

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 = $\frac{742}{6.023 \times 10^{23}} = 1.24 \times 10^{-21}$ gm.

5. Compound 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.

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

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

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

11. weight of CO_2 = 8.8 gm

$$\text{mole of } CO_2 = \frac{8.8}{44} = 0.2, \quad \text{mole of C} = 0.2$$

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

$$\text{So mole of } H_2 = 0.3$$

$$\text{wt. of hydrogen} = 0.3 \times 2 = 0.6$$

$$\text{wt. of carbon + hydrogen} = 2.4 + 0.6 = 3$$

= Initial wt. of hydrocarbon

∴ 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 = $CaBr_2$

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

Hence : Molecular formula = $CaBr_2$

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

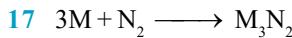
$$\therefore 32 \text{ g sulphur (1 mole atom) will be present in} = \frac{100}{8} \times 32 \\ = 400 \text{ g}$$

[→ compound must be having at least one atom of sulphur]
⇒ min. mol. mass = 400 g.

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

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

$$M = 360.1.$$



Let Atomic wt. of metal = a

So $(3a + 28)$ g nitride contains metal = 3a gram

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

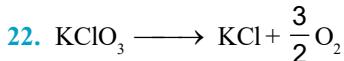
$$\text{So } a = 40.$$

21. By applying POAC for C atoms

$$\text{moles of ethylene} \times 2 = \text{mole of polythene} \times n \times 2$$

$$\frac{100g}{28} \times 2 = \frac{\text{wt. of polythene}}{28 \times n} \times n \times 2$$

$$\text{wt. of polyethene} = 100 \text{ g}$$



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

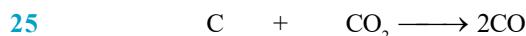
$$11.2 \text{ litre of } O_2 \text{ formed by } \frac{1}{3} \text{ mole } KClO_3$$



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MOLE CONCEPT



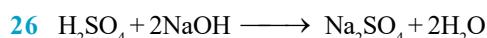
$$\text{Given moles } \left(\frac{6}{12}\right) = 0.5 \quad \left(\frac{44}{44}\right) = 1$$

So C is limiting reagent

∴ CO formed = 1 moles

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

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



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

70 g H_2SO_4 in 100 g solution

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



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

$$\text{final mole } 0 \quad 4 - 2 \times 1.88 \quad 1.88 \quad 2 \times 1.88$$

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

$$\% \text{ yield} = \frac{32 \times 100}{358 \times 48} = 35.38 \%$$



$$\text{Weight } W \text{ gram} \quad \text{Weight } W \text{ gram} \quad 0$$

$$\text{Mole } \frac{W}{36} \quad \frac{W}{24}$$

$$\text{L.R.} \rightarrow \frac{W}{36} \times \frac{1}{2} \quad \frac{W}{24 \times 3}$$

$$\frac{1}{72} \quad \frac{1}{72}$$



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

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

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



$$31 \text{ gram} \quad 32 \text{ gram}$$

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

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

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

$$12a + 20b = 4$$

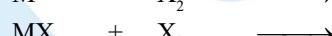
$$12a + 12b = 3 \quad \text{So } b = \frac{1}{8}$$

$$8b = 1$$

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

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

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



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

POAC for X Atom :

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

$8 [\text{No. of mole of } M_3X_8] = 1 [\text{No. of mole of NX}]$

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

Now POAC for M Atom

$$3 [\text{No. of mole of } M_3X_8] = 1 \times [\text{No. of Mole of M}]$$

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

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



$$0.05 \text{ mole} \quad (\text{M.W.} = 254) 12.7 \text{ gram}$$

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

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 $LiAlHC_{12}H_{27}O_3 = 0.05$

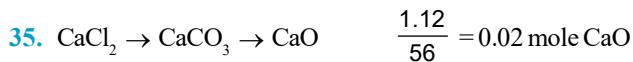
$$\% \text{ yield} = \frac{0.05}{0.05} \times 100 = 100\%$$



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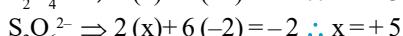
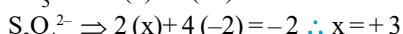
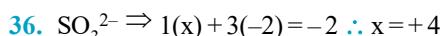
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\therefore Moles of $\text{CaCl}_2 = 0.02$ Mole

$$\text{Mass of } \text{CaCl}_2 = 0.02 \times 111 = 2.22 \text{ g}$$

$$\therefore \% \text{ of } \text{CaCl}_2 = \frac{2.22}{4.44} \times 100 = 50 \%$$



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

$$\therefore x = +5$$

40. Fe_3O_4 can be written as $\text{FeO} \cdot \text{Fe}_2\text{O}_3$,

In FeO , Fe has oxidation state +2, in Fe_2O_3 has oxidation state +3.

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

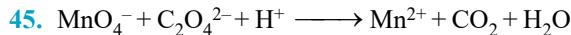


(-2)

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

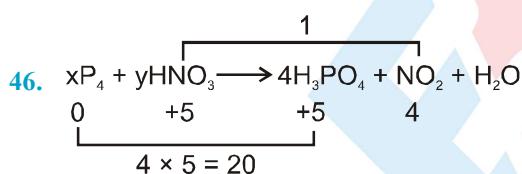
$$\therefore 2x = 6$$

$$\therefore x = +3.$$



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

\therefore Balanced equation :



$$\therefore (\text{V.f.})\text{P}_4 : (\text{V.f.})\text{HNO}_3 = 20 : 1$$

$$\therefore x = 1; y = 20$$

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

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

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

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

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

50. Let, $n_{\text{H}_2\text{O}} = n_{\text{NaCl}} = n$

$$m = \frac{\text{Mole of solute}}{\text{wt. of solvent (kg)}} = \frac{n}{n \times 18} \times 1000 = \frac{1}{18} \times 1000 \\ = 55.55 \text{ m.}$$

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

$$\text{So } X_{\text{H}_2\text{O}} = \frac{n_{\text{H}_2\text{O}}}{\text{Total moles}}$$

$$\text{Now } \frac{X_A}{X_{\text{H}_2\text{O}}} = \frac{n_A}{n_{\text{H}_2\text{O}}}$$

$$\text{and molality} = \frac{n_A \times 1000}{n_{\text{H}_2\text{O}} \times 18} = \frac{X_A \times 1000}{X_{\text{H}_2\text{O}} \times 18} = \frac{0.2 \times 1000}{0.8 \times 18} \\ = 13.9 \text{ Ans.}$$

