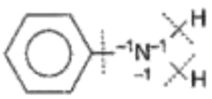
SOLUTIONS

EXERCISE # (O-I)

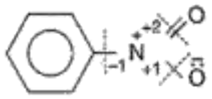
3. Oxidation state of Cr in both compounds is + 6 .

4. $2(+2)+2x+7(-2)=0 \Rightarrow x=+5$

5.



Oxidation state of N = –3



Oxidation state of N = +3

6. (A) $H_2S_2O_7, Na_2S_4O_6, Na_2S_4O_3, S_8$

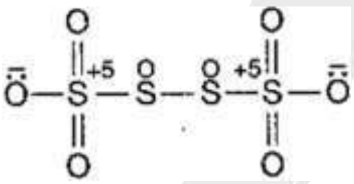
(B) $SO^{2+}, SO_4^{2-}, SO_3^{2-}, HSO_4^{-4}$

(C) $H_2SO_5, H_2SO_3, SCl_2, H_2S$

(D) $H_2SO_4, SO_2, H_2S, H_2S_2O_8$

7. $3x+2(-2)=0 \Rightarrow x=+\frac{4}{3}$

8.



9. CO is a neutral oxide.

10. $2x+4(-2)+2\times 0+2\times 0=-2$

$\Rightarrow x=+3$

11. $H_2O_2 \longrightarrow H_2O + O_2$

Oxidation as well as reduction of O atom takes place.

12. All are disproportion reaction

13. A, B & C are disproportionation reaction

14. Oxidising agent = IO_3^-

Oxidised = $Cr(OH)_3$

$(n_f)_I = 6$

15. In option B

Cl_2 is reduced to Cl^-

16. On balancing

$6HI + 2HNO_3 \longrightarrow 2NO + 3I_2 + 4H_2O$

17. $2VO + 3Fe_2O_3 \longrightarrow 6FeO + V_2O_5$

x, y = 2, 3

18. Balancing $\Rightarrow$

$AS_2O_3 + 6\ NaOH \longrightarrow Na_3ASO_3 + Na_3AsS_3 + 3H_2O$

x = 1

y = 6

19. On balancing

$3CN^- + 7\ NO_3^- + 10H^+ \longrightarrow 10\ NO + 3CO_2 + 5H_2O$

20. $\dfrac{\text{staichionetric coefficient of } X^-}{\text{staichionetric coefficient of } XO_3^-} = \dfrac{5}{1}$

21. On balancing

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

Total = 26

22. Only (i) reaction is balanced.

23. $NaHC_2O_4$ is behaving as acid and hence, $E = \dfrac{M}{1}$.

24. Equivalent wt. of Acid = $\dfrac{\text{Molar mass}}{\text{No. of replaceble } H^+ \text{ ions}}$

25. K_2CrO_4 is behaving as salt and hence, $E = \dfrac{M}{2}$.

26. $n_f = 2$

$HNO_2 \longrightarrow N_2O \ / \ HNO_3$

27. $\overset{+5}{NO_3^-} \longrightarrow \overset{-1}{N}H_2OH$

$n_f = 6$

28. $N = M \times n_f$

$M = \frac{0.6}{3} = 0.2$

29.

$Fe_{0.9}O \xrightarrow{(O.A)} Fe_2O_3$

$\swarrow \quad \searrow$

% Fe^{2+} % Fe^{+3}

$= \frac{7}{9} \qquad \frac{2}{9}$

$Fe^{+2} \xrightarrow{K_2Cr_2O_7} Fe^{+3}$

$\frac{7}{9} \times 0.9$

$n_f = 1 \times \frac{7}{9} \times 0.9 = 0.7$

Equivalent mass = $\frac{M}{0.7} = \frac{10M}{7}$

30. $\frac{M}{5}$

31. $Ba(SCN)_2 \longrightarrow Ba^{2+} + SO_4^{2-} + CO_3^{2-} + NO_3^-$

$^{\ominus}\underset{0}{S}-\underset{+2}{C}\equiv\underset{-3}{N}$

$n_f = 12 + 4 + 16$

$= 32$

<u>Redox titration ($KMnO_4$ and $K_2Cr_2O_7$ titration)</u>

32. In option D ,

gm eq · $KMnO_4$ = moles of $KMnO_4 \times n_f = \frac{4}{5} \times 5 = 4$

gm eq · $H_2C_2O_4$ = moles of $H_2C_2O_4 \times n_f = 2 \times 2 = 4$

Also CO_2 produced $\Rightarrow$ 4 moles

$\Rightarrow 4 \times 22.7$ lit.

33. $0.132 = 6 \times$ moles

Moles $= 0.022$

34. $1 \times 4 = 0.02 \times 5 \times V$ (ml)

35. $KBrO_3 + Na_2S_2O_3 \Rightarrow Br^- + Na_2S_4O_6$

$N_1V_1 = N_2V_2 \Rightarrow \frac{0.167}{167} \times 6 = 45 \times N \times 10^{-3} \Rightarrow N = \frac{2}{15} N$

36. Equivalents $=$ Mol x n_f

$$= \frac{6 \times 10^{20}}{6 \times 10^{23}} \times 1 = 10^{-3}$$

37. gm eq. $KMnO_4$ = gm eq $\cdot$ H_2O_2

$n \times 5 = 2 \times (4)$

$n = 8/5$

38. gm eq. $KHC_2O_4 \cdot 2H_2C_2O_4$ = gm eq. of H_2O_2

Moles $\times 6 = 3 \times \frac{2.8}{22.4} \times 2 \times 2$

Moles $= 0.25$

m moles $= 250$

39. n_f when acid $= 1 + 4 = 5 = x$

n_f in redox $= 2 + 4 + 6 + (4 \times 6) + [3 \times (1 + 2)]$

$= 45$

40. $MnO_4^{2-} \longrightarrow MnO_4^- + MnO_2$

Gram eq. of MnO_4^{2-} = gm eq. of MnO_4^-

$1 \times \left(\frac{1 \times 2}{1+2}\right) = 1 \times$ moles of MnO_4^-

Moles of $MnO_4^- = \frac{2}{3}$

Mass of Mn in MnO_4^- = $\frac{2}{3} \times 55$

% mass of Mn = $\dfrac{\frac{2}{3}\times 55}{1\times 55} \times 100$

= 66.66 %

41. $V_1 \times 0.1 \times 6 = \frac{0.678}{38} \times n_f$ .... (1)

