

# MOLE CONCEPT

## FOUNDATION BUILDER (OBJECTIVE)

1. (D)

2. (D)

3. (B)

4. (A)

(Most stable isotope of carbon)

5. (D)

6. (C)

7. (A)

$$\text{Moles of gas} = \frac{5.6}{22.4} = 0.25$$

$$\text{Molecular weight of gas} = \frac{7.5}{0.25} = 30$$

Hence NO.

8. (A)

$$\text{Molecular weight of } C_{60}H_{122} = 60 \times 12 + 122 = 842.$$

$$\text{Weight of a molecule} = \frac{842}{6.022 \times 10^{23}} = 1.39 \times 10^{-21} \text{ g.}$$

9. (A)

1 mole contains Avogadro number of atoms.

10. (A)

$$\text{Moles of } N_2 = \frac{1.4}{28} = 0.05.$$

$$\begin{aligned} \text{Number of atoms} &= 0.05 \times 2 \times 6.02 \times 10^{23} . \\ &= 6.02 \times 10^{22} . \end{aligned}$$

11. (D)

$$(A) \quad \frac{22.4 \times 10^3}{22400} \times NA = 6.022 \times 10^{23}$$

$$(B) \quad \frac{22}{44} \times 6.022 \times 10^{23} = 3.011 \times 10^{23}$$

$$(C) \quad \frac{11.2}{22.4} \times 6.022 \times 10^{23} = 3.011 \times 10^{23}$$

$$(D) \quad 0.1 \times 6.022 \times 10^{23} = 6.022 \times 10^{22}$$

12. (C)

$$\text{Number of gms of } H_2SO_4 = 0.25 \times 98 = 24.5$$

13. (D)

$$\text{Moles of H}_2 = \frac{1}{2} = 0.5$$

$$\text{Volume of H}_2 \text{ in l} = 0.5 \times 22.4 = 11.2\text{l}.$$

14. (D)

$$\text{Moles of Au} = \frac{19.7 \times 1000}{197} = 100$$

$$\text{Atoms of Au} = 100 \times 6.022 \times 10^{23} = 6.022 \times 10^{25}.$$

15. (A)

$$\text{Mass of one molecule of CO}_2 = \frac{44}{6.02 \times 10^{23}} = 7.31 \times 10^{-23}$$

16. (C)

$$\text{Number of moles of H}_2 = \frac{0.224}{22.4} = 0.01$$

17. (B)

$$18. \quad W_{\text{H}} = 3 \times 3 = 9\text{g} \quad W_{\text{N}} = 3 \times 14 = 42\text{g}$$

[B]

19. In one H<sub>2</sub>O molecule: 10 proton, 8 neutrons, 10 electrons

$$\text{Hence in 36 ml, } n_{\text{H}_2\text{O}} = \frac{36\text{g}}{18\text{g/mol}} = 2\text{mols}$$

$$\therefore \text{Protons} = 2N_{\text{A}} \times 10 = 20N_{\text{A}}$$

[C]

20.  $n_{\text{atoms}} = \frac{W}{\text{at.wt}}$ . Hence it should be of same weight 'W'

[A]

$$21. \quad \text{no. of moles} = \frac{10^{-3}N_{\text{A}}}{N_{\text{A}}} = 10^{-3}$$

$$\therefore \text{wt} = 10^{-3} \times \text{mol.wt} = 10^{-3}M_0\text{g} = M_0\text{mg}$$

[B]

$$22. \quad \text{A: } 12\text{g}; \text{ B: } \frac{1}{2} \times 16 = 8\text{g}; \text{ C: } 10\text{g}; \text{ D: } \frac{16}{2} = 8\text{g}$$

$\therefore$  [A]

$$23. \quad \text{A: } 2.5 \times 5N_{\text{A}} = 12.5N_{\text{A}}; \text{ B: } 10N_{\text{A}}; \text{ C: } 4 \times 3N_{\text{A}} = 12N_{\text{A}}; \text{ D: } 1.8 \times 8N_{\text{A}} = 14.4N_{\text{A}}.$$

Hence [D]

$$24. \quad \frac{52\text{amu}}{4\text{amu}} = 13$$

[C]

25. One ion contains:  $7 + 24 + 1 = 32 \bar{e}$   
 $\therefore \text{total } \bar{e}s = 2 N_A \times 32 = 64 N_A$   
 [B]
26.  $n_C = 0.5 \times 6 = 3 \quad \therefore \text{wt} = 36 \text{ g}$   
 [D]
27. A:  $\frac{28}{44}$ ; B:  $\frac{46}{46}$ ; C:  $\frac{36}{18}$ ; D:  $\frac{54}{108}$   
 $\therefore$  [C]
28.  $n_{\text{H}_2\text{O}} = \frac{180}{18} = 10$   
 $\therefore \text{no. of } \bar{e}s = 10 \times 10 N_A = 100 N_A$   
 [D]
29.  $n_{\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}} = \frac{2.48}{248} = 0.01$   
 $\therefore n_{\text{H}_2\text{O}} = 5 \times 0.01 \Rightarrow \text{molecules} = 0.05 N_A$   
 [c]
30.  $n_{\text{Ag}} = \frac{90}{100} \times \frac{10}{108} = \frac{1}{12} \Rightarrow \text{atom} = \frac{1}{12} N_A = 5 \times 10^{22}$   
 [c]
31.  $n_{\text{H}_2\text{O}} = \frac{18 \times 333}{54 + (96 \times 3) + (18 \times 18)} = 9$ . Hence [B]
32.  $n_{\text{H}_2\text{O}} = \frac{0.018}{18} = 10^{-3}$ . Hence, molecules =  $10^{-3} N_A$   
 $\therefore$  [C]
33.  $n_{\text{N}^{3-}} = \frac{4.2}{14} = 0.3$ .  $\therefore \text{total} = 0.3 \times 8 N_A = 2.4 N_A$   
 $\therefore$  [A]
34.  $n_C = 12 \times n_{\text{C}_{12}\text{H}_{22}\text{O}_{11}} = 12 \times \frac{3.42}{342} = 0.12$   
 $\therefore \text{atom} = 0.12 N_A \Rightarrow$  [D]
35.  $n_{\text{MgCO}_3} = \frac{8.4}{84} = 0.1$   
 Each contain  $(12 + 6 + 24)$  protons  
 Hence, total =  $0.1 \times 42 N_A = 2.5 \times 10^{24}$   
 [B]

36.  $n_{\text{total}} = \frac{4.4}{44} + \frac{2.24}{22.4} = 0.2 \quad \therefore \text{molecules} = 0.2N_A$

[B]

37. [D]

38.  $n_{\text{gas}} = \frac{w}{\text{mol.wt.}} = \frac{w}{3a}$

[B]