56. Weight of KOH = 2.8 gram

Volume of solution = 100 ml

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

$$\text{57. } M_{\text{final}} = \frac{M_1 V_1 + M_2 V_2}{V_1 + V_2 + V_{\text{water}}} ; 0.25 = \frac{0.6 \times 250 + 0.2 \times 750}{250 + 750 + V_{\text{water}}} ;$$

$$\text{So } V_{\text{water}} = 200 \text{ ml.}$$

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

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

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

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

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

\therefore ratio of the conc. = 1

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

$$\text{Mole of magnesium} = \frac{24}{24} = 1$$

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

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

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

Hence option (C) is correct



MOLE CONCEPT

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

Hydrogen is = 7.7%

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

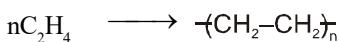
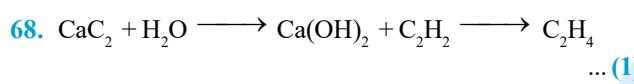
$$\% \text{C} = \left(\frac{3}{3+2+4} \right) 92.3 ; \% \text{O} = \frac{2}{9} \times 92.3 ;$$

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

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 $\text{C}_2\text{H}_6\text{OS}$

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



From equation (1)

$$\begin{aligned} \text{mole of CaC}_2 &= \text{mole of C}_2\text{H}_4 \\ \frac{64 \times 10^3}{64} &= \text{mole of C}_2\text{H}_4 \end{aligned}$$

From equation (2)

$$\begin{aligned} \frac{\text{mole of C}_2\text{H}_4}{n} &= \frac{\text{mole of polymer}}{1} \\ \frac{10^3}{n} &= \frac{\text{wt of polymer}}{n(28)} \end{aligned}$$

wt of polymer = $28 \times 10^3 \text{ g} = 28 \text{ Kg}$

70. Let mol of $\text{N}_2 = x$, mol of $\text{NO}_2 = y$,

$$\begin{aligned} \text{mol of} & \text{N}_2\text{O}_4 = z \\ \text{therefore} & \frac{28x + 46y + 92z}{1} = 55.4 \end{aligned}$$



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

$$\Rightarrow \frac{28x + 46y + 92z}{1 + z} = 39.6$$

By dividing equation (1) by equation (2)

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

$z = 0.4 \text{ mol}$

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 : $2\text{Ag} + \text{S} \rightarrow \text{Ag}_2\text{S}$

$2 \times 108 \text{ g}$ of Ag reacts with 32 g of sulphur

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

It means 'S' is limiting reagent

$$32 \text{ g of S reacts to form } 216 + 32 = 248 \text{ g of } \text{Ag}_2\text{S}$$

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

Alternately

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

(n_{eq} = number of equivalents)

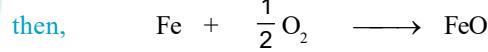
Since n_{eq} of S is less than n_{eq} of Ag

$0.0625 \text{ eq of Ag will react with } 0.0625 \text{ eq of S to form } 0.0625 \text{ eq of } \text{Ag}_2\text{S}$

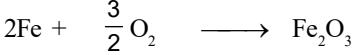
$$\begin{aligned} \text{Hence, amount of } \text{Ag}_2\text{S} &= n_{\text{eq}} \times \text{Eq. wt. of } \text{Ag}_2\text{S} \\ &= 0.0625 \times 124 = 7.75 \text{ g} \end{aligned}$$

76. Let mol of Fe undergoing formation of $\text{FeO} = x$

Let mol of Fe undergoing formation of $\text{Fe}_2\text{O}_3 = 1 - x$



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



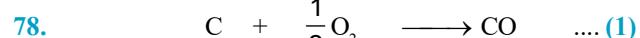
$$1 - x \quad \frac{3}{4}(1-x) \quad \frac{1-x}{2}$$

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

$x = 0.4 = \text{moles of FeO}$

$$\frac{1-x}{2} = 0.3 = \text{moles of Fe}_2\text{O}_3$$

$$\Rightarrow \frac{\text{Mole of FeO}}{\text{Mole of Fe}_2\text{O}_3} = \frac{4}{3}$$



$$\begin{array}{ccc} \text{Initial mole} & \frac{x}{12} & \frac{y}{32} & 0 \end{array}$$

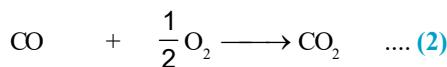


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$$\text{final mole} \quad 0 \quad \frac{y}{32} - \left(\frac{x}{12} \right) \frac{1}{2}$$



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

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

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

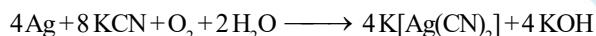
$$\frac{y}{x} > \frac{32}{24}$$

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

EXERCISE - 2

Part # I : Multiple Choice

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



- $\Rightarrow 4 \times 108 \text{ g of Ag reacts with } 8 \times 65 \text{ g of KCN}$

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.

- $\Rightarrow 4 \times 108 \text{ g of Ag require } 32 \text{ g of O}_2$

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

- $\Rightarrow 100 \text{ g of Ag require } = 7.4 \text{ g}$

Hence, choice (C) is correct.

$$\text{Hence, volume of O}_2 \text{ required} = \frac{7.4}{32} \times 22.4 = 5.20 \text{ litre}$$

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

4.	$3\text{A} + 2\text{B} \longrightarrow \text{A}_3\text{B}_2$	
initial mole	3	3
final mole	0	$3-2$
	$\text{A}_3\text{B}_2 + 2\text{C} \longrightarrow \text{A}_3\text{B}_2\text{C}_2$	
initial mole	1	1
final mole	$1 - \frac{1}{2}$	$\frac{1}{2}$

6. (A) Molarity of second solution is = $\frac{10 \times d \times x}{M} = 1 \text{ M}$
(B) Volume = $100 + 100 = 200 \text{ ml}$
(D) Mass of $\text{H}_2\text{SO}_4 = \frac{200 \times 1}{1000} \times 98 = 19.6 \text{ gm.}$

8. (A) , (B) and (D). Explanation : (A) 1.0 mol of $\text{O}_2 = 32 \text{ g}$
(B) 6.02×10^{23} molecules of $\text{SO}_2 = 64 \text{ g}$, 3.01×10^{23} molecules of $\text{SO}_2 = 32 \text{ g}$
(C) 0.5 mole of $\text{CO}_2 = 0.5 \times 44 = 22 \text{ g}$ is not correct answer.
(D) 1 g atom of sulphur = 32 g

9. (A) and (B) Explanation : 30% of molecule dissociated $\text{N}_2 \rightarrow 2\text{N}$
Amount of N_2 left = $\frac{2.8}{28} \times \frac{70}{100} = 0.1 \times 0.7 = 0.07$
(in moles)

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

- (A) Total no . of moles = $0.07 + 0.06 = 0.13$
(B) Total number of molecules = $0.07 \times 6.023 \times 10^{23} = 4.2 \times 10^{22}$ molecule = 0.421×10^{23}
→ We have to calculate molecule of nitrogen not atoms.