$V_2 \times 0.3 \times 5 = \frac{0.678}{38} \times n_f$ .... (2)

(1) / (2)

$V_1 \times 0.1 \times 6 = V_2 \times 0.3 \times 5$

$$\frac{V_1}{V_2} = \frac{15}{6} = \frac{5}{2}$$

$V_2 = \frac{2}{5} V_1$

42. n_f of FeS_2 = 11

n_f of CuS = 6

$$\frac{20}{1000} \times N = 1 \times 11 \times \frac{10}{1000} + 2 \times 6 \times \frac{10}{1000}$$

N = 11.5

43. $XeF_4 + KI \longrightarrow I_2 + Xe + KF$

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

$x \times 10^{-3} \times 4 = \frac{20}{1000} \times 0.1$

x = 0.5

44. $E\left(AsO_4^{3-}\right) = E(I_2)_I$

$\frac{1}{208} \times 2 = E(I_2)_I$

$n(I_2)_1 = \left(\frac{2}{208}\right)/2 = \frac{1}{208}$

$E(I_2)_{II} = E(Na_2S_2O_3)$

$\frac{1}{208} \times 2 = 0.2 \times V$ (lit)

V (ml) = 48.1 ml

45. (1) $V_2O_5 \longrightarrow V^{2+}$

(2) $V^{2+} + I_2 \longrightarrow VO^{2+} + I^-$

Let. Eq. $(V^{2+})_1$ = Eq. (V_2O_5) = a

Moles of $V^{2+} = \frac{a}{3}$

Eq. $(V^{2+})_2 = \frac{a}{3} \times 2 = n_{I_2} \times 2$

$n_{I_2} = \frac{a}{3}$

Eq. $(V_2O_5) = \frac{10}{182} \times 6 = a$

$n_{I_2} = \frac{10 \times 6}{182 \times 3} \Rightarrow$ 0.11 moles

46. (I) $KIO_3 + KI \longrightarrow I_2$

(II) $I_2 + S_2O_3^{2-} \longrightarrow I^- + S_4O_6^{2-}$

Gm eq. of $S_2O_3^{2-}$ = gm eq. of $I_{2(II)}$

$\frac{10}{1000} \times 0.1 \times 1$ = mole $I_{2(II)} \times 2$

Moles $I_{2(II)} = \frac{10-3}{2}$ = moles $I_{2(I)}$

Gm eq. of KIO_3 = gm eq. of $I_{2(I)}$

Moles $KIO_3 \times 5 = \frac{10-3}{2} \times \left(\frac{10 \times 2}{12}\right)$

$\therefore$ M. moles of $KIO_3 = \frac{1}{6}$

47. 2mole = 8eq 8eq

$K_3H(C_2O_4)_2 + KMnO_4 \longrightarrow CO_2$

n=4 n=5

1mole=2eq 2eq

$H_2C_2O_4 + KMnO_4 \longrightarrow CO_2 + Mn^{2+}$

n=2 n =5

Total eq. of $KMnO_4$ used = 10 eq = Normality × volume

10 eq = M × 5 × V_1

$V_1 = \frac{10}{5M}$ lit.

$= \frac{2}{M}$ lit.

2mole = 2eq 2eq = 1mole

$K_3H(C_2O_4)_2 + Ba(OH)_2 \longrightarrow Ba(K_3(C_2O_4)_2)_2 + H_2O$

n=1 n=2

1mole=2eq 2eq=1mole

$H_2C_2O_4 + Ba(OH)_2 \longrightarrow BaC_2O_4 + H_2O$

n=2 n =2

Total moles of $Ba(OH)_2$ used = 2 mole = M × V_2

$V_2 = \frac{2}{M}$ lit.

$\frac{V_1}{V_2} = 1$

48. Let V_1 & V_2 are volumes of $KMnO_4$ in 1st part & 2nd part

Reaction (1) $KMnO4 + C_2O_4^{2-} \xrightarrow{\text{Acidic}} CO_2 + Mn^{2+}$

$\Rightarrow 0.5 \times V_1 \times 5 = 1.5 \times 125 \times 2 \Rightarrow V_1 = 150$ mL

Reaction (1) $KMnO_4 + I^- \xrightarrow{\text{Basic}} I_2 + MnO_2$

$\Rightarrow 0.5 \times V_2 \times 3 = 0.5 \times 270 \times 1 \Rightarrow V_2 = 90$ mL

So initial volume = 150

49. Since $AlCl_3$ & NaCl are formed

100 × 0.1 × 4 = 0.25 × V (ml)

V = 160 ml

50. $CHCl_2\,COOH \longrightarrow 2\overset{+4}{C}O_2 + H_2O + \overset{0}{Cl_2}\ (\overset{+2}{C_2}H_2\overset{-1}{Cl_2}O_2)$

$n_f = 6$

Moles × 6 = 600

Mole = 100 M moles

For NH_3, $moles_{NH_3} = \frac{100\text{ M moles} \times 1}{1}$

= 100 M moles

= 0.1 moles

Acid – Base titration

51. Eq. (HNO_3) = Eq. (NaOH)

$M_1 n_1 V_1 = M_2 n_2 V_2$

$\frac{18.9}{63} \times 1 \times V_1 = \frac{3.2}{40} \times 1 \times V_2$

$\frac{V_1}{V_2} = \frac{4}{15}$

52. x = 1

y = 1

z = 1

53. $\frac{25}{1000} \times N = \frac{1.06}{106} \times 2$

N = 0.8

54. 23.6 mL of 0.1 NH_2SO_4 solution will be required for complete reaction with a solution containing 0.125 g of pure Na_2CO_3

For complete reaction no. of equivalents must be equal.

No. of moles of Na_2CO_3 = mass / molar mass = 0.125/106 = 0.001179 mol

No. of equivalents of Na_2CO_3 = no. of moles x valence factor = 0.001179 × 2 = 0.002358

This is no. of equivalents H_2SO_4 must be present for complete reaction.

