Sri Chaitanya IIT Academy., India

A.P, TELANGANA, KARNATAKA, TAMILNADU, MAHARASHTRA, DELHI, RANCHI

A right Choice for the Real Aspirant

ICON Central Office – Madhapur – Hyderabad

Some Basic Concepts of Chemistry Solutions

EXERCISE-01

1. Except (C) all postulates were given by Dalton.
2. Let molar mass of $^{35}Cl = x$

 Then molar mass of $^{37}Cl = 1 - x$

 $M_{av} = 35x + 37(1-x) = 35.5$

 $35x + 37 - 37x = 35.5$

 $2x = 1.5$

 $x = \frac{1.5}{2} = \frac{3}{4}$ then $1 - x = \frac{1}{4}$

 Ratio of $^{35}Cl : ^{37}Cl = 3:1$
3. I . Mass of oxygen present $= \frac{4.4}{44} \times 32 = 3.2g$

 II. Mass of oxygen present $= \frac{2.3}{46} \times 32 = 1.6g$

 III. Mass of oxygen present $= \frac{6.8}{34} \times 32 = 6.4g$

 IV. Mass of oxygen present $= \frac{1.6}{64} \times 32 = 0.8g$

 $\therefore$ II and IV have least mass of oxygen.
4. $0.5g\, Se\, is\, present\, in\, 100g$ of enzyme

 $\therefore 78.4\, g\, Se$ will be present in $\frac{100}{0.5} \times 78.4\, g$ enzyme.

 $= 1.5680\, amu = 1.568 \times 10^4\, amu$

 $= 1.568 \times 10^4\, amu$
5. $FeC_2O_4 \rightleftharpoons Fe^{+2} + C_2O_4^{-2}$

 For 1 mole of Fe^{+2} $\frac{2}{10}$ moles of $KMnO_4$ is needed and for 1 mole of $C_2O_4^{-2}, \frac{2}{5}\, mol$ of $KMnO_4$ is needed,

 So for 1 mol FeC_2O_4,

 Moles of $KMnO_4$ required $= \frac{2}{10} + \frac{2}{5} = \frac{6}{10}$

$Fe_2\left(C_2O_4\right)_3 \rightleftharpoons 2Fe^{+3} + 3C_2O_4^{-2}$

Fe^{+3} is not affected by $KMnO_4$

For $3C_2O_4^{-2}$, moles of $KMnO_4$ needed $= 3\times\frac{2}{5}$ moles.

1 mole of $FeSO_4$ requires $= \frac{2}{10}$ moles of $KMnO_4$.

$Fe_2\left(SO_4\right)_3$ is not oxidized by $KMnO_4$.

So, total moles of $KMnO_4 = \frac{6}{10} + \frac{6}{5} + \frac{2}{10} = \frac{6+12+2}{10}$ =2 moles.

6. $4Fe + 3O_2 \rightarrow 2Fe_2O_3$

Each 1g of Fe requires $0.428g\,of\,O_2$.

$2Mg + O_2 \rightarrow 2MgO$

Each 1g ofMg requires $0.66g$ of O_2.

$P_4 + 5O_2 \rightarrow P_4O_{10}$.

Each 1g of P_4 requires $1.29g$ of o_2

$C_3H_8 + 5O_2 \rightarrow 3O_2 + 4H_2O$

Each 1g of C_3H_8 requires 3.63g of O_2.

7. 88 g of CO_2 $= 2\,moles\,of\,CO_2$

In 2 moles of CO_2, amount of C is 24 g

9 g of $H_2O = \frac{1}{2}$ mole of H_2O

In $\frac{1}{2}$ mole of H_2O amount of H is 1 g.

8. Wt of $C_{57}H_{110}O_6 = 2\times 890 = 1780g$

Wt. of $H_2O = 110\times 18 = 1980g$

$\because$ 1780 g $C_{57}H_{110}O_6$ produces 1980 g H_2O

$\because$ 445 g $C_{57}H_{110}O_6$ produces $= \frac{1980}{1780}\times 445 = 495g$

9. Hint: Mass of $O_2 = x$

Mass of $N_2 = 4x$

No of molecules of O $= \frac{x}{32}$

No. of molecules of $N_2 = \frac{4x}{28} = \frac{x}{7}$

$\therefore$ Ratio $\frac{x}{32} : \frac{x}{7} = 7:32$

10.
$$\begin{array}{lcc} & {}^{35}Cl & {}^{37}Cl \\ Molar\ ratio & x & (1-x) \end{array}$$

$$M_{avg} = 35\times x + 37(1-x) = 35.5$$

$$= 35x + 37(1-x) = 35.5$$

$$\Rightarrow 2x = 1.5,\ x = \frac{3}{4}$$

So, ratio of ${}^{35}Cl : {}^{37}Cl = \frac{3}{4} / \frac{1}{4} = 3:1$.

11.

Element	Relative mass	Relative mole	Simple whole number ratio
C	6	$\frac{6}{12} = 0.5$	1
H	1	$\frac{1}{1} = 1$	2

So, $x = 1,\ y = 2$

Equation for combustion of C_xH_y

$$C_xH_y + \left(x + \frac{y}{4}\right)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$$

Oxygen atoms required $= 2\left(x + \frac{y}{4}\right)$

As mentioned,

$$2\left(x + \frac{y}{4}\right) = 2z; \left(x + \frac{y}{4}\right) = z$$

Now putting the values of x and y

$$\Rightarrow \left(1 + \frac{2}{4}\right) = z \quad \Rightarrow z = 1.5$$

$\therefore$ Molecular $(C_xH_yO_z)$ can be written as $C_1H_2O_{3/2}$

$\Rightarrow C_2H_4O_3$.