39.  $n_{\text{Fe}} = \frac{558.5}{55.85} = 10 \text{ moles}$

In 60 g carbon,  $n_{\text{C}} = 5 \quad \therefore \text{twice} = 10 \text{ moles}$

[A]

40. Say  $n_{\text{Mg}_3(\text{PO}_4)_2} = n$ ; then  $n_{\text{O}} = 8n$

$\therefore 8n = 0.25 \Rightarrow n = \frac{0.25}{8} = 3.125 \times 10^{-2}$

[B]

41.  $n_x : n_y = \frac{(w/2)}{10} : \frac{(w/2)}{20} = 2 : 1$

Hence [B]

42.  $\frac{X}{100} \times (46 + 96 + 180) = 180 \Rightarrow X = 55.9$

[C]

43.  $n_{\text{I}} : n_{\text{O}} = \frac{25.4}{127} : \frac{8}{16} = \frac{1}{5} : \frac{1}{2} = 2 : 5$

Hence  $\text{I}_2\text{O}_5$ . [C]

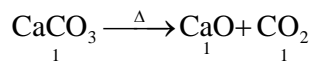
44. mol. Wt = 2 VD = 100

$w_{\text{chlorine}} = \frac{71}{100} \times 100 = 71\text{g}$

$w_{\text{metal}} = 29\text{g}$

[A]

45. (D)

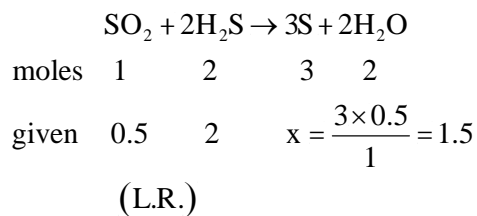


Quantity of limes tones = wt. of one mole of  $\text{CaCO}_3$   
= 100 kg

46. (A)

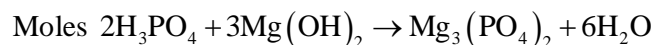
Moles of  $\text{H}_2\text{S} = 2$

Moles of  $\text{SO}_2 = \frac{11.2}{22.4} = 0.5$



47. (C)

$$\text{Moles of Mg(OH)}_2 = \frac{100}{58} = 1.724$$



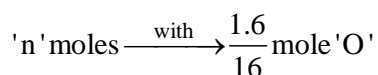
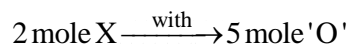
|       |   |   |   |   |
|-------|---|---|---|---|
| Moles | 2 | 3 | 1 | 6 |
|-------|---|---|---|---|

Given  $\frac{2 \times 1.724}{3}$

$$\text{Weight of H}_3\text{PO}_4 = \frac{2 \times 1.724}{3} \times 98 = 112.6\text{g}$$

48.  $n_{\text{H}_2\text{O}} = n_{\text{CH}_3\text{OH}} \times 2 = 4 \quad \therefore \text{wt} = 4 \times 18 = 72\text{g}$   
[D]

49.  $W_{\text{O}} = 3.6769 - 2.0769 = 1.6\text{g}$



$$n = \frac{0.2}{5} = 0.04$$

[A]



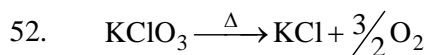
$$\therefore W_{\text{Ag}} = \frac{2.7}{(216 + 60)} \times 2 \times 108 = 2.11\text{g}$$

[A]

51.  $n_{\text{CO}_2} = 2 \times n_{\text{C}_2\text{H}_5\text{OH}} = 2$

$$\therefore W_{\text{CO}_2} = 2 \times 44 = 88\text{g}$$

Hence [D]



$$\text{Hence \% loss in wt} = \frac{48\text{g}}{122.5} \times 100 = 39.18$$

[C]

53.  $n_{\text{Fe}} = \frac{2}{3} \times n_{\text{H}_2\text{O}} = \frac{2}{3} \quad \therefore W_{\text{iron}} = \frac{2}{3} \times 56 = 37.39$

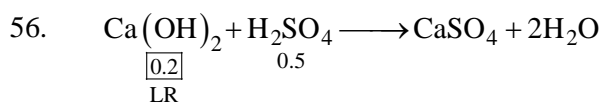
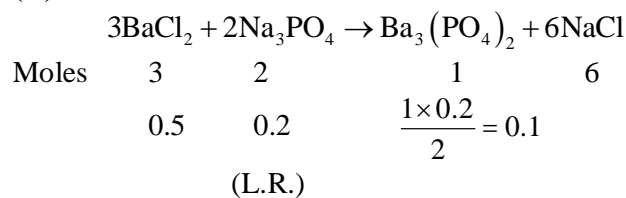
[A]

54.  $n_{\text{CaCO}_3} = n_{\text{CaO}} = \frac{1.62}{56} = n_{\text{CaCl}_2} = 0.0289$

$$\% \text{ of CaCl}_2 = \frac{0.0289 \times 111}{10} \times 100 = 32.11\%$$

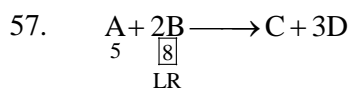
[B]

55. (D)



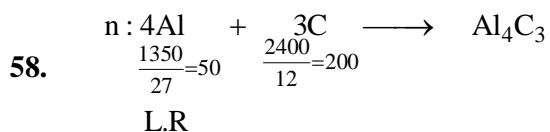
$$n_{\text{CaSO}_4} = n_{\text{Ca}(\text{OH})_2} = 0.2$$

[A]



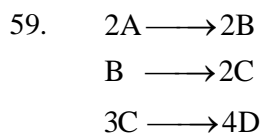
$$n_{\text{C}} = \frac{n_{\text{B}}}{2} = 4; \quad n_{\text{D}} = 3 \times \frac{n_{\text{B}}}{2} = 12$$

Hence [B]



$$\left. \begin{array}{l} 4\text{Al} \xrightarrow{\text{given}} 144 \\ 50 \xrightarrow{\text{given}} \text{W} \end{array} \right\} \Rightarrow w = 1800\text{g}$$

[D]



$$\begin{aligned} \therefore n_{\text{D}} &= n_{\text{A}} \times \frac{2}{2} \times \frac{2}{1} \times \frac{4}{3} \\ &= \frac{32}{3} \end{aligned}$$

[D]

60. Mol.wt. =  $0.8 \times 28 + 0.2 \times 32 = 28.8$

$$\therefore \text{VD} = \frac{\text{M}}{2} = 14.4$$

[C]

61.  $D_{\text{Cl}_2 \text{ wrt air}} = \frac{D_{\text{Cl}_2}}{D_{\text{air}}} = \frac{M_{\text{Cl}_2}}{M_{\text{air}}} \approx \frac{71}{29}$

