SOLUTIONS

Module - 1 / JEE-2022

Chemistry	Chapter - 1	Stoichiometry - I

EXERCISE-A

1. (a) gm-atoms $= \dfrac{g}{A} \Rightarrow$ gm-atoms in 24 gm Mg $\equiv \dfrac{24}{24} = 1$

(b) gm-atoms in 62 gm $P_4 \equiv \dfrac{62}{31} = 2$

(c) $H_3PO_4 \equiv$ n-factor $= 3 \Rightarrow$ moles $= \dfrac{196}{98} = 2$ and gm – eq $= \dfrac{196}{98/3} = 6$

(d) $Ca(OH)_2 \equiv$ n-factor $= 2 \Rightarrow$ moles $= \dfrac{196}{74} = 2.65$ and gm-eq = n-factor × moles $= 2 \times 2.65 = 5.30$

(e) 1 mol $Na_2CO_3 \equiv M_o$ gm = 106 gm

(f) moles of $SO_2 = \dfrac{16}{64} = \dfrac{1}{4} \Rightarrow$ No. of Molecules = moles × $N_o = \dfrac{1}{4} \times 6.02 \times 10^{23} = 1.5 \times 10^{23}$

(g) $(M_o)_{H_2O} = 18$ gm $\equiv$ Mass of 6.02×10^{23} H_2O molecules $\Rightarrow$ Mass of 1 H_2O molecule $= 3 \times 10^{-23}$ gm

2.(C) No. of CO_2 molecules $= 10^{21} = \dfrac{g_{CO_2}}{44} \times 6.02 \times 10^{23} \Rightarrow g_{CO_2}$ removed = 73.3 mg

$\Rightarrow$ mass of CO_2 left $= 200 - 73.3 = 126.7$ mg $\equiv 0.126$ gm

3.(A) Volume of 1 mol atoms $= \dfrac{60}{10}$ cm^3 $\Rightarrow$ Vol. of 1 atm $= \dfrac{60}{10} \times \dfrac{1}{6.02 \times 10^{23}} = \dfrac{4}{3}\pi r^3 = 1.0 \times 10^{-23}$ cm^3

4. (i) (B) Let weight of compound = 100 gm

$$\Rightarrow \begin{array}{c|c|c|c|c} A & 50\,gm & 50/10 \text{ moles} & 5 & 2 \\ B & 50\,gm & 50/20 \text{ moles} & 2.5 & 1 \end{array}\Bigg\} \quad \text{Simplest Ratio} \Rightarrow A_2B$$

(ii) (A) Let density of $H_2O \equiv 1$ gm/ml $\Rightarrow$ gm in drop of $H_2O = 1 \times 0.0018$ gm $\Rightarrow$ moles $\equiv \dfrac{0.0018}{18} = 10^{-4}$

$\Rightarrow$ molecules of $H_2O = 6.02 \times 10^{23} \times 10^{-4} = 6.02 \times 10^{19}$

(iii) (B) (a) gm of $N_2 = 7 \times 2 = 14$ **(c)** 1 moles S $\equiv$ 32 gm

(b) gm of C $= \dfrac{3 \times 10^{23}}{6 \times 10^{23}} \times 12 = 6$ **(d)** 7 gm Ag

EXERCISE-B

1. (a) Sugar $\equiv C_{12}H_{22}O_{11} \equiv 342$ gm $\Rightarrow$ moles of sugar $(n_B) = \dfrac{1000}{342}$; moles of H_2O $(n_A) = \dfrac{2000}{18}$

$\Rightarrow \quad \chi_{sugar}(B) = \dfrac{n_B}{n_A + n_B} = 0.0256$; $\chi_A = 1 - \chi_B = 0.974$

% of sugar (by mass) $= \dfrac{g_B}{g_A + g_B} = \dfrac{1000}{1000 + 2000} = 33.3\%$ $\Rightarrow$ % of H_2O(by mass) $= 66.7\%$

