HINTS & SOLUTIONS

EXERCISE - 1

Single Choice

2. mole = number of molecules / N_A
Hence : $n = N/N_A$

4. Gram mol. wt. of $C_{60}H_{22} = 742$ gm
i.e. wt. of 6.023×10^{23} molecules = 742

So wt. of 1 molecules $= \dfrac{742}{6.023 \times 10^{23}} = 1.24 \times 10^{-21}$ gm.

5.

Compound	mole of molecule	mole of atom	No. of atom
C_4H_{10}	$\frac{1}{58}$	$14 \times \frac{1}{58}$	$\frac{14}{58} N_A$
N_2	$\frac{1}{28}$	$2 \times \frac{1}{28}$	$\frac{1}{14} N_A$
Ag	$\frac{1}{108}$	$\frac{1}{108}$	$\frac{1}{108} N_A$
H_2O	$\frac{1}{18}$	$3 \times \frac{1}{18}$	$\frac{N_A}{6}$

Hence C_4H_{10} has maximum number of atoms.

6.

	$CO_2(g)$	$N_2O(g)$
Weight	2 w	5 w
No. of mole	$\frac{2w}{44}$	$\frac{5w}{44}$
No. of molecule	$\frac{2w}{44} \times N_A$	$\frac{5w}{44} \times N_A$
ratio	2 : 5	

7

	H_2	:	He	:	O_2	:	O_3
Ratio of total no. of molecules =	1	:	1	:	1	:	1
So ratio of total no. of atoms =	2	:	1	:	2	:	3

10 Atomic mass $= \dfrac{10 \times 19 \times 81 \times 11}{100} = \dfrac{190 + 891}{100} = \dfrac{1081}{100}$
$= 10.81.$

11 weight of $CO_2 = 8.8$ gm

mole of $CO_2 = \dfrac{8.8}{44} = 0.2$, mole of C = 0.2

wt. of C = $0.2 \times 12 = 2.4$ g, mole of $H_2O = \dfrac{5.4}{18} = 0.3$

So mole of 'H_2' = 0.3
wt. of hydrogen = $0.3 \times 2 = 0.6$

wt. of carbon + hydrogen = $2.4 + 0.6 = 3$
= Initial wt. of hydrocarbon
$\therefore$ It illustrate law of conservation of mass.

13.

Elements	%	$\frac{\%}{\text{Atomic mass}}$	Simple ratio	Simplest whole no.
Ca	20	20/40 = 0.5	1	1
Br	80	80/80 = 1	2	2

Hence : Empirical formula = $CaBr_2$

$n = \dfrac{200}{200} = 1$

Hence : Molecular formula = $CaBr_2$

15 8% sulphur by mass means – 8 g sulphur is present in 100 g solid.

$\therefore$ 32 g sulphur (1 mole atom) will be present in $= \dfrac{100}{8} \times 32$
$= 400$ g

[$\because$ compound must be having at least one atom of sulphur]
$\Rightarrow$ min. mol. mass = 400 g.

16. % of C $= \dfrac{\text{mass of C}}{\text{molar mass}} \times 100$

$69.98 = \dfrac{21 \times 12}{M} \times 100$

M = 360.1.

17 $3M + N_2 \longrightarrow M_3N_2$
Let Atomic wt. of metal = a
So (3a + 28) g nitride contains metal = 3a gram

$\therefore$ 14.8 g nitride contains metal $= \dfrac{3a}{3a + 28} \times 14.8 = 12$

So a = 40.

21. By applying POAC for C atoms
moles of ethylene × 2 = mole of polythene × n × 2

$\dfrac{100g}{28} \times 2 = \dfrac{\text{wt. of polethene}}{28 \times n} \times n \times 2$

wt. of polyethene = 100 g

22. $KClO_3 \longrightarrow KCl + \frac{3}{2} O_2$

$\frac{3}{2}$ mole or 33.6 litre O_2 from 1 mole $KClO_3$

11.2 litre of O_2 formed by $\frac{1}{3}$ mole $KClO_3$

25 $C + CO_2 \longrightarrow 2CO$

Given moles $\left(\frac{6}{12}\right) = 0.5 \quad \left(\frac{44}{44}\right) = 1$

So C is limiting reagent

$\therefore$ CO formed = 1 moles

Now moles of Ni need to react with 1 moles of CO are

$\frac{1}{4} \times 58.7 = 14.675$ gm.

26 $H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$

for 1 mole NaOH $\frac{1}{2}$ mole H_2SO_4 required

70 g H_2SO_4 in 100 g solution

$\frac{98}{2}$ g H_2SO_4 in $= \frac{100}{70} \times 49 = 70$ g solution.

27. $TiCl_4 + 2Mg \longrightarrow Ti + 2MgCl_2$

Initial mole $\frac{358}{190} = 1.88 \quad \frac{96}{24} = 4$

final mole $0 \quad 4 - 2 \times 1.88 \quad 1.88 \quad 2 \times 1.88$

wt of Ti obtained $= \frac{358}{190} \times 48$

% yield $= \dfrac{32 \times 100}{\frac{358 \times 48}{190}} = 35.38\,\%$

29. $2X + 3Y \longrightarrow X_2Y_3$

Weight: W gram, W gram, 0

Mole: $\frac{w}{36}$, $\frac{w}{24}$

L.R. $\rightarrow$ $\frac{w}{36} \times \frac{1}{2}$, $\frac{w}{24 \times 3}$

$\frac{1}{72}$, $\frac{1}{72}$

No. one is L.R. $2X + 3Y \longrightarrow X_2Y_3$

$\frac{w}{36} \quad \frac{w}{24} \quad \frac{w}{2[36]}$

Weight of $X_2Y_3 = \frac{w}{2 \times 36}[72 \times 2] = 2$ w

So weight of $X_2Y_3 =$ 2 [weight of X Taken]

31. $P_4 + O_2 \longrightarrow P_4O_6 + P_4O_{10}$

31 gram 32 gram

According to question weight of P is conserved so

Let Mole of $P_4O_6 = a$

Mole of $P_4O_{10} = b$

Initial weight of P = Final weight of P.

$31 = [a \times 4] \times 31 + [b \times 4] \times 31$

$4a + 4b = 1] \quad (1) \times 3$

Initial weight of oxygen = Final weight of oxygen

$32 = [a \times 6] \times 16 + [a \times 10] \times 16$

$3a + 5b = 1] \quad (2) \times 4$

$12a + 20b = 4$

$12a + 12b = 3 \quad$ So $b = \frac{1}{8}$

$8b = 1$

Similarly $a = \frac{1}{8}$

So weight of $P_4O_6 = \frac{1}{8} \times 220 = 27.5$

$P_4O_{10} = \frac{284}{8} = 35.5.$

33 $M + X_2 \longrightarrow MX_2$

$MX_2 + X_2 \longrightarrow M_3X_8$

$M_3X_8 + Na_2CO_3 \longrightarrow NX + CO_2 + M_3O_4$

mole of NX $= \frac{206}{103} = 2$

POAC for X Atom :

No. of X atom in M_3X_8 = No. of X Atom in NX

8 [No. of mole of M_3X_8] = 1 [No. of mole of NX]

No. of mole of $M_3X_8 = \left[\frac{2}{8}\right] = \frac{1}{4}$ mole

Now POAC for M Atom

3 [No. of mole of M_3X_8] = 1 × [No. of Mole of M]

$\therefore \quad 3 \times \frac{1}{4} =$ No. of mole of M

weight of M atom $= \frac{3}{4} \times 56 = 42$ gram

34. $LiAlH_4$ + t-butyl alcohol $\xrightarrow{\text{Ether}} LiAlHC_{12}H_{27}O_3$

0.05 mole (M.W. = 254) 12.7 gram

$= \frac{12.7}{254} = 0.05$ mole

Li atom remain conserved so

No. of mole of $LiAlH_4$ = No. of mole of $LiAlHC_{12}H_{27}O_3$

So No. of mole of $LiAlHC_{12}H_{27}O_3 = 0.05$

% yield $= \frac{0.05}{0.05} \times 100 = 100\%$

35. $CaCl_2 \rightarrow CaCO_3 \rightarrow CaO \quad \frac{1.12}{56} = 0.02$ mole CaO

$\therefore$ Moles of $CaCl_2 = 0.02$ Mole

Mass of $CaCl_2 = 0.02 \times 111 = 2.22$ g

$\therefore$ % of $CaCl_2 = \frac{2.22}{4.44} \times 100 = 50\%$

36. $SO_3^{2-} \Rightarrow 1(x) + 3(-2) = -2 \therefore x = +4$

$S_2O_4^{2-} \Rightarrow 2(x) + 4(-2) = -2 \therefore x = +3$

$S_2O_6^{2-} \Rightarrow 2(x) + 6(-2) = -2 \therefore x = +5$

37 $2(+2) + 2x + 7(-2) = 0$

$\therefore \quad x = +5$

40. Fe_3O_4 can be written as $FeO.Fe_2O_3$.
In FeO, Fe has oxidation state +2, in Fe_2O_3 has oxidation state +3.

resultant oxidation number $= \frac{1 \times 2 + 2 \times 3}{3} = \frac{8}{3}$.

43. $N_2H_4 \xrightarrow{-10e^-} 2N^{x+}$

(-2)

$\therefore \quad 2x - 2(-2) = 10.$

$\therefore \quad 2x = 6$

$\therefore \quad x = +3.$

45. $MnO_4^- + C_2O_4^{2-} + H^+ \longrightarrow Mn^{2+} + CO_2 + H_2O$

V.f. = 5 V.f. = 2

$\therefore$ Balanced equation :

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

46. $xP_4 + yHNO_3 \longrightarrow 4H_3PO_4 + NO_2 + H_2O$

(oxidation states: P: 0 → +5; N: +5 → 4; change for N = 1; change for P_4 = $4 \times 5 = 20$)

$\therefore$ (V.f.)P_4 : (V.f.) HNO_3 = 20 : 1

$\therefore$ x = 1; y = 20

48. Equating number of O-atoms on both sides :

$3b = a + b + 2a + c/2$

$\therefore \quad 4b = 6a + c$

Also, from charge balance : $c = a + b$

$\therefore$ a : b : c = 3 : 7 : 10

50. Let, $n_{H_2O} = n_{NaCl} = n$

$$m = \frac{\text{Mole of solute}}{\text{wt. of solvent (kg)}} = \frac{n}{n \times 18} \times 1000 = \frac{1}{18} \times 1000$$

$= 55.55$ m.