Hence [A]

62. Say  $\text{NO}_x$ . Then  $\frac{30.4}{100}(14 + 16x) = 14 \Rightarrow x = 2$   
 $\therefore D_{\text{oxide wrt O}_2} = \frac{M_{\text{oxide}}}{M_{\text{O}_2}} = \frac{46}{32} = 1.44$

[B]

63. 
$$\text{molality} = \frac{n}{w_{\text{solvent}}} \times 1000 \left( \text{urea : } \text{NH}_2 \underset{\text{O}}{\underset{\parallel}{\text{C}}} \text{NH}_2 \right)$$
  

$$= \frac{18/60}{(1500 \times 1.052 - 18)} \times 1000 = 0.192$$

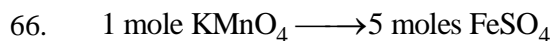
[B]

64. 
$$\text{Molarity} = \frac{n}{V(\text{mL})} \times 1000 = \frac{1/98}{1000} \times 1000 \approx 0.01$$

[D]

65. 
$$[\text{Al}^{3+}] = \frac{20 \times 0.2 \times 2}{40} = 0.2\text{M}$$

[A]



$$V \times 0.01 \longrightarrow 50 \times 0.01$$

$$\Rightarrow V = 10\text{mL}$$

[D]

67. 
$$n_{\text{H}^+} = \left( \frac{100}{1000} \right) \times 0.001 \times 2 = 2 \times 10^{-4}$$

$$\therefore \text{no. of H}^+ = 2 \times 10^{-4} N_A = 1.2 \times 10^{20}$$

[B]



$$\therefore \text{vol} = \frac{\omega}{d} = \left( \frac{120 + 1000}{1.11} \right) = 1009\text{mL}$$

$$\therefore \text{Molarity} = \frac{n}{V(\text{mL})} \times 1000 = \frac{3}{1.009} = 2.97$$

[A]

69. (B)

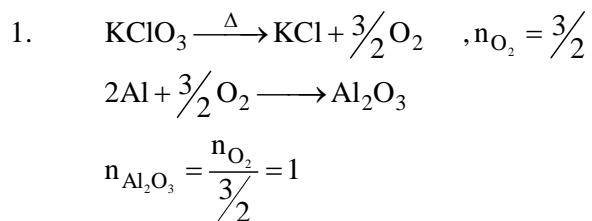
$$\text{Molarity of } \text{NO}_2\text{CO}_3 = \frac{2.65 \times 1000}{106 \times 250} = 0.1 \text{ M.}$$

$$\text{After dilution of 10 mL solution} = \frac{0.1 \times 10}{1000} = 0.001 \text{ M}$$

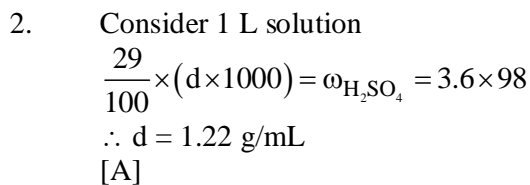
70. 
$$X_{\text{NaCl}} = \frac{n_{\text{NaCl}}}{n_{\text{NaCl}} + n_{\text{H}_2\text{O}}} = \frac{1}{1 + \frac{1000}{18}} = 0.0177$$

[A]

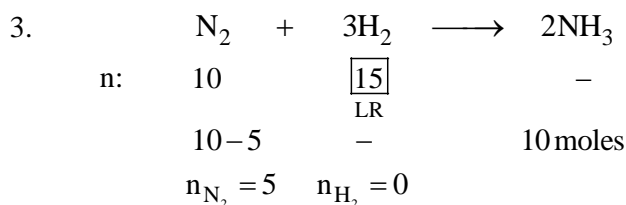
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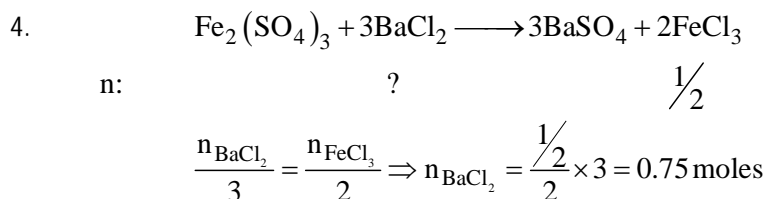
[A]



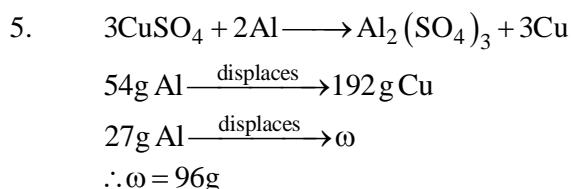
[A]



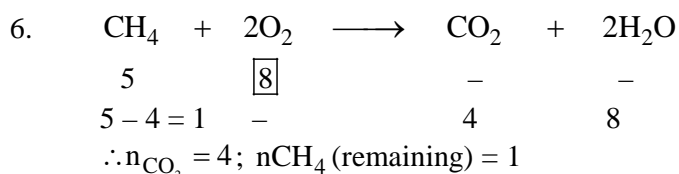
[A]



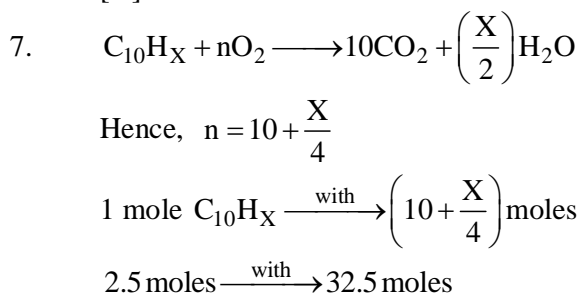
[C]



[C]



[A]

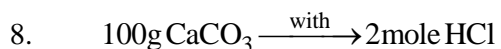




$$\text{i.e. } 10 + \frac{x}{4} = \frac{32.5 \times 1}{2.5} = 13$$

$$\therefore x = (13 - 10) \times 4 = 12$$

[C]



$$\omega\text{g} \xrightarrow{\text{with}} \left(\frac{25\text{L}}{1000}\right) \times 0.75\text{ M HCl}$$

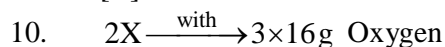
$$\therefore \omega = 0.9375\text{g}$$

[D]

9.  $n_{\text{AgCl}} = n_{\text{Cl}^-} = n_{\text{HCl}} = \frac{2.125}{143.5} = V(\text{L}) \times \text{Molarity}$

$$\therefore \text{Molarity} = \frac{2.125 \times 1000}{143.5 \times 25} = 0.59$$