(b) $n_{MgCl_2}(B) = \dfrac{x}{95}$; $n_{H_2O}(A) = \dfrac{750}{1000}$kg $\Rightarrow$ $m_{MgCl_2} = \dfrac{x/95}{0.75} = 1.05$ $\Rightarrow$ $x = 74.8$ gm

2.(C) $g_{H_2SO_4} = 49$ gm $\Rightarrow$ $n_{H_2SO_4} = \dfrac{49}{98} = \dfrac{1}{2}$; $V = 1$Lt $\Rightarrow g_{solution} = 1000 \times 1.049 = 1049$ gm

$\Rightarrow \quad g_{H_2O} = 1049 - 49 = 1000$ gm

$M_{H_2SO_4} = \dfrac{1/2}{1} = \dfrac{1}{2}$; $N_{H_2SO_4} = 2 \times \dfrac{1}{2} = 1$; $m_{H_2SO_4} = \dfrac{1/2}{1} = \dfrac{1}{2}$

3. (a) x% by mass
x g of solute in 100 g solution
$(100-x)$ = mass of solvent

$$\frac{\frac{x}{M_0}}{100 - x} \times 1000 = \frac{1000x}{(100 - x)M_0} = m$$

$$\frac{\frac{x}{M_0}}{d} \times 1000 = M \quad \Rightarrow \quad \frac{10xd}{M_0} = M$$

(b) x% volume
xg of solute in 100 mL of solution.

$$\frac{\frac{x}{M_0}}{100} \times 1000 = m \quad \Rightarrow \quad \frac{1000x}{M_0(100d - x)} \qquad ; \qquad \frac{\frac{x}{M_0}}{100} \times 1000 = M \quad \Rightarrow 10\,\frac{x}{M_0} = M$$

4. (a) Let the volume of solution = 1L $\Rightarrow$ moles of solute = 1 mol

$m = 0.8 = \dfrac{1}{g_A/1000} \Rightarrow g_A = 1250,\ g_B = 1 \times 85 = 85$ gm $\quad \left[M_{NaNO_3} = 85\text{ gm/mole}\right]$

$\Rightarrow \quad g_{solution} = 1250 + 85 = 1335$ gm $\quad \Rightarrow \quad d_{solution} = \dfrac{1335}{1000} = 1.33$ g/cm^3

(b) $n_{NaCl} = \dfrac{29.2/58.5}{1} = 0.5 \Rightarrow [Cl^-] = 0.5$ M (in 1 lit) [**Note :** 2.92 gm NaCl in 100 ml. So, 29.2 gm NaCl in 1000 ml]

$$\underset{\ }{BaCl_2} \longrightarrow \underset{xM}{Ba^{2+}} + \underset{2xM}{2Cl^-} \quad \Rightarrow \quad 2x = 0.5 \quad \Rightarrow \quad x = 0.25\text{M}$$

Let 'n' be moles of $BaCl_2$ $\Rightarrow \dfrac{n_{BaCl_2}}{1/4} = 0.25 \Rightarrow n_{BaCl_2} = \dfrac{0.25}{4} \Rightarrow g_{BaCl_2} = n_{BaCl_2} \times 208.5$ gm $= 12.75$ gm

5. (i) $M = \dfrac{10\,xd}{M_o} \Rightarrow 3 = \dfrac{10 \times x \times 1.2}{158} \Rightarrow x = 39.5\%$

(ii) Let the volume of solution is 1L $\Rightarrow g_{H_2O} = 1200 - 474 = 726\,g$

$$\chi_{Na_2S_2O_3} = \dfrac{3}{3 + \dfrac{726}{18}} = 0.069$$

(iii) $m_{Na_2S_2O_3} = \dfrac{3}{726/1000} = 4.13 \Rightarrow m_{Na^+} = 2 \times 4.13 = 8.26$ and $m_{S_2O_3^{2-}} = 4.13 \quad \left[Na_2S_2O_3 \longrightarrow 2Na^+ + S_2O_3^{2-}\right]$

6. (i) (A) Moles HCl req = $0.2 \times 2 = 0.4$ (n-factor HCl = 1) [Moles = Molarity × Volume of Solution (in L)]