52. Mole fraction of A i.e. $X_A = \frac{n_A}{\text{Total moles}}$

So $X_{H_2O} = \frac{n_{H_2O}}{\text{Total moles}}$

Now $\frac{X_A}{X_{H_2O}} = \frac{n_A}{n_{H_2O}}$

and molality $= \frac{n_A \times 1000}{n_{H_2O} \times 18} = \frac{X_A \times 1000}{X_{H_2O} \times 18} = \frac{0.2 \times 1000}{0.8 \times 18}$

$= 13.9$ Ans.

56. Weight of KOH = 2.8 gram

Volume of solution = 100 ml

$M = \frac{2.8 \times 1000}{56 \times 100} = \frac{28}{56} = 0.5$ M

57. $M_{final} = \frac{M_1V_1 + M_2V_2}{V_1 + V_2 + V_{water}}$; $0.25 = \frac{0.6 \times 250 + 0.2 \times 750}{250 + 750 + V_{water}}$;

So $V_{water} = 200$ ml.

60. Moles of Cl^- in 100 ml of solution

$= \frac{2}{58.5} + \frac{4}{111} \times 2 + \frac{6}{53.5} = 0.2184$

Molarity of $Cl^- = \frac{0.2184}{100} \times 1000 = 2.184.$

61. Conc. of cation $= \frac{400 + 300 + 200}{400}$;

conc. of anion $= \frac{200 + 300 + 400}{400}$

$\therefore$ ratio of the conc. = 1

64. Mole of calcium $= \frac{20}{40} = 0.5$

Mole of maginesium $= \frac{24}{24} = 1$

Mole of carbon $= \frac{12}{12} = 1$

Mole oxygen atom in 8 g $= \frac{8}{16} = 0.5$

Mole of oxygen atom in 16 g $= \frac{16}{16} = 1$

Hence option (C) is correct

66. C : O : S = 3 : 2 : 4

Hydrogen is = 7.7%

$\therefore$ 100 – 7.7 = 92.3 % contains C,O & S

$\%C = \left(\frac{3}{3+2+4}\right)92.3$; $\%O = \frac{2}{9} \times 92.3$;

$\%S = \frac{4}{9} \times 92.3$

Elements	%	% / Atomic mass	Simple ratio	Simplest whole no.
H	7.7	7.7	6	6
C	30.76	30.76/12 = 2.56	2	2
O	20.51	20.15/16 = 1.28	1	1
S	41.02	41.02/32 = 1.28	1	1

$\therefore$ empirical formula C_2H_6OS

minimum molar mass = 24 + 6 + 16 + 32 = 78

68. $CaC_2 + H_2O \longrightarrow Ca(OH)_2 + C_2H_2 \longrightarrow C_2H_4$ ... **(1)**

$nC_2H_4 \longrightarrow -(CH_2-CH_2)_n-$ ... **(2)**

From equation **(1)**

mole of CaC_2 = mole of C_2H_4

$\frac{64 \times 10^3}{64}$ = mole of C_2H_4

From equation **(2)**

$\frac{\text{mole of } C_2H_4}{n} = \frac{\text{mole of polymer}}{1}$

$\frac{10^3}{n} = \frac{\text{wt of polymer}}{n(28)}$

wt of polymer = 28 × 10^3 g = 28 Kg

70. Let mol of N_2 = x, mol of NO_2 = y, mol of N_2O_4 = z

therefore $\frac{28x + 46y + 92z}{1} = 55.4$ ....**(1)**

If $N_2O_4 \longrightarrow 2NO_2$

$\frac{28x + (y + 2z)46}{x + y + z + z} = 39.6$

$\Rightarrow \frac{28x + 46y + 92z}{1 + z} = 39.6$ ....**(2)**

By deviding equation **(1)** by equation **(2)**

$1 + z = \frac{55.4}{39.6} = 1.4$

z = 0.4 mol

Given x + y + z = 1 ....**(3)**

Put the value of z in eq. **(1)**

28x + 46y + 92 + 0.4 = 55.4

28x + 46y = 18.6 ....**(4)**

By equation **(3)** & **(4)**

y = 0.1

$\therefore$ x = 0.5, y = 0.1, z = 0.4

73. **(A)** Explanation : $2Ag + S \rightarrow Ag_2S$

2 × 108 g of Ag reacts with 32 g of sulphur

10 g of Ag reacts with $\frac{32}{216} \times 10 = \frac{320}{216} > 1$ g

It means 'S' is limiting reagent

32 g of S reacts to form 216 + 32 = 248 g of Ag_2S

1 g of S reacts to form $= \frac{248}{32} = 7.75$ g

Alternately

n_{eq} of Ag $= \frac{10}{108} = 0.0925$ n_{eq} of S $= \frac{1}{16} = 0.0625$

(n_{eq} = number of equivalents)

Since n_{eq} of S is less than n_{eq} of Ag

$\Rightarrow$ 0.0625 eq of Ag will react with 0.0625 eq of S to form 0.0625 eq of Ag_2S

Hence , amount of $Ag_2S = n_{eq} \times$ Eq. wt. of Ag_2S

= 0.0626 × 124 = 7.75 g

76. Let of mol of Fe undergoing formation of FeO = x

Let mol of Fe undergoing formation of Fe_2O_3 = 1 – x

then, $Fe + \frac{1}{2}O_2 \longrightarrow FeO$

x   x/2   x

$2Fe + \frac{3}{2}O_2 \longrightarrow Fe_2O_3$

1 – x $\frac{3}{4}(1-x)$ $\frac{1-x}{2}$

As given, $\frac{x}{24} + \frac{3}{4}(1-x) = 0.65$ = Total moles of oxygen

x = 0.4 = moles of FeO

$\frac{1-x}{2} = 0.3$ = moles of of Fe_2O_3

$\Rightarrow \frac{\text{Mole of FeO}}{\text{Mole of } Fe_2O_3} = \frac{4}{3}$

78. $C + \frac{1}{2}O_2 \longrightarrow CO$ .... **(1)**

Initial mole $\frac{x}{12}$ $\frac{y}{32}$ 0 final mole $\quad 0 \quad \frac{y}{32} - \left(\frac{x}{12}\right)\frac{1}{2}$

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

For no solid residue C should be zero in eq. (1)

For that $\frac{y}{32} - \frac{x}{12} \times \frac{1}{2} > 0$

$\frac{y}{32} > \frac{x}{24}$

$\frac{y}{x} > \frac{32}{24}$

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

EXERCISE - 2

Part # I : Multiple Choice

2. (A), (C) and (D) Explanation :

$$4Ag + 8KCN + O_2 + 2H_2O \longrightarrow 4K[Ag(CN)_2] + 4KOH$$

⇒ 4 × 108 g of Ag reacts with 8 × 65 g of KCN

100 g of Ag reacts with

$$\frac{8 \times 65}{4 \times 108} \times 100 = 120$$

Hence ,, to dissolve 100 g of Ag , the amount of KCN required = 120 g

Hence , statement (A) is correct.

⇒ 4 × 108 g of Ag require 32 g of O_2

1 g of Ag require $\frac{32}{4 \times 108} = 0.0740$ g

⇒ 100 g of Ag require = 7.4 g

Hence, choice (C) is correct.

Hence, volume of O_2 required $= \frac{7.4}{32} \times 22.4 = 5.20$ litre

Hence, (A) , (C) , (D) are correct while (B) is incorrect.

4.

	3A	+ 2B ⟶	A_3B_2
initial mole	3	3	0
final mole	0	3–2	1

	A_3B_2	+ 2C ⟶	$A_3B_2C_2$
initial mole	1	1	0
final mole	$1 - \frac{1}{2}$	0	$\frac{1}{2}$

6. (A) Molarity of second solution is $= \frac{10 \times d \times x}{M} = 1$ M

(B) Volume = 100 + 100 = 200 ml

(D) Mass of $H_2SO_4 = \frac{200 \times 1}{1000} \times 98 = 19.6$ gm.

8 (A) , (B) and (D). Explanation : (A) 1.0 mol of $O_2 = 32$ g

(B) 6.02 × 10^{23} molecules of SO_2 = 64 g , 3.01 × 10^{23} molecules of SO_2 = 32 g

(C) 0.5 mole of $CO_2 = 0.5 \times 44 = 22$ g is not correct answer.

(D) 1 g atom of sulphur = 32 g

9 (A) and (B) Explanation : 30% of molecule dissociated $N_2 \rightarrow 2N$

Amount of N_2 left $= \frac{2.8}{28} \times \frac{70}{100} = 0.1 \times 0.7 = 0.07$ (in moles)

No. of moles of N atoms formed $= 2 \times \frac{30}{100} \times 0.1 = 0.06$

(A) Total no . of moles = 0.07 + 0.06 = 0.13

(B) Total number of molecules = 0.07 × 6.023 × 10^{23} = 4.2 × 10^{22} molecule = 0.421 × 10^{23}

✈ We have to calculate molecule of nitrogen not atoms.

10 (A) and (B) Explanation : M. Wt. = 0.001293 × 22400 = 28.96

M.Wt. = d × volume of 1 mole of gas at STP

V. D $= \frac{28.96}{2} = 14.48$

So (A) and (B) are correct answer.

11 $H_2 + S + 2O_2 \rightarrow H_2SO_4$

$n_{H_2} = \frac{5.6}{22.4} = \frac{1}{4} \qquad n_s = \frac{8}{32} = \frac{1}{4} \qquad n_{O_2} = \frac{1}{2}$

As all reactants are in stoichiometric ratios, none will be left behind.

Hence $\frac{1}{4}$ mole of H_2SO_4 is formed.

12 m = 0.2 mole / kg

weight of solvent = 1000 gram

weight of solute = 0.2 × 98 = 19.6 gram

Total weight of solution = 1000 + 19.6 = 1019.6 ml.

13 Let W gas of SO_2 and O_2 are taken

moles of $SO_2 = \frac{W}{64}$; moles of $O_2 = \frac{W}{32}$;

molecules of $O_2 = \frac{WN_A}{32}$; molecules of $SO_2 = \frac{WN_A}{64}$

hence molecules of O_2 > molecules of SO_2

since moles of O_2 > moles of SO_2 , hence volume of O_2 at STP > volume of SO_2 at STP.