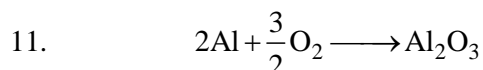
[B]



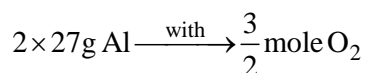
$$1\text{g} \xrightarrow{\text{with}} 0.16\text{g Oxygen}$$

$$\therefore X = \frac{3 \times 16}{0.16 \times 2} = 150$$

[D]



$$n: \quad n \quad \frac{1}{2}$$



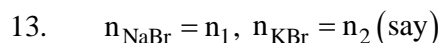
$$\omega \xrightarrow{\text{with}} \frac{1}{2}\text{mole}$$

$$\omega = \frac{2 \times 27}{3} = 18\text{g}$$

[D]



$$= \frac{8}{32} = \frac{1}{4} \quad \therefore [\text{D}]$$



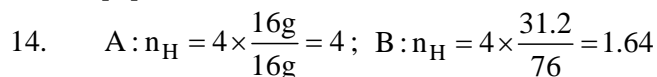
$$n_{\text{AgBr}} = n_{\text{Br}} = n_1 + n_2 = \frac{0.97}{(108 + 80)} = 0.00516$$

$$\text{Also, } n_1 \times (103) + n_2 \times (119) = 0.560$$

$$\therefore n_2 = \frac{0.56 - 103 \times 0.00516}{16} = 0.00178$$

$$\therefore W_{\text{KBr}} = 119n_2 = 0.212\text{g}$$

[B]



$$C : n_H = 22 \times \frac{34.2}{342} = 2.2; \quad D : n_H = 12 \times \frac{36}{180} = 2.4$$

Hence [A]

$$15. \quad \text{Total atoms} = 200 + 0.05 \times N_A + 10^{-20} \times N_A \\ \approx 0.05 N_A = 3 \times 10^{22}$$

[C]

$$16. \quad \text{Mol. Wt of } A_2B_3 = 150 + 96 = 246$$

$$\therefore \quad \text{For 5 mol, } (246 \times 5) \text{ g} = 1.23 \text{ kg}$$

[C]

$$17. \quad A : 10N_A; \quad B : 11 \times \frac{200}{342} = 6.43 N_A; \quad C = \frac{144}{48} N_A \times 3 = 9N_A$$

$$D : 2.5 \times 3N_A = 7.5N_A.$$

Hence [A]

18. [D] obvious

$$19. \quad A : \frac{1}{44} \times 3N_A; \quad B : \frac{1}{114} \times 26N_A; \quad C : \frac{1}{30} \times 8N_A; \quad D : \frac{1}{26} \times 2N_A$$

Hence [A]

$$20. \quad \frac{9.2}{46} \times 2 = n \times 1 \Rightarrow n = 0.4 \quad \therefore \text{ wt} = 0.4 \times 30 = 12 \text{ g}$$

[C]

$$21. \quad n_{CO_2} = n, \text{ say. Then } n_O = 2n = \frac{8}{16} \Rightarrow n = \frac{1}{4}$$

$\therefore$  [D]

$$22. \quad A : 0.2 \times 14 \text{ g} = 2.8 \text{ g}; \quad B : \frac{3 \times 10^{23}}{6 \times 10^{23}} \times 12 \text{ g} = 6 \text{ g}; \quad C : 32 \text{ g}; \quad D : 7 \text{ g}.$$

Hence [A]

$$23. \quad [D] \quad \begin{array}{l} 1 \text{ gram molecule: } 44 \text{ g} \\ 1 \text{ molecule of } CO_2 = 44 \text{ amu} \end{array}$$

$$24. \quad n_H = n \times 2 + 2n \times 4 = 10n$$

$$n_C = 2n \times 1 = 2n$$

$$\therefore n_C : n_H = 1 : 5$$

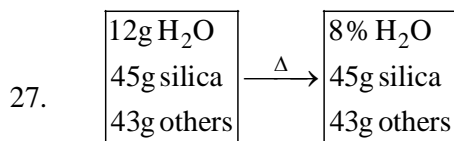
[A]

$$25. \quad \text{Total charge} = 1 \times N_A \times 3e = 3N_A e \text{ coulomb}$$

Hence [D]

$$26. \quad \frac{69.98}{100} \times \text{Mol. wt} = 21 \times 12 \Rightarrow \text{mol. wt} = 360$$

[D]



100 original 'w' grams

8 % of w = water

i.e. 92 % of w = silica others

Hence,  $\frac{92}{100} \times w = 88g \Rightarrow w = 95.65$

$\therefore$  % of silica =  $\frac{45}{95.65} \times 100 = 47\%$

[D]

28. M<sub>3</sub>N<sub>2</sub>. 28 % nitrogen

$\therefore \frac{28}{100} \times (3M + 28) = 28 \Rightarrow M = 24$

[C]

29. 0.014%  $\times$  mol.wt = 2  $\times$  at. wt of N

i.e.  $\frac{0.014}{100} \times M = 2 \times 14 = 28$

$\Rightarrow M = \frac{2800}{14 \times 10^{-3}} = 2 \times 10^5$

[D]

30. (A)

Average atomic mass =  $\frac{90 \times 20 + 21x + 22 \times (10 - x)}{100} = 20.11$

$x = 9\%$

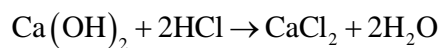
31. (B)

32. (C)

Moles of Ca(OH)<sub>2</sub> =  $\frac{6.023 \times 10^{23}}{6.023 \times 10^{23}} = 1$

Moles of HCl =  $\frac{3.01 \times 10^{22}}{6.02 \times 10^{23}} = 0.05$

HCl =  $\frac{3.01 \times 10^{22}}{6.02 \times 10^{23}} = 0.05$



(L.R.)