For H_2SO_4 no. of equivalents = Normality × volume (in litres)

Meq of H_2SO_4 = Meq of Na_2CO_3

$$0.1 \times \frac{V}{1000} = \frac{0.125}{106} \times 2$$
$$V = 23.6 \text{ mL}$$

Therefore volume in L of H_2SO_4 = 0.002358/0.1 = 0.02358 Litre = 0.02358 × 1000mil = 23.58ml

55. Weight of metal = xgm and weight of oxide = y gm

$\therefore$ Oxygen consumed = (y – x)gm

Since $(y-x)$ gm of oxygen combines with x gm of metal

$\therefore$ 8gm of oxygen will combine with $\frac{8x}{y-x}$ gm of metal

Hence equivalent weight of metal = $\frac{x}{y-x} \times 8$

56. $A_2O_x \longrightarrow ACl_x$

3 gm 5 gm

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

E = 33.25

57. Equivalents of M = equivalents of O_2

$$\frac{W_{metal}}{(\text{equivalent mass})_{metal}} = \frac{W_{O_2}}{(\text{equivalent mass})_{O_2}}$$

$$\frac{W_{metal}}{W_{O_2}} = 2$$

$$\therefore \quad \frac{W_{metal} + W_{O_2}}{W_{metal}} = \frac{3}{2} = 1.5$$

EXERCISE # (S-I)

1. (a) $Cr\,O_2\,Cl_2$

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

$x = +6$

(b) Mn_3O_4

$3x + 4x(-2) = 0$

$x = +\frac{8}{3}$

(c) $Ca\,(Cl\,O_2)_2$

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

$x = +3$

(d) $Zn\,O_2^{2-}$

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

$x = +2$

(e) $K_4\,P_2\,O_7$

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

$x = +5$

(f) $Fe_{0.93}O$

$0.93\,x - 2 = 0$

$x = \frac{200}{93}$

(g) $K[Co(C_2O_4)_2\,(NH_3)_2]$

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

$x = 3$

10. Eq. wt. of salt = $\frac{MM}{\text{Total cationic charge } (n_f)}$

(a) $n_f = 1$

(b) $n_f = 2$

(c) $n_f = 6$

11. (a) Eq. wt. = $\frac{158}{5} = 31.6$

(b) Eq. wt. = $\frac{158}{3} = 52.67$

12. n_f (CuS) = 6

n_f (Cu_2S) = 8

n_f ($KMnO_4$) = 5

Redox titration

13. gm eq. of SO_2 = gm eq. of MnO_4^-

$$2 \times n_{SO_2} = \frac{10}{1000} \times 0.1 \times 5$$

Milli moles of SO_2 = 2.5

14. $\underset{n=6}{K_2Cr_2O_7} + \underset{n=1}{KI} \longrightarrow Cr^{3+} + I_2$

meq. of $K_2Cr_2O_7$ = meq. of KI

mmoles × 6 = 0.1 × 1 × 40

mmoles of $K_2Cr_2O_7 = \frac{4}{6}$ = 0.667 mmoles

15. $\underset{n=4}{Sn} + \underset{n=6}{K_2Cr_2O_7} + HCl \longrightarrow SnCl_4 + Cr^{3+}$

equivalent of Sn = equivalent of $K_2Cr_2O_7$

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

V = 4 lit

16. Equivalents of MnO_4^- = eq. of SO_4^{2-}

18 × 5 = 4X

X = 22.5

17. $\underset{n=4-x}{\overset{4+}{Ce}} + \underset{n=2}{\overset{2+}{Ce}} \longrightarrow Sn^{4+} + Ce^{x}$

m.e. of Ce^{4+} = m.e. of Sn^{2+}

1 × (4 – x) × 40 = 1 × 2 × 20

x = 3

18. $\underset{n=(4-x)}{SeO_2} + \underset{n=1}{CrSO_4} \longrightarrow Ce^{3+} + Se^{x}$

m.e. of SeO_2 = m.e. of $CrSO_4$

$1 \times (4 - x) \times 10 = 2 \times 1 \times 20$

$x = 0$

19. Moles × 6 = 0.76 × 1

Moles = 0.1266

20. $H_2O_2 + KMnO_4 + H^+ \longrightarrow Mn^{2+} + O_2(g)$

n = 2 n = 5

Number of equivalent of H_2O_2 = Number of equivalent of $KMnO_4$

$N_1V_1 = N_2V_2$

$2 \times 0.1 \times V = 5 \times 0.1 \times 1$

V = 2.5 litre

= 2500 ml.

21. Weight of H_2O_2 in the mixture = $1 \times \frac{x}{100}$ gm

mole of H_2O_2 in the mixture = $\frac{x}{100 \times 34}$ mole

$\underset{n=2}{H_2O_2} + \underset{n=5}{KMnO_4} \longrightarrow M_n^{2+} + O_2$

equivalent of H_2O_2 = equivalent of $KMnO_4$

$\frac{x}{100 \times 34} \times 2 = N \times x \times 10^{-3}$

$N = \frac{20}{34} = 0.588$

22. Eq. of MnO_4^-

= Eq of FeC_2O_4

$5 \times nKMnO_4 = 3 \times 1$

$nKMnO_4 = \frac{3}{5}$

23. $V \times 0.03 \times 6 = 5 \times 0.2 \times 4$

V = 2.22 ml

24. $0.1 \times \frac{10}{1000} \times 5 = \text{moles} \times \frac{5}{3}$

Milli moles = 3 m moles of Br_2

25. Fe_2O_3 do not react with $KMnO_4$

$KMnO_4 + FeO \longrightarrow Fe^{3+} + Mn^{+2}$

equation of $KMnO_4$ = equation of FeO

$\frac{158}{158} \times 5 = \eta_{FeO} \times 1$

$\eta_{FeO} = 5$ $W_{FeO} = 360$

$W_{Fe_2O_3} = 160$ $\eta_{Fe_2O_3} = 1$

Mole % of $Fe_2O_3 = \frac{1}{6} \times 100 = 16.67$

26. $5 \times 0.1 \times \frac{100}{1000} = x \times 2$

$x = 25 \times 10^{-3}$ moles

= moles of CuO = moles of Cu_2O

Milli moles of Cu^{2+} $= 3 \times 25 \times 10^{-3}$ moles

= 75 Milli moles

27. (a) $0.4 \times 5 \times V = 1 \times 2 + 2 \times 2$

V = 3 lit

(b) $0.2 \times 5 \times V = 1 \times 2 + 2 \times 2$

V = 6 lit

28. $\underset{n=8}{K_2C_2O_4} \cdot 3H_2C_2O_4 \cdot 4H_2O + \underset{n=5}{MnO_4^-} + H^+ \longrightarrow Mn^{2+} + CO_2$