14. $2P + Q \longrightarrow R$

	2P	Q	R
initial mole	12	8	0
final mole	0	8 – 6	6

$\therefore$ moles of R formed = 6

% of Q left behind $= \frac{2}{8} \times 100 = 25\%$

16. 10^{-3} g NH_3 in 100 g solution
one litre water has mass = 1000 × 1 g
As NH_3 is very less hence we can say
100 g water has 10^{-3} g NH_3

$\therefore$ 1000 gm water has $= \frac{10^{-3}}{100} \times 1000$ g

$= 10^{-2}$ g $NH_3 = \frac{10^{-2}}{17}$ mole $NH_3 = 5.88 \times 10^{-4}$ mole NH_3.

17. Let wg water in added to 16 g CH_3OH

molality $= \frac{16 \times 1000}{W \times 32} = \frac{500}{W}$

$\frac{500}{W} = \frac{x_A \times 1000}{(1 - x_A)m_B} = \frac{0.25 \times 1000}{0.75 \times 18}$ W = 27 gm.

19. Mass of ethyl alcohol = 1.5 × 0.792 g
Mass of water = 15 × 1
Total mass of solution = 15 + 0.792 × 15 = 26.88

Volume of solution $= \frac{\text{mass}}{\text{density}} = \frac{26.88}{0.924} = 29.09$

% decrease in volume $= \left(\frac{30 - 29.09}{30}\right) \times 100 \cong 3\%$.

20. $Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$

$(H_2O_2 \longrightarrow O_2 + 2H^+ + 2e^-) \times 3$

$Cr_2O_7^{2-} + 8H^+ + 3H_2O_2 \longrightarrow 2Cr^{3+} + 7H_2O + 3O_2$

The reaction practically occurs with this stoichiometry.

22. Let volume of solution is 1000 ml
moles of H_2SO_4 = 18
mass of H_2SO_4 = 18 × 98 = 1764 g
mass of solution = 1000 × 1.8 = 1800 g
mass of solvent = 1800 – 1764 = 36 g

molality $= \frac{18}{\left(\frac{36}{1000}\right)} = 500.$

24. Mole fraction of $H_2O = 1 - 0.25 = 0.75$

$\frac{X_{C_2H_5OH}}{X_{C_2H_5OH} + X_{H_2O}} = \frac{n_{C_2H_5OH}}{n_{C_2H_5OH} + n_{H_2O}}$ or

wt. % $= \frac{0.25 \times 46}{0.25 \times 46 + 0.75 \times 18} \times 100 = 46\%$.

25. Mole of Al $= \frac{54}{27} = 2$

$\therefore$ mass of Mg = 2 × 24 = 48 gm

26.

	A	B
Atomic mass	40	80
given weight	x gram	2x gram
No. of mole	$\frac{x}{40}$	$\frac{2x}{80}$
No. of Atom	$\frac{x}{40} \times N_A$	$\frac{x}{40} \times N_A$

But according to question $= \frac{x}{40} \times N_A = y$

27. (B) Explanation : 1 mole of electrons weighs
$= 9.1 \times 10^{-31}$ kg × 6.023×10^{23}
$= 54 \times 10^{-8}$ kg $= 54 \times 10^{-8} \times 1000$
$= 54 \times 10^{-5}$ g $= 54 \times 10^{-5}$ g $\times 10^3$ mg
$= 54 \times 10^{-2}$ mg = 0.54 mg

(A) is not correct because charge on 1 e is 1.6×10^{-19} C and not on 1 mole of electrons.(C) and (D) ruled out as explained above.

28. % of Na $= \frac{\text{mass of sodium}}{\text{molecular mass}} \times 100 \Rightarrow 7 = \frac{23}{M} \times 100$

$M = \frac{23 \times 100}{7} = 328.6$

29.

	C	H	O
mass	24	8	32
moles	$\frac{24}{12}$	$\frac{8}{1}$	$\frac{32}{16}$
ratio	2	8	2
Simple integer ratio	1	4	1

Hence empirical formula is CH_4O

30. KI is limiting reagent
$\therefore$ 3 mole of KI will give 33 mole of NO_2 according to stoichiometry.

31. $C + O_2 \longrightarrow CO_2 + CO$

POAC on 'C' atom

1 (mole of C) = 1 (mole of CO_2) + 1 (mole of CO)

$\frac{240}{12}$ = mole of CO_2 + $\frac{280}{28}$

Mole of $CO_2 = 20 - 10 = 10$

Mole % of $CO_2 = \frac{10}{20} \times 100 = 50\%$.

32. $Ag_2CO_3(s) \rightarrow 2Ag(s) + CO_2(g) + 1/2\, O_2(g)$

$C_2H_2 + 5/2\, O_2 \rightarrow 2CO_2 + H_2O$

By Stoichiometry of reaction

Moles of CO_2 formed $= \frac{11.2}{22.4} = \frac{1}{2}$

Moles of O_2 required $= \frac{5}{4} \times \frac{1}{2} = \frac{5}{8}$

$\therefore$ Moles of Ag_2CO_3 required $= 2 \times \frac{5}{8} = \frac{5}{4}$

Mass of Ag_2CO_3 required $= \frac{5}{4} \times 276 = 345$ g

33. **(1)** It is a fact.

(2) $2H_2 + O_2 \longrightarrow 2H_2O$

	$2H_2$	O_2	$2H_2O$
Initial mole	2	3	0
final mole	0	3-1 =2	2

(3) $C + O_2 \longrightarrow CO_2$

$\frac{w}{12}$ $\quad$ $\frac{w}{32}$

Here C is limiting reagent.

34. $4A + 2B + 3C \longrightarrow A_4B_2C_3$

	4A	2B	3C	$A_4B_2C_3$
Initial mole	2	1.2	1.44	0
final mole			0	0.48

C is limiting reagent.

$\therefore$ moles of $A_4B_2C_3$ is 0.48.

35. 1 gm molecule is 1 mole

Mole of SO_4^{2-} $4 \times 1 = 4$ gm ion.

36. Mass of NaCl = $10 \times 0.96 = 9.6$ gm

moles of NaCl $= \frac{9.6}{58.5}$

no. of molecules $= \frac{9.6}{58.5} \times 6.023 \times 10^{23} \simeq 10^{23}$

37. $\frac{32}{2x+3y} = 0.2$; $\frac{92.8}{3x+4y} = 0.4$

Hence: x = 56 & y = 16.

38. (A) Explanation : $2\,Ag + S \rightarrow Ag_2S$

2×108 g of Ag reacts with 32 g of sulphur

10 g of Ag reacts with $\frac{32}{216} \times 10 = \frac{320}{216} > 1$ g

It means 'S' is limiting reagent

32 g of S reacts to form $216 + 32 = 248$ g of Ag_2S

1 g of S reacts to form $= \frac{248}{32} = 7.75$ g

Alternately $\quad n_{eq}$ of Ag $= \frac{10}{108} = 0.0925$;

n_{eq} of S $= \frac{1}{16} = 0.0625$ $\quad$ (n_{eq} = number of equivalents)

Since n_{eq} of S is less than n_{eq} of Ag

$\Rightarrow$ 0.0625 eq of Ag will react with 0.0625 eq of S to form 0.0625 eq of Ag_2S

Hence , amount of $Ag_2S = n_{eq} \times$ Eq. wt. of Ag_2S

$= 0.0626 \times 124 = 7.75$ g

39. $CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 + 2\,NaCl$

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

Mole of $CaCl_2$ = mole of $CaCO_3$ = mole of CaO $= \left(\frac{1.62}{56}\right)$

Mass of $CaCl_2 = \left(\frac{1.62}{56}\right)$ Molar mass of $CaCl_2$

$= \left(\frac{1.62}{56}\right) \times 111$ gm.

% of $CaCl_2 = \frac{3.21}{10} \times 100 = 32.1\,\%$.

40.

Reduction ($BiO_3^- \rightarrow Bi^{3+}$)

$BiO_3^- + Mn^{2+} \longrightarrow Bi^{3+} + MnO_4^-$

Oxidation ($Mn^{2+} \rightarrow MnO_4^-$)

(i) $2e + 6H^+ + BiO_3^- \longrightarrow Bi^{3+} + 3H_2O$

(ii) $4H_2O + Mn^{2+} \longrightarrow MnO_4^- + 8H^+ + 5e$

(i) $\times 5 +$ **(ii)** $\times 2$, we get $14\,H^+ + 5\,BiO_3^- + 5Mn^{2+} \longrightarrow 5Bi^{3+} + 2MnO_4^- + 7\,H_2O$

Hence, (B) is the correct balanced reaction.

41. Explanation : M. wt. of $NaNO_3 = 85$
70 mg of Na^+ are present in 1 mL
50 ml of solution contains $50 \times 70 = 3500$ mg $= 3.5$ g Na^+ ion
23 g of Na^+ are present in 85 g of $NaNO_3$

3.5 g of Na^+ are present in $\frac{85}{23} \times 3.5 = 12.934$ g of $NaNO_3$

42. $3I_2 + OH^- \longrightarrow IO_3^- + 5I^-$ (balance reaction)
So, ratio is 1 : 5.

43. $MCl_x + x\,AgNO_3 \longrightarrow xAgCl + M(NO_3)_x$

$$\frac{\text{Mole of } MCl_x}{1} = \frac{\text{Mole of } AgNO_3}{x}$$

$$0.1 = \frac{1}{x}(0.5 \times 0.8)$$

$$x = \frac{0.4}{0.1} = 4$$

44. (A) Explanation : $m = \frac{M \times 1000}{(1000 \times d - M \times M.Wt.)}$

where 'm' is molality, M is molarity.

$$= \frac{10^{-2} \times 1000}{(1000 \times 1.1 - 10^{-2} \times 106)}$$

$$= \frac{10}{1100 - 1.6} = \frac{10}{1099.4} = 9.00 \times 10^{-3}$$

[Take 1099.4 = 1100]

45. At 4ºC i.e. 277 K density of water = 1 gm/ml
$\therefore$ 1 kg water $\Rightarrow$ 1000 ml water = 1 lit.
$\therefore$ Molality & molarity remains same.

