-} \longrightarrow 2Cr^{3+} \ (n = 6)$$

$$\left[\begin{array}{lll} Fe^{2+} \longrightarrow Fe^{3+} + e^- & & \\ 2(HC_2O_4^-) & \longrightarrow 4CO_2 & + 4e^- \\ 2 + 4x - 16 = -2 & 4x - 16 = 10 & \\ \quad 4x = 12 & \quad 4x = 16 & \end{array}\right] (n = 5)$$

$\therefore$ 1 mol of $Fe(HC_2O_4)_2 = \frac{5}{6}$ mol of $Cr_2O_7^{2-}$

(b) It is a acid base reaction

NaOH (n = 1, one $\bar{O}H$ ion), $(HC_2O_4^-)_2$ (n = 2, $2H^+$ ions)

Fe^{2+} does not react with base (NaOH).

2 mol of NaOH $\equiv$ 1 mol of $Fe(HC_2O_4)_2$

17. 1:5

In strong basic medium, MnO_4^- is reduced to MnO_4^{2-}.

$[e^- + MnO_4^- \longrightarrow MnO_4^{2-} (n=1)]$

$[C_2O_4^{2-} \longrightarrow 2CO_2 + 2e^- (n=2)]$

In acidic medium, MnO_4^- is reduced to Mn^{2+}.

$5e^- + MnO_4^- \longrightarrow Mn^{2+} (n=5)$

Mole of MnO_4^- in acidic medium $= \frac{1}{5}$

Mole of MnO_4^- in strong basic medium = 1

18. (10)

Strength $N = Ew$ (Mw = Ew of HCl = 36.5 g)

$N_{HCl} = \frac{\text{Strength}}{\text{Ew}} = \frac{3.65}{36.5} = 0.1\,N$

mEq of HCl $= N \times V(mL) = 0.1 \times 2000\,mL$

$= 200$ mEq

$HCl \equiv Al(OH)_3$

$mEq \equiv mEq$

$200\,mEq \equiv \frac{\text{Weight}}{\text{Ew}} \times 10^3 \qquad \left[Ew = \frac{Mw}{3} = \frac{78}{3}\right]$

$200 = \frac{\text{Weight} \times 10^3}{78/3}$

Weight of $Al(OH)_3 = \frac{200 \times 78}{1000 \times 3} = 5.2\,g = 5200\,mg$

Number of tables of $Al(OH)_3 = \frac{5200}{520} = 10$

PYQ : JEE Advanced

Only One Option Correct:

1. (A)

The change involved is $MnO_4^- + e^- \longrightarrow MnO_4^{2-}$

i.e. it involves only one electron

Eq. wt = $\frac{\text{Mol. wt}}{\text{No. of } e^- \text{ involved}} = \frac{M}{1} = M \qquad [\because \text{Mol. wt.} = M]$

2. (C)

The sum of oxidation states of all atoms in compound is zero.

Calculation of O.S. of C in CH_2O.

$x + 2 + (-2) = 0 \Rightarrow x = 0$

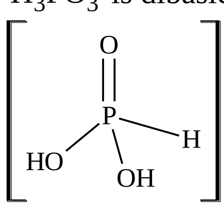
3. (B)
For equivalent weight of $MnSO_4$ to be half of its molecular weight, change in oxidation state must be equal to 2. It is possible only when oxidation state of Mn in product is +4. Since oxidation state of Mn in $MnSO_4$ is +2. So, MnO_2 is correct answer.
In MnO_2, O.S. of Mn = +4
$\therefore$ Change in O.S. of Mn = +4 – (+2) = +2

4. (C)
2 + 2 (2 + x – 4) = 0 [$\because$ $Ba(H_2PO_2)_2$ is neutral molecule]
Or $2x-2=0 \Rightarrow x=+1$

5. (B)
$BaO_2 + H_2SO_4 \rightarrow BaSO_4 + H_2O_2$
Oxygen is the most electronegative element in the reaction and has the oxidation states of –1 (in H_2O_2) and –2 (in $BaSO_4$).

6. (A)
Balance the reaction by ion electron method.
Oxidation reaction : $C_2O_4^{2-} \rightarrow 2CO_2 + 2e^-]\times 5$
Reduction reaction : $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{+2} + 4H_2O]\times 2$
Net reaction : $2MnO_4^- + 16H^+ + 5C_2O_4^{2-} \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$

7. (D)
(i) H_3PO_3 is dibasic acid as it contains two –OH groups.