12. Percentage (by mass) of elements given in the body of a healthy human adult is:
Oxygen $= 61.4\%$, carbon $= 22.9\%$,
Hydrogen $= 10.0\%$ and Nitrogen=2.6%
$\because$ Total weight of person =75kg
$\therefore$ Mass due to ${}^{1}H$ is $= 75 \times \frac{10}{100} = 7.5kg$
If ${}^{1}H$ atoms are replaced by ${}^{2}H$ atoms.
Mass gain by person would be $= 7.5kg$

13. $$\frac{V\times 45}{100} + \frac{(800-V)\times 20}{100} = \frac{800\times 29.875}{100}$$

$$\Rightarrow \frac{9V}{20} + 160 - \frac{V}{5} = 239 \Rightarrow V = 316.$$

14. Vol. of $C_xH_y = 15ml$ $C_xH_y + O_2 \longrightarrow CO_2 + H_2O_{(l)}$

Vol. of air $= 375mL$

$\therefore$ Vol. of $O_2 = 375 \times \frac{20}{100}$

$= 75 = 75mL$ of O_2.

Ratio of volumes $= \frac{15}{75} = \frac{1}{5}$

$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

$15mL \quad 75mL \qquad 45mL$

Volume of air except oxygen $= 375 - 75 = 300mL$

$\therefore$ Volume of gases $= 300 + 45 = 345\,mL$

$\because$ A little amount of CO_2 is solute in H_2O

Hence, the volume of the gases will be less than 345mL

$\therefore C_3H_8$.

15. Mass of substance=250mg=0.250g

Mass of $AgBr = 141\ mg = 0.141g$

1 mole of $AgBr = 1$g atom of Br

$188g\ of\ AgBr = 80g$ of Br.

$\therefore 188g\ of\ AgBr$ contain bromine=80g

0.141g of AgBr contain bromine

$= \frac{80}{188} \times 0.141 = 0.06g$

$0.06g$ of bromine is present in $0.250g$ of organic compound

$\therefore$ % of bromine $= \frac{0.06}{0.250} \times 100 = 24\%$.

16. In an unknown compounds containing N and H given % of H=12.5%

$\therefore$ % of $N = 100 - 12.5 = 87.5\%$.

Element	Percentage	Atomic ratio	Simple ratio
H	12.5%	$\frac{12.5}{1} = 12.5$	$\frac{12.5}{6.25} = 2$
N	87.5	$\frac{87.5}{14} = 6.25$	$\frac{6.25}{6.25} = 1$

Empirical formula $= NH_2$

Mol. $wt = 2 \times$ vapour density $= 16 \times 2 = 32$.

Molecular formula $= n \times$ empirical formula mass

$n = \frac{32}{16} = 2$

$\therefore$ Molecular formula of the compound will be $= (NH_2)_2$

$= N_2H_4$.

17. $\underset{208g}{BaCl_2} + \underset{98g}{H_2SO_4} \longrightarrow \underset{233g}{BaSO_4} + \underset{73g}{2HCl}$

Mass of $BaCl_2$ in solution $= 50 \times \frac{9.8}{100} \times 4.9 = 4.8g$

$98g$ of H_2SO_4 reacts with $208g$ $BaCl_2$

$4.9g$ H_2SO_4 will react with $\frac{208}{98} \times 4.9 = 10.4g$ $BaCl_2$

H_2SO_4 reacts as a limiting reagent because $BaCl_2$ is given in excess

$98g$ H_2SO_4 produces $233g$ $BaSO_4$

$4.9g$ H_2SO_4 will produce $\frac{233}{98} \times 4.9 = 11.65g$ $BaSO_4$.

18. $\because$ $18g$, H_2O contains $= 2g$ H

$\therefore 0.72g$ H_2O contains

$= \frac{2}{18} \times 0.72g = 0.08gH$

$\because 44g$ CO_2 contains $= 12$ gC, $\therefore 3.08g$ CO_2 contains $= \frac{12}{44} \times 3.08 = 0.08gC$

$\therefore C : H = \frac{0.84}{12} : \frac{0.08}{1} ; 0.07 : 0.08 = 7 : 8$, $\therefore$ Empirical formula $= C_7H_8$.

19. 74.75% of chlorine means 74.75g chlorine is present in 100g of metal chloride.

Weight of metal $= 100 - 74.75$

$= 25.25g$

Equivalent weight

$= \frac{\text{Weight of metal}}{\text{Weight of chlorine}} \times 35.5$, $= \frac{25.25}{74.75} \times 35.5 = 12$

Valency of metal $= \frac{2 \times V.D}{\text{Equivalent wt. of metal } + 35.5}$

$= \frac{2 \times 94.8}{12 + 35.5} = 4$,

$\therefore$ Formula of metal chloride is MCl_4.

Alternate method:

Mol. $wt = 2 \times$ vapour density

$= 2 \times 98.4 = 189.6g$

Since 74.75% is chlorine

Therefore, 189.6 metal chloride contains

$= \frac{74.75}{100} \times 189.6 = 141.72g$ chloride

Number of atoms of chloride $= \frac{141.72}{35.5} = 3.99 \approx 4$

Hence, formula of metal chloride is MCl_4.