10. (A) and (B) Explanation : M. Wt. = $0.001293 \times 22400 = 28.96$

M.Wt. = $d \times \text{volume of 1 mole of gas at STP}$

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

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



$$n_{\text{H}_2} = \frac{5.6}{22.4} = \frac{1}{4} \quad n_s = \frac{8}{32} = \frac{1}{4} \quad n_{\text{O}_2} = \frac{1}{2}$$

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

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

12. $m = 0.2 \text{ mole / kg}$

weight of solvent = 1000 gram

weight of solute = $0.2 \times 98 = 19.6 \text{ gram}$

Total weight of solution = $1000 + 19.6 = 1019.6 \text{ ml.}$

13. Let W gas of SO_2 and O_2 are taken

$$\text{moles of } \text{SO}_2 = \frac{W}{64} ; \quad \text{moles of } \text{O}_2 = \frac{W}{32} ;$$

$$\text{molecules of } \text{O}_2 = \frac{WN_A}{32} ; \quad \text{molecules of } \text{SO}_2 = \frac{WN_A}{64}$$

hence molecules of $\text{O}_2 >$ molecules of SO_2
since moles of $\text{O}_2 >$ moles of SO_2 , hence volume of O_2 at STP > volume of SO_2 at STP.



MOLE CONCEPT

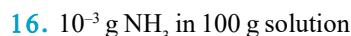


initial mole 12 8 0

final mole 0 8 - 6 6

\therefore moles of R formed = 6

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



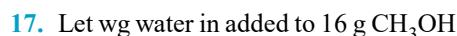
one litre water has mass = 1000×1 g

As NH_3 is very less hence we can say

100 g water has 10^{-3} g NH_3

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

$$= 10^{-2} \text{ g } \text{NH}_3 = \frac{10^{-2}}{17} \text{ mole } \text{NH}_3 = 5.88 \times 10^{-4} \text{ mole } \text{NH}_3.$$



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

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

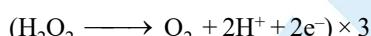
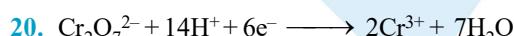


Mass of water = 15×1

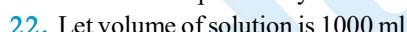
Total mass of solution = $15 + 0.792 \times 15 = 26.88$

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

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



The reaction practically occurs with this stoichiometry.



moles of H_2SO_4 = 18

mass of H_2SO_4 = $18 \times 98 = 1764$ g

mass of solution = $1000 \times 1.8 = 1800$ g

mass of solvent = $1800 - 1764 = 36$ g

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

1 24. Mole fraction of $\text{H}_2\text{O} = 1 - 0.25 = 0.75$

$$\frac{x_{\text{C}_2\text{H}_5\text{OH}}}{x_{\text{C}_2\text{H}_5\text{OH}} + x_{\text{H}_2\text{O}}} = \frac{n_{\text{C}_2\text{H}_5\text{OH}}}{n_{\text{C}_2\text{H}_5\text{OH}} + n_{\text{H}_2\text{O}}}$$

or

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



\therefore mass of Mg = $2 \times 24 = 48$ 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	$\frac{x}{40} \times N_A$	$\frac{x}{40} \times N_A$

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

27. (B) Explanation : 1 mole of electrons weighs

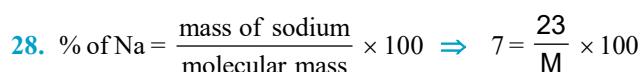
$$= 9.1 \times 10^{-31} \text{ kg} \times 6.023 \times 10^{23}$$

$$= 54 \times 10^{-8} \text{ kg} = 54 \times 10^{-8} \times 1000$$

$$= 54 \times 10^{-5} \text{ g} = 54 \times 10^{-5} \text{ g} \times 10^3 \text{ mg}$$

$$= 54 \times 10^{-2} \text{ mg} = 0.54 \text{ mg}$$

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



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

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.



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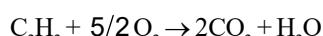
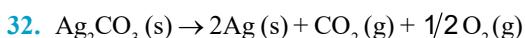
POAC on 'C' atom

$$1 \text{ (mole of } C) = 1 \text{ (mole of } CO_2) + 1 \text{ (mole of } CO)$$

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

$$\text{Mole of } CO_2 = 20 - 10 = 10$$

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



By Stoichiometry of reaction

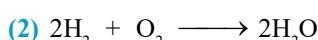
$$\text{Moles of } CO_2 \text{ formed} = \frac{11.2}{22.4} = \frac{1}{2}$$

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

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

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

33. (1) It is a fact.



Initial mole	2	3	0
final mole	0	3-1=2	2



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

Here C is limiting reagent.



Initial mole	2	1.2	1.44	0
final mole	0	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

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

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

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

Hence: $x = 56$ & $y = 16$.

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

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

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

It means 'S' is limiting reagent

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

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

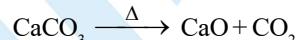
$$\text{Alternately } n_{eq} \text{ of Ag} = \frac{10}{108} = 0.0925;$$

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

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

$$\text{Hence, amount of } Ag_2S = n_{eq} \times \text{Eq. wt. of } Ag_2S \\ = 0.0626 \times 124 = 7.75 \text{ g}$$



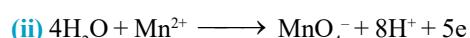
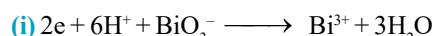
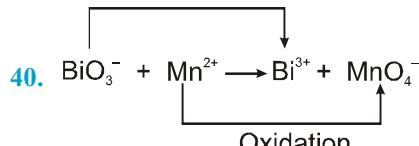
$$\text{Mole of } CaCl_2 = \text{mole of } CaCO_3 = \text{mole of } CaO = \left(\frac{1.62}{56} \right)$$

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

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

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

Reduction



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

Hence, (B) is the correct balanced reaction.



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41. Explanation : M. wt. of $\text{NaNO}_3 = 85$

70 mg of Na^+ are present in 1 mL

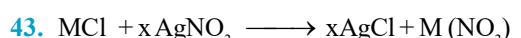
50 mL of solution contains $50 \times 70 = 3500$ mg = 3.5 g Na^+ ion

23 g of Na^+ are present in 85 g of NaNO_3

$$3.5 \text{ g of } \text{Na}^+ \text{ are present in } \frac{85}{23} \times 3.5 = 12.934 \text{ g of } \text{NaNO}_3$$

42. $3\text{I}_2 + \text{OH}^- \longrightarrow \text{IO}_3^- + 5\text{I}^-$ (balance reaction)

So, ratio is 1 : 5.



$$\frac{\text{Mole of } \text{MCl}_x}{1} = \frac{\text{Mole of } \text{AgNO}_3}{x}$$

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

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

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

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 4°C i.e. 277 K density of water = 1 gm/ml

∴ 1 kg water \Rightarrow 1000 ml water = 1 lit.

∴ Molality & molarity remains same.

46. 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 $\text{NaCl} = \frac{5.85}{58.5} = 0.1$

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

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.

∴ mass of solvent = 1000 d - M × M₂

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

1

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

50. For reaction with 2 moles NaOH

1M H_2SO_4 1 lit. volume required ;

1M HCl 2 lit. volume required

∴ cheapest will be 1M H_2SO_4 1 lit.

Part # II : Assertion & Reason

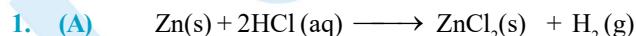
5 Statement-1 and Statement-2 both are two formula independent to each other.