equivalent of MnO_4^- = equivalent of acid oxalate

$0.1 \times 5 \times V = \frac{5.08}{508} \times 8$

V = 0.16 lit

29. On balancing

$As_2O_5 + 10HCl \longrightarrow 2AsCl_3 + 2Cl_2 + 5H_2O$

HCl is limiting

$\therefore$ Moles of Cl_2 $= \frac{5}{10} \times 2$

$= 1$

Mass of Cl_2 = 71 gm

30. Eq. of $K_2Cr_2O_7$ = Eq. of Fe^{2+} (initial + back titration)

$25 \times 0.002 \times 6 = 100 \times 1 \times M + 7.5 \times 0.01 \times 1$

$M = 2.25 \times 10^{-4}$

$$ppm = \frac{2.25\times10^{-4}\times56}{100}\times10^{6} = 126 \text{ ppm}$$

31. Bleaching powder = $CaOCl_2$

Mohr Salt = $(NH_4)_2SO_4 . FeSO_4 . 6H_2O$

$\underset{n_f=2}{CaOCl_2} + \underset{n_f=1}{Fe_2} \longrightarrow Cl^- + Fe^{3+}$

$Fe^{2+} + KMnO_4 \longrightarrow Fe^{3+} + Mn^{2+}$

meq of Mohr Salt = meq of $CaOCl_2$ + meq of $KMnO_4$

$35 \times 1 \times 1$ = mmoles $CaOCl_2 \times 2 + 30 \times 0.1 \times 5$

m moles of $CaOCl_2$ = 10

mass of chlorine $= 10 \times 10^{-3} \times 71 = 0.71$ gm

$$\% \text{ Chlorine} = \frac{0.71}{10}\times100 = 7.1\ \%$$

32. $MnO_2 + HCl \longrightarrow Cl_2 + Mn^{2+}$

$Cl_2 + KI \longrightarrow I_2 + Cl^-$

$I_2 + Na_2S_2O_3 \longrightarrow I^- + Na_2 + Na_2S_4O_6$

eq of MnO_2 = eq of hypo

$$n \times 2 = 40\times \frac{1}{10}\times\frac{1}{1000}$$

$n = 2\times10^{-3}$

$$\% \text{ w/w } MnO_2 = \frac{2\times10^{-3}\times87}{5}\times100 = 3.48\ \%$$

Acid – Base titration

33. (a) meq. of H_3PO_4 = meq. of $Ca(OH)_2$

$1 \times V \times 3 = 2 \times 30 \times 2$

V = 40 ml.

(b) meq. of H_2SO_4 = meq. of $Al(OH)_3$

$1 \times V = 1 \times 3 \times 20$

V = 60 ml.

34. Let 19 gm mixture contains x moles each of Na_2CO_3 and $NaHCO_3$.

Therefore

$106x + 84x = 19$

$x = 0.1$

Since HCl reacts with mixture as:

$HCl + Na_2CO_3 \longrightarrow NaCl + H_2CO_3$

$HCl + NaHCO_3 \longrightarrow NaCl + H_2CO_3$

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

$0.1\ V = (x \times 2) + (x \times 1) = 3x$

$0.1\ V = 3 \times 0.1$

V = 3 lit

35. $\underset{n=2}{NaH_2PO_4} + \underset{n=1}{NaOH} \longrightarrow Na_3PO_4 + H_2O$

equivalent of NaH_2PO_4 = equivalent of NaOH

mole of NaH_2PO_4 × 'n' factor = M × 'n' factor × V

$\frac{12}{120} \times 2 = 1 \times 1 \times V$

V = 0.2 lit

36. $\underset{n=2}{CaCO_3} + \underset{n=1}{HCl} \longrightarrow CaCl_2 + H_2CO_3$

$\underset{n=1}{KOH} + \underset{n=1}{HCl} \longrightarrow KCl + H_2O$

equivalent of $CaCO_3$ + equivalent of KOH = equivalent of HCl used

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

V = 25 ml

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

$NaOH + HCl \longrightarrow NaCl + H_2O$

m.e. of HCl used = m.e. of $Ca(OH)_2$ + m.e. of NaOH

0.5×0.5 = m.m. of $Ca(OH)_2 \times 2 + 0.3 \times 20$

m.m. of $Ca(OH)_2 = \frac{19}{2}$ m.m.

wt. of $Ca(OH)_2 = \frac{19}{2} \times 10^{-3} \times 74$ gm

wt % of $Ca(OH)_2 = \frac{19 \times 10^{-3} \times 74}{2 \times 50} \times 100 = 1.406\ \%$

EXERCISE # (O-II)

6. $3I_2 + 6NaOH \longrightarrow NaIO_3 + 5NaI + 3H_2O$

n-factor = $\frac{3}{5}$ of I_2

n-factor of NaOH = $\frac{5}{6}$

Eq. wt. of NaOH = $\frac{40}{5/6}$ = 48

7. (A) Eq. of MnO_4^- = mole × nf

= 1 × 5

Eq. of Fe^{2+} = 10 × 1 = 10

Eq. of MnO_4^- < Eq. of Fe^{2+}

(D) Eq. of Cu_2S = 2 × 8 = 16

Eq. of $Cr_2O_7^{2-}$ = 2.66 × 6 = 16

Eq. of Cu_2S = Eq. of $Cr_2O_7^{2-}$

8. $E_{MnBr_2} = \frac{215}{17} = 12.65$

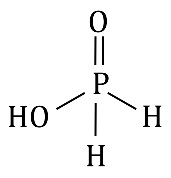
9. $E_{PbO_2} = \frac{240}{2} = 120$

10. $2MnBr_2 + 17PbO_2 + 30HNO_3 \rightarrow 2HMnO_4 + 2Pb(BrO_3)_2 + 15Pb(NO_3)_2 + 14H_2O$

The reaction is balanced by the loss or gain of 34 electrons. Hence, $E_{HNO_3} = \frac{30 \times 63}{34} = 55.6$

11. $Ba(MnO_4)_2$ n_f = (in acidic medium) = 5 × 2 = 10

12. n_f of H_3PO_2



acid : no. of replaceable H^+ = 1

$n_f = 1$

13. $\overset{+x}{Fe}_{0.95}\overset{+3}{O} \longrightarrow \overset{+3}{Fe}_2 O_3$

