Chapter 8: Volumetric analysis

Q1.

Sol: Strength in g / lit = density = ?

We have, $N_{HCl} = 3$

$M_{HCl} = \frac{3}{1} = 3 \quad (\because v.f = 1)$

$N_{H_2SO_4} = \frac{1}{2}$

$\therefore M_{H_2SO_4} = \frac{N_{H_2SO_4}}{v.f} = \frac{1/2}{2} = 1/4$

wt. of HCl / lit = 3 × Mol. wt = 3 × 36.5 = 109.5 g /lit **Ans**

$\frac{\text{moles of } H_2SO_4}{\text{lit}} = \frac{1}{4} \Rightarrow \frac{\text{wt of } H_2SO_4/\text{lit}}{\text{Mol.wt } H_2SO_4} = 1/4$

wt. of H_2SO_4 / lit = $\frac{1}{4} \times 98 = 24.5$ g/lit **Ans**

Q2.

Sol: $NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$

10 ml 1 M

1 M.

meq. of NaOH = meq. of H_2SO_4

$10 \times 1 \times 1 = V \times 1 \times 2$

$V = \frac{10}{2} = 5\text{mL}$ **Ans**

Q3.

Sol: V = 2 lit of NH_3, T = 13°C = 286 K, P = 0.9 atm

$\text{moles} = \frac{PV}{RT} = \frac{0.9 \times 2}{0.821 \times 286} = 0.076 \text{ mole}$

$NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$

meq of NH_3 = meq of H_2SO_4

76 × 1 = Volume (ml) × N

$\frac{76}{134} = N \Rightarrow N = 0.57$ N. **Ans**

Q4.

Sol: $CuSO_4.5H_2O \longrightarrow Cu^{2+}$ ion

0.5 lit & 0.01 M

∴ Moles of Cu^{2+} formed = Volume × Morality = 0.5 × 0.01 = 0.005

∴ Moles of $CuSO_4.5H_2O$ = moles of Cu^{2+} = 0.005

$\frac{\text{weight } CuSO_4.5H_2O}{(63.5 + 96 + 90)} = 0.005$

wt. of $CuSO_4.5H_2O = 0.005 \times (249.5) = 1.2475$ g **Ans**

Q5.

Sol: (a)

$$\because \frac{\text{weight}}{\text{volume}} = \frac{0.365\text{g}}{\frac{100}{1000}\text{lit}} = 3.65\,\text{gm/lit}$$

$$\therefore \text{Mole/lit} = \frac{\text{weight/lit}}{\text{Mol.wt}} = \frac{3.65}{36.5}\text{M} = 0.1\text{M}$$

(b)

$$\frac{\text{moles}}{\text{wt}_{H_2O}} = \frac{3/30}{\frac{250}{1000}\text{kg}} = \frac{\frac{1}{10}}{1/4} = \frac{4}{10} = 0.4\text{ m} \qquad \textbf{Ans}$$

Q6.

Sol: From principle of dilution

Moles of solute before = moles of solute after dilution

$$V_1 M_1 = (V_1 + V_2) M_2 \qquad (V_f = V_1 + V_2)$$

$$\therefore \text{Volume of water added } (V_2) = \frac{V_1(M_1 - M_2)}{M_2} \qquad \textbf{Ans}$$

Q7.

Sol: $Ca(OH)_2 + H_3PO_4 \longrightarrow CaHPO_4 + 2H_2O$

Since only two hydrogens are removed from H_3PO_4 its valancy factor is 2.

$$\therefore \text{Eq. wt.} = \frac{\text{Mol.wt}}{\text{V.f}} = \frac{98}{2} = 49 \qquad \textbf{Ans}$$

Q8.

Sol: $V_f = 250$ ml

$M_f = 0.2$ M

$M_1 = 11.7$ M, $V_1 = ?$

$V_1 M_1 = V_f . M_f$

$$V_1 \times 11.7 = 250 \times 0.2 = 250 \times \frac{2}{10} = 50$$

$$V_1 = \frac{50}{11.7} = 4.27\text{mL} \quad \textbf{Ans}$$

Q9.

Sol: Let volume of 12 N HCl is taken x ml

then volume of 3N HCl will be = (1000-x)

∴ From law of dilution

$$(1000 - x) \times 3 + x \times 12 = 1000 \times 6$$

$$3000 + 9x = 6000 \qquad \Rightarrow 9x = 3000$$

$$X = 333.33 \text{ mL}$$

Volume of 12 N HCl = 333.33 mL
Volume of 3N HCl = 666.67 mL } **Ans**

Q11.

Sol: $NaOH + HNO_3 \longrightarrow NaNO_3 + H_2O$

3.2 g 18.9 g

1 lit 1 lit

Let V_1 volume of NaOH & V_2 volume of HNO_3 is taken for having neutral solution

meq. of NaOH = meq. of HNO_3

$$V_1 \times \frac{32}{400} \times 1 = V_2 \times \frac{18.9}{63} \times 1$$

$$V_1 \times \frac{4}{50} = V_2 \times \frac{3}{10}$$

$$\frac{V_1}{V_2} = \frac{3 \times 5}{4} = \frac{15}{4} = \frac{3.75}{1}$$ **Ans**

Q12.

Sol: Density = sp. gravity = 1.84 g / lit

V = 10 ml

% by weight = 98%

$$\therefore \text{Normality} = \frac{\%\text{by wt} \times \text{density} \times 10}{\text{Eq.wt. } H_2SO_4} = \frac{98 \times 1.84 \times 10}{98/2} = 36.8\,N$$

$H_2SO_4 + NaOH \longrightarrow Na_2SO_4 + H_2O$

36.8 N 2.5 N

V=10 ml V = ?

meq. of H_2SO_4 = meq. of NaOH

$$36.8 \times 10 = 2.5 \times V$$

$$\text{Volume} = \frac{36.8 \times 10}{2.5} = 147.2\,\text{mL}$$

Q13.

Sol: $$\text{Molarity} = \frac{\%\text{ by wt} \times \text{density} \times 10}{\text{Mol.wt}} = \frac{13 \times 1.09 \times 10}{98} = 1.446\,M.$$

$$\text{Molarity (m)} = \frac{\text{mole of } H_2SO_4}{\text{weight of solvent}}$$

$$\%\text{ by wt} = 13/100$$

$$\frac{\text{wt of } H_2SO_4}{\text{wt of solution}} = \frac{13}{100}$$

$$\Rightarrow \frac{WH_2SO_4}{WH_2O + WH_2SO_4} = \frac{13}{100}$$

$$W\,H_2SO_4 = (WH_2O + W\,H_2SO_4)\,\frac{13}{100}$$

$$WH_2SO_4\left(1-\frac{13}{100}\right)=\frac{13}{100}WH_2O$$

$$\frac{WH_2SO_4}{WH_2O}=\frac{13}{87}$$

$$\therefore \frac{\frac{wt\,H_2SO_4}{98}}{WH_2O}=\frac{13}{98\times 87}$$

$$\frac{mole\,of\,H_2SO_4}{WH_2O(gm)}=\frac{13}{98\times 87}$$

$$\therefore molaity=\frac{mole\,of\,H_2SO_4}{wt\,H_2P(9m)}\times 1000$$

$$=\frac{13\times 1000}{98\times 87}=1.525\,m$$

Let V_f is the final volume, then

$$V_1M_1=V_fM_f$$

$$100\times 1.446\times 2=Vf\times 1.5$$

$$Vf=\frac{144.5\times 2}{1.5}=193.3\,mL$$ **Ans**

Q14.