20.

Element	%	Relative no.Of atoms	Simplest Ratio of atoms
C	9	$\frac{9}{12}=\frac{3}{4}$	3
H	1	$\frac{1}{1}=1$	4
N	3.5	$\frac{1}{1}=1$	1

Empirical formula $= C_3H_4N$

$(C_3H_4N)_n = 108$

$(12\times3+4\times1+14)_n = 108$

$(54)_n = 108$, $n=\frac{108}{54}=2$

$\therefore$ Molecular formula $= C_6H_8N_2$.

21. $C_xH_yO_z + O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$

$44g\ of\ CO_2$ contains $12g\ of\ C$.

So, $2.64g\ of\ CO_2$ contains $\frac{12}{44}\times2.64 = 0.72g\,C$

Similarly, $1.08g\ of\ H_2O$ contains $\frac{2}{18}\times1.08 = 0.12g\ H$.

$\therefore$ Mass of oxygen present $= 1.80-(0.72+0.12) = 0.96g$

$\%\ of\ O = \frac{0.96}{1.80}\times100 = 53.33\%$.

22.

Element	%	Relative no. Of atoms	Simplest Ratio of atoms
C	62	$\frac{62}{12}=5.167$	3
H	10.4	10.4	6
O	27.6	$\frac{27.6}{16}=1.725$	1

23.

C	H
$\frac{85.7}{12}$	$\frac{14.3}{1}$
7.14	14.3
1	2

Empirical formula $= CH_2$

24.

E	O
40%	60%
$\frac{40}{32}$	$\frac{60}{16}$
1.25	3.75
1	3

Simple whole number ratio 1 : 3 $\Rightarrow EO_3$.

25. $n_{KNO_3} = \frac{110}{101} = 1.09$

From stoichiometry

3 mole KNO_3 requires = 4 mole HNO_3

1.09 moles KNO_3 requires $= \frac{4}{3} \times 1.09 = 1.45$ moles

Weight of HNO_3 requires $= 1.45 \times 63 = 91.5g$

26. $C_{(S)} + O_{2_{(g)}} \longrightarrow CO_{2_{(g)}} + 400KJ$

$C_{(S)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{(g)} + 100KJ$

Weight of coal $= 0.6\ kg = 0.6 \times 10^3\ g$

Weight of pure carbon $= 0.6 \times 10^3 \times \frac{60}{100}$

$n_c = \frac{0.6 \times 10^3 \times 60}{100} \times \frac{1}{12} = \frac{6 \times 60}{100}$

40% of 'C' is converted into CO_2,

Energy released $= \frac{6 \times 60}{12} \times \frac{40}{100} \times 400 = 4800KJ$

60% of 'C' is converted into CO,

Energy released $= \frac{6 \times 60}{12} \times \frac{60}{100} \times 100 = 1800KJ$

Total energy released $= 4800 + 1800 = 6600KJ$.

27. 16 moles of $NaOH$ neutralizes 16 moles of H^+ source of $H^+ \longrightarrow 2$ moles $HCl + 1$ mole H_2So_4

$\therefore$ No of moles of $So_2Cl_2 = \frac{16}{4} = 4$ moles.

28. $CaCo_3 \longrightarrow CaO + Co_2$

$100g CaCo_3 \longrightarrow 56g\ CaO$

$? \longleftarrow 14g\ CaO$

$= \frac{100 \times 14}{56} = 25g$

Percentage purity is only up to 80%.

$\frac{25}{80} \times 100 = 31.25g$.

29. Number of milli equivalents of Cu^{+2}

$=100\times 63.5\times 10^{-3}=6.35g$

$159.5g\ \ of\ \ CuSo_4$ Should contain $\longrightarrow 63.5g\ \ of\ \ Cu$

But only $6.35g\ \ Cu$ is present

% purity$=\frac{6.35}{63.5}\times 100=10\%$.

30. $N_2+3H_2\longrightarrow 2NH_3$

$n_1=\frac{W_1}{28}\quad \frac{W_2}{2}\qquad \frac{W_2}{2}\times\frac{1}{3}$

$\frac{W_2}{2}\times\frac{1}{3}<\frac{W_1}{28}$

$\frac{W_1}{W_2}>\frac{14}{3}$

$\frac{WH_2}{WH_2}>\frac{14}{3}$

31. $N_2+3H_2 \rightleftharpoons 2NH_3$

$(g)\quad (g)\qquad (g)$

$20g\quad 5g$

No of moles $\frac{20}{28}\ \frac{5}{2}$ moles

3 moles of $H_2\cong 1$ mole of N_2 required

$\frac{5}{2}$ moles of $H_2\longrightarrow ?=\frac{5}{2}\times\frac{1}{3}=\frac{5}{6}=0.83$