$x(0.95) = 2 \qquad n_f = \left(3 - \frac{2}{0.95}\right)^{(0.95)}$

$x = \frac{2}{0.95} \qquad n_f = 0.85$

$E_W = \frac{M}{n_f} = \frac{M}{0.95}$

14. $M_{H_2O_2} = \frac{20}{22.4} \times 2 = \frac{20}{11.2}$

$\frac{20}{11.2} \times V \times 2 = 0.1 \times \frac{200}{1000}$

$V = 5.675$ ml

15. $0.1 \times \frac{200}{1000} = \frac{m}{294} \times 6$

m = 0.97 gram

16. 20V H_2O_2

1L H_2O_2 liberate 20 ? O_2

11.2 ml H_2O_2 liberate $\frac{20}{1000} \times 11.2 = \frac{22.4}{100} = 0.224$

= 224 ml

17. $NaN_3 \Rightarrow N_3^-$ (charge on N = $\frac{-1}{3}$)

$N_2H_2 \Rightarrow N_2^{2-}$ (charge of N = –1)

NO (charge on N = +2)

$N_2O_5 \Rightarrow$ (charge on N = +5)

18. $n_f\,(P_4H_4) = \frac{2\times3}{2+3} = \frac{6}{5}$

$n(I_2) = \frac{2\times10}{2+10} = \frac{20}{12} = \frac{5}{3}$

$n(Mn_3O_4) = \frac{13\times2}{13+2} = \frac{26}{15}$

$n(H_3PO_2) = \frac{4\times2}{4+2} = \frac{8}{6} = \frac{4}{3}$

19. (A) $\rightarrow$ (q); (B) $\rightarrow$ (t); (C) $\rightarrow$ (r)

EXERCISE # (S-II)

1. moles of Fe_2O_3 = 0.48 gm

moles of Fe^{3+} = $\frac{0.48}{160} \times 2 \times 10^{-2} = 6 \times 10^{-3}$

$Fe^{3+} + Zn \longrightarrow Zn^{2+} + Fe^{2+}$

6moles 6moles

meq of Fe^{2+} = meq of oxidising agent

n 25 ml = 30×0.01×n

$6 \times \frac{1}{4} \times 1 = 30 \times \frac{0.01}{100} \times n$

n = 5

2. $\underset{\eta_f = 2}{Cu} + H_2SO_4 \longrightarrow Cu^{2+} + SO_2$

$\underset{\eta_f = 2}{SO_2} + \underset{\eta_f = 5}{KMnO_4} \longrightarrow SO_4^{2-} + Mn^{2+}$

$\underset{\eta_f = 2}{H_2C_2O_4} + \underset{\eta_f = 5}{KMnO_4} \longrightarrow Mn^{2+} + CO_2$

meq of $KMnO_4$ = meq of SO_2 + meq of $H_2C_2O_4$

100 × 0.4 × 5 = meq of SO_2 + 25 × 1 × 2

150 = meq of SO_2 + meq of Cu

moles of Cu = $\frac{150}{2} \times 10^{-3}$

$W_{Cu} = 75 \times 10^{-3} \times 63.5$

Weight of sample = $\frac{75 \times 10^{-3} \times 63.5}{95.25} \times 100$ = 5 gm

3. $\underset{\eta_f = 2}{H_2O_2} + Sn^{2+} \longrightarrow Sn^{4+} + H_2O$

$H_2O_2 \longrightarrow H_2O + \frac{10}{2}$

$n_f = \frac{2 \times 2}{2 + 2} = 1$

Initial moles of H_2O_2 = $\frac{20}{34}$

moles of H_2O_2 after the with Sn^{2+}

$$= \frac{20}{34} - \frac{88.2 \times 1}{1000}$$

$= 0.5882 - 0.0882$

$= 0.5$

Moles of produced O_2 = $0.5 \times \frac{1}{2} = \frac{1}{4}$

Volume of O_2 at 1 atm 273K = $\frac{1}{4} \times 22.4$ = 5.6 lit

4. $Cu^{2+} + KI \longrightarrow I_2 + Cu^{+}$

If = 1

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

meq of Cu^{2+} = meq of I_2 = meq of hypo

moles of Cu 20 ml ×1 = $\frac{20 \times 0.03}{1000}$ = 6×10^{-4}

moles of Cu in 1 litre = $\frac{1000}{20} \times 6 \times 10^{-4} = 3 \times 10^{-2}$

% w/w Cu = $\frac{3 \times 10^{-2} \times 64}{5} \times 100 = 38.4$ %

5. $KI + KIO_3 + HCl \rightarrow I_2 + KCl + H_2O$

$$\underset{\eta_f = 1}{5KI} + \underset{\eta_f = 5}{KIO} + 6HCl \rightarrow \underset{\eta_f = \frac{5}{3}}{3\,I_2} + 6KCl + 3H_2O \quad ....(1)$$

$$\underset{\eta_f = 2}{I_2} + \underset{\eta_f = 1}{Na_2S_2O_3} + I^- + Na_2S_2O_3 \quad ....(2)$$

meq of $Na_2S_2O_3$ = meq of I_2 in 2nd R × n

$24 \times 0.02 \times 1 = 2 \times \eta_{I_2}$

moles of I_2 = 0.24

meq of I_2 in 1st R × n = meq of KIO_3

$0.24 \times \frac{5}{3} = 0.004 \times V \times 5$

$10 \times 6 \times \frac{1}{3} = V$

20 ml = V

$\Rightarrow$ moles of HCl = 6 × moles of KIO_3

24 × M = 6 × 20 × 0.004

$M_{HCl} = 0.2$

6. $Mn_3O_4 \longrightarrow 3Mn^{2+}$

x mol 3x mol

$\underset{\eta_f=5}{KMnO_4} + C_2O_4^{2-} + H^+ \longrightarrow Mn^{2+} + CO_2$

Molarity of $KMnO_4$ sol = $\frac{1.25}{5} = 0.25$

equation of $KMnO_4$ = equation of Mn^{2+}

0.25 × 4 × 3 = 3x × 1

x = 1

$\% \frac{w}{w} Mn_3O_4 = \frac{229}{458} \times 100 = 50\%$

7. $4H_2O + SCN^- \longrightarrow SO_4^{2-} + HCN + 7H^+ + 6e^-$

$I_2 + 2e^- \longrightarrow 2I^-$

$4H_2O + SCN^- + 3I_2 \longrightarrow SO_4^{2-} + HCN + 7H^+$

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

meq of I_2 = meq of SCN^- + meq of hypo

50 × 6 = 2x × 6 + 26 × 1 × 1

x = 2 moles of $Ba(SCN)_2$

% w/w of $Ba(SCN)_2$ = $\frac{2 \times 253}{2.024} \times 10^{-3} \times 100 = 25\ \%$