(a) Moles HCl = $0.5 \times 0.5 + 0.1 \times 1.5 = 0.4$

(b) Moles HCl = $0.5 \times 1.5 + 0.1 \times 0.5 = 0.8$

(c) Moles HCl = $0.5 \times 1 + 0.1 \times 1 = 0.6$

(d) Total volume = 2L ; Moles HCl = $0.5 \times 0.75 + 0.1 \times 1.25 = 0.45$

(ii) (B) Let volume of solution = 1L $\Rightarrow g_{solution} = 1000 \times 1.0585 = 1058.5$ gm

$g_B = (1 \times 1) \times 58.5 = 58.5\,gm \Rightarrow g_A = 1058.5 - 58.5 = 1000\,gm \Rightarrow m = \dfrac{1}{1000/1000} = 1$

(iii) (D) mmoles HCl (from 0.2 mol HCl) $\equiv 200$; mmoles $BaCl_2 \equiv 100$

$\Downarrow$ $\qquad\qquad$ $\Downarrow$

mmoles $Cl^- \equiv 200$ $\qquad$ mmoles $Cl^- \equiv 200$ $\qquad [BaCl_2 \longrightarrow Ba^{2+} + 2Cl^-]$

$$\Rightarrow [Cl^-] = \dfrac{400/1000}{500/1000} = 0.8M$$

(iv) (D) $Na_2SO_4.nH_2O \xrightarrow{\Delta} Na_2SO_4 + nH_2O\uparrow$

$(100\,gm) \equiv \dfrac{100}{142+18n}$ moles $\qquad (55.9\,gm) \equiv \dfrac{55.9}{18}$ moles

$1\,mol\ Na_2SO_4.nH_2O \equiv n\,mol\ H_2O \Rightarrow \dfrac{100n}{142+18n} = \dfrac{55.9}{18} \Rightarrow n = 10$

(v) (C) $M_{H_2SO_4} = \dfrac{10xd}{M_o} = \dfrac{10 \times 90 \times 1.8}{98} = 16.5 \Rightarrow 16.5 \times V = 0.2 \times 1\ [M_1V_1 = M_2V_2] \Rightarrow V = 12\,ml$

(vi) (AB) Molarity and Normality depends on the volume of solution ("T" dependent).

(vii) (C) $M_1V_2 = M_2V_2 \Rightarrow M_2 = 0.2 \times \dfrac{1}{1000} = 2 \times 10^{-4} \Rightarrow N_2 = 2 \times 2 \times 10^{-4} = 4 \times 10^{-4}\,N$

(viii) (D) Use : $m = \dfrac{\chi_B}{1-\chi_B} \times \dfrac{1000}{M_A} \Rightarrow \chi_B = 0.051 \quad [M_A = 18\,gm/mole]$

(ix) (D) Use : $A_{Avg.} = \Sigma X_iA_i \Rightarrow 63.546 = x \times 63 + (1-x) \times 65 \Rightarrow x = 0.727$

EXERCISE-C

1. (a) $Ag_2CO_3 \xrightarrow{\Delta} 2Ag(s) + CO_2(g) + \frac{1}{2}O_2(g)$ [Residue = Ag]

$\frac{2.76}{276} \equiv 0.01$ moles of $Ag_2CO_3 \Rightarrow$ gm of Ag $= (2 \times 0.01) \times 108 = 2.16$ gm

(b) $K_2SO_4 + BaCl_2 \longrightarrow BaSO_4 \downarrow + 2KCl$

$M_{K_2SO_4} = \frac{5/174}{1/4} = \frac{10}{87}$; Moles $BaSO_4 = \frac{1.2}{233}$ = Moles $K_2SO_4 = \frac{10}{87} \times V \Rightarrow V = 44.7$ ml

(c) $Ca(HCO_3)_2 \xrightarrow{\Delta} CaO + 2CO_2 + H_2O$

Moles $Ca(HCO_3)_2 = 2 \Rightarrow$ Moles $CO_2 = 2 \times 2 = 4$ $\Rightarrow$ % yield $CO_2 = \frac{1}{4} = 25\%$