Moles of $N_2=\frac{20}{28}=0.71$

$\therefore N_2$ is the limiting reagent

$n_{(NH_3)}=2\times\left(n_{N_2}\right)=2\times 0.71$

$=1.42$

32. $N_2+\quad 3H_2\longrightarrow 2NH_3$

$1mole\ \ 3mole\qquad N_2$

$28g\qquad 6g\qquad 28g$ react with 6g H_2

$\therefore$ For $56g\ \ of\ \ N_2\longrightarrow ?$

$=\frac{56\times 6}{28}=12g\ \ H_2$

33. a) $4Fe+3O_2\longrightarrow 3Fe_2O_{33}$

1g of Fe requires $=\frac{3\times 32}{4\times 56}=0.43g$ of oxygen

b) $P_4+5O_2\longrightarrow P_4O_{10}$

1g of p requires $=\frac{5\times 32}{31\times 4}=1.3g$ of oxygen

c) $C_3H_8 + 5O_2 \longrightarrow 3Co_2 + 4H_2O$

d) 1g of C_3H_8 requires $= \frac{5\times32}{44} = 3.6g \;\; of \;\; O_2$

34. 44g of Co_2 contains 12g of C

So 2.64g of Co_2 contains $\frac{12}{44}\times2.64 = 0.72\,gms$

1.08g of H_2O contains $\frac{2}{18}\times1.08 = 0.12g \quad H$

$\therefore$Mass of oxygen present $= 1.80-(0.72+0.12) = 0.90g$

% of oxygen $= \frac{0.96}{1.80}\times100 = 53.33\%$

35. For the given reaction

$2C_{57}H_{110}\underset{(s)}{O_6} + 16\underset{(g)}{3O_2} \longrightarrow 114\underset{(g)}{CO_2} + 110H_2O(l)$

Moles of $2C_{57}H_{10}O_6 = \frac{445}{890} = 05$, New moles of water$= \frac{100}{2}\times0.5 = 27.5$

$\therefore$Mass of water $= 27.5\times18 = 495g$

36. Molarity $= \frac{No\, of\; moles\, of\; sugar}{Volume\, of\; solution\,(in\, L)}$

$0.1 = \frac{n}{2}$, $n = 0.2$

$\frac{wt}{G.M.wt} = 0.2 \Rightarrow Wt\, of\; sugar = 0.2\times342 = 68.4\,g$

37. $PPM = \frac{Mass\, of\; solute(g)}{Mass\, of\; solution(g)} = \frac{0.2}{500}\times10^6 = 400\,ppm$

38. 95% H_2SO_4 by weight means 100 g H_2SO_4 solution contains 95 g H_2SO_4 by mass Molar Mass of $H_2SO_4 = 98\,gmol^{-1}$

Moles in $95\,g\,H_2SO_4 = \frac{95}{98} = 0.969 mol^-$

Volume of $100\,g\,H_2SO_4$ solution

$= \frac{mass}{density} = \frac{100\,g}{1.834\,g\,cm^{-3}} = 54.52\,cm^3$

$= 54.52\times10^{-3}\,L$

Molarity $= \frac{moles\, of\; solute}{Volume\, of\; solution\, in\, Lit}$

$= \frac{0.969}{54.52\times10^{-3}} = 17.8\,M$

39. no. of moles of $H_2O(n_1) = \frac{18}{18} = 1$

No.of moles of $NaOH\left(n_2\right)=\frac{8}{40}=\frac{1}{5}$

Mole fraction of $NaOH=\frac{n_2}{n_1+n_2}==\frac{\frac{1}{5}}{\frac{1}{5}+1}$

Morality $=\frac{no.of\ moles\ of\ solute}{mass\ of\ solvent\left(kg\right)}$

$=\frac{1}{5}\times\frac{1000}{18}$ =11.11M.

40. The relation b/w Molarity (M) and molality (m) is m=molarity , m^1=M.wt of solute

$=\frac{1000\times3}{1000\times1.252-3\times58.5}=2.79m$

41. Let total Volume $=1000ml=1L$

Total mass of solution $=1460g$

Mass of $Hcl=\frac{35}{100}\times1460$

Moles of HCl= $\frac{35\times1460}{100\times36.5}$

So, morality $=\frac{35\times1460}{100\times36.5}$=14M

42.

	1^{st} *component*	2^{nd} *component*
Mole	n_1	n_2
M.W	M_1	M_2
Mass	n_1M_1	n_2M_2

Mass of solution $=n_1M_1+n_2M_2$

Mole fraction of the 2^{nd} Component $n_2=\frac{n_2}{n_1+n_2}\Rightarrow n_1=\frac{n_2\left(1-n_2\right)}{n_2}$

Mass of solution $=n_1M_1+n_2M_2$

$$=\frac{n_1M_1\left(1-x_2\right)}{x_2}+n_2M_2=\frac{n_2}{n_2}\left[M_2x_2-x_2M_1+M_1\right]$$

Volume of solution $=\frac{n_2\left[M_2x_2-x_2M_1+M_1\right]}{1000dx_2}$

$$C_2=\frac{1000x_2dx_2}{n_2\left[M_2n_2-x_2M_1+M_1\right]},\quad C_2=\frac{1000dx_2}{M_1+x_2\left(M_2-M_1\right)}$$

43. $MV = M_1V_1 + M_2V_2$

$$M = \frac{M_1V_1 + M_2V_2}{V} = \frac{2\times10 + 0.5\times200}{210},\ M = \frac{120}{210} = 0.57M$$

44. 2 moles of water softner require 1 mole of $Ca^{+2} ion$

so, 1 mole of water softner require $\frac{1}{2}$ mole of $Ca^{+2} ions$

Thus, $\frac{1}{2\times206} = \frac{1}{412} mol/g$ Will be maximum uptake

45. Molality =Moles of solute/Mass of solvent in kg

$$= \frac{0.01/60}{0.3} = \frac{0.01}{60\times0.3} = 5.55\times10^{-4} M$$

46. For multiplication and division Number with least significant figure Considered.

EXERCISE – II

1. Let the weight of Mg in the extract=xg

$\frac{x}{2000}\times 10^6 = 48$ [Assuming 1000ml $\approx 1000kg\ for\ water$]