46. $\text{Molarity} = \frac{(\% w/w) \times \text{density} \times 10}{\text{Molar mass of solute}}$

$$= \frac{98 \times 1.84 \times 10}{98} = 18.4\text{ M}$$

47. Mole of NaCl $= \frac{5.85}{58.5} = 0.1$

$\text{Molarity} = \frac{0.1}{1} = 0.1$ M

Moles in 1 ml of solution = MV = $0.1 \times 10^{-3} = 10^{-4}$ mole.
Number of ions in 1 ml = $2 \times 10^{-4} \times 6.023 \times 10^{23} = 1.204 \times 10^{20}$.

48. Molarity = M
Let volume of be 1 ltr.
$\therefore$ mass of solvent = $1000\,d - M \times M_2$

$$\text{Molality} = m = \frac{M}{1000\,d - MM_2} \times 1000$$

49. $\text{Molarity} = \frac{10 \times 1.8 \times 98}{98} = 18$ M

50. For reaction with 2 moles NaOH
1M H_2SO_4 1 lit. volume required ;
1M HCl 2 lit. volume required
$\therefore$ cheapest will be 1 M H_2SO_4 1 lit.

Part # II : Assertion & Reason

5 Statement-1 and Statement-2 both are two formula idependent to each other.

7 Due to temperature change volume get changed. Hence concentration units dependent on volume get changed.

10 Molality & mole fraction are mass dependent terms while molarity is volume dependent term.

EXERCISE - 3

Part # I : Matrix Match Type

1. (A)

	$Zn(s)$ +	$2HCl(aq) \longrightarrow$	$ZnCl_2(s)$ +	$H_2(g)$
Initial mole	2	2	0	0
final mole	(2-1=1)	0	1	1

Excess reagent left $= \frac{2-1}{2} \times 100 = 50\%$

Volume of H_2 = 22.4 lit.
Solid product obtained = 1 mole
Limiting reagent is HCl.

(B)

	$AgNO_3(aq)$ +	HCl $\longrightarrow$	$AgCl(s)$ +	$HNO_3(g)$
Initial mole	$\frac{170}{170}=1$	$\frac{18.25}{36.5}=\frac{1}{2}$	0	0
	$1-\frac{1}{2}=\frac{1}{2}$	0	$\frac{1}{2}$	$\frac{1}{2}$

$$\text{Excess reagent} = \frac{1-\frac{1}{2}}{1} \times 100 = 50\%$$

Volume of gas = 11.2 lit.

Solid product $= \frac{1}{2}$ mole

Limiting reagent is HCl.

(C)

	$CaCO_3(s) \longrightarrow$	$CaO(s)$ +	$CO_2(g)$
Initial mole	$\frac{100}{100}=1$	0	0
	0	1	1

Excess reagent not present
Volume of gas = 22.4 lit. at STP
Solid product is 1 mole

(D) $2KClO_3(s) \longrightarrow 2KCl + 3O_2(g)$

	$2KClO_3(s)$	$2KCl$	$3O_2(g)$
Initial mole	$\frac{2}{3}$	0	0
	0	$\frac{2}{3}$	2

No excess reagent left

Volume of gas = 44.8 lit.

Solid product is $\frac{2}{3}$ mole.

3. (A) Molarity of cation $= \frac{M_1V_1 + M_2V_2}{V_1 + V_2}$

$= \frac{0.2 \times 100 + 0.1 \times 400}{500} = \frac{0.6}{5} = 0.12$

Molarity of Cl^- $= \frac{3(0.2)100 + 0.1 \times 400}{500} = \frac{0.6 + 0.4}{5}$

$= 0.2$

(B) Molarity of cation $= \frac{50 \times 0.4 + 0}{100} = 0.2$

Molarity of Cl^- $= \frac{0.4 \times 50 + 0}{100} = 0.2$

(C) Molarity of cation $= \frac{2(0.2)30 + 0}{100} = 0.12$

Molarity of SO_4^{2-} $= \frac{30 \times 0.2}{100} = 0.06$

(D) 24.5 gm H_2SO_4 in 100 ml solution

Molarity $= \frac{\frac{25.4}{98}}{0.1} = 2.5$

$\therefore$ Concentration of cation = 2 × 2.5 M

Concentration of SO_4^{2-} = 2.5 M.

Part # II : Comprehension

Comprehension # 1 :

2. 1 mole of air $\Rightarrow$ 0.8 mole of $N_2 = 0.8 \times 28$ g N_2

$\Rightarrow$ 0.2 mole of $O_2 = 0.2 \times 32$ g O_2

$\therefore$ % w/w $O_2 = \frac{w_{O_2} \times 100}{w_{O_2} + w_{N_2}} = \frac{0.2 \times 32 \times 100}{0.2 \times 32 + 0.8 \times 28} = 22.2\%$

3. Density of air at NTP

1 mole of air = 0.8 mole N_2 + 0.2 mole O_2

$= 0.8 \times 28 + 0.2 \times 32 = 28.8$ gm = 22.4 Ltr volume.

$D = \frac{m}{V} = \frac{22.8}{22.4} = 1.2857$ gm/L

Comprehension # 4 :

2. Mass of solute = 60 × 0.4 + 100 × 0.15 = 24 + 15 = 39 gm

Mass of solvent = 160 – 39 = 121 gm

Molality $= \frac{\left(\frac{39}{58.5}\right)}{121 \times 10^{-3}} = 5.509 = 5.5$ m.

3. Mass of solute = 39 gm

Volume of solution $= \frac{160}{1.6} = 100$ ml

$\therefore$ Molarity $= \frac{\left(\frac{39}{58.5}\right)}{100 \times 10^{-3}} = 6.67$ M

Comprehension # 5 :

1.

	amt	mole		fraction
C	0.2732	0.0227	1	6
H	0.0382	0.0382	1.68	10
Ca	0.152	0.0038	0.167	1
O	0.3540	0.0227	1	6

Simplest formula

$C_6H_{10}CaO_6$

$CaO_6C_6H_{10}$

2. Formula weight

3. The molecular mass of lactate pentahydrate = 308

218 gm anhydrous salt recovered = 308 g lactate pentahydrate

1 gm anhydrous salt recovered $= \frac{308}{218} = 1.41$ gm

Comprehension # 6 :

1. The cost of 1000 gm KCl is 50 kg

The cost of 74.5 g KCl is

$= \frac{50}{1000} \times 74.5 \Rightarrow 3.73$ mol^{-1}

2. The price of K_2SO_4

$= \frac{50}{174} \times 74.5 \times 2 \Rightarrow$ Rs. 42.82 kg^{-1}

3. mole of K in KCl $= \frac{1000}{74.5} \Rightarrow 13.42$

mole of K_2O form 13.42 mole of K $= \frac{13.42}{2} = 6.71$

mass of K_2O

= 6.71 × 94 = 630.8 gm = 0.631 kg

Comprehension # 7 :

1. $Ba(OH)_2 + 2HNO_3 \longrightarrow Ba(NO_3)_2 + 2H_2O$
0.4 mole   0.4mole
In resultant sol. $Ba(OH_2)$ is remaning, therefore nature of sol. basic.

2. Vol. of $Ba(OH)_2$

$$= \frac{342}{0.57} = 600\,mL$$

mole of $OH^- = 0.2 \times 2 = 0.4$

$$\text{molarity of } OH^- = \frac{0.4}{0.8} = 0.5$$

Comprehension # 8 :

1. 8 mole NaBr obtain from
= 3 mole Fe

$$\text{mole of Fe} = \text{mole NaBr} = \frac{2.06 \times 10^3}{103 \times 8} \times 3$$

$$\text{mass of Fe} = \frac{2.06 \times 10^3}{103} \times 56 \times \frac{3}{8} = 420 \text{ kg}$$

2. $$\text{mole of } Fe_3Br_8 = \frac{100 \times 2.06 \times 10^6}{103 \times 70 \times 8}$$

$$\text{mole of Fe} = \text{mole } FeBr_2 = \frac{2.06 \times 10^3 \times 100 \times 100}{103 \times 70 \times 60 \times 8} \times 3$$

$$\text{mass of Fe} = \frac{2.06 \times 10^3 \times 100 \times 100}{103 \times 70 \times 60} \times 56 \times \frac{3}{8}$$

mass of Fe = 10^3 kg

3. $$\text{mole of } CO_2 = \frac{\text{mole of NaBr}}{2}$$

$$= \frac{2.06 \times 10^3}{103 \times 2} = 10$$

Comprehension # 9 :

1. $CO_2 = 22 \text{ g} = 0.5 \text{ mol}$

$$H_2O = 13.5 \text{ g} = \frac{13.5}{18} \text{mol.}$$

C = 0.5 mol = 6 g

H = 1.5 mol = 1.5 g

O = 8 gm = 0.5 mol

E.F. = CH_3O

let molar mass = M

$$\frac{27}{108} = \frac{41.75}{M - 1 + 108} \Rightarrow M = -107 + 167 = 60$$

E.F. mass = 12 + 3 + 16 = 31

$$n = \frac{274}{31} \approx 2$$

M.F. = $(CH_3O)_2$
= $C_2H_6O_2$

EXERCISE - 4

Subjective Type

1. Ist exp. CuO = 1.375 gm
Cu = 1.098 gm
O = 0.277 gm
IInd exp. Cu = 1.179gm
CuO = 1.4476 gm
O = 0.2686 gm

$$\frac{Cu}{O} = 3.9638\ ;\ 4 \qquad \frac{Cu}{O}\ ;\ 4$$

In both the cases ratio of Cu/O is same

2. $$\left(\frac{Y}{X}\right) = \frac{0.471}{0.324} = 1.4537 = r_1$$

$$\left(\frac{Y}{X}\right) = \frac{0.509}{0.117} = 4.350 = r_2$$

$$\frac{r_2}{r_1} = 2.9926\ ;\ 3$$

So satisfy law of multiple proposition.