(d) $NaHCO_3 \equiv Na^+ + HCO_3^- \Rightarrow$ n-factor = 1 $\Rightarrow E_{NaHCO_3} = 84/1 = 84$

$SO_2 \equiv H_2SO_3 \Rightarrow$ n-factor = 2 $\Rightarrow E_{SO_2} = 64/2 = 32$

2. (i) (D) $H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$

	H_2	O_2	H_2O
Initial moles	3	1.5	–
Final moles	–	–	3

$\Rightarrow$ Both gets consumed completely (H_2 and O_2)

(ii) (C) $4I^- + Hg^{2+} \longrightarrow HgI_4^{2-}$

	I^-	Hg^{2+}	HgI_4^{2-}
Initial moles	1	1	
Final moles	–	$1-\frac{1}{4}$	$\frac{1}{4} = 0.25$

$\Rightarrow$ I^- is the limiting reactant

(iii) (A) $2H_2O_2(aq) \longrightarrow 2H_2O(\ell) + \underset{3L}{O_2(g)}$

Moles $O_2 = \frac{3}{24} = \frac{1}{2}$ moles $H_2O_2 \Rightarrow$ Moles $H_2O_2 = \frac{1}{4} = 0.1 \times X \Rightarrow X = 2.5$ M

(iv) (A) 10 gm $X_4O_6 = \frac{10}{4X+96}$ moles $\Rightarrow$ gm $X = \left[\frac{10 \times 4}{4X+96}\right] \times X = 5.72 \Rightarrow X = 32$ amu

(v) (B) 1 mole of $Mg_3(PO_4)_2 \equiv 8$ mole of Oxygen atoms.

$\Rightarrow$ 1/4 mole of oxygen atoms $\equiv \frac{1}{8} \times \frac{1}{4}$ mole of $Mg_3(PO_4)_2$

$= 3.125 \times 10^{-2}$ mole of magnesium phosphate.

(vi) (A) $\underset{(1.763\,gm)}{BaCl_2 . xH_2O} \xrightarrow{Heating} \underset{(1.505\,gm)}{BaCl_2} + xH_2O$

1 mole of $BaCl_2.xH_2O \equiv 1$ mole of $BaCl_2$

$\Rightarrow \frac{1.763}{209+18x}$ mole of $BaCl_2.xH_2O = \frac{1.505}{209}$ mole of $BaCl_2$ (given)

$$\Rightarrow \quad \frac{1.763}{209+18x} = \frac{1.505}{209} \quad \Rightarrow \quad x \approx 2$$

(vii) (B) $Zn + I_2 \longrightarrow ZnI_2$

Let 'g' grams of Zn & I_2 were taken initially.

$$\text{moles of Zn} = \frac{g}{65}\ ; \text{moles of } I_2 = \frac{g}{2\times 127} = \frac{g}{254} \quad \Rightarrow \quad \text{moles of Zn left} = \frac{g}{65} - \frac{g}{254} = \frac{189g}{65\times 254}$$

$$\therefore \text{ fraction of Zn left} = \frac{\frac{189\ g}{65\times 254}}{\frac{g}{65}} = 0.74$$

(viii) (A)

$$\underset{\text{Initially}}{} \ \underset{0.1\text{ moles}}{4Ca_5(PO_4)_3F} + \underset{0.36\text{ moles}}{18SiO_2} + \underset{0.9\text{ moles}}{30C} \longrightarrow 3P_4 + 2CaF_2 + 18CaSiO_3 + 30CO$$

Using mole concept :

4 moles of $Ca_5(PO_4)_3F \equiv$ 18 moles of $SiO_2 \equiv$ 30 moles of C $\equiv$ 3 moles of P_4

Here : SiO_2 is limiting reagent.