Sol: $N_f=\frac{1.8\times 98\times 10}{49}=36.8N$

$\therefore$ From principle of dilution

$$V_fN_f = V_1N_1$$

$$V_f = \frac{200\times 0.5}{38.8}=2.71\,mL$$ **Ans**

Q15.

Sol: Na_2CO_3 + $A \longrightarrow$

V=26 mL   10 mL

N= 1 N

From principle of chemical equivalence

meq. of Na_2CO_3 = meq. of A

$$26\times 1 = 10\times N_A$$

$$N_A=\frac{26}{10}=2.6\,N$$

Na_2CO_3 + $B \longrightarrow$

V = 26 ml   40 mm

N = 1N

$$26\times 1 = 40\times N_B$$

$$N_B=\frac{26}{40}N=\frac{2.6}{4}N$$

Let V_1 ml of A & V_2 ml of B is equired to make 1 lit of 1 N sol-^{n} then

$$V_1+V_2=1\text{ lit}=1000\text{ ml}—(1)$$

Also, $V_1V_A+V_2N_B=V_fN_f$

$$V_1\times 2.6+(1000-V_1)\frac{2.6}{4}=1000\times 1$$

$$V_1\times 2.6\times\frac{3}{4}=1000-\frac{2.6}{4}\times 1000$$

$$V_1 \times \frac{2.6 \times 3}{4} = 1000 \times \frac{1.4}{4}$$

$$V_1 = \frac{1000 \times 1.4}{2.6 \times 3} = 179.5\,mL$$

Volume of A required = 179.4 ml
Volume of B required = 1000 – 179.4 = 820.6 mL } **Ans**

Q16.

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

25 ml　　32.4 ml
v.f = 1　　0.0154 M
M=?　　(v.f = 6)

meq of Fe^{2+} = meq of $Cr_2O_7^{2-}$

$25 \times M \times 1 = 32.45 \times 0.0153 \times 6$

$$M = \frac{32.45 \times 0.0153 \times 6}{25} = 0.1192\,M$$ **Ans**

Q17.

Sol: Initial weight of HCl present in $N/2$ of 1 lit solution

$$= \frac{1}{2} \times 1 \times 1 \times 36.5 = 18.25\,gm$$

weight lost = 2.675 gm

$\therefore$ weight remained = 18.25 – 2.675 = 15.575 g

volume final = 750 mL

(i) $N_f = \dfrac{\dfrac{15.575\,g}{36.5\,g}}{750} \times 1000 = 0.569$ N.

(ii) no. of meq in 100 ml solution $= 100 \times \frac{1}{2} = 50\,meq$

Q18.

Sol: $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$

10 gm　　200 ml

Let x gm of Zn has reacted

Then wt of Cu produced $= \dfrac{x}{65.4} \times 63.5\,g$

$\therefore$ (mole of Zn reacted = mole of Cu produced)

A/q, wt of Zn remained + wt of Cu produced = 9.810 g

$$(10 - x) + \frac{63.5x}{65.4} = 9.810\,g$$

$$\frac{654 - 65.4x + 63.5x}{65.4} = 9.810\,g$$

$654 - 1.9\,x = 641.57$

$1.9\,x = 12.426$

$$x = \frac{12.426}{1.9} = 6.54$$

(i) The weight of Cu deposited = $\frac{63.5}{65.4} \times 6.54 = 6.35\,g$

(ii) Molarity = $\frac{6.35}{\frac{63.5}{200} \times 1000} = \frac{5}{20} = 0.5\,M$

Q19.

Sol: (1) $Cu + Fe_2(SO_4)_3 \longrightarrow CuSO_4 + 2FeSO_4$

0.108 g   excess   (If it is assumed that this is the reaction one)

meq. of $FeSO_4$ = meq. of $CuSO_4$

$$= \frac{0.108 \times 1000}{63.5/2} = 3.38$$

Only $FeSO_4$ can undergo oxidation, because it is only in lower oxidation State.

(2) $FeSO_4 + KMnO_4 \longrightarrow Fe^{3+} + Mn^{2+}$

33.7

0.1 N

meq of $FeSO_4$ = meq of $KMnO_4$

$= 33.7 \times 0.1 = 3.37$

Since meq in reaction (1) = meq of reaction (2)

$\therefore$ v.f of $FeSO_4$ in (1) = v.f. of $FeSO_4$ in (2)

In reaction (1)	In reaction(2)
$Fe^{3+} \longrightarrow Fe^{2+}$	$Fe^{2+} \longrightarrow Fe^{3+}$

So, the assumed reaction (1) is the correct one.

Q20.

Sol: W($NaOH + Na_2CO_3$) = 2.013 g

Let x g of Na_2CO_3 is present in the commercial sample

$\therefore$ wt of NaOH = (2.013 – x) g

$\therefore$ The amount is dissolved in 250 mL

$\therefore$ Quartz present in 10 ml = $\left(\frac{2.031}{250}\right) \times 10 = \frac{2.031}{25}\,g$

$\therefore$ wt. of Na_2CO_3 in 10 ml = $\frac{x \times 10}{250} = \frac{x}{25}\,g$

wt. of NaOH in 10 ml = $\frac{2.013 - x}{250} \times 10 = \frac{2.013 - x}{25}\,g$

$NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$

(v.f.=1)

$Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$

(v.f. = 2)

meq of NaOH + meq of Na_2CO_3 = meq of H_2SO_4

$$\frac{\frac{(2.013-x)}{25}}{40/1}\times1000+\frac{\frac{x}{25}\times100}{106/2}=20\times0.1$$

$$\Rightarrow \frac{(2.013-x)}{25\times40}\times1000+\frac{x}{25\times43}\times1000=2$$

$$\Rightarrow (2.03-x)+0.93\,x=2$$

$$\Rightarrow 0.07\,x=2.013-2=0.013$$

$$x=\frac{0.013}{0.069}=0.186$$

$$\therefore \%\text{ of } Na_2CO_3=\frac{x}{2.013}\times100=9.26\%$$

Q21.

Sol: $KCl + KOH + HCl \longrightarrow KCl + H_2O$

120 ml

0.12 N

meq. of KOH = meq of HCl (Only KOH will react with HCl).

$$\frac{wt}{\text{Eq.wt.of KOH}}\times1000=120\times0.12$$

$$\frac{wt}{56/1}\times1000=120\times0.12$$

$$wt=\frac{120\times0.12\times56}{1000}=0.8064\,g$$

(ii) $KCl + AgNO_3 \xrightarrow{HNO_3} AgCl\downarrow + AgNO_3$

total 3.7 g

$$\therefore \frac{\text{wt of } KCl_{total}}{74.5/1}=\frac{3.7}{143.5}$$

$$\text{wt of } KCl_{total}=\frac{3.7\times74.5}{143.5}=1.921\,g$$

Also wt of KCl produced from KOH $=\frac{0.8064}{56}\times74.5 = 1.0728$ g

$\therefore$ wt. of KCl originally present = 1.921 – 1.0728 = 0.8482 g

$\therefore$ total wt. initially = 0.8482 + 0.8064 = 1.6546 g

$$\therefore \%\text{ of KOH}=\frac{\text{wt of KOH}}{\text{total Wt.}}\times100=\frac{0.8064\,g}{1.6546}\times100=48.74\%\ \textbf{Ans}$$

Q22.