33. (A)

$$\text{Moles of CuSO}_4 = \frac{1.595}{1595} = 0.01$$

$$\text{Weight of solvent} = 100 - 1.595 = 98.505$$

$$\text{Volumes of solvent} = \frac{98.505}{1.2 \times 1000} = 82 \times 10^{-3} \text{ L}$$

$$\text{Molarity} = \frac{0.01}{82 \times 10^{-3}} = 0.12 \text{ M}$$

34. (B)

$$(A) \quad \text{atoms of O}_2 = \frac{2 \times 8}{32} \times 6.022 \times 10^{23} \sim 3 \times 10^{23}$$

$$(B) \quad \text{atoms of Be} = \frac{3}{9} \times 6.022 \times 10^{23} \sim 2 \times 10^{23}$$

$$(C) \quad \text{atoms of C} = \frac{8}{12} \times 6.022 \times 10^{23} \approx 4 \times 10^{23}$$

$$(D) \quad \text{atoms of F}_2 = \frac{19}{19} \times 6.022 \times 10^{23} \approx 1 \times 10^{23}$$

35. (C)

|                 |                  |   |     |                          |
|-----------------|------------------|---|-----|--------------------------|
| X               | Y                | X | Y   |                          |
| $\frac{20}{10}$ | $\frac{80}{200}$ | 1 | : 2 | $\therefore \text{XY}_2$ |

36. (C)

Auogaduos hypothesis

37. (A)

$$\text{Moles of magnesium} = \frac{3}{24} \times \frac{2.68}{100} = 0.00335$$

$$\begin{aligned} \text{Number of magnesium atoms} &= 0.00335 \times 6.022 \times 10^{23} \\ &= 2.01 \times 10^{21} \text{ atoms.} \end{aligned}$$

38. (A)

$$\text{Moles of comphon} = \frac{25 \times 10^{-3}}{10 \times 12 + 16 + 16} = 0.164 \times 10^{-3}$$

$$\begin{aligned} \text{Number of atoms} &= 0.164 \times 10^{-3} \times 6.022 \times 10^{23} \\ &= 9.9 \times 10^{19} \end{aligned}$$

39. (D)

$$\text{Moles of e}^- = 52 + 2 = 54.$$

40. (B)

$$\text{Moles of Ag} = \frac{1}{107}.$$

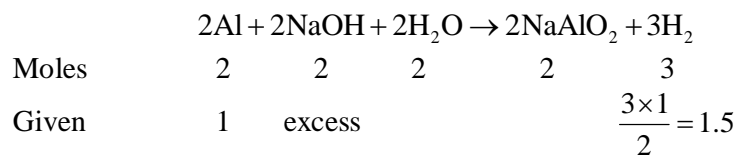
$$\text{Moles of Ag}_2\text{S required} = \frac{1}{107 \times 2}$$

$$\text{Mass of Ag}_2\text{S} = \frac{(107 \times 2 + 32)}{107 \times 2} = 1.1495$$

$$\text{Mass of ore required} = \frac{1.1495}{1.34} \times 100 = 85.78 \text{ g}$$

41. (D)

$$\text{Moles of Al} = \frac{27}{27} = 1$$



(L.R.)

Vol. of  $\text{H}_2$  evolved =  $1.5 \times 22.4 = 33.6$  L.

### WINDOW TO JEE MAIN

1. (A)

$$\text{Molarity} = \frac{n_{\text{soluble}}}{V_{\text{soluble}} (\text{Lt})}$$

$V_{\text{solution}}$  is affected by Temperature.

2. (C)

$$n_{\text{Fe}} = \frac{560}{56} = 10$$

No. of atoms =  $10 N_A$

In 70 g of N    no. of atoms =  $\frac{70}{14} \times N_A = 5 N_A$

In 20 g of H    no. of atoms =  $\frac{20}{1} \times N_A = 20 N_A$

3. (A)                      4. (D)

5. (B)

$$\text{Molarity} = \frac{6.02 \times 10^{20}}{0.1 N_A} = 0.01$$

6. (C)

7. (C)

$$V = 1 \text{ L}$$

$$W_{\text{total}} = 1 \times 1.02 \times 1000 = 1020 \text{ g}$$

$$n_{\text{soluble}} = 2.05$$

$$W_{\text{total}} = \frac{352.8}{29} \times 100 = 1216.55 \text{ g}$$

$$= 1020 - 123 = 897 \text{ g}$$

$$\text{molality} = \frac{2.05}{0.897} = 2.28$$

8. (B)

9. (B)

$$V = 1 \text{ L}$$

$$n_{\text{soluble}} = 3.6$$

$$W_{\text{soluble}} = 3.6 \times 98 = 352.8$$

$$W_{\text{total}} = \frac{352.8}{29} \times 100 = 1216.55 \text{ g}$$

$$\text{density} = \frac{1216.55}{1000} = 1.22 \text{ g/ml}$$

10. (C)                      11. (B)                      12. (C)                      13. (C)

14. (A)

$$\text{Number of atoms} = \frac{\text{weight}}{\text{atomic weight}} \times N_A \times \text{species}$$

∴ In 4 g of hydrogen

$$\text{Number of atoms} = \frac{4}{2} \times N_A \times 2 = 4N_A$$

[Here species = 2 because hydrogen is present as H<sub>2</sub>]

In 71 g of chlorine = 2N<sub>A</sub>

$$\text{Number of atoms} = \frac{71}{71} \times N_A \times 2 = 2N_A$$

In 127 g of iodine,

$$\text{Number of atoms} = \frac{127}{127} \times N_A \times 2 = 2N_A$$

In 48 g of magnesium,

$$\text{Number of atoms} = \frac{48}{24} \times N_A \times 1 = 2N_A$$

[Here Mg is present as Mg so species = 1]

Thus, the number of atoms are largest in 4 g of hydrogen.

15. (b)

Heavy water is D<sub>2</sub>O

In it,

$$\text{Number of } p^+ = 1 \times 2 + 8 = 10$$

$$\text{Number of } e^- = 1 \times 2 + 8 = 10$$

$$\text{Number of } n^0 = 1 \times 2 + 8 = 10$$

(∵ D have 1 n<sup>0</sup> because it is actually, <sup>1</sup>H<sup>2</sup>)

16. (d)

18 g H<sub>2</sub>O contains 2 g H

∴ 0.72 g H<sub>2</sub>O contains 0.08 g H.

44 g CO<sub>2</sub> contains 12 g C

∴ 3.08 g CO<sub>2</sub> contains 0.84 g C

$$\therefore \text{C:H} = \frac{0.84}{12} : \frac{0.08}{1} = 0.07 : 0.08 = 7 : 8$$

∴ Empirical formula = C<sub>7</sub>H<sub>8</sub>

17. (c)

3 M solution means 3 moles of solute (NaCl) are present in 1000 L of solution.

Mass of solution = volume of solution × density

$$= 1000 \times 1.252$$

$$= 1252 \text{ g}$$

Mass of solute = No. of mole × molar mass of NaCl

$$= 3 \times 58.5 \text{ g}$$

$$= 175.5 \text{ g}$$

Mass of solvent = (1252 – 175.5)g

$$= 1076.5 \text{ g}$$

$$= 1.076 \text{ kg}$$

$$\text{Molality} = \frac{\text{moles of solute}}{\text{mass of solvent (in kg)}}$$

$$= \frac{3}{1.076} = 2.79 \text{ m}$$

18. (a)

$$\begin{aligned}\text{Final concentration, } M &= \frac{M_1V_1 + M_2V_2}{V_1 + V_2} \\ &= \frac{10 \times 2 + 200 \times 0.5}{200 + 10} \\ &= \frac{20 + 100}{210} \\ &= \frac{120}{210} = 0.57 \text{ M}\end{aligned}$$

### FOUNDATION BUILDER (SUBJECTIVE)

1.  $\frac{X}{20} = y$  (given). For B :  $\frac{2X}{40} = \frac{X}{20} = Y$

2.  $n_{\text{CH}_4} = \frac{1.6}{16} = 0.1 \text{ moles} = 6 \times 10^{22} \text{ molecules}$

Each molecule has  $(6 + 4) = 10 \bar{e}$ s

$$\therefore \text{total } \bar{e}\text{s} = 6 \times 10^{23}$$

3.  $n_{\text{H}_2\text{O}} = \frac{18 \text{ g}}{18 \text{ g/mol}} = 1 \text{ mole}$

1 molecule has  $(2 + 8) = 10 \bar{e}$ s

$\therefore$  1 mole contains  $10N_A$  electrons.