3. = 35.125 × 28 = 983.5 gm

4. $$\text{molecular} = \left(\frac{0.07}{18}\right) \times N_A \times 3 = 2.34 \times 10^{21}$$

5. $$n_{NaClO_3} = \frac{106.5}{106.5} = 1 \text{ mole}$$

NO. of atom of
Na=1 × N_A
Cl = 1 × N_A
O = 1 × N_A

6. $$n_{P_4} = \frac{92.9}{4 \times 31} = 0.75 \text{ mole}$$

$$N_{P_4} = 0.75 \times N_A = 4.52 \times 10^{23} \text{molecules}$$

$$N_P = 18.04 \times 10^{23} \text{molecules}$$

7. $$n_{Na} = \frac{5.75}{23} = 0.25 \text{ mole}$$

8. **(a)** 1 × 23 gm **(b)** 1 × 35.5 gm
(c) 1 × 63.5 gm

9. $m_{Hg} = 13.6 \times 1000$ gm
$n_{Hg} = m_{Hg}/200 = 68$ mole

10. $3CaCO_3 + 2H_3PO_4 \longrightarrow Ca_3(PO_4)_2 + 3H_2O + 3CO_2$

50/100mole 70/98 mole

= 0.5 0.7142

-- $0.7142 - \frac{2}{3} \times 0.5 = 0.3808 \left(\frac{0.5}{3}\right)$

Limiting reactant

$$m_{CaCO_3} = \frac{0.5}{3} \times M_{Ca_3(PO_4)_2} = 51.66 \text{ gm}$$

$$m_{H_3PO_4} = 0.3808 \times M_{H_3PO_4} = 31.31 \text{gm}$$

11. $ClNH_2 + 2NH_3 \longrightarrow N_2H_4 + NH_4Cl$

$\frac{1000}{51.5}$ mole excess

= 19.417

19.417 mole

$$\% \text{ yield } = \frac{14.781}{19.417} \times 100 = 76.125\%$$

12. $5C + 2SO_2 \xrightarrow{82\%} CS_2 + 4CO$

excess $\frac{450}{64} = 7.03$ Kmole

$$0.82 \times \frac{7.03}{2} = 2.88 \text{ Kmole} = 219.09 \text{ kg}$$

13. BaO + CaO

$x \times [153] + y \times [56] = 28$ ......(I)

$BaO + 2HCl \longrightarrow BaCl_2 + H_2O$

x 2x

$CaO + 2HCl \longrightarrow CaCl_2 + H_2O$

y 2y

$2x + 2y = 6 \times 0.1008 = 0.6048$ ......(II)

$$\% \text{ of BaO} = \frac{x \times 153}{29} \times 100 = 65.65\%$$

14. $\frac{x \times 0.95}{106} = 5 \times 0.5$

$$x = \frac{2.5 \times 106}{0.95} = 278.947 \text{gm}$$

15. $M = \frac{(27/98)}{(100/1.2)} \times 1000 = 3.8$

16. $C_nH_{2n+2} + \frac{(3n+1)}{2} O_2 \longrightarrow nCO_2 + (n+1) H_2O$

$\frac{(3n+1)/2}{n} = \frac{7}{4} \Rightarrow 6n + 2 = 7n \Rightarrow n = 2$ C_2H_6

17. $C_4H_8 + 6O_2 \longrightarrow 4CO_2 + 4H_2O$

x 4x 5x

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

y 4y 5y

$(4x + 5y) \times 44 = 8.8$

$x + y = 0.05$ ......(1)

$(4x + 5y) \times 18 = 4.14$

$4x + 5y = 0.23$ ......(II)

$4x + 4y = 0.2$ ....(I)

$y = 0.03$

% by mass of C_4H_{10}

$$= \frac{0.03 \times 58}{2.86} \times 100 = 60.8\%$$

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

v excess

$\left(x + \frac{y}{4}\right)v$ xv $\frac{y}{2}v$

$+v - \left(x + \frac{y}{4}\right)v + xv + \frac{y}{2}v = 2.5v$

$\frac{y}{4} = 1.5 \Rightarrow y = 6$

$xv = 2v \Rightarrow x = 2$ C_2H_6

19. Molar mass

$= 3.2707 \times 10^{-22} \times 6.023 \times 10^{23} = 196.99426 \text{gm}$

20. $M = \pi \times (75 \times 10^{-8} \text{ cm})^2 \times (5000 \times 10^{-8} \text{ cm})$

$$\times \frac{1}{0.75 \text{ cm}^3/\text{gm}} \times 6.023 \times 10^{23} = 7.09 \times 10^7 \text{ gm}$$

21. $\frac{M_{gas}}{M_{air}} = 1.17 \Rightarrow M_{gas} = 1.17 \times 29 = 33.93$ gm

22. $Y_3A_5O_{12}$

$200 \times 200 \times 10^{-3}$

(a) y = 44.95%, Al = 22.73%, O = 32.32%

(b) 17.98 gm

23. $n = \frac{\frac{28.3 \times 1 \times 10^{-4}}{100}}{[12 \times 12 + 4 + 35.5 \times 4 + 16 \times 2]} = 8.8 \times 10^{-8}$ mole

24. $6LiH + 8BF_3 \longrightarrow 6LiBF_4 + B_2H_6$

2 2 0.25

25. $Al + 3HCl \longrightarrow AlCl_3 + \frac{3}{2}H_2\uparrow$

$1.5x + y = 0.04925$ ....**(I)**

x mole

$1.5x \quad x + 27 + y \times 24 = 1$

$Mg + 2HCl \longrightarrow MgCl_2 + H_2\uparrow$

$x \times 9 + y \times 8 = 0.33$ ....**(II)**

y mole y

$\% Al = \frac{x \times 27}{1} \times 100 = 54.6\%$

$Mg = 45.4\%$

26. $CaCl_2 + NaCl$

$\downarrow$

Na_2CO_3

$\downarrow$

$CaCO_3$

$\downarrow$

CaO

$n_{CaCl_2} = n_{CaO} = \frac{1.62}{56} = 0.02892$

$m_{CaCl_2} = 0.02892 \times 111 = 3.211\ g$

$m_{NaCl} = 6.7889\ gm$

$\% NaCl = 67.9\%$

27. $n_{O_2} = 625$

$n_C = 1$ mole

$\frac{n_{O_2}}{n_C} = 0.625$

$O_2 + C \longrightarrow CO + CO_2$

$2 \times n_{O_2} = n_{CO} + 2n_{CO_2}$ ....**(I)**

$2 \times n_C = n_{CO} + n_{CO_2}$ ....**(II)**

$\Rightarrow \frac{n_{CO} \times 28}{n_{CO_2} \times 44} = \frac{21}{11}$

28.

element	mass per 100 gm	mole	simplest ratio
C	58.77	58.77 / 12	5
H	13.81	13.81 / 1	14
N	27.42	27.14 / 2	2

E.F. = $C_5H_{14}N_2$ = 102 = M.F.

30. $n_{N_2} = \frac{\frac{(774.5 - 14.5)}{760} \times \frac{82.1}{1000}}{0.081 \times 300} = 3.3786 \times 10^{-3}$ mole

$m_{N_2} = 0.0946\ gm$

$\% N_2 = \frac{0.0946}{0.14} \times 100 = 66.7\%$

31. **(a)** $M = \frac{4/40}{0.2} = 0.5$

(b) $M = \frac{5.3/106}{0.1} = 0.5$

(c) $M = \frac{0.365/36.5}{0.05} = 0.2$

32. $X_{ethanol} = \frac{46/46}{46/46 + 54/18} = 0.25$

33. $CO + \frac{1}{2}O_2 \longrightarrow CO_2$

x $\quad -x/2 \quad$ x

$Cl_{+4} + 2O_2 \longrightarrow CO_2 + 2H_2O\ (\bullet)$

y $\quad -2y \quad$ y

$\frac{x}{2} + 2y = 6.5$ .....**(I)**

$x + y = 7$ .....**(II)**

$x + y + z = 10$ .....**(III)**

x = 5 ml $\quad$ y = 2 ml $\quad$ z = 3 ml

34. $O_3 \longrightarrow \frac{3}{2}O_2$

20 $\quad$ 80

$\frac{3}{2} \times 20 + 80 = 110$

Increase in volume = 110–100 = 10ml

35. Empirical formula

	Al	K	S	O	Elements
	10.5	15.1	24.8	49.6	Mass percentage
$= KAlS_2O_8$	0.388	0.387	0.775	3.1	Mole ratio
	1	1	2	8	Simple ratio

Empirical formula weight = 258

From weight loss information: 54.4 g anhydrous salt ≡ 45.6 g H_2O

$\Rightarrow$ 258 g anhydrous salt ≡ 216.26 g = 12 mol H_2O

$\Rightarrow$ Empirical formula of hydrated salt = $KAlS_2O_8 \cdot 12\ H_2O$

36. 1.0 mole of $KClO_3 \equiv$ 3.0 mole of Zn

$$\frac{5.104}{122.5} \text{ mole } KClO_3 \equiv \frac{3\times 5.104}{122.5}$$

$$\text{mole of Zn} = \frac{3\times 5.104\times 65}{122.5} \;\; = \mathbf{8.124\ g\ Zn}$$

37. Apply conservation of moles of silver before and after precipitate exchange reaction as :

$$\frac{1.8}{143.5} = \frac{x}{188} + \frac{2.052 - x}{143.5}$$

where, x is mass of AgBr in mixed precipitate.