Sol: 10.03 g of vinegar (contain CH_3COOH)

The solution is made upto 100 ml and out of which 25 ml is taken out for the experiment.

$2CH_3COOH + Ba(OH)_2 \longrightarrow Ba(CH_3COO)_2 + 2H_2O$

V = 25 ml   0.0176 M

v.f = 1   34.30 ml

v.f = 2

$$\frac{\text{wt of } CH_3COOH}{\text{eq.wt}} \times 1000 = 34.30 \times 0.0176 \times 2 = 1.2074$$

$$\frac{\text{wt of } CH_3COOH}{60/1} \times 1000 = 1.2074$$

$$\text{wt } CH_3COOH \text{ in 25 ml} = \frac{1.2074 \times 60}{1000} = 0.0724$$

$$\therefore \text{wt of } CH_3COOH \text{ in 100 ml} = \frac{0.0724}{25} \times 100 = 0.290\%$$

$$\therefore \% \text{ of } CH_3COOH \text{ in vinegar} = \frac{0.296}{10.3} \times 100 = 2.90\%$$ **Ans**

Q23.

Sol: $3Zn^{2+} + 2[4K^+ Fe(CN)_6^{4+}] \longrightarrow K_2Zn_3[Fe(CN)_6]_2 \downarrow$ ok

1.5432 g   0.1043 M

(Impure)   34.68 ml

From balanced reaction coefficient (stoichiometry)

3 mole of $Zn^{2+} \equiv$ 2 mole of $K_4[Fe(CN)_6]$

$2 \times$ mole of $Zn^{2+} = 3 \times$ mole of $K_4[Fe(CN)_6]$

$$2 \times \frac{wt}{64.5} = 3 \times 0.1043 \times \frac{34.68}{1000}$$

wt actually present = 0.35 g

$$\therefore \% \text{ of } Zn^{2+} = \frac{0.35}{1.5432} \times 100 = 22.7\% \approx 23\%$$

Q24.

Sol: $FeSO_4.7H_2O + KMnO_4 \longrightarrow Fe^{3+}$

(v.f = 1)   5.4 ml

0.1 N

meq of $FeSO_4.7H_2O$ = meq. of $KMnO_4$

$$\frac{wt}{278/1} \times 1000 = 5.4 \times 0.1$$

$$wt = \frac{0.54 \times 278}{1000} = 0.15 g$$

$\therefore$ wt of $Fe_2(SO_4)_3.9H_2O$ in the sample = 5.5 – 0.15 = 5.35 g

$$\therefore \text{Moles of } Fe_2(SO_4)_3.9H_2O = \frac{535}{562} = 0.0095 \text{ mole;}$$ **Ans**

Q25.

Sol: $5U^{4+} + 2MnO_4^- + 6H_2O \longrightarrow 5UO_2^{2+} + Mn^{2+} + 4H_3O^+$

Balance reaction is given, so it is better to use Mole – stoichiometric relationship.

5 mole of U^{4+} = 2 mole of MnO_4^-

2 mole of U^{4+} = 5 × mole of MnO_4^-

$$2\times\frac{0.5}{238}=5\times\frac{50}{1000}\times M$$

$$M=\frac{2\times5\times100}{2380\times5\times5}=\frac{4}{238}=0.0168M$$

Ans

Q26.

Sol: $2KH\,C_8H_4O_2 + Ba(OH)_2 \longrightarrow 2H_2O + 2K^+ + 2C_8H_4O_2^{2-} + Ba^{2+}$

0.2 g 27.80 ml

Mol. wt = 204.2 g

2 mole of KH $C_8H_4O_2 \equiv$ 1 mole of $Ba(OH)_2$

1 mole of KH $C_8H_4O_2$ = 2 × mole of $Ba(OH)_2$

$$\frac{0.2}{204.2}=2\times\frac{27.80}{1000}\times M$$

$$M=\frac{200}{204.2\times2\times27.80}=0.0176M$$ **Ans**

Q27.

Sol: Mg + MgO

↓

Dissolved in H_2SO_4 (125 ml & 0.1 N H2SO$_4$)

(1) $Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2\uparrow$

120.1 ml

At T = 27.3^0 C, P = 1 atm

(2) $MgO + H_2SO_4 \longrightarrow MgSO_4 + H_2O$

H_2SO_4 remained = 0.02 N

$\therefore H_2SO_4$ reacted = (0.1 – 0.02) = 0.08 N.

From equation(1)

mole of H_2 evolved = mole of Mg = mole of H_2SO_4 used in (1)

$$\frac{\frac{120.1}{1000}\times1}{0.821\times300.3}=\frac{Wt\,Mg}{24}$$

wt of Mg = 0.117 g

Mole of $H_2SO_4 = 4.871\times10^{-3}$ (reacted in reaction (1))

Moles of H_2SO_4 reacted in reaction (2)

= Total moles reacted – moles reacted reaction (1)

$$=\frac{125}{1000}\times0.08/2-4.871\times10^{-3}$$

= (5-4.871) × 10^{-3} = 0.129 × 10^{-3}

∴ Moles of MgO in reaction (2) = mole of H_2SO_4 reacted in (2)

$$\frac{wt\,MgO}{40}=0.129\times10^{-3}$$

wt MgO = 0.00516 g

$\therefore$ Total wt (Mg – 1000) 0.1178 g + 0.00516 g = 0.123 g

$$\% \text{ by wt of Mg} = \frac{0.1170}{0.123} \times 100 = 95.9\%$$ **Ans**

Q28.

Sol: $MH_2SO_4 \frac{1.18 \times 24.7 \times 10}{98} = 2.97\,M$

Volume = 75 mL

Weight of Al = 2.7 g

$Al + H_2SO_4 \longrightarrow Al_2(SO_4)_3 + H_2$

2.7 g   75 ml

2.97 M

v.f=3   (v.f=2)

meq of Al = meq of H_2SO_4 reacted.

$$\frac{2.7}{27/3} \times 1000 = \text{mmole of } H_2SO_4 \times 2$$

$$\frac{300}{2} = \text{mole of } H_2SO_4 \text{ reacted.}$$

$\therefore$ mole of H_2SO_4 remained = $75 \times 2.97 - 150 = 73$ mole

$$\therefore \text{Molarity} = \frac{73}{400} = 0.18\,M$$ **Ans**

Q29.

Sol: 4 g of NaCl + Na_2CO_3 is dissolved in 250 ml

↓

25 ml is taken for reaction

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

V = 25 ml   50 m

V. f = 2 $\frac{1}{10}$ N

Mol. wt.= 106

meq. of Na_2CO_3 = meq of HCl used

$$\frac{\text{wt. in 25 ml}}{106/2} \times 1000 = 50 \times \frac{1}{10}$$

$$\text{wt in 25 ml} = \frac{5 \times 53}{1000}$$

$$\therefore \text{wt in 250 ml} = \frac{5 \times 53}{1000} \times \frac{250}{25} = 2.65\,g$$

$$\therefore \% \text{ of } Na_2CO_3 = \frac{2.65}{4} \times 100 = 66.25\%$$

$$\% \text{ of NaCl} = \frac{1.35}{4} \times 100 = 33.75\%$$ **Ans**

Q30.