$x = 96\times 10^{-3}$

$n_{Mg} = \frac{weight}{Molar\ mass} = \frac{96\times 10^{-3}}{24} = 0.004$

Number of Mg atoms $= 0.004\times 6.02\times 10^{2.3}$

$= 24.8\times 10^{20} \approx 25\times 10^{20}$

2. No. of atoms $= \frac{8}{23}\times 6.02\times 10^{23} = 2.09\times 10^{23} = 2\times 10^{23}$

3. 2700 kJ heat is produced by 1 mole of glucose No. of moles of glucose required for production of 10000 kJ heat $= \frac{10000}{2700} mole$

$\therefore$ Total mass of glucose required$= = \frac{10000}{2700}\times 180 = 666.67 \approx 667g$

4. Na^+ Present in 50 ml $= \frac{70mg\times 50ml}{1ml} = 3500\,mg\ or\ 3.5\,g$

Moles of $Na^+ = \frac{35}{23} =$ moles of $NaNO_3$.

Mass of $NaNO_3 = \frac{3.5}{2.3}\times 85 = 12.9 = 13g$

5. $CH_3 - CH_3 + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O$

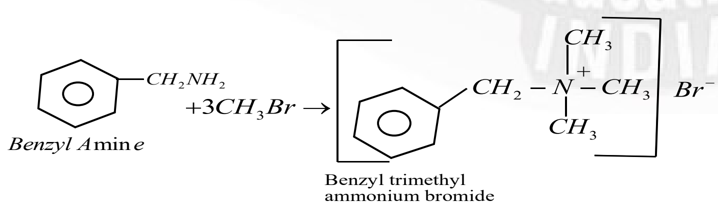
$30g$ of Ethane produces 54 g of water.

3g of ethane produces $\frac{54}{30}\times 3g$ of water $= 5.4g$ of H_2O.

18 g of H_2O contains 6.022×10^{23}. molecules of H_2O. So, $5.4\,g$ of H_2O will contain

$= \frac{5.4\times 6.022\times 10^{23}}{18} = 18\times 10^{23}$ Molecules of H_2O.

6.



1 mole of benzyl amine requires 3 mole of bromomethane. So, 0.1 mol of benzyl amine required 3×0.1mol of bromo methane.

So, the number of moles of bromo methane required $= 0.3\,mol = 3\times10^{-1.}$ mol

The value of n=3.

7. Hint: $\underset{(g)}{N_2} + \underset{(g)}{3H_2} \Rightarrow \underset{(g)}{2NH_3}$

Moles of $N_2 = \dfrac{2.8\times10^3}{28} = 10^2\,moles$

Moles of $H_2 = \dfrac{1\times10^3}{2} = 5\times10^2\,moles$

For 10^2 moles $N_2 - 3\times10^2$ H_2 Needed

$\therefore N_2$ is limiting reagent

1 mole $N_2 \rightarrow 2$ moles NH_3

$\therefore 100$ moles $N_2 \rightarrow 200$ mole NH_3

$\therefore Mass\ of\ 200\ moles\ of\ NH_3 = 200\times17 = 3400\,gm$

8. $CO_2 = 44g$

$1g\ CO_2 \rightarrow \dfrac{12}{44} g\ C$

$420g\ of\ CO_2 \rightarrow \dfrac{12}{44}\times420 = 114.54g\ C$

$H_2O \rightarrow 18g$

$18g\ of\ H_2O \rightarrow 2g\ H_2$, $1g\ H_2O \rightarrow \dfrac{2}{18} g\ of\ H_2$, $210g\ H_2O \rightarrow \dfrac{2}{18}\times210 \Rightarrow 23.33g\ H_2$

$\%\ H_2 \Rightarrow \dfrac{23.33}{750}\times100 = 3.11\%$, $\therefore n=3$

9.

Element	Percentage	Atomic mass	Relative no. Of atoms	Divided by Lowest number	Simple ratio
S	47.4	32	$\dfrac{47.4}{32} = 1.48$	$\dfrac{1.48}{1.48} = 1$	1
Cl	52.6	35.5	$\dfrac{52.6}{35.5} = 1.48$	$\dfrac{1.48}{1.48} = 1$	1

$\therefore$ The empirical formula of the compound is SCl.

Calculation of molecular formula

Empirical formula mass $= 1\times32 + 1\times35.5 = 67.35\ amu$

$n = \dfrac{\text{Molecular mass}}{\text{Empirical formula mass}} = \dfrac{135}{67.5} = 2$

$\therefore$ Molecular formula $= n\times$ empirical formula

$2\times SCl = S_2Cl_2 = s_x cl_y$

$\therefore x + y = 4$.

10. $\%Fe = \frac{No.of.\ Fe - atoms \times At.Wt.of\ \ Fe}{GMW\ \ of\ \ \ Haemoblobin} \times 100$

$2 \times 56 \times 100$ divided by

$0.33 = \frac{2 \times 56 \times 100}{x}$

$x = \frac{2 \times 56 \times 100}{0.33} = 34000$

$= 34 \times 10^3$

$x = 34$.