So : moles of P_4 formed $= \frac{3}{18} \times 0.36 = 0.06$

(ix) (A) $Al + \frac{3}{2}Cl_2 \longrightarrow AlCl_3$

1 mole of Al $\equiv$ 1 mole of $AlCl_3$

moles of $AlCl_3$ produced $= \frac{6.67}{133.5} = 0.05 \quad \Rightarrow \quad$ moles of Al reacted = 0.05

Total moles of Al taken $= 0.05 + \frac{0.54}{27} = 0.07$

(x) (A)

$$\underset{1\text{ mole (given)}}{KClO_3} \longrightarrow \underset{1\text{ mole}}{KCl} + \underset{3/2\text{ moles}}{\frac{3}{2}O_2}$$

$$\underset{2\text{ moles}}{2Al} + \underset{3/2\text{ moles}}{\frac{3}{2}O_2} \longrightarrow \underset{1\text{ mole}}{Al_2O_3}$$

EXERCISE-D

1. (a) $S_{HCl} = 3g/L \ \Rightarrow\ N_{HCl} = \frac{3}{36.5/1} \ \Rightarrow\ \text{Meq HCl} = \frac{3}{36.5/1}\times 2.5$

$$\text{Meq Al(OH)}_3 \equiv \frac{4000\times 10^{-3}}{78/3}\times x = \text{Meq HCl} \ [x = \text{No. of tablets}] \ \Rightarrow\ x \sim 14$$

(b) $N_{Ca(OH)_2} = \frac{10xd}{E} = \frac{10\times 1.85\times 1.025}{74/2} = 0.51$

Meq $Ca(OH)_2$ = Meq HCl $\quad \Rightarrow \quad 0.51 \times 25 = (0.1\times 1)\times V_{HCl} \ \Rightarrow\ V_{HCl} = 127.5$ ml

(c) Meq NaOH $= 0.1 \times 40 = 4 =$ Meq H_3PO_4 (in 25 ml)

$\Rightarrow$ Meq $H_3PO_4 = 4 \times \dfrac{250}{25} = 40 = \dfrac{g}{98/3} \times 1000 \Rightarrow g_{H_3PO_4} = 1.32 \Rightarrow d = \dfrac{1.32}{1} g/cm^3$

(d) Meq NaOH $= \dfrac{1}{15} \times 25 = \dfrac{5}{3} =$ Meq oxalic acid in 16.68 ml.

$\Rightarrow$ Meq oxalic acid in 250 ml $= \dfrac{5}{3} \times \dfrac{250}{16.68} = \dfrac{1.575}{M_o/2} \times 1000$

$\Rightarrow \quad M_o = 126 = 18n + 90 \quad \Rightarrow \quad n = 2 \quad \Rightarrow \quad H_2C_2O_4.2H_2O$

(e) Meq $H_2SO_4 = \dfrac{1}{2} \times 40 = 20 =$ Meq carbonate $= \dfrac{0.84}{E} \times 1000 \Rightarrow E = 42$

(f) Moles $NH_3 = \dfrac{2.24}{22.4} = 0.1 =$ Meq $NH_3(\equiv NH_4OH) =$ Meq $H_2SO_4 = (M_{H_2SO_4} \times 2) \times \dfrac{100}{1000}$

$\Rightarrow \quad M_{H_2SO_4} = 0.5M$

2. Meq acids = Meq HCl + Meq $H_2SO_4 = (1 \times 2) \times 500 + (2 \times 2) \times 100 = 1400$

Meq base $= (1000 \times 1) = 1000 \quad \Rightarrow \quad$ Meq $\text{acid}_{\text{left}} = 1400 - 400$ (in 600 ml)

$\Rightarrow$ Meq $\text{acid}_{\text{left}}$ in 30 ml $= 400 \times \dfrac{30}{600} = 20 =$ Meq $Na_2CO_3.xH_2O = \dfrac{143}{E(\equiv M_o/2)} \times 20$

Thus, $M_o = 286 = 106 + 8x \Rightarrow x = 10$

3. $\underbrace{NaCl + Na_2CO_3}_{4gm} \xrightarrow{250ml} \xrightarrow{25ml} \equiv 50\,ml, \dfrac{N}{10} HCl \left(= \dfrac{1}{10} \times 50 = 5 \text{ meq HCl}\right)$