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



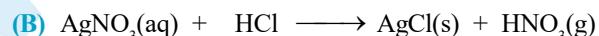
Initial mole	2	2	0	0
final mole	(2-1=1)	0	1	1

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

Volume of H_2 = 22.4 lit.

Solid product obtained = 1 mole

Limiting reagent is HCl.



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.

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

Limiting reagent is HCl.



Initial mole	$\frac{100}{100} = 1$	0	0	0
	0	1	1	1

Excess reagent not present

Volume of gas = 22.4 lit. at STP

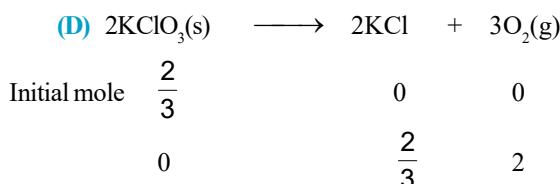
Solid product is 1 mole



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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 = $2 \times 2.5 \text{ M}$

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

Part # II : Comprehension

Comprehension # 1 :

- 1 mole of air $\Rightarrow 0.8$ mole of $\text{N}_2 = 0.8 \times 28 \text{ g N}_2$
 $\Rightarrow 0.2$ mole of $\text{O}_2 = 0.2 \times 32 \text{ g O}_2$
 $\therefore \% \text{ w/w O}_2 = \frac{w_{\text{O}_2} \times 100}{w_{\text{O}_2} + w_{\text{N}_2}} = \frac{0.2 \times 32 \times 100}{0.2 \times 32 + 0.8 \times 28} = 22.2\%$
- Density of air at NTP
 $1 \text{ mole of air} = 0.8 \text{ mole N}_2 + 0.2 \text{ mole O}_2$
 $= 0.8 \times 28 + 0.2 \times 32 = 28.8 \text{ gm} = 22.4 \text{ Ltr volume.}$

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

Comprehension # 4 :

- Mass of solute = $60 \times 0.4 + 100 \times 0.15 = 24 + 15 = 39 \text{ gm}$
 Mass of solvent = $160 - 39 = 121 \text{ gm}$

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

- Mass of solute = 39 gm

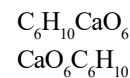
$$\text{Volume of solution} = \frac{160}{1.6} = 100 \text{ ml}$$

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

Comprehension # 5 :

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

Simplest formula



- Formula weight

- The molecular mass of lactate pentahydrate = 308
 218 gm anhydrous salt recovered = 308 g lactate pentahydrate

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

Comprehension # 6 :

- The cost of 1000 gm KCl is 50 kg
 The cost of 74.5 g KCl is

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

- The price of K_2SO_4

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

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

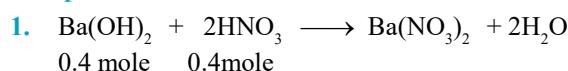
$$\text{mole of K}_2\text{O form 13.42 mole of K} = \frac{13.42}{2} = 6.71$$

mass of K_2O

$$= 6.71 \times 94 = 630.8 \text{ gm} = 0.631 \text{ kg}$$



Comprehension # 7 :



In resultant sol. $\text{Ba}(\text{OH})_2$ is remaning, therefore nature of sol. basic.

2. Vol. of $\text{Ba}(\text{OH})_2$

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

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

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

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. mole of $\text{Fe}_3\text{Br}_8 = \frac{100 \times 2.06 \times 10^6}{103 \times 70 \times 8}$

$$\text{mole of Fe} = \text{mole FeBr}_2 = \frac{2.06 \times 10^3 \times 100 \times 100}{103 \times 70 \times 60 \times 8} \times 3$$

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

$$\text{mass of Fe} = 10^3 \text{ kg}$$

3. mole of $\text{CO}_2 = \frac{\text{mole of NaBr}}{2}$
 $= \frac{2.06 \times 10^3}{103 \times 2} = 10$

Comprehension # 9 :

1. $\text{CO}_2 = 22 \text{ g} = 0.5 \text{ mol}$

$$\text{H}_2\text{O} = 13.5 \text{ g} = \frac{13.5}{18} \text{ mol}$$

$$\text{C} = 0.5 \text{ mol} = 6 \text{ g}$$

$$\text{H} = 1.5 \text{ mol} = 1.5 \text{ g}$$

$$\text{O} = 8 \text{ gm} = 0.5 \text{ mol}$$

$$\text{E.F.} = \text{CH}_3\text{O}$$

let molar mass = M

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

$$\text{E.F. mass} = 12 + 3 + 16 = 31$$

$$\begin{aligned} n &= \frac{274}{31} \approx 2 \\ \text{M.F.} &= (\text{CH}_3\text{O})_2 \\ &= \text{C}_2\text{H}_6\text{O}_2 \end{aligned}$$

EXERCISE - 4

Subjective Type

1. Ist exp. $\text{CuO} = 1.375 \text{ gm}$

$$\text{Cu} = 1.098 \text{ gm}$$

$$\text{O} = 0.277 \text{ gm}$$

$$\text{IIInd exp. Cu} = 1.179 \text{ gm}$$

$$\text{CuO} = 1.4476 \text{ gm}$$

$$\text{O} = 0.2686 \text{ gm}$$

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

$$\frac{\text{Cu}}{\text{O}} ; 4$$

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. $= 35.125 \times 28 = 983.5 \text{ gm}$

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

5. $n_{\text{NaClO}_3} = \frac{106.5}{106.5} = 1 \text{ mole}$

NO. of atom of

$$\text{Na} = 1 \times N_A$$

$$\text{Cl} = 1 \times N_A$$

$$\text{O} = 1 \times N_A$$

6. $n_{\text{P}_4} = \frac{92.9}{4 \times 31} = 0.75 \text{ mole}$

$$N_{\text{P}_4} = 0.75 \times N_A = 4.52 \times 10^{23} \text{ molecules}$$

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

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

8. (a) $1 \times 23 \text{ gm}$ (b) $1 \times 35.5 \text{ gm}$
 (c) $1 \times 63.5 \text{ gm}$