11. Percentage of Nitrogen= $\frac{28}{22400} \times \frac{vol.of.N_2\ \ in\left(ml\right) \times 100}{molecular\ \ weight\ \ of\ \ organic\ \ compound}$

$= \frac{28}{22400} \times \frac{50 \times 100}{0.132} = 47.34$

12. Sol: percentage of carbon= $\frac{weight\ \ of\ \ carbon}{molecular\ \ weight\ of\ Co_2} \times 100$

$= \frac{12}{44} \times 100$

$= 27.27\%$.

13. $M_x Cl_y = MCl_y \left(\because \text{valency of } Cl = 1\right)$

Molar mass of $M_x Cl_y = 85.5 \times 2 = 171 g/mol$

$\left(M\right)\left(x\right) + \left(35.5\right)\left(y\right) = 171 ......(1)$

$\frac{\text{Mass of chloride}}{\text{Mass of metallic chloride}} = \frac{0.835}{1}$

$= \frac{35.5y}{M\left(x\right) + \left(35.5\right)\left(y\right)}$

On solving $y = 4$ and $x = 1$

$x + y = 5$.

14. Mass ratio of C:H is $4:1 \Rightarrow 12:3$ and

$C:O\ is\ 3:4 \Rightarrow 12:16$ So,

	mass	mole	mole ratio
C	12	1	1
H	3	3	3
O	16	1	1

Empirical formula $\Rightarrow CH_3O$

As compound is saturated acyclic, so molecular formula is $C_2H_6O_2$.

$$\underset{2\,mole}{C_2H_6O_2} + \underset{5\,mole}{\frac{5}{2}O_2\left(g\right)} \longrightarrow 2CO_2\left(g\right) + 3H_2O\left(g\right)$$

$\therefore$ Number of moles of O_2 required to oxidise 2 moles of (X) =5.

15. Weight of H in 210g of $H_2O = \frac{210}{18} \times 2 = 23.333g$

$\%$ of $H = \frac{23.333}{750} \times 100 = 3.111 \cong 3$.

16. Propane

$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

1 mole of $C_3H_8 \longrightarrow 5\ mole\ of\ O_2$

Butane

$C_4H_{10} + \frac{13}{2}O_2 \longrightarrow 4CO_2 + 5H_2O$

1 mole of $C_4H_{10} \longrightarrow \frac{13}{2}$ mole of O_2

$\therefore$ 2............$\longrightarrow \frac{13}{2} \times 2$ mole of O_2

=13 mole O_2

Minimum $= 5 + 13$ =18 moles O_2

17. Moles of $N_2 = \frac{2800}{28} = 100$ and moles of $H_2 = \frac{1000}{2} = 500$

	$\underset{(g)}{N_2}$	$+\underset{(g)}{3H_2}$	$\longrightarrow \underset{(g)}{2NH_3}$
Initial mole	100	500	0
Final mole	0	200	200

Mass of NH_3 formed $= 200 \times 17 = 3400\ g$

18. $2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$

Moles of $Cu_2O = \frac{2.86 \times 10^3}{143} = 20$

Moles of $Cu_2S = \frac{4.77 \times 10^3}{159} = 30$

Cu_2O is limiting reagent

$2Cu_2O$	$+Cu_2S$	$\longrightarrow 6Cu$	$+SO_2$
20	30	–	–
–	20	60	10

$\therefore$Mass of copper $= 60 \times 63.5 = 3810$ gms.

19.

$$\underset{x\ g}{H_2C-CH_2-\overset{\overset{O}{\|}}{C}-H} \xrightarrow[-H_2O]{\Delta} \underset{7.8\ g}{H_2C=CH-\overset{\overset{O}{\|}}{C}-H}$$

$x/74\ mole$ $\qquad$ $x/74 \times 0.64\ mole$

$\therefore \frac{x}{74} \times 0.64 = \frac{7.8}{56}$

Sri Chaitanya Educational Institutions INDIA

$x = 16 \cdot 10 \simeq 16$.

20. $H_2O_2 + \overset{(+7)}{MnO_4^-} + 4^+ \longrightarrow Mn^{+2} + O_2 + H_2O$

Moles of $KMnO_4 = \frac{0.316}{158} = 2\times10^{-3}$

Equivalents of H_2O_2 = Equivalents of $KMnO_4$

Equivalents of $KMnO_4 = 2\times10^{-3}\times5 = 0.01$

Moles of $H_2O_2 = \frac{\text{Equivalents of } H_2O_2}{\text{n} - \text{factor of } H_2O_2} = \frac{0.01}{2} = 0.005$

Mass of pure $H_2O_2 = 0.005\times34 = 0.170g$

Percentage purity $= \frac{0.17}{0.2}\times100 = 85\%$.