8. Let the m mole of FeO = x

Let the m mole of Fe_2O_3 = y

$\underset{n_f=5}{KMnO_4} + \underset{n_f=1}{FeO} \longrightarrow Fe^{3+} + Mn^{2+}$

meq of $KMnO_4$ = m eq of FeO

$$\frac{2}{5} \times 100 \times 5 = x \times 1$$

$x = 200$

Total m moles of Fe^{3+} after the oxidation = x + 2y

$Fe^{3+} + Zn \longrightarrow Fe^{2+} + Zn^{2+}$

$Fe^{2+} + \underset{n_f=6}{K_2Cr_2O_7} \longrightarrow Fe^{3+} + Cr^{3+}$

meq of Fe^{2+} = meq of $K_2Cr_2O_7$

$$(x + 2y) \times 1 = \frac{2}{15} \times 1000 \times 6 = 800$$

$y = 300$

9. Let the m mole of As_2O_3 = x

As_2O_5 = y

$\underset{n_f=4}{As_2O_3} + \underset{n_f=2}{2I_2} + 2\,H_2O \longrightarrow As_2O_5 + 4H^+ + 4I^-$

equation of As_2O_3 = equation of I_2

$x \times 4 = 20 \times 0.05$

$x = 25$

Total moles of As_2O_5 after the P × n = x + y

$\underset{n_f=4}{As_2O_5} + 4H^+ + 4I^- \longrightarrow As_2O_3 + 2I_2 + 2H_2O$

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

equation of As_2O_5 = equation of I_2 = equation of hypo

$$(x + y) \times 4 = \frac{1.116}{248} \times 1000 = 4.5$$

$x + y = 1.125$

$y = 0.875$

$W_{AS_2O_3} = 0.25 \times 198 \times 10^{-3} = 49.5 \times 10^{-3}$

$W_{AS_2O_5} = 0.875 \times 230 \times 10^{-3} = 201.25 \times 10^{-3}$

Total weight = 0.25075 gm

10. $n_{eq}\,NaOH = n_{eq}$ Oxalate

or $\frac{27\times0.12}{1000}=\frac{30\times\frac{9.15}{M}}{1000}\times y$ ...(1)

$n_{eq}KMnO_4 = n_{eq}$ Oxalate

or $\frac{36\times0.12}{1000}=\frac{30\times\frac{9.15}{M}}{1000}\times 2z$ ...(2)

From charge conservation,

$x+y=2z$ ...(3)

and molar mass,

$M=39x+y+88z+18n$ ... (4)

Solving (1),(2),(3) and (4)

We get, x:y:z = 1 : 3 : 2 and n = 2.

EXERCISE # (JEE-MAINS)

1. $AgNO_3 + KI \longrightarrow AgI + KNO_3$

is not redox

2. $CaOCl_2$ has Cl^- & ClO^-

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

$\overset{+6}{Mn}O_4^{2-}$

$\overset{+4}{Mn}O_2$

$\overset{+3}{M}_2O_3$

4. $K_4[\overset{+2}{Ni}(CN)_6]$

5. $KI + K_2Cr_2O_7 \longrightarrow Cr^{+3}$

6. $[\overset{+3}{Cr}(NH_3)_4Cl_2]^+$

7. $2MnO_4^- + 5C_2O_4^{2-} + 8H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 4H_2O$

x = 2, y = 5, z = 8

8. $6Na_2HAsO_3 + 2NaBrO_3 + 12HCl \longrightarrow 2NaBr + 6H_3AsO_4 + 12NaCl$

x : y : Z (lowest ratio of whole number)

6 : 2 : 12

$\Rightarrow$ 3 : 1 : 6

9. R.A. loose electrons

10. Sn^{4+} is the oxidizing agent because it undergoes reduction

11. Total e^- = 6

12.

$$\overset{+4}{Xe}F_4 + \overset{+1}{O}_2F_2 \longrightarrow \overset{+6}{Xe}F_6 + \overset{0}{O}_2$$

Oxidation Red^n

13. $C_2O_4^{2-} + MnO_4^- + H^+ \longrightarrow 2CO_2 + Mn^{+2}$

e^- involved in the reaction = 10

e^- involved per mole of CO_2 = 5

14. $\frac{25}{1000} \times M \times 1 = \frac{30}{1000} \times 0.1 \times 2$

M = 0.24

$\Rightarrow 0.24 \times V \times 1 = 30 \times 0.2 \times 1$

$V = \frac{6}{0.24} = 25$ mL

15. $50 \times 0.5 \times 2 = 25 \times M \times 1$

M = 2

Moles = $M \times V = 2 \times \frac{50}{1000} \Rightarrow 0.1$

Mass = 0.1×40

= 4 gm

16. $M \times 5 = 1 \times [(1+2) + (6) + (1)]$

$M \times 5 = 10$

M = 2

17.

NO	+2
N_2O	+1
NO_2	+4
N_2O_3	+3

18. $2CuBr \longrightarrow CuBr_2 + Cu$

is a disproportion reaction.

19. Eq of H_2O_2 = Eq of $KMnO_4$

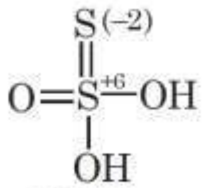
$x \times 2 = \frac{0.316}{158} \times 5$

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

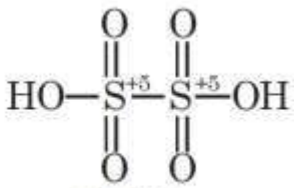
$m_{H_2O_2} = 5 \times 10^{-3} \times 34 = 0.17$gm

$\%H_2O_2 = \frac{0.17}{0.2} \times 100 = 85$

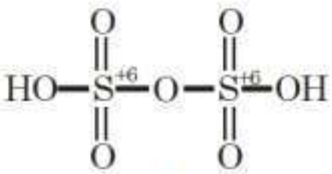
22.