$\Rightarrow \quad x = 1.064$

Also, moles of $CuBr_2 = \frac{1}{2}$ moles of AgBr $= \frac{1}{2}\times\frac{x}{188}$

$\Rightarrow$ Mass of $CuBr_2 = \frac{1}{2}\times\frac{x}{188}\times 223.5 = 0.6324$

(on substituting x)

Mass % of $CuBr_2$ **= 34.18**

38. Moles of NaCl in sample = 0.01 = moles of AgCl from NaCl in precipitate

Total moles of AgCl precipitate $= \frac{2}{143.5} = 0.01393$

$\Rightarrow$ Moles of AgCl from KCl= 0.00393 = moles of KCl

$\Rightarrow$ Mass of KCl in sample = 0.00393× 74.5= 0.2928g

Mass % of KCl in the sample **= 29.28**

39. Let the mixture contain x g $CuSO_4 \cdot 5H_2O$.

$$\Rightarrow \frac{x}{249}\times 159 + \frac{5-x}{246}\times 120 = 3 \Rightarrow x = 3.72$$

$\Rightarrow$ Mass percentage of $CuSO_4.5H_2O$ **= 74.4**

40. Mass % of Ca

$$= \frac{0.16}{100}\times 40\times\frac{100}{0.25} = 25.6$$

Mass % of S

$$= \frac{0.344}{233}\times\frac{32\times 100}{0.115} = 41$$

Mass % of N

$$= \frac{0.155}{17}\times\frac{14\times 100}{0.712} = 17.9$$

$\Rightarrow$ Mass % of C = 15.48

Now :

Elements	Ca	S	N	C
Mass %	25.6	41	17.9	15.48
Mol ratio	0.64	1.28	1.28	1.29
Simple ratio	1	2	2	2

Empirical formula $= CaC_2N_2S_2$,

Empirical formula weight =156

Hence, molecular formula $= CaC_2N_2S_2$

41. Working in backward direction

In the last step moles of(AgBr+AgI) = moles of AgI

$$\Rightarrow \frac{0.4881 - x}{188} + \frac{x}{235} = \frac{0.5868}{235} \Rightarrow x = 0.0933\text{ g}$$

Mass % of NaI

$$= \frac{0.0933}{235}\times 150\times\frac{100}{0.2} = \mathbf{29.77}$$

Now subtracting mass of AgI from 1st and 2nd precipitate gives

Mass of (AgCl + AgBr) = 0.3187 g

and mass of AgBr = 0.3948 g

$$\text{Again } \frac{y}{143.5} + \frac{0.3187 - y}{188} = \frac{0.3948}{188} \Rightarrow y = 0.245\text{g}$$

$\Rightarrow$ Mass % of NaCl

$$= \frac{0.245}{143.5}\times 58.5\times\frac{100}{0.2} = 50$$

Mass % of NaBr = **20.23**

42. Weight loss is due to conversion of $NaHCO_3$ into Na_2CO_3 : 31 g weight is lost per mole of $NaHCO_3$.

$\Rightarrow$ 0.3 g wt. loss from $\frac{0.3}{31}$ mol of $NaHCO_3$ producing $\frac{0.3}{62}$ moles of Na_2CO_3.

Total moles of carbonate $= 15\times 10^{-3}$

$\Rightarrow$ Moles of carbonate in original sample $= 0.015 - \frac{3}{620} = 0.01$

Mass of Na_2CO_3 in original sample = 1.06 $\Rightarrow$ **42.4 % Na_2CO_3**

43. If M is molar mass of $(CH_3)_x\,AlCl_y$

$$m(CH_4) = \frac{0.643\,x}{M}\times 16 = 0.222$$

$$\text{and } m(AgCl) = \frac{0.643\,y}{M}\times 143.5 = 0.996$$

$$\text{dividing : } \frac{x}{y} = 2,$$

$$\text{Al So } M = 15x + 27 + 35.5y = 15x + 27 + \frac{35.5x}{2} = 32.75x + 27$$

$$\Rightarrow \frac{0.643x\times 16}{32.75x + 27} = 0.222 \Rightarrow \mathbf{x = 1.98 \approx 2} \Rightarrow \mathbf{y=1}$$

44. Mass of AgCl = 0.09 × 143.5 = 12.915 g which is 95.77 % of total ppt.

$\Rightarrow$ Total mass of precipitate

= 13.485g and mass of impurity = 0.57 g

$\Rightarrow$ Mass of NaCl + KCl = 5.9 g

$$\Rightarrow \frac{x}{58.5} + \frac{5.9 - x}{74.5} = 0.09$$

$\Rightarrow$ x = 2.94 g NaCl, 2.96 g KCl

m (Na_2O) = 1.558 g $\Rightarrow$ m% (Na_2O) = **31.16**

m (K_2O) = 1.867 g $\Rightarrow$ m% (K_2O) = **37.34**

45. In order to obtain maximum yield from a reaction, the reactants must be supplied in stoichiometric amount So that no reactant should be left unreacted.

The balanced chemical reaction is

$Pb(NO_3)_2 + 2KI \longrightarrow PbI_2 + 2KNO_3$

Let x g of KI is taken

$\Rightarrow$ moles of KI $= \frac{x}{166}$ $\Rightarrow$ moles of $Pb(NO_3)_2$ present $= \frac{x}{2 \times 166}$

$\Rightarrow \frac{x}{2 \times 166} = \frac{5 - x}{330}$ $\Rightarrow$ x = 2.5 g $\Rightarrow$ mass of $PbI_2 = \frac{x}{332} \times$ 460 = **3.464 g**

46. Mass of uranium in the sample $= \frac{1.48}{394} \times 238 = 0.894$ g

Mass % of uranium in the sample = 89.4

$UO_2(NO_3)_2 + Na_2C_2O_4 + xH_2O \rightarrow UO_2(C_2O_4)\,xH_2O \downarrow + 2NaNO_3$

m mol 3.756 2.985

Here $Na_2C_2O_4$ is the limiting reagent, therefore, m mol of $UO_2(C_2O_4).xH_2O$ formed is 2.985.

$\Rightarrow$ $M(UO_2(C_2O_4)).xH_2O = \frac{1.23}{2.985} \times 1000 = 412$

= 238 + 32 + 88 + 18 x

$\Rightarrow$ $x = \frac{54}{18} = 3$

47. Volume of smallest cell $= \pi r^2 l = \pi (60 \times 10^{-8}\, cm)^2 (6000 \times 10^{-8}\, cm) = 6.785 \times 10^{-17}\, cm^3$

mass of one smallest cell $= 7.6 \times 10^{-17}$ g

$\Rightarrow$ Molar mass of mother cell $= 7.6 \times 10^{-17} \times 24 \times 60 \times 6.023 \times 10^{23}$

= **6.6 × 1010 amu**

48. Let the sample contain x g Mohr's salt

$[FeSO_4(NH_4)_2SO_4 . 6H_2O]$

$$\Rightarrow \frac{x}{392} \times 2 \times \frac{0.5 - x}{132} = \frac{0.75}{233}$$

Solving x = 0.23 g $\Rightarrow$ Mohr's salt $= \frac{0.23}{0.50} \times 100 = 46\,\%$, $(NH_4)_2SO_4 = 54\%$

Also moles of Fe in 0.2g sample $= \frac{x}{392} \times \frac{0.2}{0.5}$

$= 2.347 \times 10^{-4}$

$\Rightarrow$ mass of Fe_2O_3 obtained on ignition of 0.2 sample $= \frac{2.347 \times 10^{-4}}{2} \times 160$ = **18.77 mg**

49. Smallest volume of $AgNO_3$ would be required when the entire mass is due to highest molecular weight constituent.

Hence, for smallest volume, the whole mass should be of $BaCl_2 . 2H_2O$

m mol of $BaCl_2.2H_2O = \frac{0.3}{244} \times 1000 = 1.229$ m mol

m mol of $AgNO_3$ required = 2 × 1.229 = 2.458

Volume of $AgNO_3$ required $= \frac{2.458}{0.15} = 16.38$ mL (smallest)

Largest volume of $AgNO_3$ would be required when entire mass is due to lowest molecular weight constituent, i.e., NaCl.

m mol of NaCl $= \frac{0.3}{58.5} \times 1000 = 5.128$ = m mol of $AgNO_3$ required

$\Rightarrow$ Volume of $AgNO_3$ required $= \frac{5.128}{0.15} =$ **31.18 mL (largest)**

50. Mixture(N_2,NO_2,N_2O_4)has mean molar mass=55.4.

x y z

Given : $N_2O_4 \longrightarrow 2NO_2$

z 2z

$$\therefore 55.4 = \frac{28x + 46(y + 2z)}{x + y + z}$$

$$\left\{ \text{mean molar mass} = \frac{\text{wt.} \times \text{mole}}{\text{Total mole}} \right\}$$

Given : x + y + z = 1 (mole)

So 55.4 = 28x + 46 (y + 2z) ...(1)

$$\therefore 39.3 = \frac{28x + 46(y + 2z)}{x + y + 2z}$$

$\therefore$ 39.6 (x + y + 2z) = 28 x + 46 (y + 2z)

From eq (1) & x + y + z = 1

or 39.6 (1 + z) = 59.4

or $1 + z = \frac{59.4}{39.6}$

or z = 0.4

from eq. (1)

55.4 = 28x + 46(y + 2z)

$\boxed{z = 0.4}$ put

55.4 = 28x + 46y + 36.8

$28x + 46y = 18.6$ ...(2)

$\Rightarrow x + y + z = 1$

$x + y + 0.4 = 1 \quad (\Rightarrow z = 0.4)$

$x + y = 0.6$ ...(3)

eq. (2) × 1 ..... eq. (3) × 28

$28x + 46y = 18.6$

$28x + 28y = 16.8$

$- \quad - \quad -$

$18y = 1.8$

$\boxed{y = 0.1}$

$\Rightarrow x + y + z = 1$

$\boxed{x = 0.5}$

51. $C_xH_yO_z + \left(x + \frac{y}{4} - \frac{z}{2}\right) O_2 \rightarrow xCO_2 + \frac{y}{2} H_2O$

Given vol. 10mL + 100mL 0 + 0

After reaction – $+ 100 - 10\left(x + \frac{y}{4} - \frac{z}{2}\right)$ 10x –

$100 - 10\left(x + \frac{y}{4} - \frac{z}{2}\right) + 10x = 90$

$\frac{y}{4} - \frac{z}{2} = 1$

$y - 2z = 4$ ...(1)

Property of KOH has to absorbed all CO_2.

$\therefore 10x = 20$

$\boxed{x = 2}$

V.D. of compound $(C_xH_yO_z) = 23 \Rightarrow V.D. = \frac{M_w}{2}$

$M_w = 46 \qquad M_w = 2 \times 23 = 46$

$12x + y + 16z = 46$

$12 \times 2 + y + 16z = 46$

$y + 16z = 22$ ...(2)

from eq. (1) & (2)

$y - 2z = 4$

$y + 16z = 22$

$- \quad - \quad -$

$-18z = -18$

$\boxed{z = 1}, \boxed{y = 6}$

Molecular formula $= C_2H_6O$.