4.  $\text{O}^{2-}$  :  $10 \bar{e}$ , 8 protons, 8 neutrons per ion.

$\therefore$  in 1 mole :  $10N_A \bar{e}$ ,  $8N_A$  protons,  $8N_A$  neutrons

5. Atomic mass =  $N_A \times \text{mass of one atom}$   
 $= 6 \times 10^{23} \times 6.64 \times 10^{-23} \text{ g} = 40 \text{ g}$

6. no. of atoms =  $\frac{\text{wt}}{\text{wt of one atom}} = \frac{1}{3.98 \times 10^{-23}}$   
 $= 2.5 \times 10^{22}$

7.  $w_{\text{removed}} = 10^{21} \times 44 \text{ amu} = 7.35 \times 10^{-2} \text{ g}$   
 $\therefore w_{\text{CO}_2, \text{remaining}} = 200 - 73.5 = 126.5 \text{ mg}$   
 $\therefore n_{\text{CO}_2} = \frac{126.5 \times 10^{-3}}{44} = 0.002875$

8. 1 mole  $\text{N}^{3-}$   $\therefore$  charge =  $N_A \times 3e = 2.88 \times 10^5 \text{ C}$

$$9. \quad n_{\text{O}} = n_{\text{SO}_2} \times 2 = \frac{3.2 \times 10^{-3}}{64} \times 2 = 10^{-4} \text{ moles}$$

$$n_{\text{S}} = n_{\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}} \times 2 = 2 \times 5 \times 10^{-3} = 10^{-2}$$

$$\therefore n_{\text{O}} : n_{\text{S}} = \frac{10^{-4}}{10^{-2}} = 0.01$$

$$10. \quad n_{\text{O}} = 3 \times n_{\text{NaNO}_3} + 2 \times n_{\text{NO}_2}$$

$$= m \times (10\text{m}) + 2 \times \frac{1}{6} = 0.03 + 0.333 = 0.363$$

$$n_{\text{N}} = n_{\text{NaNO}_3} + n_{\text{NO}_2} = 10 \times 10^{-3} + \frac{1}{6}$$

$$= 0.01 + 0.166$$

$$= 0.176$$

$$11. \quad t(\text{s}) = \frac{6 \times 10^{23}}{10^6} = 6 \times 10^{17} \text{ s}$$

$$t(\text{hr}) = \frac{6 \times 10^{17}}{3600} = 1.67 \times 10^{14}$$

$$t(\text{yr}) = \frac{1.67 \times 10^{14}}{24 \times 365} = 1.9 \times 10^{10} \text{ years}$$

$$12. \quad \text{atomic wt} = 6.644 \times 10^{-23} \times 6 \times 10^{23}$$

$$= 40 \text{ g/mol}$$

$$\therefore n = \frac{40 \times 1000 \text{ g}}{40 \text{ g/mol}} = 1000 \text{ moles}$$

$$13. \quad n_{\text{C}} = \frac{10^{-6} \text{ g}}{12 \text{ g/mol}}$$

$$\text{No. of atoms} = n_{\text{C}} \times 6 \times 10^{23} = 5 \times 10^{16}$$

$$14. \quad r = 0.1 \text{ inch} = 0.254 \text{ cm}$$

$$\omega_{\text{Fe}} = \frac{85.6}{100} \times \omega_{\text{ball}}$$

$$\omega_{\text{ball}} = V_{\text{ball}} \times \text{density}$$

$$= \frac{4}{3} \pi \times (0.254)^3 \times 7.75 = 0.532 \text{ g}$$

$$\omega_{\text{Fe}} = \frac{85.6}{100} \times 0.532 \text{ g} = 0.455 \text{ g}$$

$$n_{\text{Fe}} = \frac{0.455}{56} \text{ and no. of atoms} = 4.9 \times 10^{21}$$

$$15. \quad \frac{0.086}{100} \times \omega_{\text{starch}} = \text{wt of 1 atom} = 31 \text{ g}$$

$$\therefore \omega_{\text{starch}} = \frac{3100}{0.086} = 3.6 \times 10^4$$

$$16. \quad V_{\text{NH}_3} = n_{\text{NH}_3} \times 22.4 \text{ L}$$



$$= \frac{3.4}{17} \times 22.4 = 4.48 \text{ L}$$

$$17. \quad n_{\text{O}_2} = \frac{PV}{RT} = \frac{1 \times 1}{0.0821 \times 273} = 0.04464$$

$$\therefore n_{\text{molecules}} = n_{\text{O}_2} \times N_A = 2.69 \times 10^{22}$$

$$18. \quad \text{O}_3 + \text{O}_2 \longrightarrow 600 \text{ mL}$$

$$V \text{ mL} \quad (600 - V) \text{ mL}$$

$$\frac{V}{22400} \times 48 + \frac{(600 - V)}{22400} \times 32 = 1 \text{ g}$$

$$\therefore V = 200 \text{ mL}$$

| 19. Element | % (with in 100 g) | no. of (in 100 g) atom   | ratio |
|-------------|-------------------|--------------------------|-------|
| K           | 40.2              | $\frac{40.2}{39} = 1.03$ | 2     |
| Mn          | 26.8              | $\frac{26.8}{55} = 0.48$ | 1     |
| P           | 33                | $\frac{33}{31} = 1.06$   | 2     |