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



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- 10.** $3\text{CaCO}_3 + 2\text{H}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + 3\text{H}_2\text{O} + 3\text{CO}_2$
- | | | |
|------------|------------|--|
| 50/100mole | 70/98 mole | 17. $\text{C}_4\text{H}_8 + 6\text{O}_2 \rightarrow 4\text{CO}_2 + 4\text{H}_2\text{O}$ |
| =0.5 | 0.7142 | x 4x 5x |
- $$-- \quad 0.7142 - \frac{2}{3} \times 0.5 = 0.3808 \left(\frac{0.5}{3} \right)$$
- Limiting reactant**
- $$\text{m}_{\text{CaCO}_3} = \frac{0.5}{3} \times M_{\text{Ca}_3(\text{PO}_4)_2} = 51.66 \text{ gm}$$
- $$\text{m}_{\text{H}_3\text{PO}_4} = 0.3808 \times M_{\text{H}_3\text{PO}_4} = 31.31 \text{ gm}$$
- 11.** $\text{ClNH}_2 + 2\text{NH}_3 \rightarrow \text{N}_2\text{H}_4 + \text{NH}_4\text{Cl}$
- | | | |
|--------------------------|--------|---|
| $\frac{1000}{51.5}$ mole | excess | 18. $\text{C}_x\text{H}_y + \left(x + \frac{y}{4} \right) \text{O}_2 \rightarrow x\text{CO}_2 + \frac{y}{2} \text{H}_2\text{O}$ |
| =19.417 | | v excess |
| 19.417 mole | | $\left(x + \frac{y}{4} \right)v \quad xv \quad \frac{y}{2}v$ |
- $$\% \text{ yield} = \frac{14.781}{19.417} \times 100 = 76.125\%$$
- 12.** $5\text{C} + 2\text{SO}_2 \xrightarrow{82\%} \text{CS}_2 + 4\text{CO}$
- | | | |
|--------|---|---|
| excess | $\frac{450}{64} = 7.03 \text{ Kmole}$ | $+v - \left(x + \frac{y}{4} \right)v + xv + \frac{y}{2}v = 2.5v$ |
| | | $\frac{y}{4} = 1.5 \Rightarrow y = 6$ |
| | $0.82 \times \frac{7.03}{2} = 2.88 \text{ Kmole} = 219.09 \text{ kg}$ | $xv = 2v \Rightarrow x = 2$ |
- 13.** $\text{BaO} + \text{CaO}$
- | | |
|---|---|
| $x \times [153] + y \times [56] = 28$ | 19. Molar mass |
| $\text{BaO} + 2\text{HCl} \rightarrow \text{BaCl}_2 + \text{H}_2\text{O}$ | $= 3.2707 \times 10^{-22} \times 6.023 \times 10^{23} = 196.99426 \text{ gm}$ |
| x 2x | |
- $\text{CaO} + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O}$
- | | |
|--------------------------------------|--|
| y 2y | 20. $M = \pi \times (75 \times 10^{-8} \text{ cm})^2 \times (5000 \times 10^{-8} \text{ cm})$ |
| $2x + 2y = 6 \times 0.1008 = 0.6048$ | $\times \frac{1}{0.75 \text{ cm}^3 / \text{gm}} \times 6.023 \times 10^{23} = 7.09 \times 10^7 \text{ gm}$ |
- $\% \text{ of BaO} = \frac{x \times 153}{29} \times 100 = 65.65\%$
- 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.** $\text{C}_n\text{H}_{2n+2} + \frac{(3n+1)}{2}\text{O}_2 \rightarrow n\text{CO}_2 + (n+1)\text{H}_2\text{O}$
- $$\frac{(3n+1)/2}{n} = \frac{7}{4} \Rightarrow 6n+2 = 7n \Rightarrow n = 2 \quad \text{C}_2\text{H}_6$$
- 21.** $\frac{M_{\text{gas}}}{M_{\text{air}}} = 1.17 \Rightarrow M_{\text{gas}} = 1.17 \times 29 = 33.93 \text{ gm}$
- 22.** $\text{Y}_3\text{A}_5\text{O}_{12}$
 $200 \times 200 \times 10^{-3}$
(a) $y = 44.95\%, \quad \text{Al} = 22.73\%, \quad \text{O} = 32.32\%$
(b) 17.98 gm
- 23.** $n = \frac{100}{[12 \times 12 + 4 + 35.5 \times 4 + 16 \times 2]} = 8.8 \times 10^{-8} \text{ mole}$
- 24.** $6\text{LiH} + 8\text{BF}_3 \xrightarrow{2 \quad 2} 6\text{LiBF}_4 + \text{B}_2\text{H}_6$



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36. 1.0 mole of $\text{KClO}_3 \equiv 3.0$ mole of Zn

$$\frac{5.104}{122.5} \text{ mole } \text{KClO}_3 \equiv \frac{3 \times 5.104}{122.5}$$

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

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.

$$\Rightarrow x = 1.064$$

$$\text{Also, moles of } \text{CuBr}_2 = \frac{1}{2} \text{ moles of } \text{AgBr} = \frac{1}{2} \times \frac{x}{188}$$

$$\Rightarrow \text{Mass of } \text{CuBr}_2 = \frac{1}{2} \times \frac{x}{188} \times 223.5 = 0.6324 \quad (\text{on substituting } x)$$

Mass % of $\text{CuBr}_2 = 34.18$

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

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

$$\Rightarrow \text{Moles of } \text{AgCl} \text{ from } \text{KCl} = 0.00393 = \text{moles of } \text{KCl}$$

$$\Rightarrow \text{Mass of } \text{KCl} \text{ in sample} = 0.00393 \times 74.5 = 0.2928 \text{ g}$$

Mass % of KCl in the sample = 29.28

39. Let the mixture contain x g $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.

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

\Rightarrow Mass percentage of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O} = 74.4$

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 = $\text{CaC}_2\text{N}_2\text{S}_2$,

Empirical formula weight = 156

Hence, molecular formula = $\text{CaC}_2\text{N}_2\text{S}_2$

41. Working in backward direction

In the last step moles of ($\text{AgBr} + \text{AgI}$) = 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

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

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

Mass of ($\text{AgCl} + \text{AgBr}$) = 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 $\text{NaBr} = 20.23$

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 = 15×10^{-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 $(\text{CH}_3)_x \text{AlCl}_y$

$$m(\text{CH}_4) = \frac{0.643 x}{M} \times 16 = 0.222$$

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

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

$$\text{AlSoM} = 15x + 27 + 35.5y = 15x + 27 + \frac{35.5x}{2} = 32.75x + 27$$

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

44. Mass of $\text{AgCl} = 0.09 \times 143.5 = 12.915 \text{ g}$ which is 95.77 % of total ppt.

\Rightarrow Total mass of precipitate

= 13.485 g and mass of impurity = 0.57 g



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$$\Rightarrow \text{Mass of NaCl} + \text{KCl} = 5.9 \text{ g}$$

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

$$\Rightarrow x = 2.94 \text{ g NaCl}, 2.96 \text{ g KCl}$$

$$m(\text{Na}_2\text{O}) = 1.558 \text{ g} \Rightarrow m\%(\text{Na}_2\text{O}) = 31.16$$

$$m(\text{K}_2\text{O}) = 1.867 \text{ g} \Rightarrow m\%(\text{K}_2\text{O}) = 37.34$$

- 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



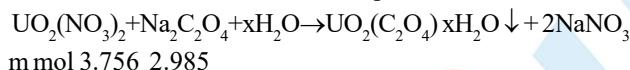
Let x g of KI is taken

$$\Rightarrow \text{moles of KI} = \frac{x}{166} \Rightarrow \text{moles of } \text{Pb}(\text{NO}_3)_2 \text{ present} \\ = \frac{x}{2 \times 166}$$

$$\Rightarrow \frac{x}{2 \times 166} = \frac{5 - x}{330} \Rightarrow x = 2.5 \text{ g} \Rightarrow \text{mass of PbI}_2 = \frac{x}{332} \times 460 = 3.464 \text{ g}$$