Thus, Meq Na_2CO_3 in 25 ml = 5 [As HCl doesn't react with NaCl]

$\Rightarrow$ Meq Na_2CO_3 in 250 ml $= 50 = \dfrac{g}{106/2} \times 1000 \Rightarrow g_{Na_2CO_3} = 2.65$ gm

$\Rightarrow \% Na_2CO_3 = \dfrac{2.65}{4} \times 100 = 66.25\%$ and $\%$ NaCl $= 33.75\%$

4. (i) (D) In 30 ml $\left\{\begin{array}{l}\text{Meq HCl} = 0.1 \times 100 = 10 \\ \text{Meq NaOH} = 0.2 \times 30 = 6\end{array}\right\}$ Meq HCl left $= 10 - 6 = 4 =$ Meq KOH $= 0.25 \times V_{KOH} \Rightarrow V_{KOH} = 16$ ml

(ii) (B) $\left.\begin{array}{l}\text{Meq } H_2SO_4 = (2 \times 0.2) \times 100 = 40 \\ \text{Meq NaOH} = (1 \times 0.2) \times 100 = 20\end{array}\right\}$ Meq H_2SO_4 left $= 40 - 20 = 20 \Rightarrow [H^+] = \dfrac{20}{100 + 100} = 0.1N$

(iii) (C) Meq HCl $= (1 \times x) \times 20 = 20x$

Meq $NaHCO_3$ + Meq $Na_2CO_3 = (0.1 \times 1) \times 10 + (0.2 \times 2) \times 5 = 3 \Rightarrow 20x = 3 \Rightarrow x = 0.15$ M

MISCELLANEOUS EXERCISE

1.(C) Moles $H_2S = \frac{17}{M_{H_2S}} = \frac{17}{34} = \frac{1}{2}$

Also, 1 mol $H_2S \equiv 5$ moles H_2SO_4 [from Stoichiometry of reaction]

$\Rightarrow \frac{1}{2}$ mol $H_2S \equiv \frac{5}{2}$ moles $H_2SO_4 = M \times V_{L.}$ $\Rightarrow$ $V_L = \frac{2.5}{0\ 1} = 25L$

2.(B) $CaCl_2 + NaCl \xrightarrow{CO_3^{2-}} CaCO_3 \downarrow \xrightarrow{\Delta} CaO + CO_2$

Moles of CaO $= \frac{1.62}{56} \equiv$ Moles $CaCO_3 \equiv$ Moles $CaCl_2 = \frac{g_{CaCl_2}}{111}$

$\Rightarrow g_{CaCl_2} = 3.21$ gm $\Rightarrow \%CaCl_2 = \frac{3.21}{10} \times 100 = 32.1\%$

3.(A)

$$\underset{x \text{ moles}}{C_4H_8(g)} + 6O_2(g) \longrightarrow \underset{4x \text{ moles}}{4CO_2(g)} + \underset{4x \text{ moles}}{4H_2O(\ell)}$$

$$\underset{y \text{ moles}}{C_4H_{10}(g)} + \frac{13}{2}O_2(g) \longrightarrow \underset{4y \text{ moles}}{4CO_2(g)} + \underset{5y \text{ moles}}{5H_2O(\ell)}$$

Equate moles of CO_2 :

$\Rightarrow 4x + 4y = \frac{35.2}{44} = 0.8 \Rightarrow x + y = 0.2$ . . . . . .(i)

and Equating moles of H_2O

$\Rightarrow 4x + 5y = \frac{16.2}{18} = 0.9$ . . . . . .(ii)

Solve for x and y to get : x = 0.1 $\Rightarrow g_{Butene} = 0.1 \times 56 = 5.6$ gm

y = 0.1 $\Rightarrow g_{Butane} = 0.1 \times 58 = 5.8$ gm $\Rightarrow$ % Butane $= \frac{5.8}{11.4} \times 100 = 50.8$

4.(B) $2P + 3Q \longrightarrow P_2Q_3$

$P + 2Q \longrightarrow PQ_2$

$M_{P_2Q_3} = \frac{15.9}{0.15} = 2P + 3Q$ and $M_{PQ_2} = \frac{9.3}{0.15} = P + 2Q$ $\Rightarrow$ P = 26 and Q = 18.

