Miscellaneous Exercise Question Bank

1.(D) $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

3 moles of $CO_2 \longrightarrow$ 4 moles of H_2O

0.15 moles of $CO_2 \longrightarrow \frac{4}{3} \times 0.15$ moles of H_2O

= 0.2 moles of H_2O $= 0.2 \times N_A$ molecules of water

No. of drops formed $= \frac{0.2 \times 6.022 \times 10^{23}}{1.7 \times 10^{21}} = 70$

2.(A) $\underset{\text{Excess}}{Ca(OH)_2} + \underset{50\,mol}{(NH_4)_2SO_4} \longrightarrow CaSO_4 + 2NH_3 + 2H_2O$

$-$ $-$ $50\,mol$ $100\,mol$ 100 mol

Density of sol = 0.85 g/ml

Let solution be 100 g.

Then volume $= \frac{100}{0.85}$ ml $= 117.64$

Molarity $\frac{\frac{20}{17}}{117.64} \times 1000 = 10\,M$ $\Rightarrow$ 10 L of such solution can be prepared.

3.(B) $Al(OH)_3$ $\because$ it will neutralize large amount of acid for a smaller amount than the other antacids.

4.(B) $M + 3F_2 \longrightarrow MF_6$

$\frac{0.25}{M} = \frac{0.547}{M + (19)(6)}$

M = 95.95

$\therefore$ M should be molybdenum.

5.(B) $U(s) + 3F_2(g) \longrightarrow UF_6(g)$

$\frac{n_{F_2}}{3} = n_{uF_6}$

$n_{F_2} = \frac{3 \times 2 \times 10^{-3}}{352} = 0.0170$

Molecules of F_2 required $= n_{F_2} \times N_A \simeq 1.026 \times 10^{19}$

6.(C) $H_2S + \frac{3}{2}O_2 \longrightarrow H_2O + SO_2$

51g. excess

Oxygen used $= \frac{3}{2} \times \frac{51}{31} = 72$ grams

Mass of products formed = Mass of reactants = 51 + 72 = 123 g

7.(A) $B_2Cl_4 + 6NaOH \longrightarrow 2NaBO_2 + 2H_2O + H_2 + 4NaCl$

1 mole of $H_2 \longrightarrow 1\,\text{mole of}\; B_2Cl_4$

$\frac{1.362}{22.4}$ mole of $H_2 \longrightarrow \frac{1.362}{22.4}$ mole of B_2Cl_4

$\frac{1.362}{22.4} \times 164\,g$ of B_2Cl_4 = 9.97 g

8.(A) 2 mol of $NH_4NO_3 \longrightarrow$ 7 moles of gaseous products

$\frac{16}{80}$ mole of $NH_4NO_3 \longrightarrow \frac{7}{2} \times \frac{16}{80}$ of gaseous products

pV = nRT

$1 \times V = \frac{7}{10} \times 0.0821 \times 10^3 \quad \Rightarrow \quad V = 57.47\,L$

9.(A) $FeCl_y + y\,Ag\,NO_3 \longrightarrow yAgCl + Fe(NO_3)y$

$$\frac{n_{AgCl}}{y} = n_{FeCly}$$

$\frac{287 \times 10^{-3}}{143.5} \times \frac{1}{y} = \frac{127 \times 10^{-3}}{56 + y(35.5)} \quad \Rightarrow \quad y = 2$

10.(A) 1 mole of $(CF_2)_n \longrightarrow 4n$ moles of CoF_2

$\frac{10^3}{n(50)}$ of $(CF_2)_n \longrightarrow \frac{4n(10^3)}{n(50)}$ moles of CoF_3

$\longrightarrow 80\,\text{moles of}\; CoF_3$

$\longrightarrow 40\,\text{moles of}\; F_2$

$\longrightarrow 40 \times 38\,g\,\text{of}\; F_2$

= 1520 g of F_2

11.(C) $\frac{9}{4}A + 2BO_3 \longrightarrow \frac{3}{4}A_3O_4 + B_2O_3$

$9A + 8BO_3 \longrightarrow 3A_3O_4 + 4B_2O_3$

1	1	–	–
–	$\frac{1}{9}$	$\frac{3}{9}$	$\frac{4}{9}$

12.(B) The amount of tin present in the SnO_2 is the amount of tin that was in the original sample.