$\therefore \text{K}_2\text{MnP}_2$

$$20. \quad \text{Say } n_{\text{O}} = n$$

$$\text{Then } n_{\text{H}} = 15n$$

$$\text{And } n_{\text{C}} = \frac{70}{100} \times 15n = 10.5n$$

$$\therefore \text{C}_{10.5}\text{H}_{15}\text{O} \text{ or } \text{C}_{21}\text{H}_{30}\text{O}_2 \text{ is empirical formula}$$

$$\text{Mol. Wt} = \frac{1}{0.00318} = 314$$

$$\therefore \text{C}_{21}\text{H}_{30}\text{O}_2$$

$$21. \quad 9.03 \times 10^{20} \xrightarrow{\text{weight}} 0.311 \text{ g}$$

$$6.02 \times 10^{23} \xrightarrow{\text{weight}} \text{mol.wt.}$$

$$\therefore \text{mol. wt} = 207.33 \text{ g}$$

$$\Rightarrow 131.3 + 19n = 207.3 \Rightarrow n = 4$$

$$22. \quad \omega_{\text{C}} = \frac{58.97}{100} \times 102 = 59.9 \Rightarrow n_{\text{C}} = 5$$

$$\omega_{\text{H}} = \frac{13.81}{100} \times 102 = 14.08 \Rightarrow n_{\text{H}} = 14$$

$$\omega_{\text{N}} = \frac{27.42}{100} \times 102 = 27.97 \Rightarrow n_{\text{N}} = 2$$

$$\therefore \text{C}_5\text{H}_{14}\text{N}_2$$

$$23. \quad \omega_{\text{C}} = \frac{12}{44} \times \omega_{\text{CO}_2} = \frac{12}{44} \times 0.9482 = 0.2586$$

$$\therefore n_C = 0.02155$$

$$\omega_H = \frac{2}{18} \times \omega_{H_2O} = 0.02154$$

$$\therefore n_H = 0.02154$$

$$n_C : n_H = 1 : 1 \quad \therefore CH$$

$$24. \quad \omega_{Co} = \frac{12}{100} \times \omega_{cylinder}$$

$$\omega_{cylinder} = \pi r^2 h \times \text{density}$$

$$= (3.14 \times 6.25 \times 10) \times 8.2 = 1610.7$$

$$\therefore \frac{\omega_{Co}}{58.9} = n_{Co} = \frac{1}{58.9} \times \frac{12}{100} \times 1610.7 = 3.28$$

$$\therefore \text{no. of atoms} = 3.28 \times 6 \times 10^{23}$$

$$\approx 1.98 \times 10^{24}$$

$$25. \quad \text{Mol. Wt} = \text{wt of 1 mole mix} = 2VD = 76.6$$

$$(x \text{ mol. NO}_2 + (1-x) \text{ mol. N}_2\text{O}_4) = 76.6 \text{ g}$$

$$\therefore x \times 46 + (1-x) \times 92 = 76.6$$

$$x = \frac{15.4}{46} = n_{NO_2} \text{ in 1 mole} = 0.335$$

$$n_{\text{mix}} \text{ in } 100 \text{ g} = \frac{100}{76.6}$$

$$\therefore n_{NO_2} \text{ in } 100 = 0.335 \times n_{\text{mix}}$$

$$= 0.437$$

$$26. \quad \text{molality} = \frac{n}{\omega_{\text{solvent}}} \times 1000$$

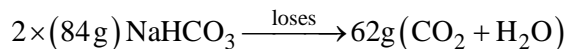
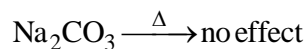
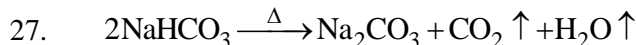
Consider 1L of solvent

|             |
|-------------|
| $C_2H_5OH$  |
| mol.wt = 46 |

$$n = 8$$

$$\omega_{\text{solvent}} = (1.025 \times 1000) - (8 \times 46) = 657$$

$$\therefore \text{molality} = \frac{8}{657} \times 1000 = 12.18$$



$$\omega_g \xrightarrow{\text{loses}} 0.124$$

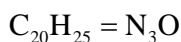
$$\therefore \omega = \frac{0.124}{62} \times 168 = 0.336 \text{ g}$$

$$\% \text{ of } NaHCO_3 = \frac{0.336 \times 100}{2} = 16.8\%$$

$$\text{and } Na_2CO_3 = 100 - 16.8 = 83.2\%$$

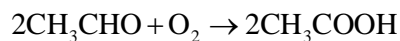
28.

|         |                             |                             |
|---------|-----------------------------|-----------------------------|
| C 74.27 | $\frac{74.27}{12} = 6.1892$ | $\frac{6.1892}{0.309} = 20$ |
| H 7.79  | $\frac{7.79}{1} = 7.79$     | $\frac{7.79}{0.309} = 25$   |
| N 12.99 | $\frac{12.99}{14} = 0.928$  | $\frac{0.918}{0.309} = 3$   |
| O 4.95  | $\frac{4.95}{16} = 0.309$   | $\frac{0.309}{0.309} = 1$   |



$$\begin{aligned} \% \text{ of C atoms} &= \frac{20}{49} \times 100 \\ &= 40.816\% \end{aligned}$$

29.



$$\begin{aligned} \omega : & \quad 20g \quad 10g \\ n : & \quad \frac{20}{44} = 0.45 \quad \frac{10}{32} = 0.31 \end{aligned}$$

L.R

$$(A) n_{CH_3COOH} = n_{CH_3CHO} = 0.45$$

$$\omega_{CH_3COOH} = 27.27g.$$

$$(B) n_{O_2} (\text{left}) = \frac{10}{32} - \frac{20/44}{2} = 0.852$$

$$\omega_{O_2} = n_{O_2} \times 32 = 2.727g$$

$$(C) \% \text{ yeild} = \frac{23.8}{27.3} \times 100 = 87.2\%$$

30.

$$n_{CH} = n_A \times \frac{3}{2} \times \frac{20}{100} \times \frac{4}{2} \times \frac{40}{100} \times \frac{8}{3} \times \frac{50}{100} = 3.2$$

31.

$$n_{CH_4} = n_1 \text{ and } n_{C_2H_4} = n_2, \text{ say}$$

$$\text{now, } n_1 \times 16 + n_2 \times 28 = 5g$$

$$\text{also, } n_{CO_2} = n_1 + 2n_2 = \frac{14.5}{44} = 0.33$$

$$\therefore n_1 = 0.193 \text{ and } n_2 = 0.068$$

$$\%CH_4 = \frac{\omega_{CH_4} \times 100}{5} = \frac{16n_1 \times 100}{5} = 60\%.$$

$$\%C_2H_4 = 40\%$$

32.