5.(B) Let volume of HCl and KOH each be V ml $\Rightarrow$ Volume of solution 2V

Meq HCl = 1 × 0.2 × V = 0.2 V ; Meq KOH = 1 × 0.4 × V = 0.4 V

$\Rightarrow$ KOH is in excess

	HCl +	KOH $\longrightarrow$	KCl +	H_2O
Mmoles	0.2 V	0.4 V		
MMoles	-	0.2 V	0.2 V	-

Mmoles $K^+_{Total} = 0.2V + 0.2V$

$\Rightarrow$ Mmoles $K^+_{Total} = 0.2V + 0.2V$

Mmoles OH^- = 0.2 V and Mmoles Cl^- = 0.2 V $\Rightarrow$ $[K^+] = 0.2M$; $[OH^-] = 0.1M$, $[Cl^-] = 0.1M$

6.(A) NaCl doesn't react with HCl as it is a salt of strong acid and strong base.

Meq of HCl $= \frac{1}{10} \times 120 = 12 =$ Meq $CaCO_3$ $= \frac{g_{CaCO_3}}{100/2} \times 1000$

$\Rightarrow \quad g_{CaCO_3} = 0.6 \quad \Rightarrow \quad \%\ NaCl = \frac{0.4}{1} \times 100 = 40$

7.(D) $Z_2O_3 + 3H_2 \longrightarrow 2Z + 3H_2O$

Mmoles $H_2 = \frac{6}{2} = 3$

$\Rightarrow \quad$ 3 mmoles $H_2 \equiv 1$ mmoles $Z_2O_3 = \frac{0.16}{(2Z + 48)} \times 1000 \qquad \Rightarrow \qquad Z = 56$ gm

8.(A) Meq carbonate used for HCl = $(0.1 \times 1 \times 50) - (0.1 \times 1 \times 24) = 2.6$

$\Rightarrow \quad 2.6 = \frac{0.13}{E_{Carbonate}} \times 1000 \quad \Rightarrow \quad E_{carbonate} = 100 \quad \Rightarrow$ carbonate is $CaCO_3$

9.(D) Note : NaOH absorbs CO_2

Only N_2 gas will remain as H_2O will become liquid at $25°C$

$n_{urea} = \frac{0.120}{60} \equiv 2$ mmoles

From Stoichiometry, $n_{N_2} \equiv 2 \times 2 = 4$ mmoles $\equiv 4 \times 24\ cm^3 = 96\ cm^3$

10.(B) $M_1V_1 = M_2V_2$

$1.5 \times V_1 = \frac{1.7}{17} \times 100 \quad \left[M = \frac{S}{M_0}\right] \qquad \Rightarrow \qquad V_1 = 6.67$ ml

11.(B) Moles of anhydrous $CaCl_2 = \frac{222}{111} = 2 \qquad \Rightarrow \qquad$ No. of $CaCl_2$ molecules = $2N_A$

No. of ions = $2N_A$ And No. of ions = $4N_A$

12.(D) Let 100g/mol be molar mass of the compound

Moles of atoms of element $X = \frac{76}{76} = 1$; Moles of atoms of element $Y = \frac{24.2}{16} = 1.5$

So, formula of compound is $XY_{1.5}$ or X_2Y_3

13.(A) Let x be valency of element M $\quad \Rightarrow \quad$ Formula of oxide is M_2O_x

Now, $(2 \times x \times 14) + (x \times 16) = 44 \Rightarrow x = 1 \quad \Rightarrow \quad$ Atomic weight of element = $14 \times 1 = 14$

14.(D)