Tin in $SnO_2 = 0.5 \times \frac{119}{(119 + 92)} = 0.39\,g$

% Tin in original sample $\frac{0.39}{1.5} \times 100 = 26.27\%$

13.(C) $A + 2B \longrightarrow I, I + C \longrightarrow D + B$

$\Rightarrow \quad A + 2B + C \longrightarrow D + B$

$\Rightarrow \quad A + B + C \longrightarrow D$

5	6	Excess	–
–	1	Excess	5

14.(C) $4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$

$\frac{25.5}{17}$ Excess

– – $\frac{25.5}{17}$ moles $\frac{25.5}{17} \times \frac{6}{4}$ moles

$$2NO + 2CH_4 \longrightarrow 2HCN + 2H_2O + H_2$$

Initial moles $\frac{25.5}{17}$ $\frac{32}{16}$

Final moles – $0.5 \longrightarrow 1.5$ 1.5 $\frac{1.5}{2}$

HCN produced $= 1.5 \times 27\,g = 40.5\,g$

15.(B) Let the mass of extract is 100 grams

Then SiO_2 found $= x1.52\,g = \frac{1.52}{60}x$ moles $= 0.0253x$

Al_2O_3 found $= x1.02\,g = \frac{1.02}{1.02}x$ moles $= 0.01x$

Koolin is $2SiO_2.Al_2O_3$

Now the amount of Al_2O_3 flown from Kaolin is half the amount of $3iO_2$ flown from Kaolin in moles.

$\Rightarrow$ free SiO_2 in rock being analysed $= 0.0253x - 0.02x = 0.0053x$ moles $= 0.32$ grams

Weight of rock being analysed $= 100x - 1.02x - (0.02)(60)x = 100x - 1.02x - 1.2x = 97.78x$ grams

% free SiO_2 in being analysed $= \frac{0.32}{97.78} \times 100 = 0.32\%$

16.(C) $FeO : Fe_2O_3 = 2 : 1 = 2x : 1x$. (Initially)

After oxidation $2FeO + \frac{1}{2}O_2 \longrightarrow Fe_2O_3$

$FeO : Fe_2O_3 = 132$

Let y moles of FeO be oxidized

Then $\frac{2x - y}{\frac{y}{2} + x} = \frac{1}{2} \Rightarrow 3x = \frac{5y}{2}$

FeO moles oxidized per mole of initial mixture $= \frac{y}{3x} = \frac{2}{5} = 0.4$

17.(B) $C + O \longrightarrow CO$

For no residue C should be the limiting reagent

$\Rightarrow \quad n_C < n_O$

$\frac{x}{12} < \frac{y}{16}$

$1.33 < \frac{y}{x}$

18.(D) $CaCN_2 + 3H_2O \longrightarrow CaCO_3 + 2NH_3$

H_2O is limiting reagent.

19.(B) $\because \quad$ 1 mole of HCl was required

$\Rightarrow \quad$ 1 mole of NH_4OH was formed

$\Rightarrow \quad$ 1 mole of NH_3 was formed

N_2	+	$3H_2$	$\longrightarrow$	$2NH_3$
1		4		
0.5		2.5		1

$x_{H_2} = \frac{5}{6}$

20.(A)

	I_2	+	H_2S	$\longrightarrow$	$2HI$	+	S
Initial moles	0.02		$\frac{1}{50}$				
	0.02		0.02		–		–
Final moles	–		–		–		0.02

S formed is 0.64 grams

21.(B) 1 mole of $K_2CO_3 \longrightarrow \frac{1}{12}$ moles of $K_2Zn_3[Fe(CN)_6]_2$

0.2 mole of $K_2CO_3 \longrightarrow \frac{1}{60}$ moles of $K_2Zn_3[Fe(CN)_6]$

So, $\longrightarrow \frac{1}{60} \times 696.2$ grams of $K_2Zn_3[Fe(CN)_6] = 11.6$ g

22.(A) 1 moles of cyclohexanol give $\rightarrow$ 1 mole of cyclohexene

But the yield being 75 %

Moles of cyclohexane obtained = 0.75 moles $= 82 \times \frac{3}{4}$ g $= 61.5$ g

23.(B)

	Cu	+	O	$\longrightarrow$	CuO
Initial moles	$\frac{4}{64}$	+	Excess		–
Final moles	$\frac{4}{64} - x$	+	Excess		x

Final weight $\left(\frac{4}{64}-x\right)64$ + Excess (x) 80

$4+16x=4.9\,g$

$x=\frac{0.9}{16}$ $\Rightarrow$ Amount of Cu left $=\left(\frac{4}{64}-x\right)64=4-64\times 0.9=4-3.6=0.4$ g

% copper unoxidized $=\frac{0.4}{4}\times 100=10\%$

24.(A) $CH_{4(g)} + 3Cl_{2(g)} \longrightarrow CHCl_{3(g)} + 3HCl_{(g)}$

Ideal : 1 1

Actual : 1 0.75

$\therefore$ $\frac{n_{CHCl_3}}{n_{CH_4}}=0.75$ for the given case

$\left(\frac{w_{CHCl_3}}{M^{\circ}_{CHCl_3}}\right)=\frac{3}{4}\left(\frac{w_{CH_4}}{M^{\circ}_{CH_4}}\right)$