Sol: M_2CO_3 & M'_2CO_3 (suppose the two carbonates of univalent metal are)

Say x gm (1 – x) g

Let At. Wt. of M = 7g & M' is y gm, then meq of Metal carbonates = meq of HCl

$$\frac{x}{74/2}\times1000+\frac{1-x}{(2y+60)/2}\times1000=44.4\times0.5-----(1)$$

Also A/q, moles of M_2CO_3 = moles of M'_2CO_3

$$\frac{x}{74}=\frac{1-x}{(2y+60)}$$

$$(1)\Rightarrow\frac{2x}{74}\times1000+\frac{2x}{74}\times1000=22.2$$

$$\Rightarrow\frac{4x}{74}\times1000=22.2\ \Rightarrow\ x=\frac{22.2\times70}{4\times1000}=0.41g$$

$\therefore$ Wt of M_2CO_3 = 0.41 g

Wt of $M'_2CO_3=0.59g$

$$\text{Also, }\frac{x}{74}=\frac{1-x}{24+60}\ \Rightarrow\ \frac{0.41}{74}=\frac{0.59}{2y+60}$$

$$\Rightarrow\ 2y+60=\frac{0.59\times74}{0.41}$$

$$Y=23.2\ g$$

$\therefore$ At. Wt. of M' = 23.2 g ; **Ans**

$$M_2CO_3+M'_2CO_3\longrightarrow M_2SO_4+M'_2SO_4$$

x: $\frac{x}{74}\times110$ (to M_2SO_4); $\frac{(1-x)}{106.4}\times142.0$ (to M'_2SO_4)

$$\therefore\text{wt of }SO_4^{2-}\text{ formed}=\frac{x}{74}\times110+\frac{1-x}{106.4}\times142.4$$

$$=\frac{0.41}{74}\times110+\frac{0.59}{106.4}\times142.4$$

$$=0.61\ g+0.789\ g\ =1.4\ g\quad \textbf{Ans}$$

Q31.

Sol: $W(Na_2CO_3+K_2CO_3)=1.22$ g

dissolved in 100 ml

↓

20 ml extracted

Let wt of Na_2CO_3 is x gm, then wt of $K_2CO_3 = 1.22 - x$.

In 20 ml, Wt. of $Na_2CO_3 = \frac{x}{100} \times 20 = x/5$ g

wt of $K_2CO_3 = \frac{1.22 - x}{100} \times 20 = \frac{(1.22 - x)}{5}$ g

$Na_2CO_3 + K_2CO_3 + HCl \longrightarrow NaCl + KCl + H_2O + CO$

meq of Na_2CO_3 + meq of K_2CO_3 = meq of HCl.

$$\Rightarrow \frac{\frac{x}{5}}{106/2} \times 1000 + \frac{\frac{1.22 - x}{5}}{138/2} \times 1000 = 40 \times 0.1$$

$$\Rightarrow \frac{x}{265} \times 1000 + \frac{(1.22 - x)}{345} \times 1000 = 4$$

$$\Rightarrow \frac{x}{265} + \frac{(1.22 - x)}{345} = \frac{4}{1000}$$

$$\Rightarrow \frac{345x - 265 - x + 265 \times 1.22}{265 \times 345} = \frac{4}{1000}$$

$$\Rightarrow 80x + 323.3 = 365.7$$

$$\Rightarrow 80x = 42.4$$

$$\Rightarrow x = \frac{42.4}{80} = 0.53 g$$

$\therefore$ wt of Na_2CO_3 present in 1.22 g mix = 0.53 g **Ans**

$Na_2CO_3 + K_2CO_3 + BaCl_2 \rightarrow BaCO_3$

$\frac{x}{5}$ (from Na_2CO_3) $\rightarrow \frac{x}{5 \times 106} \times 197$ g

$\frac{(1.22 - x)}{5}$ (from K_2CO_3) $\rightarrow \frac{(1.22 - x)}{5 \times 138} \times 197$ g

wt. of $BaCO_3$ obtained

$$= \frac{x}{5 \times 106} \times 197 + \frac{1.22 - x}{5 \times 138} \times 197$$

$$= (0.197 + 0.197)\ g = 0.397\ g$$ **Ans**

Q32.

Sol: $W(KCl + KClO_3) = 1.0 g$ is dissolved in 250 mL

Say (x g) (y g)

25 ml extracted, which will contain $\left(\frac{x}{10} g\, KCl, \frac{y}{10} g\, KClO_3\right)$

$ClO_3^- + SO_2 \longrightarrow Cl^- + SO_4^{2-}$

25 ml

v.f = 6   v. F = 2

$Cl^- \downarrow$ AgCl

0.1435 g

mole of AgCl $= \frac{0.1435}{143.5} = 0.001$ mole

$\therefore$ mole of Cl = 0.001 mole

$\therefore$ All of the chlorine comes from ClO_3^- & Cl^-

$\therefore$ (mole of KCl + mole of Cl in $KClO_3$) in 25 ml = mole of Cl in AgCl

(By POAC principle)

$\therefore$ (mole of KCl + mole of $KClO_3$) in 25 ml = mole of AgCl

$$\frac{x/10}{74.5} + \frac{\frac{y}{10}}{122.5} = 0.001$$

$$\frac{x}{74.5} + \frac{y}{122.5} = 0.01 ------(1)$$

Also

$$ClO_3^- + Fe^{2+} \longrightarrow Fe^{3+} + Cl^-$$

v.f = 6 v.f = 1

meq of ClO_3^- = meq of Fe^{2+} (used in the reac-^{n})

$$\frac{y/10}{122.5/6} \times 1000 = 30 \times 0.2 - 37.5 \times 0.08$$

$$\frac{y}{204.16} \times 1000 = (6-3)$$

⇨ Y = 0.6125 g

$\therefore$ moles of $KClO_3 = \frac{y}{122.5} = 5 \times 10^{-3}$

moles of KCl $= \frac{x}{74.5} = 5 \times 10^{-3}$ moles **Ans**

From ----(1)

Q33.

Sol: $MnO_2 + H_2C_2O_4 \longrightarrow Mn^{2+} + CO_2$

0.6 g 200 ml

(impure) $\frac{1}{10}$N

Let x gm of MnO_2 of present in the reaction, then

meq of MnO_2 = meq of $H_2C_2O_4$(reacted)

$$\frac{x}{87/2} \times 1000 = \text{meq of } H_2C_2O_4\text{(reacted)}$$

meq of $H_2C_2O_4$ (remained) in 500 ml $= 200 \times \frac{1}{10} - \frac{2x \times 1000}{87} = 20 - \frac{2000x}{87}$

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

remained 50 ml

in 100 ml $\frac{1}{30}$N

meq of $H_2C_2O_4$ in 100 ml = meq of $KMnO_4$ used.

$$\frac{20-\frac{2000x}{87}}{5}=50\times\frac{1}{30}=\frac{5}{3}$$

$$\frac{2000x}{87}=20-\frac{25}{3}=\frac{60-25}{3}=\frac{35}{3}$$

$$x=\frac{35\times87}{3\times2000}=0.5075\,gm$$

$\therefore$ % of MnO_2 in the sample of ore = $\frac{x}{0.6}\times100=\frac{0.5075}{0.6}\times100=84.58\%$ **Ans**

Q34.