21. Concentration of glucose in blood $= 0.72\, g / L$

$= \frac{0.72}{180} = 4\times10^{-3} mol / L$

22. Normality$= \frac{No\, of\ equivalents\, of\ solute}{Volume\, of\ solution\, in\, L}$

$$0.1 = \frac{1.43}{\frac{(106+18^x)}{2}\times0.1} \Rightarrow \frac{106+18x}{2} = 3$$

$18x = 286 - 106 = 180$

$x = 10$

23. $\frac{10.3\times10^{-3}}{1.03\times1000}\times10^6 = 10$

24. let total mole of solution =1

So, mole of glucose =0.1

Mole of H_2O =0.9

$\%(W/W)$ of $H_2O == \left(\frac{0.9\times18}{0.9\times18+0.1\times180}\right)\times100 = 47.368 = 47.31$

25. Sol:- Number of moles of x= $\frac{6.022\times10^{22}}{6.023\times10^{23}} = \frac{10}{Molar\, mass\, of\ x}$

So, molar mass of x $= 100\, g$

Molarity $= \frac{5}{100\times2} = 0.025M$

26. Sol:- Moles of H_2SO_4 in solu $A = 50\%\, original\, solution = 0.02/2 = 0.01 Mmol$

27. Hint: Zero's before Number not significant .

Zero's after number before decimal significant. 0.00340

28. Hint: - Zero's between Numbers are significant.

EXERCISE -III

1. Same $E.F \Rightarrow$ same % i.e., same ratio of masses.

2. $57.2 = \frac{4x}{M} \times 100$; 43.8 , $= \frac{96}{M} \times 100 \Rightarrow x = 32$.

3.

$C \quad H$

$80g \quad 20g$

$= \frac{80}{12} : \frac{20}{1}$

$1 : 3$

$\frac{n}{2n+2} = \frac{1}{3} \Rightarrow n = 2$.

4. $\%Fe = \frac{4 \times 56}{65000} \times 100 = 0.35\%$

Weight Fe in 1mole $= 4 \times 56 = 224g$

If % Fe↑ , m. wt↑

5. $C = 26.7 \quad H = 2.2\% \quad P = 71.1\%$

$C = \frac{26.7}{12} \quad H = \frac{2.2}{1} \quad O = \frac{71.1}{16}$

$= 2.22 \quad = 2.2 \quad = 4.44$

Empirical formula $= CHO_2$

Empirical formula wt= $= 45$

Molecular weight $= 2 \times VD$

$= 2 \times VD = 2 \times 73 = 146$

(mol wt. of diethyl ester)

Molecular weight of acid $= 146 - 58 + 2 = 90$

$n = 2$ so molecular formula $= (CHO_2)n$

$= (CHO_2)_2 = C_2H_2O_4$.

6. $N_2 + 3H_2 \longrightarrow 2NH_3$

$\frac{140}{28} \quad \frac{40}{2} \quad 0$

5moles 20 moles 0

0 5 moles 10

$10 \times 17 = 17$ gram

% yield=80 $= \frac{\text{Acutal wt}}{\text{expect}} \times 100$

$\Rightarrow \frac{80}{100} = \frac{w}{30} \quad \Rightarrow w = 24g$

$\therefore \quad N_2 [L.R]$ completely consumed in reaction

$\frac{50}{100} = \frac{w}{170} \Rightarrow w = 85gm$

7. $C_xH_y + \left(x+\frac{y}{4}\right)O_2 \rightarrow xCo_2 + \frac{y}{2}H_2O$

$x+\frac{y}{4}=6 : x=4$, $\frac{y}{4}=2 : y=8$.

8. $146g = 4\,moles$

$\Rightarrow MnO_2$ is limiting reagent

$MnO_2 + 14Hcl \rightarrow MnCl_2 + Cl_2 + 2H_2O$

$0.8 + 4\times 0.8 \rightarrow 0.8$.

9. $N_2 + 3H_2 \longrightarrow 2NH_3$ $\quad H_2 \rightarrow L.R$

$In\ 10 \quad 20 \quad\quad 0$ $\quad N_2 \rightarrow E.R$

3ml of H_2 —— $1\ ml$

$20ml\ \ of\ \ N_2$ —— x

$3x = 20$

$x = 6.7ml - N_2$ consumed

3ml of H_2 —— $2ml\ \ NH_3$

$20ml\ \ of\ \ H_2$ —— x

$3x = 40$

$x = \frac{40}{3} = 13.3ml\ \ NH_3$

Volume of gas left $= 13.3 + 3$

$16.7ml$, Volume of N_2 $= 10 - 6.66$, $= 3.4ml$.

10. Concentration terms involving with volume term is temperature dependent

Molality & Mole fraction does not contain Volume term, thus it is temperature independent

11. $M = wt\,of\ solute = 49$

$wt\,of\ solution = 130$

$wt\,of\ \ solvent = 100 - 49 = 51$

$M = \frac{49}{98}\times\frac{1000}{51}$

$wt\,of\ solute = 49$

$wt\,of\ solvent = 100 - 49 = 51$

Ans: - $(1,3,4)$

Sol:- wt of solute=49

Wt of solvent=100-49=51

Molality = $\frac{wt}{G.MWt}\times\frac{1000}{51} = \frac{500}{51}$

Molality$= \frac{wt}{G.M.wt}\times\frac{1000}{V_{ml}}\left(d = \frac{m}{V} \Rightarrow V = \frac{m}{d}\right) = \frac{1000}{1.3}$

$= \frac{49}{98} \times \frac{1000}{100} \times 1.3 = 6.5$

$N = M \times Z$

$6.5 \times 2 = 13$

$\%\left(w/v\right) = \frac{49}{\frac{100}{1.3}} \times 100 = 49 \times 1.3$

12. $80\%\left(w/w\right)NaOH$

80gm $NaOH$ in 100gm of solution

40 gm of $NaOH$ 50 gm of solution

$M = \frac{wt}{G.M\,wt} \times \frac{1000}{50} \left(\because d = 1gm/ml\right)$

$wt = \frac{M \times G.M.wt \times 50}{1000} = \frac{20 \times 40 \times 50}{1000} = 40gm$