$\left(\frac{30}{119.5}\right)=\frac{3}{4}\left(\frac{w_{CH_4}}{16}\right)$

$w_{CH_{4(g)}}=\frac{64\times 10}{119.5}=\frac{640}{119.5}=5.36\,g$

25.(D) Mass of pure $CaCO_3=200\times\frac{95}{100}=190\,kg$

$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

100 g 56

1g $\frac{56}{100}$

190 kg $\frac{56}{100}\times 190\,kg=106.4\,kg$

26.(A) Let CH_4 be x gm in the 12 g sample

$CH_4 \xrightarrow{O_2} CO_2 + 2H_2O$

$\frac{x}{16}$ $\frac{x}{16}$

$C_2H_4 \xrightarrow{O_2} 2CO_2 + 2H_2O$

$\frac{12-x}{28}$ $2\times\frac{(12-x)}{28}$

Mean molar mass $=\frac{12}{\frac{6.4}{16}+\frac{5.6}{2.8}}=20$

27.(B) Ratio $=\frac{\left(x+\frac{y}{4}\right)}{x}=1+\frac{y}{4x}$

For alkene $y=2x$

Hence ratio is free from x.

28.(A) $CO + \frac{1}{2}O_2 \longrightarrow CO_2$

	CO	O_2	CO_2
Initially	x	$\frac{x}{5}$	–
Finally	$x - \frac{2x}{5}$	–	$\frac{2x}{5}$

Initially total volume $= 2x$

Final total volume $= x + \frac{4x}{5}$

$\therefore$ Decrease $= \frac{x}{5}$

Fraction decrease $= \frac{\frac{x}{5}}{2x} = 0.1$

29.(C) With 80% yield in the reaction moles of $(CO_{(g)} + CO_{2(g)})$ obtained by dehydration of 5 moles of the oxalic acid, are (4 + 4) = 8.

$$P = \frac{nRT}{V} = \frac{8 \times 24.60}{10} = 8 \times 2.46 = 19.68\,\text{atm}$$

30.(B) In reaction (A) $\frac{n_{CaO}}{n_{CaCO_3}} = 1$; $\frac{\frac{w_{CaO}}{56}}{\frac{w_{CaCO_3}}{100}} = 1$, put $w_{CaCO_3} = 1g$

$w_{CaO} = \frac{56}{100} = 0.56\,g$ (per g of $CaCO_3$)

In reaction (B) $\frac{w_{P.O.P.}}{145} = \frac{w_{Gypsum}}{154}$

$w_{P.O.P.} = \left(\frac{145}{154}\right) = 0.94\,g$

In reaction (C) $\frac{w_{CaCl_2}}{111} = \frac{w_{CaCl_2 \cdot 6H_2O}}{(111+108)}$

$w_{CaCl_2} = \frac{111}{219} \approx 0.50\,g$

In reaction (D) $\frac{w_{NaNO_2}}{69} = \frac{w_{NaNO_3}}{85}$

$w_{NaNO_2} = \frac{69}{85} = 0.81\,g$

31.(C) $nf_1 \times M_1 \times V_1 = nf_2 \times n_2$

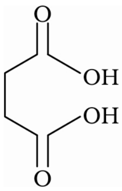
$1 \times 80 \times 10^{-3} \times 3 = 3 \times \frac{2.6}{0.1} \times \frac{V_2}{78}$

$V_2 = 0.24\,L = 240\,ml$

32.(D) Total moles of H_2SO_4 = 0.01 mole

Total volume $= \frac{150+400}{1.25} = \frac{500}{1.25} = 440$

$\therefore$ $M = \frac{0.1}{440} \times 1000 = \frac{1}{4.4} = 0.227\,M$

33.(C)  Succinic acid.

moles of succinic acid $= \dfrac{23.6}{118} = 0.2$

Moles of acetic acid $= 0.1 \times 0.1 = 0.05$

Moles of $^{-}$COOH in the solution $= (0.2) \times 2 + 0.05 = 0.45$

Molarity $= \dfrac{0.45}{500} \times 1000 = 0.9\,\text{M}$

34.(A) pV = nRT

V = 200n

Vol of 1 mol = 200 n

$$[CCl_3F] = \frac{275 \times 10^{-12}}{200} = 1.375 \times 10^{-12}\ \text{mol / L}$$

$$[CCl_2F_2] = \frac{605 \times 10^{-12}}{200} = 3.025 \times 10^{-12}\ \text{mol / L}$$

35.(A) $M_1 \times V_1 = M_2 \times V_2$

$1 \times 1 = M_2 \times 5 \quad \Rightarrow \quad M_2 = 0.2\ \text{M}$

36.(C) V.D. of the vapours = 25

$M'_{avg} = 25 \times 2 = 50$

In option A : M^{o}_{Avg} is between 20 and 40

In option B : M^{o}_{Avg} is between 60 and 80

In option C : M^{o}_{Avg} is between 40 and 60

In option D : $M^{\circ} = 20$

37.(A) Let wt. of NH_4NO_3 and $(NH_4)_2HPO_4$ are x and y gram respectively

$$\frac{\frac{x}{80} \times 2 \times 14 + \frac{y}{132} \times 2 \times 14}{x + y} \times 100 = 30.4 \quad \Rightarrow \quad x : y = 2 : 1$$