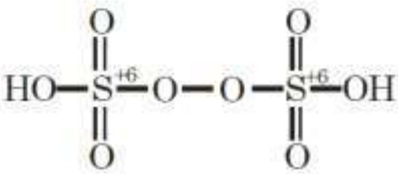
$H_2S_2O_3$



$H_2S_2O_6$



$H_2S_2O_7$



$H_2S_2O_8$

24. Acid + Base $\longrightarrow$ Salt + H_2O

0.1 M $\quad$ $M(OH)_2$

10ml $\quad$ 0.05 M

30 ml

at equivalence point

equivalent of acid = equivalent of base

$0.1 \times 10 \times n = 30 \times 0.05 \times 2$

$n = 3$

25. $MnO_2 + HCl \longrightarrow Cl_2\ Mn^{+2}$

6 meq $\quad$ 6 meq

= 3m mol

$Cl_2 + KI \longrightarrow Cl^- + I_2$

6 meq $\quad$ 6 meq

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

6 meq $\quad$ 6m mol

= 6meq

$\%MnO_2 = \frac{3\times10^{-3}\times87}{2}\times100$

= 13.05%

Ans. 13

26. $n_{eq.}$ of I_2 = $n_{eq.}$ of $Na_2S_2O_3 = 20 \times 0.002 \times 1$

$2 \times n_{mol}$ of $I_2 = 0.4$

n_{mol} of $I_2 = 0.2$ m mol

n_{mol} of $Cu^{+2} = 0.2 \times 2 \times 10^{-3}$

$$[Cu^{+2}] = \frac{0.4 \times 10^{-3}}{10 \times 10^{-3}} = 0.04 = 4 \times 10^{-2}$$

Change in oxidation state of Mn is from +7 to +4 which is 3.

EXERCISE # (JEE-ADVANCED)

1. $Ba(H_2PO_2)_2$

$\Rightarrow P = +1$

2. $NO_3^- + 4H^+ + e^- \longrightarrow 2H_2O + NO$

For charge balance $3e^-$

3. $BaO_2 + H_2SO_4 \longrightarrow BaSO_4 + H_2O_2$

4. $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$

5. Meq. Of H_2O_2 = Meq. of I_2

$\Rightarrow \frac{W_{H_2O_2}}{34} \times 2 \times 1000 = \frac{0.508}{254} \times 2 \times 1000$

$\therefore W_{H_2O_2} = 0.06g$

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

Θ 34g H_2O_2 gives 11.2 litres of O_2 at STP

$\therefore$ 0.068 g gives = $\frac{11.2}{34} \times 0.068$ = 22.4 mL O_2

$\therefore$ Volume Strength of H_2O_2 = $\frac{22.4}{5}$ = 4.48 volume

6. $FeC_2O_4 + KMnO_4 \longrightarrow Mn^{+2} + Fe^{+3} + C^{+4}$

n×5 = 1×3

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

7. n×5 = 1×2

n = $\frac{2}{5}$

8. Let the total moles of O_2 and O_3 in the mixture be n.

Applying PV = nRT

$1\times1 = n\times0.0821\times273$

$n = 0.044$ moles

Moles of O_3 = moles of I_2 = 1/2 moles of $Na_2S_2O_3$

$=\frac{1}{2}\times\frac{1}{10}\times\frac{40}{1000}$ = 0.002 moles

Moles of O_2 in the mixture = 0.044 – 0.002 = 0.042 moles

Mass of O_2 = 0.042×32 = 1.344 g

Mass of O_3 = 0.002×48 = 0.096 g

% O_3 = $\frac{0.096}{1.44}\times100$ = 6.67

Number of photons required to decompose 0.002 moles of ozone

$= 0.002\times6.02\times10^{23}$

$= 1.204\times10^{21}$

9. When $n_t = 2$

i.e. $Mn^{+2} \longrightarrow Mn^{+4}$

10. The reaction is as follows :

$KIO_3 + 5KI \longrightarrow K_2O + 3I_2$

Moles of KIO_3 = $3\times\frac{0.1}{214}$

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

Moles of $Na_2S_2O_3$ required = $3\times\frac{0.1}{214}\times2$

Molarity = $\frac{\text{Number of moles}}{\text{volume}_{\text{mL}}}\times1000 = 3\times\frac{0.1}{214}\times2\times\frac{1}{45}\times1000 = 0.0623$

11. S_8 0

S_2F_2 +1

H_2S –2

12. In CrO_2Cl_2, Cr is in +6

13. Fe_3O_4 is an equimolar mixture of $Fe_2O_{=3}$ and FeO. Thus, the sample contains Fe_2O_3, FeO and impurities. The amount of iodine liberated depends on the amount of Fe_2O_3 and the entire iron is converted into Fe^{2+}.

$Fe_3O_4 + 2KI + H_2SO_4 \longrightarrow 3FeO + H_2O + K_2SO_4 + I_2$

$Fe_2O_3 + KI + H_2SO_4 \longrightarrow 2FeO + H_2O + K_2SO_4 + I_2$

5×11.0 mL of 0.5 M $Na_2S_2O_3 \equiv 55.0$ mL of 0.5 N $Na_2S_2O_3$ soln.

$\equiv 55.0$ mL of 0.5 N I_2soln.

$\equiv 55.0$ mL of 0.5 N Fe_2O_3 soln.

$= 27.5\times10^{-3}$ equivalent Fe_3O_4 soln.

$= 13.75\times10^{-3}$ mole Fe_2O_3

2×12.8 mL of 0.25 M $KMnO_4$soln.

$\equiv 25.6$ mL of 1.25 N $KMnO_4$soln.

$\equiv 25.6$ mL of 1.25 N FeO soln.