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

$$\text{Mass \% of uranium in the sample} = 89.4$$



Here $\text{Na}_2\text{C}_2\text{O}_4$ is the limiting reagent, therefore, m mol of $\text{UO}_2(\text{C}_2\text{O}_4)x\text{H}_2\text{O}$ formed is 2.985.

$$\Rightarrow M(\text{UO}_2(\text{C}_2\text{O}_4)) \cdot x\text{H}_2\text{O} = \frac{1.23}{2.985} \times 1000 = 412$$

$$= 238 + 32 + 88 + 18x$$

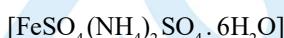
$$\Rightarrow x = \frac{54}{18} = 3$$

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

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

$$\Rightarrow \text{Molar mass of mother cell} = 7.6 \times 10^{-17} \times 24 \times 60 \times 6.023 \times 10^{23} \\ = 6.6 \times 10^{10} \text{ amu}$$

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



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

$$\text{Solving } x = 0.23 \text{ g} \Rightarrow \text{Mohr's salt} = \frac{0.23}{0.50} \times 100 = 46\%, \\ (\text{NH}_4)_2\text{SO}_4 = 54\%$$

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

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

$$\Rightarrow \text{mass of Fe}_2\text{O}_3 \text{ obtained on ignition of 0.2 sample} \\ = \frac{2.347 \times 10^{-4}}{2} \times 160 = 18.77 \text{ mg}$$

- 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 $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$

$$\text{m mol of BaCl}_2 \cdot 2\text{H}_2\text{O} = \frac{0.3}{244} \times 1000 = 1.229 \text{ m mol}$$

$$\text{m mol of AgNO}_3 \text{ required} = 2 \times 1.229 = 2.458$$

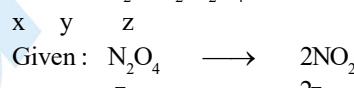
$$\text{Volume of AgNO}_3 \text{ required} = \frac{2.458}{0.15} = 16.38 \text{ mL (smallest)}$$

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

$$\text{m mol of NaCl} = \frac{0.3}{58.5} \times 1000 = 5.128 = \text{m mol of AgNO}_3 \text{ required}$$

$$\Rightarrow \text{Volume of AgNO}_3 \text{ required} = \frac{5.128}{0.15} = 31.18 \text{ mL (largest)}$$

- 50.** Mixture($\text{N}_2\text{NO}_2, \text{N}_2\text{O}_4$) has mean molar mass = 55.4.



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

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

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

$$\text{So } 55.4 = 28x + 46(y + 2z) \quad \dots(1)$$

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

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

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

$$\text{or } 39.6(1 + z) = 59.4$$

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

$$\text{or } z = 0.4$$

from eq. (1)

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

$$\boxed{z = 0.4} \text{ put}$$

$$55.4 = 28x + 46y + 36.8$$



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$$28x + 46y = 18.6 \quad \dots(2)$$

$$\rightarrow x + y + z = 1$$

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

$$x + y = 0.6 \quad \dots(3)$$

eq. (2) $\times 1$ eq. (3) $\times 28$

$$28x + 46y = 18.6$$

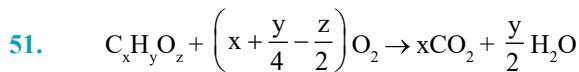
$$28x + 28y = 16.8$$

$$\begin{array}{r} - \\ - \\ \hline 18y = 1.8 \end{array}$$

$$\boxed{y = 0.1}$$

$$\rightarrow x + y + z = 1$$

$$\boxed{x = 0.5}$$



Given vol. 10mL + 100mL 0 + 0

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

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

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

$$y - 2z = 4 \quad \dots(1)$$

Property of KOH has to absorbed all CO_2 .

$$\therefore 10x = 20$$

$$\boxed{x = 2}$$

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

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

$$12x + y + 16z = 46$$

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

$$y + 16z = 22$$

from eq. (1) & (2)

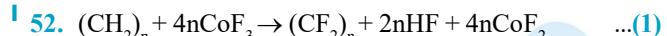
$$y - 2z = 4$$

$$y + 16z = 22$$

$$\begin{array}{r} - \\ - \\ \hline -18z = -18 \end{array}$$

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

Molecular formula = C_2H_6O .



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

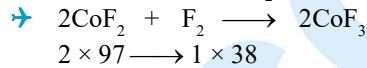
$$\text{from eq. (1)} \quad (CF_2)_n = 4nCoF_2$$

$$\frac{w}{E} = \frac{w}{E}$$

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

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

$$w = 80 \times 97 \text{ g (CoF}_2)$$

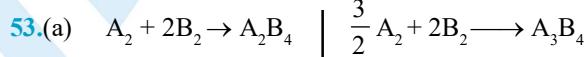


$$2 \times 97 \rightarrow 1 \times 38$$

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

$$2HF \rightarrow H_2 + F_2 \quad \left\{ \begin{array}{l} \rightarrow (CF_2)_n \text{ moles} = \frac{1000}{50n} = \frac{20}{n} \text{ moles of (CF}_2)_n \\ HF = \frac{20}{n} \times 2n = 40 \text{ mol} \end{array} \right.$$

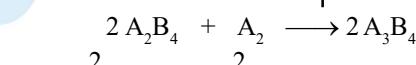
$$40 \quad 20 \quad 2n \quad \left\{ \begin{array}{l} 1 \rightarrow \frac{20}{40} \times 1.52 \\ 1.52 = 0.76 \text{ kg} \end{array} \right.$$



$$\text{Initial} \quad 4 \quad 4 \quad -$$

$$\text{After} \quad 4-2 \quad 4-4 \quad 2$$

$$2 \quad 0 \quad 2$$



$$2 \quad 2$$

$$2-2 \quad 2-1 \quad 2$$

$$1 \quad 2$$

$$\therefore A_2 = 1, A_2B_4 = 2$$

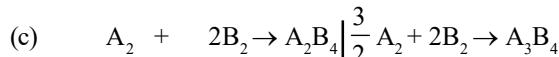


$$\text{Initial} \quad \frac{1}{2} \quad 2$$

$$\text{After} \quad 0 \quad 2-1 \quad 0.5$$

$$1 \quad 0.5$$

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



$$\text{Initial} \quad 1.25 \quad 2$$

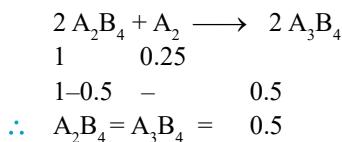
$$\text{After} \quad 1.25 \quad -1 \quad -1$$

$$0.25 \quad -1$$



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54. (a) 1L $\text{KMnO}_4 \rightarrow 79\% (\text{w/v})$ i.e. 100 mL solution contain 79 g KMnO_4

$$\text{moles of } \text{KMnO}_4 = \frac{\text{wt.}}{\text{M}_w} = \frac{79}{158} = 0.5$$