38.(A) Let V mL of alcohol be required

$\because$ mass of alcohol is same in both solutions

$\therefore \quad \dfrac{75}{100} \times 0.8 \times V = \dfrac{30}{100} \times 0.9 \times 150 \quad \Rightarrow \quad V = 67.5\,\text{mL}$

39.(A) Since, phenolphthalein indicates conversion of Na_2CO_3 into $NaHCO_3$ only hence, x mL, of HCl will be further required to convert $NaHCO_3$ to H_2CO_3 . So, total volume of HCl required to convert Na_2CO_3 into $H_2CO_3 = x + x = 2x$ mL

40.(D) In presence of phenolphthalein $\left(\underset{50\%}{Na_2CO_3} + \underset{\text{No reaction}}{NaHCO_3}\right)$

$\frac{1}{2}$ eq. of Na_2CO_3 = eq. of HCl

$$\frac{1}{2} \times \frac{x}{106} \times 2 = \frac{10 \times 0.01}{1000}$$

$x = 0.0106$

$$\% \text{ of } Na_2CO_3 = \frac{0.0106}{0.1} \times 100 = 10.6$$

41.(C) Phenolphthalein gives the end point corresponding to the reactions :

$NaOH + HCl \longrightarrow NaCl + H_2O$

$Na_2CO_3 + HCl \longrightarrow NaHCO_3 + NaCl$

$\therefore$ m-moles of NaOH + m-moles of Na_2CO_3

= m-moles of HCl = 2.5

Methyl orange gives the end point corresponding to the reactions:

$NaOH + HCl \longrightarrow NaCl + H_2O$

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

$\therefore$ m-moles of NaOH + m-moles of $Na_2CO_3 \times 2$ = m-moles of HCl = 30 × 0.1 = 3

m-moles of $Na_2CO_3 = 0.5$

m-moles of NaOh $= 2.5 - 0.5 = 2$

Ratio of m-moles of NaOH and $Na_2CO_3 = \frac{2}{0.5} = 4:1$

42.(D) 9.8% H_2SO_4 solution ; Molarity $= \frac{10 \times 9.8}{98} = 1M$

4.9% H_2SO_4 solution of density 1.1 g/ml, molarity $= \frac{10 \times 49 \times 1.1}{98} = 0.55\,M$

$$[H_2SO_4]_f = \frac{M_1V_1 + M_2V_2}{V_1 + V_2} = \frac{1 \times 1 + 0.55 \times 2}{3} = \frac{2.1}{3.0} = 0.7\,M$$

43.(C) Milli-equivalents of Ca^{2+} + milli-equivalents of Mg^{2+} = milli-equivalents of Na_2CO_3

$$= \frac{20}{20} + \frac{12}{12} = V \times 2$$

$\therefore$ $V = 1\,mL$ for 1 L of tap water

For 5000 L of pond water

V = 5000 mL or 5L

44.(B)

C	H	O
10.5	15	1
21	30	2

$\therefore$ E.F. of the compound is $C_{21}H_{30}O_2$

Hence M° of the compound $= 21 \times 12 + 30 \times 1 + 2 \times 16 = 314$

45.(D) Dalton's law is valid for a mixture of Non-reacting gases only. Avogadro's number was not given by Avogadro. Using the formula $M = \dfrac{1000\,md}{1000 + m\,M^{o}}$

Put $m = 1, d = 1.5, M^{\circ} = 98$

$$M = \frac{1500}{1000 + 98}$$

$$M = \frac{1500}{1098} > 1$$

46.(BCD) Molar vol. of STP = 22.4 L

Mol. of gas $= \dfrac{122 \times 10^{-3}}{22.4} = \dfrac{1}{200}$ moles

Molar mass $= \dfrac{0.22}{\dfrac{1}{200}} = 44\ \text{g mol}^{-1}$

47.(AC) Number of H atoms in 0.9 $C_6H_{12}O_6 = 12 \times \dfrac{0.9 \times N_A}{(12 \times 6 + 12 + 6 \times 16) \times N_A} = \dfrac{3}{50}$

48.(ACD) Hydrogen ${}_{1}^{1}H$, Oxygen ${}_{8}^{16}O$

49.(BC) $(M + 0.5) = \dfrac{xM + y(M+1) + z(M+2)}{z + y + z}$

(B) and (C) option satisfy this equation.

50.(A) $N_A = 1$ mole particles

51.(ABC) In $Ti_{0.75}O$. (Min mass % of Ti, Max mass % of O)

$$\% \text{ of O} = \frac{16}{16 + 48 \times 0.75} \times 100 = 30.8\%$$

$\%$ of Ti $= 69.2\%$

In $TiO_{0.69}$ (Min mass % of O) (Max mass % of Ti)

Minimum mass % of O $= \dfrac{16 \times 0.69}{48 + 16 \times 0.69} = 18.7\%$

52.(BD) Take example of CH_4 and C_2H_6 to show that they don't have same empirical formula.

53.(ABC) Acetic acid : CH_3COOH

Empirical formula $= C_1O_1H_2$

Hence (A), (B) and (C) are correct.