13. $M = \frac{wt}{G.Mwt} \times \frac{1000}{100}$

$= \frac{12 \times 10^{-3}}{120} \times \frac{1000}{100} = 10^{-3} M$

$N = M \times Z = 10^{-3} \times 2N$

$\because$ Very dilute solute $M \simeq m$

$ppm = \frac{12 \times 10^{-3}}{100} \times 10^{6} = 120\,ppm.$

14. $M = \frac{wt}{G.Mwt} \times \frac{1000}{100}$

$= \frac{12 \times 10^{-3}}{120} \times \frac{1000}{100} = 10^{-3} M$

$N = M \times Z = 10^{-3} \times 2N$

$\because$ Very dilute solute $M \simeq m$

$ppm = \frac{12 \times 10^{-3}}{100} \times 10^{6} = 120\,ppm.$

15. $M_1V_1 = M_2V_2$

$1 \times 1 = M_2 \times 1000$

$M_2 = 10^{-3} M$

10^{-3} moles in 1000ml ?_____10ml

$= 10^{-5} moles$

16. Fact.

EXERCISE -IV

(1-6) Fact

7. SOLUTION: 1amu $=\frac{1}{12}\times mass\,of\,one\,C-12\,atom$

$=\frac{1}{12}\times\frac{12}{N_{AV}}=\frac{1}{N_{AV}}$

$\therefore 10\,amu=\frac{10}{N_{AV}}$

8. Solution:- moles of $CO_2=\frac{Volume}{Motar\,volume}=\frac{11.2}{22.4}=0.5\,mole$

9. $\therefore 1\,mole\,H_2S_2O_8$ Contains 8g atoms of O

$\therefore 0.2\,mole\,H_2S_2O_8\,will\,contain=0.2\times 8$

$=1.6\,g\,atoms\,of\,O$

10. ${}_6c^{12}$ is not radioactive hence can be used to decide the scale of atomic mass

11. Average atomic mass $=\frac{A_1P_1+A_2P_2}{100}=\frac{12\times 90+14\times 10}{100}=\frac{1220}{100}=12.2$

Moles of carbon present in 12 g sample= $\frac{12}{12.2}=0.98$

Total number fof C-atoms present in 12g sample=0.98 N_A

Since c-12 atoms are 90% of total atoms hence number of C-12 atoms present in the sample $=0.98N_A=\frac{90}{100}=0.88N_A$

12. Let % of ${}_{17}Cl^{35}=x\,and\,{}_{17}Cl^{37}=100-x$

$\frac{A_1P_1+A_2P_2}{100}=35.5$

$\frac{35x+37(100-x)}{100}=35.5$

35x+3700-37x=3550

37x-35x=3700-3550

2x=150, X=75

100-x=25

Ratio of ${}_{17}Cl^{35}:{}_{17}Cl^{37}=75:25=3:1$

13. $m_{LHS}=m_{RHS}$

14. Fact

(15-17) In B, wt, of oxygen = $4.77-3.81=0.96\,g$

Equivalent of oxygen $=\frac{0.96}{8}=0.12$, So, equivalent of metal $=0.12$

Eq. wt. of metal in $B = \frac{3.81}{0.12} = \frac{381}{12} = 31.8$, By considering eq. wt. of metal in B.

$\frac{5.72}{x+8} = \frac{6.36}{39.8}$, Where x is the equivalent weight of metal in A.

X=63.5.

Valency of metal in black oxide $= \frac{63.8}{31.8} = 2$

So, formula is MO.

1. Answer (c), 2. Answer (a), 3.Answer (d)

(18-19).Fact

EXERCISE - V

1. Fact
2. H_3PO_4

$$\begin{array}{c} O \\ \uparrow \\ H-O-P-O-H \\ | \\ O \\ | \\ H \end{array}$$

H_3PO_4 is a tribasic acid and its 3 H atoms are replaceable

3. Since molecular mass of H_2O and ice are same, hence 18 g H_2O and 18 g ice will lcontain same number of molecules.
4. Atomic mass of Mg =24

$_{12}Mg^{24}$

Atomic mass $= \dfrac{mass\ of\ single\ atom\ of\ element}{\dfrac{1}{12} \times Mass\ of\ single\ atom\ of\ element}$

From above relation we can say that an atom of Mg is 24 times heavier than $\dfrac{1}{12}$ of the mass of

C^{12}

5. Average atomic weight may be in fraction while atomic wt.of an atom never be in fraction.
6. On chemical reaction, mass of reaction is equal to mass of products.
7. In a solution, solvent is always one but solute may be more than one.
8. If density is one then weight of solution is equal to volume of solution. To calculate molality,
   weight of solvent is required. Which is independent from temperature.
9. On dilution, molarity decreases which number of moles of solution does not change.
10. Solution: Equivalent weight of acid may be equal to molecular weight if basicity of acid is one.
11. Number of molecule may change in a reaction.
12. Moles may very in a reaction.
13. Fact.
14. H_2O is liquid.
15. Molecular wt.of O_2 is 32 g mol^{-1}.
16. Fact
17. Fact
18. Fact
19. Conceptual
20. Conceptual
21. Conceptual
22. Conceptual

Sri Chaitanya Educational Institutions INDIA