Sol: In pressure of bromocresol green

H_3PO_4 + nOH^- $\longrightarrow$ nH_2O + $[H_{(3-x)}PO_4]^{n-}$

25 ml 23.1 ml

0.107 M 0.115 M

V. f = n V.f = 1

{3-(3-n)} = no. of replaced hydrogen

meq of H_3PO_4 = meq of NaOH

$25\times0.107\times n=23.1\times0.115\times1$

$$n=\frac{23.1\times115}{25\times0.107}=1 \quad \textbf{Ans}$$

In pressure of phenolphthalein indicator

H_3PO_4 + nOH^- $\longrightarrow$ $n'H_2O+[H_{(3-n')}PO_4]^{n-}$

25 ml 46.8 ml

0.107 M 0.115 M

v. f = n' v.f = 1

meq of H_3PO_4 = meq of OH^-

$25\times0.107\times n'=46.8\times0.115$

$$n'=\frac{46.8\times0.115}{25\times0.107}=2 \quad \textbf{Ans}$$

Q35.

Sol: $FeSO_4(NH_4)_2SO_4.xH_2O$

9.8 g in 250 ml

↓

20 ml extracted

wt. of $FeSO_4(NH_4)_2SO_4.xH_2O$ present in 20 ml of solution $=\frac{9.8}{250}\times20=0.784\,g$

$FeSO_4(NH_4)_2SO_4.xH_2O$ + $KMnO_4$ $\longrightarrow$ Mn^{2+} + Fe^{3+}

0.784 g 3.53 g/ lit

v.f = 1 90% pure

20 ml

meq of $FeSO_4(NH_4)_2SO_4 . xH_2O$ = meq of $KMnO_4$

$$\frac{0.784}{\left(\frac{284+18x}{1}\right)}\times 1000 = \left(\frac{3.53\times\frac{90}{100}}{158/5}\right)\times 1000\times\frac{20}{100}$$

$$\frac{0.784}{(284+18x)} = \frac{0.1}{50}$$

$$284 + 18x = \frac{0.784\times 50}{0.1} = 7.84\times 50 = 392$$

$$18x = 392 - 284$$

$$x = \frac{108}{18} = 6 \quad \textbf{Ans}$$

Q36.

Sol: 10 ml of Solution containing 10.25 g of H_2O_2 diluted to 250 ml, which will contain same mass of H_2O_2

Now 25 ml is extracted which will contain $= \frac{10.25}{250}\times 25 = 1.025\,g$

H_2O_2 + $KMnO_4$ $\longrightarrow$ O_2 + Mn^{2+}

1.025 g   35.8 ml

(v.f = 2) $\frac{1}{10}N$

meq of H_2O_2 in 25 ml = meq of $KMnO_4$ used

$$\frac{wt}{34/2}\times 1000 = 35.8\times\frac{1}{10} = 3.58$$

wt of H_2O_2 in 25 ml $= \frac{3.58\times 17}{1000} = 0.06086\,g$

$\therefore$ wt of 250 ml (Diluted) = 0.06086 × 10 = 0.6086 g

$\therefore$ wt of original 10 ml solution = 0.6086 g

$\therefore$ wt in original 100 ml solution = 0.6086 × 10 g = 6.086 g

Volume strength = Normality of solution × 5.6

$$= \frac{6.086/17}{100}\times 1000\times 5.6 \quad [\therefore 5.6\text{ N } H_2O_2 \text{ solution} = 1 \text{ volume of } H_2O_2 \text{ solution}]$$

= 20 volume   **Ans**

Q37.

Sol: H_2O_2 + KI $\longrightarrow$ H_2O + I_2

50 ml   (excess)   (v.f. = 2)

meq of I_2 librated = meq of H_2O_2 ----------(1)

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

(v.f = 2)

meq of I_2 = meq of $Na_2S_2O_3$ -------------(2)

Since v.f. of I_2 in both (1) & (2) are same, so (1) & (2) ⇒

meq of H_2O_2 = meq of $Na_2S_2O_3$

$50 \times N = 20 \times 0.1$

$N = \frac{2}{50} = \frac{4}{100} = 0.04\,N$

Also, $\frac{gm.eq}{lit} = N = 0.04\,N$

$\frac{wt/17}{lit} = 0.04\,N \quad \Rightarrow \frac{wt}{lit} = 0.04 \times 17 = 0.68\ g/lit$ **Ans**

Q38.

Sol: 3.546 g dissolved in bleaching powder [Co(OCl)Cl]

$Ca(OCl)Cl + KI \longrightarrow I_2 + Cl_2$

25 ml v.f. = 2

(v.f. = 2)

meq, of Ca(OCl)Cl = meq of I_2 evolved -------------(1)

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

(v.f. = 2)

meq of I_2 (reacted) = meq of $Na_2S_2O_3$ -----------(2)

(1) & (2) ⇒

Meq of Ca(OCl)Cl = meq. of $Na_2S_2O_3$

$= 20 \times 0.125$

$\frac{\text{wt of Ca(OCl)Cl}}{127/2} \times 1000 = 20 \times 0.125$

wt of Ca (OCl)Cl present in 25 ml = 0.15875 g

$\frac{\text{wt of } Cl_2 \text{ evolved}}{71/2} \times 1000 = 20 \times 0.125$

(meq of Cl_2 = meq of I_2 = meq of hypo)

wt of Cl_2 evolved from 25 ml $= \frac{20 \times 0.125 \times 35.5}{1000} = 0.08875\,g$

∴ wt of Cl_2 evolved from 100 ml sol-^{n} $= \frac{0.8875}{25} \times 100 = 0.355$

∴ % available chlorine $= \frac{0.355}{3.546} \times 100 = 10.01\%$ **Ans**

Q39.

Sol: $CuSO_4 + Zn \longrightarrow ZnSO_4 + Cu \downarrow$

Initially: 100 ml 25 g

1 M

After reaction 0.8 M

∴ Morality of SO_4^{2-} after reaction = 0.8 + 0.2 = 1.0 M

(SO_4^{2-} ion comes from $ZnSO_4$ & $CuSO_4$ both)

Also, moles of Zn consumed = moles of $CuSO_4$ reacted

$$\frac{\text{wt.consumed}}{65.4\,g} = \frac{100\times0.2}{1000}$$

wt. consumed = 6.54 g × 0.2 = 1.308 g

∴ wt. of Zn rod after reaction = (25 – 1.308) g = 23.692 g **Ans**

(b)

$Cu + ZnSO_4 \longrightarrow \times$ No reaction

25 g 2M (Cu is very less electropositive than Zn so can't replace Zn from $ZnSO_4$)

Zn^{2+} after reaction = 2M **Ans**

Q40.

Sol: In the case of phenolphthalein as indicator only Na_2CO_3 reacts with HCl to give $NaHCO_3$

$Na_2CO_3 + HCl \longrightarrow NaHCO_3 + NaCl$

25 ml 12 ml & $\frac{1}{20}N$

mmole of Na_2CO_3 in 25 ml = mmole of HCl = $12\times\frac{1}{20} = 0.6$

$$\frac{wt}{106}\times1000 = 0.6$$

Wt Na_2CO_3 in 25 ml = $\frac{0.6\times106}{1000} = 0.0636\,g$

∴ wt Na_2CO_3 in 1 lit = $\frac{0.0636}{25}\times1000 = 2.544\,g$ **Ans**

In presence of methyl orange as indicator

$$Na_2CO_3 + 2HCl \longrightarrow NaCl + H_2O + CO_2$$
$$NaHCO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$$

mmole of Na_2CO_3 + meq of $NaHCO_3$ = meq of HCl

2 × mmole of Na_2CO_3 + mmole of $NaHCO_3$ = mmole of HCl

2×0.6 + mmole of $NaHCO_3$ = $30\times\frac{1}{20}\times1$

mmole of $NaHCO_3$ = 1.5 – 1.2 = 0.3

$$\therefore \frac{\text{wt of } NaHCl_3}{84}\times1000 = 0.3$$

wt of $NaHCO_3$ in 25 ml = $0.3\times\frac{84}{1000} = 0.0252$

∴ wt. of $NaHCO_3$ in 1 lit = $\frac{0.0253}{25}\times1000$ = 1.089 g **Ans**

Q41.