$= 32.0\times10^{-3}$ equivalent FeO

$= 32.0\times10^{-3}$ moles FeO

Moles of FeO in $Fe_2O_4 = 0.032 - 0.0275 = 0.0045$

Mass of $Fe_3O_4 = 0.0045\times232 = 1.044$ g

Moles of $Fe_2O_3 = 0.0045\times232 = 1.044$ g

Moles of Fe_2O_3 existing separtely

$= 0.01375 - 0.0045 = 0.00925$

% $Fe_3O_4 = \frac{1.044}{3}\times100 = 34.8$

% $Fe_2O_3 = \frac{148}{3}\times100 = 49.33$

14. $\frac{6.3}{126}\times\frac{10}{250} = 0.1\times V$

V = 40 mL

15. $2KMnO_4 + 3H_2SO_4 + 5H_2O_2 \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O$

$2KMnO_4 + 3MnSO_4 + 2H_2O_2 \longrightarrow 5MnO_2 + 2H_2SO_4 + K_2SO_4$

$MnO_2 + Na_2C_2O_4 + 2H_2SO_4 \longrightarrow MnSO_4 + Na_2SO_4 + 2H_2O + 2CO_2$

Millimoles of $Na_2C_2O_4 = 10\times0.2 = 2$

mEq of $Na_2C_2O_4 = 4$

mEq of $MnO_2 = 4$

mEq of $KMnO_2 = 4$

mEq of $H_2O_2 = 4$

Millimoles of $H_2O_2 = 2\times10^{-3}$

Molarity = $\dfrac{0.002}{20}\times1000M$

Molarity = 0.1 M

16. $Mn^{+7} \xrightarrow{\text{Acidic}} Mn^{+2}$

$Mn^{+7} \xrightarrow{\text{Neutral}} Mn^{+4}$

$Mn^{+7} \xrightarrow{\text{Basic}} Mn^{+6}$

17. $3Na_2CO_3 + 3Br_2 \longrightarrow 5NaBr + NaBrO_3 + 3CO_2$

18.

HNO_3	(+5)
NO	(+2)
NH_4Cl	(–3)
N_2	(0)

19. Household bleach + 2KI $\longrightarrow$ I_2 + Products

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

Amount of $Na_2S_2O_3$ used = VM = $(48\times10^{-3}L)(0.25\text{ mol }L^{-1}) = 12\times10^{-3}$ mol

Amount of I_2 generated = $\frac{1}{2}(12\times10^{-3}\text{ mol}) = 6\times10^{-3}$ mol

Assuming 1 mol of household bleach products 1 mol I_2, we will have

Amount of household bleach in 25 mL solution = 6×10^{-3} mol

Molarity household bleach = $\dfrac{n}{V} = \dfrac{6\times10^{-3}\text{mol}}{25\times10^{-3}L} = 0.24M$

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

22. $\underset{a\,mg}{MnCl_2} + K_2S_2O_8 + H_2O \longrightarrow \underset{a\,mg}{KMnO_4} + H_2SO_4 + HCl$

$C_2O_4^{2-} + MnO_4^- \xrightarrow{H^+} CO_2 + Mn^{2+}$

m_{eq} of $C_2O_4^{2-}$ = m_{eq} of MnO_4^-

$2\times0.255/90 = a\times5$

$a = 1\times[55 + 71]$

= 126 mg

23. Conc. HNO_3 oxidises rhombic sulphur (S_8) to H_2SO_4 and itself gets reduced to NO_2.

$$\overset{0}{S}_8 + 48H\overset{+5}{N}O_3 \longrightarrow 8H_2\overset{+6}{S}O_4 + 48\overset{+4}{N}O_2 + 16H_2O$$

1 mole of S_8 gives 16 moles of H_2O

Mass of H_2O = 16×18 = 288 gm

24. Chemical reaction of $KMnO_4$ and KI in weakly basic solution is given as

$KMnO_4 + KI \xrightarrow[\text{Basic}]{\text{weak}} MnO_2 + I_2$

$KMnO_4 \longrightarrow MnO_2$

Oxidation state of Mn

$+7 \quad +4$

n-factor of $KMnO_4 = 3$

$2I^- \longrightarrow I_2$

n-factor of I_2 is $= 2$

$KMnO_4 + KI \longrightarrow MnO_4 + I_2$

n-factor $= 3$ n-factor $= 2$

Equivalents of $KMnO_4 =$ Equivalents of I_2

n-factor × Number of moles (n) = n-factor × Number of moles (n)

$3 \times$ moles of $KMnO_4 = 2 \times$ moles of I_2

$3 \times 4 = 2 \times$ moles of I_2

Moles of $I_2 = 6$ moles

25. $8H^+ + 5Fe^{2+} + MnO^- \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$

For 25ml,

meq of $Fe^{2+} =$ meq of MnO^-

$= 12.5 \times 0.03 \times 5$

For 250ml,

mmoles of $Fe^{2+} = 12.5 \times 0.03 \times 5 \times 250/25$

moles of $Fe^{2+} = 18.75/1000$ mol

$= 18.75 \times 10^{-3}$ mol

$= 1.875 \times 10^{-2}$ mol

$x = 1.875$

Weight of $Fe^{2+} = 1.875 \times 10^{-2} \times 56 = 1.05$ g

% purity of $Fe^{2+} y = 18.75\%$

$= 1.05/5.6 \times 100$

26. $8H^{+} + 5Fe^{2+} + MnO^{-} \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$

For 25ml,

meq of $Fe^{2+} =$ meq of MnO^{-}

$= 12.5 \times 0.03 \times 5$

For 250ml,

mmoles of $Fe^{2+} = 12.5 \times 0.03 \times 5 \times 250/25$

moles of $Fe^{2+} = 18.75/1000$ mol

$= 18.75 \times 10^{-3}$ mol

$= 1.875 \times 10^{-2}$ mol

$x = 1.875$

Weight of $Fe^{2+} = 1.875 \times 10^{-2} \times 56 = 1.05$ g

% purity of $Fe^{2+} y = 18.75\%$

$= 1.05/5.6 \times 100$

27. $KMnO_4 \xrightarrow{H^*} Mn^{+2}$

$S^{-2} \longrightarrow \overset{0}{S}$

$\therefore$ n_{tactor} of $KMnO_4 = 5$

n_{tactor} of $S^{-2}(H_2 S) = 2$

$(n_{KMnO_4} \times 5) = (5 \times 2)_{H_2 S}$

$[(GEN)_{KMnO_4} = (GEP)_{H_2 S}]$

$\therefore$ $n_{KMnO_4} = 2$

$\therefore 2KMnO_4 + 3H_2SO_4 + 5H_2 S \rightarrow K_2SO_4 + 2MnSO_4 + 5 S + 8H_2O$

Number of moles of water produced $=$ ' 8 '

Number of moles of electrons involved $= 10$

$\therefore$ $x = 8, y = 10 \Rightarrow (x + y) = 18$