	$2NH_3$	+ $5F_2$	$\longrightarrow$ N_2F_4	+ $6HF$
Initially	$\frac{2}{17}$ moles	$\frac{8}{18}$ moles	-	-
Finally	-	$\frac{8}{18} - \frac{5}{17}$ moles	$\frac{1}{17}$ moles	-

$$= \frac{1}{17} \times 100g = 5.9g$$

$$\%\ yield = \frac{3.56}{5.9} \times 100\% = 60\ \%$$

15.(B) Moles of H_2SO_4 used $= \frac{10}{1000} \times 0.5 = 0.005$

$\Rightarrow$ Moles of H^+ ions used $= 2 \times 0.005 = 0.01$

$\Rightarrow$ Moles of NaOH used = 0.01 (As Na_2SO_4 is neutral being a salt of strong acid and strong base)

$\Rightarrow$ Mass of NaOH used $= 0.01 \times 40 = 0.4$g

16.(D) $\frac{(20\times1)+(10\times0.25)}{40+20} = 0.75$ $\quad \frac{(100\times1)+(50\times0.25)}{100+50} = 0.75$ $\quad$ Using : $M_{new} = \left(\frac{M_1V_1 + M_2V_2}{V_1+V_2}\right)$

$\frac{(40\times1)+(20\times0.25)}{40+20} = 0.75$ $\quad \frac{(50\times1)+(25\times0.25)}{50+25} = 0.75$

17.(A) Let M gm/mol be molar mass of acid

Now $\frac{6}{M} \times 2 \times 1000 \times \frac{12.5}{1000} = 10 \times 0.1 = 1$ (Decinormal means normality is 0.1 N)

$\Rightarrow$ M = 150

18.(A) Mass of alcohol in 2nd solution $= \frac{10}{100} \times 80 \times 0.9 = 7.2\,g$

Mass of alcohol in 1st solution $= \frac{90}{100} \times V \times 0.8 = \frac{7.2V}{10}\,g$

Since same alcohol content is used.

So $\quad 7.2 = \frac{7.2V}{10} \Rightarrow V = 10\,mL$

19.(C) Strength of NH_3 = 1.7 g /L.

(100 mL)

$\Rightarrow$ n_{NH_3} in 100 mL solution $= \frac{1.7}{17} \times \frac{100}{1000}$

= 0.01 moles.

These many moles must be present is 1.5 M NH_3.

So, volume of NH_3 required $= V_{mL}$

$V_{mL} \times 1.5 = 0.01 \times 10^3$

$V_{mL} = \frac{10}{1.5} = \frac{20}{3} = 6.7$ mL.

20.(B) $\underbrace{Na_2CO_3 + NaHCO_3}_{2gm} \longrightarrow 0.248\,gm$ loss due to $CO_2 + H_2O$

$Na_2CO_3 \xrightarrow{\Delta}$ No reaction $\qquad 2\,NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + CO_2 + H_2O$

x gm $\qquad 2 - x$ gm $\qquad \equiv \left(\frac{2-x}{84}\right) \times \frac{106}{2}$ gm

$\Rightarrow 1.752$ (Residue Na_2CO_3) $= x + \left(\frac{2-x}{84}\right) \times \frac{106}{2}$ gm $\Rightarrow x = 1.325$ gm $\Rightarrow$ % $Na_2CO_3 = \frac{1.325}{2} \times 100 = 66.6\%$

21.(A) Let meq of NaOH = x and meq of Na_2CO_3 = y

$$\text{Meq NaOH} + \frac{1}{2}\text{ Meq } Na_2CO_3 = \text{Meq HCl}$$

$\Rightarrow \quad x + \frac{y}{2} = 0.5 \times 21 = 10.5 \qquad$ **. . . . .(i)**

and $\quad \frac{\text{Meq } Na_2CO_3}{2}(\equiv \text{left}) = \text{Meq HCl}$

$\Rightarrow \quad \frac{y}{2} = 0.5 \times 7 \;\Rightarrow\; y = 7 \qquad$ **. . . . .(ii)** $\qquad \Rightarrow \quad x = 7$

Now, $\quad \frac{g_{Na_2CO_3}}{106/2} \times 1000 = y \;\Rightarrow\; g_{Na_2CO_3} = 0.371 \qquad \Rightarrow \quad \%\ Na_2CO_3 = \frac{0.371}{0.75} \times 100 = 49.5$