(ii) Normality = Molarity × basicity of acid.
(iii) Basicity of $H_3PO_3 = 2$
$\therefore$ Normality $= 0.3 \times 2 = 0.6$

8. (A)
O.N. of S in $S_8 = 0$;
O.N. of S in $S_2F_2 = +1$;
O.N. of S in $H_2S = -2$.

9. (C)
(i) $3\overset{+1}{Cl}O^-(aq) \longrightarrow \overset{+5}{Cl}O_3^- + 2\overset{-1}{Cl^-}$
It is disproportionation reaction because Cl is both oxidised (+1 to +5) and reduced (+1 to –1) during reaction.

10. (A)

Equivalents of $H_2C_2O_4 \cdot 2H_2O =$ Equivalence of NaOH (At equivalence point)

Strength of $H_2C_2O_4 \cdot 2H_2O$ (in g/L) = $\frac{6.3}{250/1000} = 25.2\ g/L$

Normality of $H_2C_2O_4 \cdot 2H_2O = \frac{\text{Strength}}{\text{Eq. Wt.}} = \frac{25.2}{63} = 0.4\ N$

$\left\{\text{Eq. wt. of oxalic acid} = \frac{\text{Mol. wt}}{2} = \frac{126}{2} = 63\right\}$

Using normality equation :

$$N_1V_1 = N_2V_2$$

$(H_2C_2O_4 \cdot 2H_2O)$ (NaOH)

$0.4 \times 10 = 0.1 \times V_2$ or $V_2 = \frac{0.4 \times 10}{0.1} = 40\ mL$

11. (B)

(i) Find change in oxidation number of Cr atom.

(ii) Eq. wt. $= \frac{\text{Molecular wt.}}{\text{change in O.N.}}$

In iodometry, $K_2Cr_2O_7$ liberates I_2 from iodides (NaI or KI).

Thus, it is titrated with $Na_2S_2O_3$ solution.

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

O.N. of Cr changes from +6 (in $K_2Cr_2O_7$) to + 3. *i.e.* 3 change for each Cr atom

$Cr_2O_7^{--} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

Thus, one mole of $K_2Cr_2O_7$ accepts 6 mole of electrons.

$\therefore$ Equivalents weight $= \frac{\text{Molecular weight}}{6}$

One or More than One Option Correct:

1. (A, B, D)

Balancing the chemical equation by half-reaction method.

$I^- + ClO_3^- + H_2SO_4 \longrightarrow Cl^- + HSO_4^- + I_2$

$2I^- \longrightarrow I_2 + 2e^-] \times 3$

$ClO_3^- + 6H^+ + 6e^- \longrightarrow Cl^- + 3H_2O$

$ClO_3^- + 6I^- + 6H^+ \longrightarrow 3I_2 + Cl^- + 3H_2O$

Adding $6HSO_4^-$ to both sides.

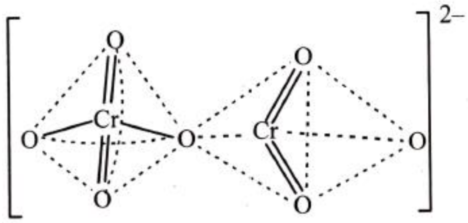
$ClO_3^- + 6I^- + 6H_2SO_4 \longrightarrow 3I_2 + Cl^- + 6HSO_4^- + 3H_2O$

Matrix-Match Type :

1. (A-P, S); (B-R); (C-P, Q); (D-P)

(A) The reaction is redox reaction because the O.N. of O in O_2^- is –0.5 and that in O_2 is zero. In O_2^{2-} is –1.0. It involves reduction oxidation reaction. Since, here a part of molecules is oxidised and a part is reduced, so it is disproportionation.

(B) The structure of $Cr_2O_7^{2-}$ is given below



[In any solution dichromate ions and chromate ions exist in equilibrium. In alkali solution, dichromate ions are converted into chromate ions and on acidification chromate ions are converted back into dichromate ion.]