Sol: In presence of phenolphthalein as indicator

(1) $Na_2CO_3 + HCl \longrightarrow NaHCO_3 + NaCl$

(2) $NaOH + HCl \longrightarrow NaCl + H_2O$

meq of Na_2CO_3 + meq of NaOH = meq of HCl used

mmole of Na_2CO_3 + mmole of NaOH $= 17.5 \times \frac{1}{20}$ --------(1)

(Because v.f. of Na_2CO_3 & NaOH = 1, in the above reaction).

(1)$\Rightarrow$ Also mmole of $NaHCO_3$ formed = mmole of Na_2CO_3 --------(2)

Also in presence of Methyl orange

$$NaHCO_3 \xrightarrow[2.5\ ml\ N/10]{1HCl} NaCl + H_2O + CO_2$$

$\therefore$ meq of $NaHCO_3$ = meq of HCl

mmole of $NaHCO_3 = 2.5 \times \frac{1}{10} = 0.25$

$\therefore$ (2) $\Rightarrow$ mmole of $Na_2CO_3 = 0.25$

$\therefore \frac{wt}{106} \times 1000 = 0.25$

Wt. of $Na_2CO_3 = \frac{0.25 \times 106}{1000} = 0.0265\,g$ **Ans**

(1)$\Rightarrow$ mmole of NaOH = 1/75 = 0.25 = 1.5

$\frac{wt\ NaOH}{40} = \frac{1.5 \times 4}{100} = 0.06\ g$ **Ans**

Q42.

Sol:- Let the chloride is MCl_m

$MCl_m + AgNO_3 \longrightarrow AgCl + M(NO_3)_m$

0.2 g $\qquad$ 0.47 g

meq of MCl_m = meq of AgCl

$$\frac{0.29}{Eq.wt.MCl_m} \times 1000 = \frac{0.47\,g}{Eq.wt.AgCl} \times 1000$$

Eq. wt $MCl_m = \frac{0.2 \times 143.5}{0.47} = 61.06\,g$

Eq. wt of M + Eq. wt of Cl = 61.06 g

Eq. wt of M = 61.06 – 35.5 = 25.56 g **Ans**

Q43.

Sol: (1) $4\,Fe^{3+} + N_2H_4SO_4 \longrightarrow N_2 + 4Fe^{2+} + 4H^+$

(v.f = 4)

(2) $MnO_4^- + 5Fe^{2+} \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$

In 10 ml solution :-

From reaction (1)

meq of Fe^{3+} = meq of $N_2H_4SO_4$ = Fe^{2+} formed -------(1)

From reaction (2)

meq of Fe^{2+} = meq of MnO_4^- (used) ----------(2)

(1) & (2) $\Rightarrow$ meq of $N_2H_4SO_4$ = meq of MnO_4^- (because V.F Fe^{2+}(1) = V.f Fe^{2+} (2))

$$= \frac{wt}{128/4} \times 1000 = 20 \times \frac{1}{50} \times 5 = 2$$

wt of $N_2H_4SO_4$ in 10 ml = $\frac{2 \times 32}{1000} = 0.064$ g

$\therefore N_2H_4SO_4$ in 100 ml = 0.64 g

$\therefore$ wt $N_2H_4SO_4$ in 1 lit = $\frac{0.64 \times 1000}{100} = 6.4$g **Ans**

Q44.

Sol: 5 g present in 500 ml of which 20 ml extracted

$$Ca(OCl)Cl + KI \xrightarrow{CH_3COOH} I_2 + Cl_2$$

20 ml (v . f =2)

meq of Cl_2 = meq of I_2 –(1)

Also meq of I_2 = meq of hypo solution used –(2)

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

$\therefore$ meq of $Cl_2 = 2 \Rightarrow \frac{wtCl_2}{71/2} \times 1000 = 2 \Rightarrow$ Wt $Cl_2 = \frac{71}{1000} = 0.071$g

In 20 ml wt of Ca(OCl)Cl present = $\frac{5}{500} \times 20 = 0.2$ g

$\therefore$ % available chlorine = $\frac{0.671}{0.2} \times 100 = \frac{7.1}{0.2} = 35.5\%$ **Ans**

Q45.

Sol:

(1) $Cu_2S + CuS + MnO_4^- \longrightarrow Cu^{2+} + SO_2 + Mn^{2+}$

(v.f = 8) 200 ml & 0.75 M

v.f = 5

(2) MnO_4^- (remained) + $Fe^{2+} \longrightarrow Fe^{3+} + Mn^{2+}$

(V.f = 5) 175 ml & 1 M

v.f = 1

meq of Cu_2S + meq of CuS = meq of MnO_4^-(used)

mmole of Cu_2S × 8 = mmole of CuS × 6 = (200 × 0.75 × 5- 175 × 1 × 1)

Let x g of Cus is present, then wt of Cu_2S (10 –x) g

$$\therefore \frac{10-x}{159} \times 1000 \times 8 + \frac{x}{95.5} \times 1000 \times 6 = 575$$

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

$$\frac{7640 - 764x + 954x}{159 \times 95.5} = 0.575$$

$$\frac{7640 + 190x}{159 \times 95.5} = 0.575$$

190 x = 8731.08-7640 = 1-91. 0875

X = 5.74 g

$\therefore$ % of CuS = $\frac{x}{10} \times 100 = 57.4\%$ **Ans**

Q46.

Sol: 0.518 g sample

meq of MnO_4^- = meq of CaC_2O_4

$400 \times 0.25 = 2 \times$ mmole of CaC_2O_4

Mm mole of $CaC_2O_4 = \frac{40 \times 25}{2 \times 100} = \frac{10}{2} = 5$

$\therefore$ mmole of Ca = mmole of CaO $= 5$ (By POAC)

$\therefore \frac{\text{wt of CaO}}{56} \times 1000 = 5$

wt CaO $= \frac{56 \times 5}{1000} = 0.28\,g$ $\therefore$ % of CaO $= \frac{0.28}{0.518} \times 100 = 54.1\%$ **Ans**

Q47.

Sol: (1) $\overset{+5}{Br}O_3^- + \overset{+4}{Se}O_3^{2-} + H^+ \longrightarrow \overset{+6}{Se}O_4^{2-} + Br_2$

20 ml $\frac{1}{60}$M

(v.f=5) (v.f=2)

(2) $\overset{+5}{Br}O_3^- + \overset{+3}{A}SO_2^- + H_2O \longrightarrow \overset{-}{Br} + \overset{+5}{A}SO_4^{3-}$

(excess) 5.1 ml

(v.f = 6) $\frac{1}{25}$M

(v.f = 2)

(1)$\Rightarrow$ meq of BrO_3^- (reacted) = meq of SeO_3^{2-}

$5 \times$ mmole of BrO_3^- (used) $= 2 \times$ mmole of SeO_3^{2-} ----------(1)

(2)$\Rightarrow$ meq of BrO_3^- (excess) = meq of AsO_2^- used.