54.(BC) The precipitate formed will be AgCl and AgBr.

$\therefore$ Group A & C will obtain same mass and Group B & D will obtain same mass.

55.(AB) $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

(a) is correct

(b) is correct

(c) is incorrect since the H_2O formed is liquid instead of gas.

(d) Is incorrect because not every 3 molecules of H_2, O_2 mixture will give H_2O unless one of them is O_2 and two of them are H_2.

56.(ABC) $\underset{(16\ g)}{CH_4} + \underset{(64\ g)}{2O_2} \longrightarrow \underset{(44\ g)}{CO_2} + \underset{(36\ g)}{2H_2O}$ ...(i)

So, CH_4 used $= \frac{28}{4} g = 7g$

(a) is correct

$\underset{(16\ g)}{CH_4} + \underset{(48\ g)}{\frac{3}{2}O_2} \longrightarrow \underset{(28\ g)}{CO} + \underset{(36\ g)}{2H_2O}$ ...(ii)

Here 8 g CH_4 requires 24 g O_2.

(b) is correct

$\underset{(32\ g)}{2CH_4} + \underset{(112\ g)}{\frac{7}{2}O_2} \longrightarrow \underset{(28\ g)}{CO} + \underset{(44\ g)}{CO_2} + \underset{(72\ g)}{4H_2O}$ ...(iii)

$\frac{112}{32} = \frac{28}{8} = \frac{O_2 \text{ given}}{CH_4 \text{ given}}$

(C) is also correct.

(D) can be rejected using (i).

57.(ACD) Oxygen needed $= 8 \times 4 = 32g$

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

$\frac{2}{3} \rightarrow \frac{2}{3} \times \frac{3}{2} = 1\text{mole of } O_2$

(a) Is correct. Similarly, C and D also correct.

(b) $2H_2O_2(aq) \rightarrow 2H_2O + O_2(g)$

$1 \rightarrow 1 \quad \frac{1}{2}\text{moles}$

58.(ABC) $C_xH_y + \left(\frac{x+y}{4}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$

For alkanes x = n, y = 2n + 2.

$\therefore \quad CO_2 = n \ ; \ H_2O = n + 1$

For alkenes, x = n and y = 2n

$\therefore \quad CO_2 = n; H_2O = n$

For alkynes, $x = n$ and $y = 2n - 2$

$\therefore \quad CO_2 = n; H_2O = n - 1$

59.(ABD) Refer to solution of question 207 and proceed in the same manner.

60.(A) $\underset{x}{NaCl} + \underset{(1-x)}{MCl} + AgNO_3 \rightarrow \underset{2.567\ g}{AgCl}$

Moles of $AgCl = 0.018$ moles = Moles of Cl

$$0.018 = \frac{x}{58.5} + \frac{1-x}{M+35.5}$$

When salt is heated, NaCl does not decompose but MCl decomposes.

$$\frac{1.341}{143.23} = \frac{1-x}{M+35.5} = 0.0094$$

Solve for x and M

$x = 0.5$ and M=18g

61.(AB) $2H_2 + O_2 \to 2H_2O(l)$

In (a) 1 ml H_2 is left after reaction [the water formed is not considered as it will be liquid]

In (b) 1 ml O_2 is left after reaction.

62.(ABCD)

	$2NH_3$	$\longrightarrow$	$N_{2(g)}$	+	$3H_{2(g)}$
Initial	170 g (10 moles)		0		0
	$10-2x$		x		$3x$

Mass of $N_{2(g)} + H_{2(g)}$ produced after electric park = 100g

$$\frac{100}{M^{\circ}_{avg}} = x + 3x = 4x$$

Here $M^{\circ}_{avg} = \frac{x(28)+3x(2)}{4x} = \frac{28+6}{4} = \frac{34}{4} = 8.5$

$\Rightarrow \quad \frac{100}{8.5} = 4x$

$x = \left(\frac{100}{34}\right)$ moles

Moles of $NH_{3(g)}$ in the mixture $= 10 - \frac{200}{34} = \left(\frac{140}{34}\right)$ moles

Moles of HCl required $= \left(\frac{140}{34}\right)$

Required minimum molarity $= \frac{140/34}{5} = \frac{140}{5\times 34} = \frac{140}{170}$ M

63.(AB) $M_1V_1 = M_2V_2 \quad \Rightarrow \quad \frac{40}{M_{Ag}}V_1 = \frac{16}{M_{Ag}} \times V_2$

$\frac{5}{2} = \frac{V_2}{V_1} \quad \Rightarrow \quad V_2 = 2.5\ V_1$

64.(BD) Molarity of $H_2O_2 = \frac{20}{11.2}$

$M_1V_1 = M_2V_2$

$\frac{M_1}{M_2} = 2$

New Volume Strength $= \frac{M_1}{2} \times 11.2$ = 10 Vol.

$\Rightarrow$ 1L of this sol will give 10 ltr of O_2.