(C) The reaction is

$$2MnO_4^- + 6H^+ + 5NO_2^- \rightarrow 2Mn^{2+} + 3H_2O + 5NO_3^-$$

In involves change in O.N of Mn from +7 (in MnO_4^-) to +2 (in Mn^{2+}). So Mn is reduced and NO_2^- is oxidised to NO_3^-; it is a redox reaction.

The structure of NO_3^- (one of the products) is **trigonal planar.**

(D) $3Fe^{2+} + NO_3^- + 2H_2SO_4 \rightarrow 3Fe^{3+} + NO + 2SO_4^{2-} + 2H_2O$

It is a **redox reaction.**

Numerical / Integer Answer Type :

1. (1.875)
2. (18.75)

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

For 25 mL

meq of Fe^{2+} = meq of MnO_4^-

$= 12.5 \times 0.03 \times 5$

For 250 mL

m.moles of $Fe^{2+} = \dfrac{12.5 \times 0.03 \times 5 \times 250}{25}$

Moles of $Fe^{2+} = \dfrac{18.75}{1000}$ mol

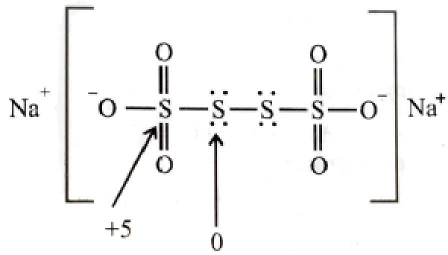
$= 18.75 \times 10^{-3} = 1.875 \times 10^{-2}$

$x = 1.875$

% Purity of $Fe^{2+} = \dfrac{1.05}{5.6} \times 100 = 18.75\%$

$y = 18.75$

3. (5)



Difference in oxidation number = 5 – 0 = 5

Fill In the Blanks:

1. $(+\frac{7}{3})$

Sum of oxidation states of all atoms (elements) in a neutral compound is zero.

As $YBa_2Cu_3O_7$ is neutral.

(+3) + 2(+2) + 3(x) + 7(–2) = 0

or 3 + 4 + 3x – 14 = 0; $x = +\frac{7}{3}$

Subjective Problems:

1. Balance the reactions by ion electron method.

(i) $Cu_2O + 2H^+ \rightarrow 2Cu^{2+} + H_2O + 2e^-] \times 3$ ...(1)

$NO_3^- + 4H^+ + 3e^- \rightarrow NO + 2H_2O] \times 2$ ...(2)

$3Cu_2O + 14H^+ + 2NO_3^- \rightarrow 6Cu^{2+} + 2NO + 7H_2O$

(ii) $K_4[Fe(CN)_6] + 6H_2SO_4 + 6H_2O \rightarrow 2K_2SO_4 + FeSO_4 + 3(NH_4)_2SO_4 + 6CO$

2. $HI < I_2 < ICl < HIO_4$; O.N. of I in $I_2 = 0, HI = -1, ICl = +1, HIO_4 = +7$.

3. Balance the atoms as well as charges by ion electron / oxidation number method.

(i) $6Ag^+ + AsH_3 + 3H_2O \rightarrow 6Ag + H_3AsO_3 + 6H^+$

(ii) $ClO_3^- + 6I^- + 6H_2SO_4 \rightarrow Cl^- + 6HSO_4^- + 3I_2 + 3H_2O$

(iii) $4S + 6OH^- \rightarrow 2S^{2-} + S_2O_3^{2-} + 3H_2O$

(iv) $2Mn^{2+} + 5PbO_2 + 4H^+ \rightarrow 2MnO_4^- + 2H_2O + 5Pb^{2+}$

(v) $Cl_2 + 2OH^- \rightarrow Cl^- + ClO^- + H_2O$

(vi) $2Ce^{3+} + S_2O_8^{2-} \rightarrow 2SO_4^{2-} + 2Ce^{4+}$

(vii) $2HNO_3 + 6HCl \rightarrow 2NO + 3Cl_2 + 4H_2O$

(viii) $Cr_2O_7^{2-} + 3C_2H_4O + 8H^+ \rightarrow 3C_2H_4O_2 + 2Cr^{3+} + 4H_2O$

(ix) $4Zn + NO_3^- + 10H^+ \rightarrow 4Zn^{2+} + NH_4^+ + 3H_2O$