52. $(CH_2)_n + 4nCoF_3 \rightarrow (CF_2)_n + 2nHF + 4nCoF_2$ ...(1)

$2CoF_2 + F_2 \rightarrow 2CoF_3$

wt. $\Rightarrow$ F = 19, C = 12, Co = 59, $M_{wt.}\ (CF_2)_n = 50n$

from eq. (1) $\quad (CF_2)_n = 4nCoF_2$

$\frac{w}{E} \qquad \frac{w}{E}$

$\frac{1000}{50n} = \frac{w}{4n \times 97}$

$w = \frac{1000}{50n} \times 4n \times 97$

$w = 80 \times 97$ g (CoF_2)

$\Rightarrow 2CoF_2 + F_2 \longrightarrow 2CoF_3$

$2 \times 97 \longrightarrow 1 \times 38$

$= 80 \times 97 \rightarrow \frac{1 \times 38}{2 \times 97} \times 80 \times 97 = 1520\ g = 1.52kg.$

$2HF \rightarrow H_2 + F_2$ $\quad \Rightarrow (CF_2)_n$ moles $= \frac{1000}{50n} = \frac{20}{n}$ moles of $(CF_2)_n$

40 $\quad$ 20 2n $\quad HF = \frac{20}{n} \times 2n = 40$ mol

$1 \longrightarrow \frac{20}{40} \times 1.52$

$1.52 = 0.76$ kg

53.(a) $A_2 + 2B_2 \rightarrow A_2B_4 \quad \Big| \quad \frac{3}{2} A_2 + 2B_2 \longrightarrow A_3B_4$

Initial	4	4	-
After	4–2	4–4	2
	2	0	2

$2A_2B_4 + A_2 \longrightarrow 2A_3B_4$

2	2	
2 – 2	2 – 1	2
	1	2

$\therefore A_2 = 1, A_2B_4 = 2$

(b) $A_2 + 2B_2 \rightarrow A_2B_4 \quad \Big| \quad \frac{3}{2} A_2 + 2B_2 \longrightarrow A_3B_4$

Initial	$\frac{1}{2}$	2	
After	0	2–1	0.5
		1	0.5

$\therefore A_2B_4 = 0.5,\ B_2 = 1$

(c) $A_2 + 2B_2 \rightarrow A_2B_4 \quad \Big| \quad \frac{3}{2} A_2 + 2B_2 \rightarrow A_3B_4$

Initial	1.25		2		
After	1.25	–	1	–	1
	0.25	–	1		

$$2\,A_2B_4 + A_2 \longrightarrow 2\,A_3B_4$$
1   0.25

1–0.5   –   0.5

$\therefore$ $A_2B_4 = A_3B_4 = 0.5$

54. (a) 1L $KMnO_4 \to 79\%$ (w/v) i.e. 100 mL solution contain 79 g $KMnO_4$

$$\text{moles of } KMnO_4 = \frac{\text{wt.}}{M_w} = \frac{79}{158} = 0.5$$

$$\text{Molarity (M)} = \frac{0.5}{100} \times 1000 = 5M$$

HCl→10%(w/w)i.e.100 g solution contain 10g HCl

D = 1.825 g/mL

$$V = \frac{M}{D} = \frac{100}{1.825 \times 1000}$$

$$\text{Molarity} = \frac{10 \times 1.825 \times 1000}{36.5 \times 100} = 5\text{ M}$$

$$2KMnO_4 + 16HCl \to 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$$

$M \times V_1$ $M \times V_1$

5 × 1   5 × 9

5   45

–   5   12.5

$$Cl_2 = 12.5 \times \frac{80}{100} = 10\text{ mol.}$$

(b) $2KMnO_4 + 16HCl \to 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$

$$1 \times \frac{710}{28.4} = 25L$$

(c) $$\eta = \frac{\text{vol. of water treated}}{\text{vol. of total feed}}$$

$$= \frac{25}{\text{vol. of } KMnO_4 + HCl} = \frac{25}{1+9} = 2.5$$

55. D = 1.03 g/cm^3

2.8% NaCl → 100 g solution contain 2.8 g NaCl.

$$V = \frac{100}{1.03 \times 1000} L$$

$$1\text{ L} \longrightarrow \frac{2.8 \times 1.03 \times 1000}{100} g$$

$$\text{moles} = \frac{2.8 \times 10.3}{58.5} = 0.493$$

$M_2V_2 = M_1V_1$

$0.493 \times 10^6 = 5.45 \times V_1$

$V_1 = 9 \times 10^4$

So water evaporated $= 10^6 - 9 \times 10^4$

$= 9.095 \times 10^5$ L

56. Let free $SO_3 \to$ xg

$$SO_3 \text{ in form of } H_2SO_4 \to \frac{x}{80} \times 98 = 1.225\,x$$

So total

$x + 1.225\,x = 100$

$x = 449.49$

$$\text{water required} = \frac{44.94}{80} \times 18 = 10..11 \text{ g \% oleum}$$

$= 100 + 10.11 = 110.11\%$

57. 100 mL milk → 4mL fat

1 L milk → 40 mL fat

density of fat = 875 kg/m^3 = 0.875 g/mL

mass of fat = 40 × 0.875 = 35g

fat free milk mass = 1035 – 35 = 1000g

Vol. = 1000 – 40 = 960 mL

$$\rho = \frac{1000}{960} = 1.0416\text{ g/mL}$$

58. $\left.\begin{array}{l} H_2SO_4 \to a \\ SO_3 \to b \\ SO_2 \to c \end{array}\right\}$ a + b + c = 1 g

$SO_2 \to 1.5\%$

so, C = 0.015 g $\longrightarrow SO_2$

a + b = 0.985 g

$$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4$$
$$\frac{a}{98}$$

$$SO_3 + 2NaOH \longrightarrow Na_2SO_4 + H_2O$$
$$\frac{b}{80}$$

$$SO_2 + 2NaOH \longrightarrow Na_2SO_3 + H_2O$$
$$\frac{0.015}{64}$$

$$\left(\frac{a}{98} + \frac{b}{80} + \frac{0.015}{64}\right) = 23.47 \times 10^{-3}$$

0.0102 a + 0.0125 b + 0.00234 = 0.011735

a + 1.225 b = 1.1275

a + b = 0.985

0.225 b = 0.1425

b = 0.633 g → SO_3

a = 0.35 M g → H_2SO_4

$$\text{Combined } SO_3 = \frac{0.3514}{98} \times 80 = 0.2868g$$

59. Volume $=1 \times 3 \times 300 \times 6 \times 10^{-10}$
$= 5.4 \times 10^{-7}\ m^3 = 0.54\ cm^3$
$\rho = 1\ g/cm^3$
mass $= 0.54$ g
$n(CH_3)_2SiCl_2 + 2nOH^- \rightarrow 2nCl^- + nH_2O + [(CH_3)_2SiO]_n$

$\frac{w}{129}$ $\qquad\qquad$ $\frac{w}{129n} \times \{74n\}$

$\frac{74w}{129} = 0.54 \Rightarrow w = 0.9413$ g

60. $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$
a $\quad$ 2a $\quad$ a

$C_nH_{2n-2} + \left(\frac{3n-1}{2}\right) O_2 \longrightarrow nCO_2 + (n-1)\ H_2O$

(20–a) $\left(\frac{3n-1}{2}\right)$(20–a) $\quad$ n(20–a)

For methane $a + n(20 - a) = 40$ ...**(1)**
For oxygen

$$\left[100 - 2a - \left(\frac{3n-1}{2}\right)(20-a)\right] = 40$$

$$2a + \left(\frac{3n-1}{2}\right)(20-a) = 60$$

$2a + 30n - 1.5na - 10 + 0.5a = 60$
$2.5a - 1.5na + 30n = 70$
$2.5a - 1.5n(a - 20) = 70$
$2.5a + 1.5n(20 - a) = 70$ ...**(2)**
from **(1)** & **(2)**
a = 10
n = 3
C_3H_4
% composition $\rightarrow$ 50%

61. $CaCl_2 \rightarrow 5M = 555$ g in 1 L solution or in 1050g solution
wt. of (solvent + $MgCl_2$) = 1050 – 555 = 495 g
$MgCl_2 \rightarrow 5$ m
1000 g solvent $\rightarrow$ 5 mol of $MgCl_2$
$= 5 \times 95 = 475$ g $MgCl_2$
i.e., 1475 (solvent + $MgCl_2$) $\rightarrow$ 475g $MgCl_2$

495 (solvent + $MgCl_2$) $\rightarrow \frac{475}{1475} \times 495$

$= 159.4$ g $MgCl_2$

moles of $MgCl_2 = \frac{159.4}{95} = 1.678$

Total moles of Cl^-
$= (5 + 1.678) \times 2 = 13.356$
volume of solution = 1 L
Molarity of Cl^- = 13.356 M

EXERCISE - 5

Part # I : AIEEE/JEE-MAIN

1. Molarity $= \frac{\text{Moles of solute}}{V_{lt}}$

$$= \frac{6.02 \times 11^{20} / 6.02 \times 10^{23}}{100/1000} = 0.01\ M$$

2. The mass of one mole of a substance will remain unchanged.

3. Let the oxidation state of Cr is x.
$x + 4(0) + 2(-1) = +1$
$x - 2 = +1$ or, $x = +1 + 2 = +3$.

4. $\overset{+6}{Cr_2}O_7^{2-} + 14H^+ + 6I^- \longrightarrow \overset{+3}{Cr^{3+}} + 7H_2O + 3I_2$

5. Final molarity $= \frac{M_1V_1 + M_2V_2}{V_1 + V_2}$

$$= \frac{1.5 \times 480 + 1.2 \times 520}{480 + 520} = 1.344M$$

6. In the reaction.
$\underset{+1\ -1}{2HI} + \underset{+1\ +6\ -2}{H_2SO_4} \rightarrow \underset{0}{I_2} + \underset{+4}{SO_2} + \underset{+1\ -2}{2H_2O}$
I[st] half reaction : $\underset{-1}{2HI} \rightarrow \underset{0}{I_2}$
In this reaction oxidation number of I increases by one, thus this is an oxidation reaction and HI behaves as a reducing agent.
IInd half reaction : $\underset{+6}{H_2SO_4} \rightarrow \underset{+4}{SO_2}$
On the other hand, in this reaction, oxidation number of S decreases by two, thus this is a reduction reaction and H_2SO_4 behaves as oxidizing agent.

7. 8 moles of O-atom are contained by 1 mole $Mg_3(PO_4)_2$.