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

$\text{HCl} \rightarrow 10\% (\text{w/w})$ i.e. 100 g solution contain 10 g HCl
 $D = 1.825 \text{ g/mL}$

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

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



$M \times V_1$	$M \times V_1$
5×1	5×9
5	45
-	5
	12.5

$$\text{Cl}_2 = 12.5 \times \frac{80}{100} = 10 \text{ mol.}$$

- (b) $2\text{KMnO}_4 + 16\text{HCl} \rightarrow 2\text{KCl} + 2\text{MnCl}_2 + 8\text{H}_2\text{O} + 5\text{Cl}_2$

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

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

$$= \frac{25}{\text{vol. of } \text{KMnO}_4 + \text{HCl}} = \frac{25}{1+9} = 2.5$$

55. $D = 1.03 \text{ g/cm}^3$

$2.8\% \text{ NaCl} \rightarrow 100 \text{ g solution contain } 2.8 \text{ g NaCl.}$

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

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

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

$$\begin{aligned} M_2 V_2 &= M_1 V_1 \\ 0.493 \times 10^6 &= 5.45 \times V_1 \\ V_1 &= 9 \times 10^4 \end{aligned}$$

$$\begin{aligned} \text{So water evaporated} &= 10^6 - 9 \times 10^4 \\ &= 9.095 \times 10^5 \text{ L} \end{aligned}$$

56. Let free $\text{SO}_3 \rightarrow x \text{ g}$

$$\text{SO}_3 \text{ in form of } \text{H}_2\text{SO}_4 \rightarrow \frac{x}{80} \times 98 = 1.225 x$$

So total

$$x + 1.225 x = 100$$

$$x = 449.49$$

$$\begin{aligned} \text{water required} &= \frac{44.94}{80} \times 18 = 10.11 \text{ g \% oleum} \\ &= 100 + 10.11 = 110.11\% \end{aligned}$$

57. 100 mL milk \rightarrow 4mL fat

1 L milk \rightarrow 40 mL fat

density of fat = $875 \text{ kg/m}^3 = 0.875 \text{ g/mL}$

mass of fat = $40 \times 0.875 = 35 \text{ g}$

fat free milk mass = $1035 - 35 = 1000 \text{ g}$

Vol. = $1000 - 40 = 960 \text{ mL}$

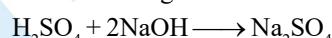
$$\rho = \frac{1000}{960} = 1.0416 \text{ g/mL}$$

$$\left. \begin{array}{l} \text{H}_2\text{SO}_4 \rightarrow a \\ \text{SO}_3 \rightarrow b \\ \text{SO}_2 \rightarrow c \end{array} \right\} a + b + c = 1 \text{ g}$$

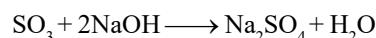
$$\text{SO}_2 \rightarrow 1.5\%$$

$$\text{so, C} = 0.015 \text{ g} \rightarrow \text{SO}_2$$

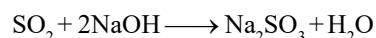
$$a + b = 0.985 \text{ g}$$



$$\frac{a}{98}$$



$$\frac{b}{80}$$



$$\frac{0.015}{64}$$

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

$$0.0102 a + 0.0125 b + 0.00234 = 0.011735$$

$$a + 1.225 b = 1.1275$$

$$a + b = 0.985$$

$$0.225 b = 0.1425$$

$$b = 0.633 \text{ g} \rightarrow \text{SO}_3$$

$$a = 0.35 \text{ M g} \rightarrow \text{H}_2\text{SO}_4$$

$$\text{Combined SO}_3 = \frac{0.3514}{98} \times 80 = 0.2868 \text{ g}$$



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59. Volume = $1 \times 3 \times 300 \times 6 \times 10^{-10}$

$$= 5.4 \times 10^{-7} \text{ m}^3 = 0.54 \text{ cm}^3$$

$$\rho = 1 \text{ g/cm}^3$$

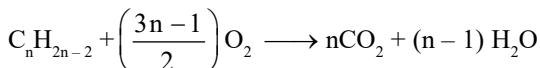
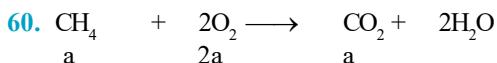
$$\text{mass} = 0.54 \text{ g}$$



$$\frac{w}{129}$$

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

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



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

$$\text{For methane } a + n(20-a) = 40$$

For oxygen

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

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

$$2a + 30n - 1.5na - 10 + 0.5a = 60$$

$$2.5a - 1.5na + 30n = 70$$

$$2.5a - 1.5n(a-20) = 70$$

$$2.5a + 1.5n(20-a) = 70$$

from (1) & (2)

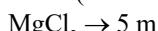
$$a = 10$$

$$n = 3$$



% composition $\rightarrow 50\%$

61. $\text{CaCl}_2 \rightarrow 5\text{M} = 555 \text{ g in 1 L solution or in 1050g solution}$
 $\text{wt. of (solvent + MgCl}_2\text{)} = 1050 - 555 = 495 \text{ g}$



1000 g solvent $\rightarrow 5 \text{ mol of MgCl}_2$

$$= 5 \times 95 = 475 \text{ g MgCl}_2$$

i.e., 1475 (solvent + MgCl₂) \rightarrow 475 g MgCl₂

$$495 (\text{solvent} + \text{MgCl}_2) \rightarrow \frac{475}{1475} \times 495$$

$$= 159.4 \text{ g MgCl}_2$$

$$\text{moles of MgCl}_2 = \frac{159.4}{95} = 1.678$$

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 = $\frac{\text{Moles of solute}}{\text{V}_l}$

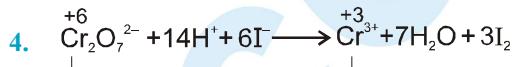
$$= \frac{6.02 \times 10^{20} / 6.02 \times 10^{23}}{100/1000} = 0.01 \text{ M}$$

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

3. Let the oxidation state of Cr is x.

$$x + 4(0) + 2(-1) = +1$$

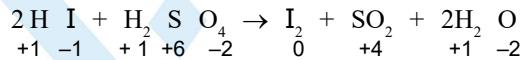
$$x - 2 = +1 \quad \text{or, } x = +1 + 2 = +3.$$



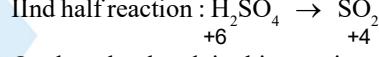
5. Final molarity = $\frac{M_1 V_1 + M_2 V_2}{V_1 + V_2}$

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

6. In the reaction.



In this reaction oxidation number of I increases by one, thus this is an oxidation reaction and HI behaves as a reducing agent.



+6 +4

On the other hand, in this reaction, oxidation number of S decreases by two, thus this is a reduction reaction and H₂SO₄ behaves as oxidizing agent.

7. 8 moles of O-atom are contained by 1 mole Mg₃(PO₄)₂.