$\Rightarrow$ 2L of this sol will give 20 ltr of O_2.

i.e. Same as before

65.(ABCD) $M(Na^+) = \dfrac{0.1 \times 1}{2} = 0.05\ M$

$M(Cl^-) = \dfrac{0.1 \times 1 + 0.1 \times 2 \times 2}{2} = 0.25\ M$

$M(Mg^{2+}) = \dfrac{2 \times 0.1 + 0.3 \times 4}{2} = 0.7\ M$

$M(NO_3^-) = \dfrac{0.3 \times 4 \times 2}{2} = \dfrac{2.4}{2} = 1.2\ M$

66.(BC) Let n_A be number of moles of solute

n_B be the number of moles of solvent

$\therefore \quad n_A = n_B$

Mass of solute = $n_A \times X$

Mass of solvent = $n_B \times Y$

Mass percent of solvent = $\dfrac{m_A}{m_A + m_B} \times 100 \quad = \dfrac{n_A X}{n_A X + n_B Y} \times 100 = \left(\dfrac{X}{X+Y} \times 100\right)\%$

Similarly, Mass % of solvent $= \left(\dfrac{Y}{X+Y} \times 100\right)\%$

67.(ABCD) $M = \dfrac{230}{46} \times 1L = 5M$

$d = \dfrac{950}{1} g / L$ or $950\ kg/m^3$

$m = \dfrac{230}{46} \times \dfrac{1000}{720} = \dfrac{500}{72} = 6.94\ m$

$X_{Ethanol} = \dfrac{\frac{230}{46}}{\frac{230}{46} + \frac{720}{18}} = \dfrac{5}{5+40} = \dfrac{5}{45} = 0.11$

68.(CD) 1g-atom of nitrogen = 1 mol N atoms

$= \dfrac{1}{2} \text{mol}\ N_2 \text{ gas} = \dfrac{1}{2} \text{mol}\ N_2 \text{ gas} = 11.2\ L\ N_2 \text{ at STP} = 14\ g\ N_2$

69.(AB) 1g molecule $V_2O_5 = 1 \text{ mole } V_2O_5 = 2 \text{ mole V Atom} = 5$ mole O atom

70.(BCD) $xA + yB \longrightarrow A_xB_y$

As per equivalent concept

Number of equivalent of A = No. of equivalent of B = No. of equivalent of A_xB_y.

71.(BCD) Equivalent of $Ba(OH)_2 = 1 \times 2 = 2$

Acids having 2 equivalents will be exactly neutralised by 1 mole of $Ba(OH)_2$

72.(BD) $\because$ Both are liquid, CH_3OH is solute (less amount)

Mass of $CH_3OH = 30 \times 0.8 = 24\,g$,

Mass of $C_2H_5OH = 60 \times 0.92 = 55.2\,g$

Mass of solution $= 24 + 55.2 = 79.2\,g$

Volume of solution $= \dfrac{79.2}{0.88} = 90\,\text{mL}$

Molarity $= \dfrac{n_{CH_3OH}}{V(L)} = \dfrac{24/32}{90} \times 1000 = 8.33\,\text{mol}\,L^{-1}$

Molality $= \dfrac{n_{solute}}{W_{solvent}(kg)} = \dfrac{24/32}{55.2} \times 1000 = 13.59$ m

Mole fraction of solute $= \dfrac{\frac{24}{32}}{\frac{24}{32} + \frac{55.2}{46}} = 0.385$

Mole fraction of solvent $= 1 - 0.385 = 0.615$

73.(CD) Inter relationship of 1M and 1m depends upon M°_{solute} and density of the solution. Vapour density is $\dfrac{M^{\circ}}{2}$ only if reference gas is $H_{2(g)}$.

74.(AB) **(A)** 46g of 70% $(W/V)\,HCOOH\,(d_{solution} = 1.4\,g/mL)$

$70\%(W/V)\,HCOOH \longrightarrow 70\,g\,HCOOH$ in 100 mL solution.

Mass of solution $= 1.4 \times 100 = 140g$

So, in 140 g solution, mass of HCOOH = 70 g

in 46 g, mass of HCOOH $= \dfrac{70}{140} \times 46 = 23g$

(B) $10\,M\,HCOOH \longrightarrow 10\,\text{mole}\,HCOOH$ in 1000 mL solution

Mass of solution = 1000 g

Mass of HCOOH $= 10 \times 46 = 460\,g$

So in 50 g solution mass of HCOOH $= \dfrac{460}{1000} \times 50 = 23\,g$

(C) $25\%(W/W)\,HCOOH \longrightarrow 25g\,HCOOH$ in 100 g solution.