Hence, 0.25 moles of O-atom $= \frac{1}{8} \times 0.25 = 3.125 \times 10^{-2}$ mole $Mg_3(PO_4)_2$.

8. molality (m) $= \frac{M}{1000d - MM_1} \times 1000$
M = Molarity, M_1 = Molecular mass of solute, d = density

$$= \frac{2.05}{(1000 \times 1.02) - (2.05 \times 60)} \times 1000 = 2.28\ mol\ kg^{-1}$$

9. $2Al(s) + 6HCl(aq) \longrightarrow 2Al^{3+}(aq) + 6Cl^-(aq) + 3H_2(g)$
3 mole H_2 from 6 mole HCl consumed.
$\therefore$ 1 mole H_2 from 2 mole HCl consumed.
1/2 mole(11.2 Lit) H_2 from 1 mole HCl consumed.

10. 3.6 M solution means 3.6 mole of H_2SO_4 is present in 1000 ml of solution
$\therefore$ Mass of 3.6 moles of H_2SO_4 is $= 3.6 \times 98$ g $= 352.8$ g
$\therefore$ Mass of H_2SO_4 in 1000 ml of solution = 352.8 g
Given, 29g of H_2SO_4 is present in 100 g of solution

$\therefore$ 352.8 g of H_2SO_4 is present in $\frac{100}{29} \times 352.8 = 1216$ g of solution

Now density $= \frac{\text{Mass}}{\text{Volume}} = \frac{1216}{1000} = 1.216$ g/mL $= 1.22$ g/mL

11. $X_{\text{ethyl alcohol}} = \frac{5.2}{5.2 + \frac{1000}{18}} = 0.086$

12. Molality $= \frac{0.01/60}{0.3} = \frac{0.01}{60 \times 0.3}$; d = 1 g/ml

$= 5.55 \times 10^{-4}$ m.

13. Molarity $= \frac{\text{moles of solute}}{\text{volume of sol. (l)}}$

$$= \frac{120 \times 1.15}{60 \times 1120} \times 1000 = 2.05 \text{ M}$$

14. % of N $= \frac{1.4 \times \text{milliequivalents of acid consumed}}{\text{mass of organic compound}}$

Meq of acid consumed $= \left(60 \times \frac{1}{2} \times 2\right) - \left(20 \times \frac{1}{10} \times 1\right) = 10$

$\therefore$ % of N $= \frac{1.4 \times 10}{1.4} = 10\%$

15. $2C_8H_7SO_3Na + Ca^{7+} \longrightarrow (C_8H_7SO_3)_2Ca$

2 mole 1 mole

2×206 gm take 1 mole of Ca^{2+}

$\therefore$ 1gm takes $\frac{1}{412}$ mole of Ca^{2+}.

16. moles of Br $= 1 \times$ moles of AgBr

$$= 1 \times \frac{141 \times 10^{-3}}{188}$$

mass of Br $= \frac{141 \times 10^{-3}}{188} \times 80$

$\therefore$ % of Br $= \frac{141 \times 10^{-3}}{188} \times \frac{80}{250 \times 10^{-3}} \times 100 = 24\%$

17. CH_3COOH (0.06M)

50 ml

m. moles $= 50 \times 0.06 = 3$

m. moles left $= 50 \times 0.042 = 2.1$

m. moles absorbed $= 0.9$

mass absorbed $= \frac{0.9 \times 10^{-3} \times 60}{3} \times 10^3 = \frac{54}{3} = 18$ mg

18. Bonus

19. Mass in the body of a healthy human adult has :-

Oxygen = 61.4%, Carbon = 22.9%

Hydrogen = 10.0% and Nitrogen = 2.6%

Total weight of person = 75 kg

Mass due to ^1H is $= 75 \times \frac{10}{100} = 7.5$kg

^1H atoms are replaced by ^2H atoms.

So mass gain by person = 7.5 kg

20. Given chemical eqn.

$M_2CO_3 + 2HCl \longrightarrow 2MCl + H_2O + CO_2$

1 gm (0.01186 mol)

$\Rightarrow$ from the balanced chemical eqn.

$$\frac{1}{M} = 0.01186 \Rightarrow M = 84.3 \text{ gm/mol}$$

21. $\frac{12x}{y} = \frac{6}{1}$

$2x = y$ for $C_xH_yO_z$

$C_xH_y(g) + \left(x + \frac{y}{4}\right)O_{2(g)} \longrightarrow xCO_{2(g)} + \frac{y}{2}H_2O(\bullet)$

no. of oxygen atom in $C_xH_yO_z = z$

no. of oxygen atom required for C_xH_y combustion is $\left(x + \frac{y}{4}\right) \times$

$2 = \left(2x + \frac{y}{2}\right)$.

So $z = \frac{1}{2}\left(2x + \frac{y}{2}\right) \Rightarrow z = x + \frac{y}{4} \Rightarrow z = x + \frac{2x}{4} = \frac{3x}{2}$

$x : 2x : \frac{3x}{2} \Rightarrow 2x : 4x : 3x$

2 : 4 : 3 Hence $C_2H_4O_3$

Part # II : IIT-JEE ADVANCED

1. MnO_4^- ; $x + 4(-2) = -1$ or $x = +7$;

CrO_2Cl_2 ; $x + 2(-2) + 2(-1) = 0$ or $x = +6$.

2.

(i) 4.0 M, 500 ml NaCl

no. of m moles of NaCl $= 500 \times 4$

= 2000 m moles

= 2 moles

= 2 moles of Cl^- ions

as $2Cl^- \longrightarrow Cl_2 + 2e^-$

So 1 mole of Cl_2 is generated.

(ii) no. of moles of Na^+ = 2 moles

So max. wt of Na amalgam (assuming equimolar Na & Hg)

= 46 + 400 = 446 gm.

(iii) Two moles of e^- are required

$= 2 \times 96500$ C

= 193000 C.

3. $^{54}Fe \longrightarrow 5\%$

$^{56}Fe \longrightarrow 90\%$

$^{57}Fe \longrightarrow 5\%$

Av. atomic mass $= x_1A_1 + x_2A_2 + x_3A_3$

$= 54 \times 0.05 + 56 \times 0.9 + 57 \times 0.05 = \mathbf{55.95.}$

4. Average titre value $= \dfrac{25.2 + 25.25 + 25.0}{3} = \dfrac{75.45}{3}$

$= 25.15 = 25.2$ mL

number of significant figures will be 3.

5. Only Na & F will show one non-zero oxidation state. These are

Na^+ & F^-.

6. The balance chemical equation is

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

7. Mole $= \dfrac{120}{60} = 2$

mass of solution = 1120 g

$V = \dfrac{1120}{1.15 \times 1000} = \dfrac{112}{115}$ L

$M = \dfrac{2 \times 115}{112} = 2.05$ mol/litre

8. 29.2% (w/w) HCl has density = 1.25 g/ml

Now, mole of HCl required in 0.4 M HCl

$= 0.4 \times 0.2$ mole $= 0.08$ mole

if v mol of orginal HCl solution is taken

then volume of solution = 1.25 v

mass of HCl = $(1.25\,v \times 0.292)$

mole of HCl $= \dfrac{1.25v \times 0.292}{36.5} = 0.08$

so, $v = \dfrac{36.5 \times 0.08}{0.29 \times 1.25}$ mol $= 8$ mL

9. Since the vessel is the thermally insulated so

$q = 0$

$P_{ext} = 0$, So $w = 0$

So $\Delta U = 0$ (ideal gas)

Hence $\Delta T = 0$

$\Rightarrow \Delta T = 0 \quad \Rightarrow T_2 = T_1 \quad \Rightarrow P_2V_2 = P_1V_1$

The process is however adiabatic irriversible.

So we cannot apply $P_2V_2^{\gamma} = P_1V_1^{\gamma}$

Hence ans is (A), (B), (C)

10. $K = \dfrac{R}{N_A} \quad \therefore R = K.N_A$

$= 6.023 \times 10^{23} \times 1.380 \times 10^{-23}$ J.mol^{-1}.k^{-1}

There are 4 significant figures in each term.

Hence, these be 4 significant figure in R.

11. Given 3.2 M solution

$\therefore$ moles of solute = 3.2 mol

Consider 1 L Solution.

$\therefore$ volume of solvent = 1 L

$P_{solvent} = 0.4$ g.mL^{-1} $\quad \therefore m_{solvent} = P \times V = 400$ g

$\therefore$ molality $= \dfrac{3.2\text{ mol}}{0.4\text{ kg}} = 8$ molal

13. $Ca(OH)_2 + (NH_4)_2SO_4$

1584 g $\longrightarrow 2NH_3 + CaSO_4.2H_2O$

$\downarrow [Ni(H_2O)_6]Cl_2$

Complex Compound

Number of Moles of $(NH_4)_2SO_4 = \dfrac{1584}{132} = 12$ moles

Moles of NH_3 released = 24 moles

Moles of moles of $NiCl_2.6H_2O = \dfrac{952}{238} = 4$ moles

Number of moles of Gypsum $(CaSO_4.2H_2O)$ formed = 12 moles

Mass of Gypsum formed = 12 × 172 = 2064

Number of moles of complex formed $[Ni(NH_3)_6]Cl_2 = \dfrac{24}{6}$

= 4 moles

Mass of complex formed = 4 × 232 = 928 g

Total Mass = 2064 + 928 = 2992 g

14. $PbS + O_2 \longrightarrow Pb + SO_2$

Mole $\quad \dfrac{10^3}{32}$

Moles of Pb formed $= \dfrac{10^3}{32}$

$\therefore$ Mass of Pb formed $= \dfrac{10^3}{32} \times 207 = 6468.75$gm

$= 6.46875$ kg $= 6.47$ kg

15. $2MnCl_2 + 5K_2S_2O_8 + 8H_2O \longrightarrow 2KMnO_4 + 4K_2SO_4 + 6H_2SO_4 + 4HCl$ .... (1)

$2KMnO_4 + 5H_2C_2O_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2$ .... (2)

Mass of oxalic acid added = 225 mg

Milimoles pf oxalic acid added $= \dfrac{225}{90} = 2.5$

From equation (2)

Milimoles of $KMnO_4$ used to react with oxalic acid = 1

and milimoles of $MnCl_2$ required initially = 1

$\therefore$ Mass of $MnCl_2$ required initially = 1 × 126 = 126 mg