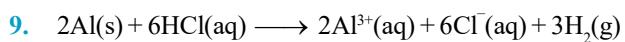
Hence, 0.25 moles of O-atom = $\frac{1}{8} \times 0.25 = 3.125 \times 10^{-2}$

mole Mg₃(PO₄)₂.

8. molality (m) = $\frac{M}{1000d - MM_1} \times 1000$

M = Molarity, M₁ = Molecular mass of solute, d = density

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



3 mole H₂ from 6 mole HCl consumed.

\therefore 1 mole H₂ from 2 mole HCl consumed.

1/2 mole(11.2 Lit) H₂ from 1 mole HCl consumed.

10. 3.6 M solution means 3.6 mole of H₂SO₄ is present in 1000 ml of solution

\therefore Mass of 3.6 moles of H₂SO₄ is $= 3.6 \times 98 \text{ g} = 352.8 \text{ g}$

\therefore Mass of H₂SO₄ in 1000 ml of solution = 352.8 g

Given, 29g of H₂SO₄ is present in 100 g of solution



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MOLE CONCEPT

$\therefore 352.8 \text{ g of H}_2\text{SO}_4 \text{ is present in } \frac{100}{29} \times 352.8 = 1216 \text{ g of solution}$

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

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

$$12. \text{ Molality} = \frac{0.01/60}{0.3} = \frac{0.01}{60 \times 0.3} ; d = 1 \text{ g/ml} \\ = 5.55 \times 10^{-4} \text{ m.}$$

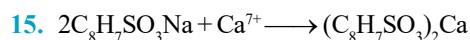
$$13. \text{ Molarity} = \frac{\text{moles of solute}}{\text{volume of sol. (l)}}$$

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

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

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

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



2 mole 1 mole

2 × 206 gm take 1 mole of Ca^{2+}

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

$$16. \text{ moles of Br} = 1 \times \text{moles of AgBr}$$

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

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

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

$$17. \text{CH}_3\text{COOH (0.06M)}$$

50 ml

$$\text{m. moles} = 50 \times 0.06 = 3$$

$$\text{m. moles left} = 50 \times 0.042 = 2.1$$

$$\text{m. moles absorbed} = 0.9$$

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

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%

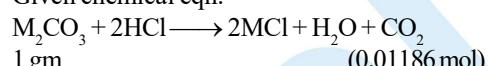
Total weight of person = 75 kg

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

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

So mass gain by person = 7.5 kg

20. Given chemical eqn.



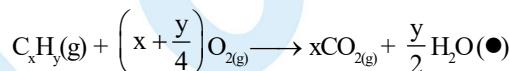
1 gm (0.01186 mol)

\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 $\text{C}_x\text{H}_y\text{O}_z$



no. of oxygen atom in $\text{C}_x\text{H}_y\text{O}_z = z$

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

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

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

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

2 : 4 : 3 Hence $\text{C}_2\text{H}_4\text{O}_3$

Part # II : IIT-JEE ADVANCED

$$1. \text{MnO}_4^- ; x + 4(-2) = -1 \quad \text{or} \quad x = +7; \\ \text{CrO}_2\text{Cl}_2 ; x + 2(-2) + 2(-1) = 0 \quad \text{or} \quad x = +6.$$

2.

(i) 4.0 M, 500 ml NaCl

$$\text{no. of m moles of NaCl} = 500 \times 4 \\ = 2000 \text{ m moles} \\ = 2 \text{ moles} \\ = 2 \text{ moles of Cl}^- \text{ ions}$$

as $2\text{Cl}^- \longrightarrow \text{Cl}_2 + 2\text{e}^-$

So 1 mole of Cl_2 is generated.

(ii) no. of moles of $\text{Na}^+ = 2$ moles

So max. wt of Na amalgam (assuming equimolar Na & Hg)
 $= 46 + 400 = 446 \text{ gm.}$

(iii) Two moles of e^- are required

$$= 2 \times 96500 \text{ C}$$

$$= 193000 \text{ C.}$$



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CHEMISTRY FOR JEE MAIN & ADVANCED

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

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

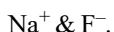
$^{57}\text{Fe} \longrightarrow 5\%$

$$\text{Av. atomic mass} = x_1 A_1 + x_2 A_2 + x_3 A_3 \\ = 54 \times 0.05 + 56 \times 0.9 + 57 \times 0.05 = 55.95.$$

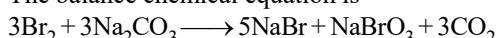
4. Average titre value = $\frac{25.2 + 25.25 + 25.0}{3} = \frac{75.45}{3}$
 $= 25.15 = 25.2 \text{ mL}$

number of significant figures will be 3.

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



6. The balance chemical equation is



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

mass of solution = 1120 g

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

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

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

Now, mole of HCl required in 0.4 M HCl
 $= 0.4 \times 0.2 \text{ mole} = 0.08 \text{ mole}$

if v mol of orginal HCl solution is taken
 then volume of solution = 1.25 v
 mass of HCl = $(1.25 v \times 0.292)$

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

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

9. Since the vessel is the thermally insulated so
 $q = 0$

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

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

Hence $\Delta T = 0$

$$\Rightarrow \Delta T = 0 \quad \Rightarrow T_2 = T_1 \quad \Rightarrow P_2 V_2 = P_1 V_1$$

The process is however adiabatic irrversible.

So we cannot apply $P_2 V_2^\gamma = P_1 V_1^\gamma$

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

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

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

There are 4 significant figures in each term.
 Hence, these be 4 significant figure in R.

11. Given 3.2 M solution

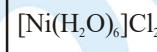
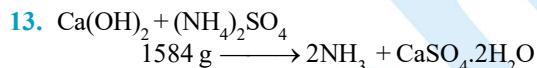
\therefore moles of solute = 3.2 mol

Consider 1 L Solution.

\therefore volume of solvent = 1 L

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

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



Complex Compound

$$\text{Number of Moles of } (\text{NH}_4)_2\text{SO}_4 = \frac{1584}{132} = 12 \text{ moles}$$

Moles of NH_3 released = 24 moles

$$\text{Moles of moles of } \text{NiCl}_2 \cdot 6\text{H}_2\text{O} = \frac{952}{238} = 4 \text{ moles}$$

Number of moles of Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) formed = 12 moles

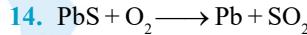
Mass of Gypsum formed = $12 \times 172 = 2064$

$$\text{Number of moles of complex formed } [\text{Ni}(\text{NH}_3)_6]\text{Cl}_2 = \frac{24}{6}$$

= 4 moles

Mass of complex formed = $4 \times 232 = 928 \text{ g}$

Total Mass = $2064 + 928 = 2992 \text{ g}$

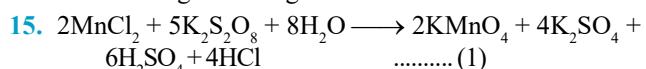


$$\text{Mole} \quad \frac{10^3}{32}$$

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

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

$$= 6.46875 \text{ kg} = 6.47 \text{ kg}$$



Mass of oxalic acid added = 225 mg

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

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 = $1 \times 126 = 126 \text{ mg}$



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