So in 50 g solution, mass of HCOOH = 12.5 g

(D) 5M HCOOH $\rightarrow$ 5 mole HCOOH in 1000 mL solution So, mass of 1000 mL solution = 1000 g (d = 1 g/mL)

Mass of HCOOH = 46 × 5 = 230 g

So, in 46 g solution, mass of HCOOH = $\dfrac{230}{1000} \times 46 = 10.58$ g

75.(ACD) $V_{strength} = 28;$

$\therefore \quad M = \dfrac{28}{11.2} = 2.5$

$\therefore$ 1 L contain 2.5 moles of H_2O_2

or $2.5 \times 34 = 85\,g\,H_2O_2$

Mass of 1 litre solution = 265 g

$(\because\ d = 265\,g/L)$

$\therefore \quad W_{H_2O} = 180\,g$ or moles of $H_2O = 10$ moles

$$X_{H_2O_2} = \frac{2.5}{2.5+10} = 0.2$$

$$\%\frac{w}{v} = \frac{2.5\times 34}{1000}\times 100 = 8.5$$

$$m = \frac{2.5}{180}\times 1000 = 13.88$$

76.(B) $H_2O + SO_3 \longrightarrow H_2SO_4$;

18 g water combines with 80 g SO_3

$\therefore$ 4.5 g of H_2O combines with 20 g of SO_3

$\therefore$ 100 g of oleum contains 20 g of SO_3 or 20% free SO_3.

77.(C) Initial moles of free SO_3 present in oleum $= \frac{12}{18} = \frac{2}{3}$ moles

= moles of water that can combine with SO_3

Moles of free SO_3 combined with 9g water = $\frac{9}{18} = \frac{1}{2}$ moles

$\therefore$ moles of free SO_3 left $= \frac{2}{3} - \frac{1}{2} = \frac{1}{6}$ mole

$\therefore$ volume of free SO_3 at STP $= \frac{1}{6}\times 22.4 = 3.73\,L$

78.(C) $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$

moles of CO_2 formed = moles of Na_2CO_3 reacted $= \frac{5.3}{106} = 0.05$

volume of CO_2 formed at 1 atm pressure and 300 K = 0.05 × 24.63 = 1.23 L

79.(B) eq. of H_2SO_4 + eq. of SO_3 = eq. of NaOH

$$\frac{x}{98}\times 2 + \frac{(1-x)\times 2}{80} = 54\times 0.4\times 10^{-3}$$

$x = 0.74$

% of free $SO_3 = \frac{1-0.74}{1}\times 100 = 26\%$

80.(C) Fe reacts with steam to give $Fe_3O_{4(s)}$ and $H_{2(g)}$

81.(A) $Ba_3(PO_4)_{2(s)} + 6\,HCl \longrightarrow 3\,BaCl_{2(aq)} + 2\,H_3PO_{4(aq)}$

$\left(\frac{20}{601}\right)$ $\quad 6\left(\frac{20}{601}\right)$ $\quad \Rightarrow V_{HCl} = \frac{120}{601\times 5} \approx 0.04\,L$

82.(D) $N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$

$\frac{50}{28}$ kmoles $\quad \frac{30}{2}$ kmoles

≈ 1.75 kmoles $\quad$ 15 kmoles

(Limiting reagent)

Theoretical moles of $NH_3(g)$ that can be obtained.

≈ 3.50 kmoles.

Actual yield = 0.6 [3.5] kmoles = 2.1 kmoles

Mass of $NH_3 = 2.1\times 17$ kg $= 35.7$ kg

83.(C) Na_2CO_3 do not decompose upto $1000°C$

84.(A) $Cl_2 + 2NaOH \longrightarrow NaCl + NaClO + H_2O$

$4\text{mole} \longleftarrow 4\text{mole}$

$3NaClO \longrightarrow 2NaCl + NaClO_3$

$\frac{3}{1} \times \frac{4}{3} = 4\text{mole} \longleftarrow \frac{4}{3}\text{mole}$

$4NaClO_3 \longrightarrow 3NaClO_4 + NaCl$

$\frac{4}{3}\text{mole} \longleftarrow 1\text{mole}$

Moles of $NaClO_4 = \frac{122.5}{122.5} = 1\,\text{mole}$

4 mol Cl_2 = 284 g Cl_2 will be required

85.(C) $\underset{1\,\text{mole}}{Cl_2} + 2NaOH \longrightarrow \underset{1\,\text{mole}}{NaCl} + \underset{1\,\text{mole}}{NaClO} + H_2O$

$\underset{1\,\text{mole}}{3NaClO} \longrightarrow \underset{\frac{2}{3}=0.67\,\text{mole}}{2NaCl} + NaClO_3$

$\underset{\frac{1}{3}\text{mole}}{4NaClO_3} \longrightarrow \underset{\frac{1}{4}\times\frac{1}{3}=\frac{1}{12}\text{mole}=0.083\text{mole}}{3NaClO_4 + NaCl}$

Total $NaCl = 1 + 0.67 + 0.083 = 1.75\,\text{mole}$

86.(B) As $NaClO_3$ is intermediate it will be consumed in the complete reaction.