$6 \times$ m mole of BrO_3^- (excess) $= 2 \times$ mmole of ASO_2^- used -----------(2)

Also mmole of BrO_3^- (excess) + mole of BrO_3^- (used in (1) = $20 \times \frac{1}{60} = \frac{1}{3}$

(1)$\Rightarrow$ $5 \times (\frac{1}{3}$ m mole of BrO_3^- excess) $= 2 \times$ mmole of seO_3^{2-}

$$\Rightarrow 5 \times \left(\frac{1}{3} - \frac{2 \times 5.1 \times \frac{1}{25}}{6}\right) = 2 \times \text{m mole of } SeO_3^{2-}$$

$\Rightarrow$ mmole of BrO_3^- excess $= \frac{2 \times 5.1 \times \frac{1}{25}}{6}$ $\Rightarrow 5\left(\frac{1}{3} - 0.068\right) = 2 \times \frac{wt}{(79 + 16 \times 3)} \times$

$\Rightarrow 0.6633 = \frac{wt}{127} \times 1000$ $\Rightarrow$ Wt $SeO_3^{2-} = \frac{127 \times 0.6633}{1000} = 0.084\,g$

Ans

Note:- Here v.f. of BrO_3^- in both reaction are different, so meq. of BrO_3^- can't equated.

Q48.

Sol: Normality of concentrated HCl solution $= \frac{37 \times 1.19 \times 10}{36.5} = 12.06\,N$

By principle of dilution

$V_1N_1 = V_fN_f$

$4.5 \times 12.06 = 100 \times N_f$ & $N_f = \frac{4.5 \times 12.6}{100} = 0.543\,N$

$HCl + AgNO_3 \longrightarrow AgCl + HNO_3$

10 ml   0.108 M

0.543 N   V = ?

For complete precipitation

meq of HCl = meq of $AgNO_3$

$10 \times 0.543 = 0.108 \times VAgNO_3$

$VAgNO_3 = 50.26$ ml   **Ans**

Q49.

Sol: $NaKC_4H_4O_6.4H_2O \xrightarrow{\Delta} NaKCO_3$

By POAC

mmole of $NaKCO_3$(produced) = mmole of $NaKC_4H_4O_6.4H_2O$ –(1)

$NaKCO_3 + H_2SO_4 \longrightarrow NaKSO_4 + H_2O + CO_2$

41.72

0.1307 N

excess H_2SO_4 required = 1.91 ml of 0.1297 N NaOH

meq of $NaKCO_3$ = meq of H_2SO_4 used = $(41.72 \times 0.1307 - 1.91 \times 0.1297)$

mmole of $NaKCO_3 \times 2 = 5.21$

(1)⇒ mmole of $NaKC_4H_4O_6.4H_2O$ = [illegible]

$\Rightarrow \frac{wt}{282} \times 1000 = \frac{5.[illegible]}{2} \Rightarrow Wt = 0.73361$

$\therefore \%\text{ purity} = \frac{0.73461}{0.9546} \times 100\% = 76.9\%$ **Ans**

Q50.

Sol: $KMnO_4 + K_2Cr_2O_7 + KI \xrightarrow{H^+} I_2 + Cr^{3+} + Mn^{2+}$

v.f = 5   v.f = 6 (v.f = 1)   v.f = 2

Also I_2 + hypo $\longrightarrow I^- + S_4O_6^{2-}$

(v.f = 2) ($Na_2S_2O_3$)

$\therefore$ meq of $KMnO_4$ + meq of $K_2Cr_2O_7$ = meq of I_2 = meq of hypo solution

$= 60 \times 0.1 = 6$

mmole of $KMnO_4 \times 5$ + mmole of $K_2Cr_2O_7 \times 6 = 6$

$$\frac{wt\,KMno_4}{158} \times 5 \times 1000 + \frac{(0.24 - wt_{KMno_4})}{294} \times 6 \times 1000 = 6$$

wt $KMnO_4$ = x (say)

wt $K_2Cr_2O_7$ = (0.24-x) y

$$\frac{5x}{158}+\frac{6(0.24-x)}{294}=\frac{6}{1000}$$

$$\frac{1470x-948x+227.52}{158\times294}=\frac{6}{1000}$$

$$552x = 279.712 - 227.52 = 52.19$$

$$x\frac{51.19}{552}=00.937$$

wt of $KMnO_4$ = 0.0937 g

wt of $K_2Cr_2O_7$ = 0.146 g

wt of Cr = $\frac{0.146}{294}\times2\times52=0.051$ & wt of Mn = $\frac{0.0937}{158}\times55=0.034$

% of Cr = $\frac{0.051}{0.24}\times100=20.8\%$ & % of Mn = $\frac{0.034}{0.24}\times100=14.17\%$ **Ans**

Q51.

Sol: 50 ppm = 50 ml NH_3 per $[O^6$ ml of air

Density NH_3 at Room temp = 0.771 g / lit

NH_3 + HCl $\longrightarrow$ NH_4Cl

100 ml

0.0105 M

In 10 min, volume of air passed = 10 lit / min × 10 min = 100 lit air

∴ meq of NH_3 present in 100 lit air = meq of HCl reacted = 100 ×0.105 – 13.1 ×0.058

mmole of NH_3 in 100 lit air = 0.2797

$\frac{wt}{17}$ in 10^5 ml air = 0.2797

(a) wt of NH_3 drawn to acid solution = 0.2797 × 17 = 4.755 g **Ans**

wt of NH_3 in 10^5 ml air = 0.2797 × 10 × 17 = 47.55 g

∴ Volume of NH_3 present = $\frac{wt}{density}=\frac{47.55}{0.771}=61.6ml$

(b) ∴ ppm of NH_3 = 61.6 ppm **Ans**

(c) No, because max-^{m} allowed ppm is 50 ppm

Objective Questions

Q1: Ans-(a) Normality = $\frac{\text{no. of equivalent}}{\text{litre of solution}}$

Q2: Ans -(a) $2\overset{2}{S_2}O_3^{2-} + I_2 \longrightarrow \overset{2.5}{S_4}O_6^{2-} + 2I^-$

V . f = 0.5 × 2 = 1

$\therefore$ eq. Wt. = $\frac{\text{Mol.wt}}{\text{v.f}}$ = Mol wt

Q3: Ans -(c) $\overset{+2}{V} + Fe_2O_3 \longrightarrow FeO + \overset{+5}{V_2}O_5$

v.f = 3 × 2 = 6

$\therefore$ eq. wt = $\frac{\text{Mol.wt}}{6}$

Q4: Ans -(b) $Na_2CO_3 + HCl \longrightarrow NaHCO_3 + NaCl$

v.f = 1, because it reacts with one mole of H

$\therefore$ eq.wt = $\frac{\text{Mol.wt}}{\text{v.f}} = \frac{106}{1} = 106$

Q5: Ans -(b) v.f. of I_2 in $I_2 + 2S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + 2I^-$ is 2

$\therefore$ eq. wt = $\frac{\text{Mol.wt}}{2}$

Q6: Ans -(c) $CrO_4^{2-} \xrightarrow{H^+} Cr^{3+}$ (in acidic med-^{n})