87. **A → P, R, S ; B → P ; C → P, Q, R ; D → S**

(A) 0.5 mole of $SO_2(g) = 32\,g$

Weight = $1.5N_A$ atoms = 11.2 L at 1 atm and 273 K

(B) $1\,g\,\text{of}\,H_2(g) = 0.5\,\text{mole}$

$H_2 = 11.2\,L$ at 1 atm and 273 K $= N_A$ atoms

(C) 0.5 moles of $O_3 = 1.5N_A$ atoms = 11.2 L at 1 atm and 273 K = 24 g weight

(D) 1 g molecules of $O_2 = 1\,\text{mole of}\,O_2 = 2N_A$ atom = 22.4 L at 1 atm and 273 K = 32 g weight

88. **A → P, Q, R ; B → R, S ; C → P, Q ; D → P, Q, R, T**

(A) Moles of $CO_2(g) = \frac{44}{44} = 1$

1 mole $CO_2(g) = 1\,g - \text{molecule}\,CO_2(g)$

(B) Moles of $CH_4(g) = \frac{35.2}{16} = 2.2$ moles

$V = 2.2 \times 22.4 = 49.28\,L$ at 1 atm and 273 K

(C) Moles of $O_3(g) = \frac{48}{48} = 1$

(D) Moles of $N_2O(g) = \frac{44}{44} = 1$

Number of O atoms $= N_A \times 1 = N_A$

89. **$A \to P, R$; $B \to Q, R$; $C \to Q, S$; $D \to Q, R$**

Use % by moles $= \frac{M_{avg} - M_1}{M_2 - M_1} \times 100$

% by mass = % by moles $\times \frac{M_2}{M_{avg}}$

90.(D)

	Molecules	**Atomicity**
(i)	P_4	4
(ii)	HNO_3	5
(iii)	C_2H_4	6
(iv)	H_2SO_4	7

91.(C) Number of atoms of gold $= \frac{39.4 \times 10^3}{197} \times 6.022 \times 10^{23} = 6.022 \times 10^{25}$

92.(C) $\frac{4}{N_A}$ mol of $O_2 = \frac{4}{N_A} \times N_A$ molecules of $O_2 = 8$ atoms of O_2

$\frac{4}{N_A}$ mol of $O_2 = \frac{4}{N_A} \times 22.4$ litre at STP $= \frac{89.6}{N_A}$ litre at STP

$\frac{4}{N_A}$ moles of $O_2 = \frac{4}{N_A} \times 32$gm of oxygen = 128 amu of oxygen

93.(A) moles of $D_2O = \frac{4}{20}$

Moles of neutrons in 4 gm $D_2O = \frac{4}{20} \times 10$ total number of neutrons in 4 gm $D_2O = 2N_A$

94.(A) $2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + CO_2 + H_2O$

Moles of $CO_2 = \frac{448}{22400} = 0.02$

Moles of $NaHCO_3$ will be twice of CO_2 that is 0.04

95.(B) 3 moles of $Cl_{2(g)}$ require 6 moles of OH^- which can be produced here by using 500 ml of 12 M KOH solution.

96.(A) Volume occupied by 1 mole of ideal gas at STP = 22.4 lt

$\Rightarrow$ number of moles of $H_2 = \frac{1}{2}$

$\therefore$ volume $= \frac{1}{2} \times 22.4 = 11.2$ lt

97.(BC) $\underset{6\ \text{mole}}{3x} + \underset{6\ \text{moles}}{4y} \longrightarrow x_3y_4$

y is liming reagent

$\Rightarrow$ 6 mole of $y \equiv 1.5$ moles. of x_3y_4

$\Rightarrow$ 1.5 mole of x is left

$= \frac{1.5}{6} \times 100 = 25\%$ is left

98.(D) moles of $BaSO_4 = \frac{1.165}{233} = 0.005$

Moles of sulphur = moles of $BaSO_4$

$= 0.005$

Mass of sulphur $= 0.005 \times 32$

$= 0.160$ gm

% of sulphur by mass $= \frac{0.160}{0.5} \times 100 = 32$

99.(A) Number of moles of C in

$kr[Fe(CN)_6]$ = number of moles of C

$6 \times nk_4[Fe(CN)_6] = 12 \times {}^{n}C_{12}H_{22}OH$

${}^{n}C_{12}H_{22}O_{11} = \frac{1}{2} \times \frac{73.6}{368}$

Mass $= \frac{1}{2} \times \frac{73.6}{368} \times 342 = 34.2$ in $C_{12}H_{22}O_{11}$

ratio of milimoles of C : H : O $= 0.033 : \frac{0.033}{12} \times 22 : \frac{0.033}{12} \times 11$

mass of $C_{12}H_{22}O_{11} = 0.033 \times 12 + \frac{0.033 \times 22 \times 1}{12} \times 1 + \frac{0.033 \times 11 \times 16}{12} = \frac{0.033}{12}\left[12 \times 12 + 22 + 11 \times 16\right]$

mass of $C_{12}H_{22}O_{11} = 0.94\,\text{mg}$

100.(4) mass of nitrogen in molecule $= \frac{175}{100} \times 32 = 56$

Number of atoms of nitrogen in one molecule $= \frac{56}{14} = 4$