V .f = 3

$\therefore$ Eq. Wt. = $\frac{\text{Mol.wt}}{3}$

Q7: Ans -(b) eq.wt = $\frac{\text{Mol.wt}}{\text{v.f}} = \frac{158}{1}$ v.f in $MnO_4^- \longrightarrow MnO_4^{2-}$

V.f = 1

Q8: Ans -(d) meq of acid = meq of base

$\frac{126}{M.w} = 20 \times 0.1$ $\Rightarrow$ Mol.wt = $\frac{126}{2} = 63$

Q9: Ans -(b) $NaH_2PO_4 \longrightarrow Na_3PO_4$

v.f = 2 because 2 H^+ are removed from NaH_2PO_4

$\therefore$ meq of acid = meq of base

$\frac{12}{120/2} \times 1000 = V \times 1 \times 1$

$\frac{100}{5} = V$ => V = 20 ml

Q10: Ans -(b) meq of acid = meq of base

$\frac{2}{40} = \frac{3}{\text{Eq.wt}}$

Eq. wt of acid 60 g

Q11: Ans -(b) 1 mole of HNO_3 when take 4 mole of e-, oxidation state of nitrogen decrease by 4.

In HNO_3, oxidation state of N = +5

Final oxidation state of N = +1.

Which is in N_2O. (Also it should be $\frac{1}{2}$ mole be present after reaction).

Q12: Ans -(c) $N = \frac{\%\text{by wt} \times \text{density} \times 10}{\text{Eq.wt}} = \frac{1 \times 10 \times 1}{98/2}$ ($\therefore$ For very dilute solution we can take)

d solution $\approx$ d solvent = d_w = 1 g/cc

Q13: Ans - (a) $0.1 \times V = \frac{6.3}{6.3} \times 1000$

V = 1000 ml = 1 lit

Q14: Ans -(d) Let V is the volume required to make it deci normal

Q15: Ans -(b) meq of H_2O_2 = meq of $KMnO_4$

$\frac{W}{34/2} \times 1000 = 10 \times 1$ (because v.f of $H_2O_2 = 2$)

$w = \frac{170}{1000} = 0.17\text{g}$ $\therefore$ % by wt = 85%

Q16: Ans -(c) meq of NaOH = 100 × 0.5 = 50

meq of H_2SO_4 = 10 × 3 = 30

meq of HCl = 20 × 1 = 20

$\therefore$ meq of base (NaOH) = meq of acid = meq of H_2SO_4 + meq of HCl

$\therefore$ the sol-^{n} will be neutral.

Q17: Ans -(c) Normality = Molarity × v.f

(a) V . f H_2SO_4 = 2

(b) V.f H_3PO_3 = 2

(c) V.f. H_3PO_4 = 3

(d) V.f. HNO_3 = 1

} $\therefore$ Normality will be higher if v.f will be larger as acid

Q18: Ans -(d) meq. of metal = gm eq. of acid

$\frac{xg}{\text{eq.wt}_{\text{metal}}} = 1$

eq.wt (metal) = x g

Q19: Ans -(b) $M = \frac{98 \times 1.8 \times 10}{98} = 18$

Q20:Ans -(c) meq of Na_2CO_3. X H_2O in 20 ml = meq of HCl (used)

$$\frac{0.7}{\left(\frac{106+18x}{2}\right)} \times \frac{20}{100} = 19.8 \times 0.1$$

Calculating the value of x, we have

X = 2

Q21: Ans -(b) 1 N H_2SO_2 sol-^{n} 5.6 volume of H_2O sol-^{n}

$\therefore$ 5.6 volume of H_2O_2 has normality 1 N

$\therefore 1 \longrightarrow \frac{1}{56}$

$\therefore 20 \longrightarrow \frac{20}{5.6} = 3.58$

Q22: Ans -(d) $V_1N_1 = V_f N_f$

$8.3 \times 36 = (441.7 + 8.8) \times Nf$

$Nf = \frac{8.3 \times 36}{999.0} = 0.29\,N = 0.3\,N$

Q23: Ans -(a) meq of HCl = meq of AgCl precipitated

$10 \times N = \frac{0.1435 \times 1000}{143.5/1} = 1$

$N = \frac{1}{10} = 0.1$

Q24: Ans -(b) NO_3^- will remain in the solution which has now volume =1 lit

$\therefore \frac{500}{1000} \times 0.1 = 1 \times Nf \Rightarrow \quad Vf = \frac{0.1}{2} = 0.05\,N$

Q25: Ans -(a) Ratio of amount $= \frac{\text{Amount of } H_2S \text{ for ppt. of } AgNO_3}{\text{Amount of } H_2S \text{ for ppt. of } CuSO_4}$

For same, moles of $AgNO_3$ & $CuSO_4$ present in the solution;

Meq of H_2S required = meq of $AgNO_3$

= mmole of $AgNO_3 \times 1$

meq of H_2S required = meq of $CuSO_4$.

= mmole of $CuSO_4 \times 2$

$\therefore$ Ratio of amount of $H_2S = \frac{\text{mmole of } AgNO_3 \times 1}{\text{mmole of } CuSO_4 \times 2} = \frac{1}{2}$

Q26: Ans -(d) $2Na_3PO_4 + 3BaCl_2 \longrightarrow Ba_3(PO_4)_2 + 6NaCl$

0.2 mole   0.5 mole

2 mole of Na_3PO_4 reacts with 3 mole of $BaCl_2$

$\therefore 0.2 \longrightarrow 0.3$ mole of $BaCl_2$

$\therefore$ 0.5 mole of $BaCl_2$ is given in excess amount

$\therefore Na_3PO_4$ is the limiting reagent

$\therefore$ mole of $Ba_3(PO_4)_2$ formed $= \frac{0.2}{2} = 0.1$ mole

Q27: Ans -(b) meq of acid = meq of base (caustic potash (KOH)

$\frac{0.45 \times 1000}{20/v.f} = 20 \times 0.5$

$\frac{450}{90} \times v.f = 20 \times \frac{5}{10}$

v.f =2, basicity of acid =2

Q28: Ans -(d) $1 \times 18 = 100 \times M$

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$M = 0.18\ M$

$\therefore N = 0.18 \times v.f = 0.18 \times 2 = 0.36\ N$

Q29: Ans -(d) For weak acid & strong base titration, final solution will be basic i.e, PH > 7

$\therefore$ only those indicators can be used which shown and point at PH > 7,

So (d) is the correct option

Q30: Ans -(b) Eq of A = Eq. of B= Eq. of AxBy

Q31: Ans -(b) Volume strength = $1.5 \times 5.6 = 8.4$ volume

Q32: Ans -(a):- mole × v.f. = mole of $FeSO_4 \times$ V.f.

mole of $KMnO_4 \times 5 = 1 \times (1+2)$

mole of $KMnO_4 = 3/5$

Q33: Ans -(a) mole of $KMnO_4 \times 5 = 1$ mole of $SO_3^{2-} \times 2$ $\quad (SO_3^{2-} \rightarrow SO_4^{2-})$

$\therefore$ mole of $KMnO_4 = \frac{2}{5}$

Q 34: Ans -(b) In disproportionation reaction, same substance oxidises as well as reduces. In (b) Cl_2 is reducing to HCl and oxidising to HClO