POAC on carbon

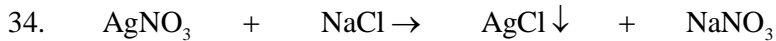
$$n_C = n_{K_2CO_3} \times 1 = n_{K_2Zn_2[Fe(CN)_6]_2} \times 12$$

$$\therefore \text{ moles of product} = \frac{n_{K_2CO_3}}{12} = 0.0166$$

33.  $n_{\text{Cu}} = n_{\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}}$  (POAC on Cu)

$$\omega_{\text{product}} = \left( \frac{10}{63.5} \right) \times [63.5 + 124 + 54]$$

$$= 38.03\text{g}$$



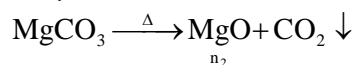
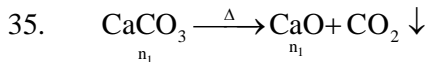
$$n = \frac{5.77}{170} \quad n = \frac{4.77}{58.5}$$

$$= 0.03394 \quad = 0.08$$

L.R.

$$n_{\text{AgCl}} = n_{\text{AgNO}_3} = 0.03394$$

$$\therefore \omega_{\text{AgCl}} = 0.03394 \times 143.5 = 4.87\text{g}$$



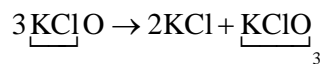
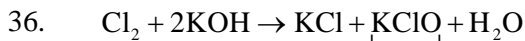
$$n_1 \times 100 + n_2 \times 84 = 1.84$$

$$n_1 \times 56 + n_2 \times 40 = 0.96$$

$$n_1 = 0.01$$

$$n_2 = 0.01$$

$$\therefore \% \text{CaCO}_3 = \frac{0.01 \times 100}{1.84} \times 100 = 54.35\%$$



$$n_{\text{KClO}_3} = n_{\text{Cl}_2} \times \frac{1}{1} \times \frac{1}{3} \times \frac{3}{4} = \frac{n_{\text{Cl}_2}}{4}$$

$$\Rightarrow n_{\text{Cl}_2} = 4 \times \frac{1385}{(39 + 35.5 + 64)} = 40$$

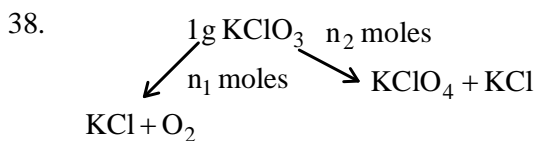
$$\Rightarrow \omega_{\text{Cl}_2} = 40 \times 71 = 2840\text{g}$$

37. POAC on Cl (eventually on completion)

$$n_{\text{Cl}_2} \times 2 = n_{\text{KCl}} \times 1 + n_{\text{KClO}_3}$$

$$\Rightarrow n_{\text{KCl}} = \frac{142}{71} \times 2 - \frac{n_{\text{Cl}_2}}{4} = 4 - 0.5$$

$$= 3.5 \text{ moles}$$



$$n_{\text{O}_2} = \frac{3}{2} \times n_1 = \frac{146.8}{22400} \Rightarrow n_1 = 0.00437$$

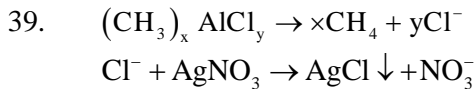
$$n_2 = \frac{1\text{g}}{(39 + 35.5 + 48)} - n_1 = 0.00379$$

$$n_{\text{KClO}_4} = \frac{3}{4}n_2 = 0.00284$$

$$\omega_{\text{residue}} = 1\text{g} - \omega_{\text{O}_2} = 0.79029\text{g}$$

$$\therefore \% \text{KClO}_4 = \frac{0.00284(39 + 35.5 + 64)}{0.79} \times 100$$

$$= 49.789\%$$



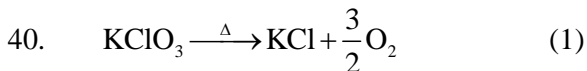
1.  $n_{\text{CH}_4} = x \cdot n_{(\text{CH}_3)_x \text{AlCl}_y}$   
 $\Rightarrow \frac{0.222}{16} = x \cdot \frac{0.643}{(15x + 27 + 35.5y)}$

2.  $n_{\text{AgCl}} = n_{\text{Cl}^-} = y \cdot n_{(\text{CH}_3)_x \text{AlCl}_y}$   
 $\Rightarrow \frac{0.996}{(108 + 35.5)} = y \cdot \frac{0.643}{(15x + 27 + 35.5y)}$

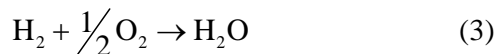
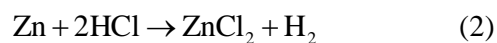
$$1 \div 2 \Rightarrow \frac{x}{y} = 1.99 = 2$$

$$\therefore \text{in 1, } \frac{0.222}{16} = \frac{0.643(2y)}{(30y + 27 + 35.5y)}$$

$$\Rightarrow y = 1 \text{ and } x = 2$$



6.125g



in (1),

$$n_{\text{O}_2} = \frac{3}{2} \times n_{\text{KClO}_3} = 0.075$$

in (3),

$$n_{\text{H}_2} = 2 \times n_{\text{O}_2} = 0.15$$

in (2),

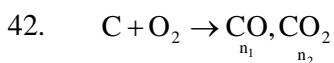
$$n_{\text{Zn}} = n_{\text{H}_2} = 0.15$$

$$\therefore \omega_{\text{Zn}} = 0.15 \times 65.3 = 9.795\text{g}$$

41. (A): B,

(B): A,

(C):  $n_{\text{C}} = \frac{7}{2} \times n_{\text{B}} = \frac{7}{2}$ .



POAC on C

$$n_{\text{C}} = \frac{12}{12} = n_1 + n_2 = 1$$

POAC on O :  $n_{\text{O}} = n_1 + 2n_2 = \frac{20}{16} = 1.25$

$$\Rightarrow n_2 = 1.25 - 1 = 0.25$$

$$\text{and } n_1 = 0.75$$

$$\therefore n_{\text{CO}} : n_{\text{CO}_2} = n_1 : n_2 = 3 : 1$$



$$\frac{n_{\text{NaOH}}}{2} = n_{\text{H}_2\text{SO}_4} = \left(\frac{15}{1000}\right) \times \frac{1}{10} \times \frac{1}{2} = 7.5 \times 10^{-4}$$

$$\begin{aligned} \therefore \text{strength} &= \frac{\omega_{\text{H}_2\text{SO}_4}}{V_{\text{H}_2\text{SO}_4} (\text{mL})} \times 1000 \\ &= 6.125 \text{g/L} \end{aligned}$$

44.  $\text{Molarity} = \frac{n}{V(\text{mL})} \times 1000 = \frac{10 \times 10^{-3}}{100} \times 10^{-3} = 0.1 \text{M}$

$$\text{in gram/L} = 0.1 \times (39 + 16 + 1) = 5.6 \text{g/L}$$

45.  $n_{\text{SO}_4^{2-}} = n_{\text{H}_2\text{SO}_4} = \left(\frac{100}{1000}\right) \times 0.001 \text{M} = 10^{-4}$

$$\therefore \text{no. of ion} = n_{\text{SO}_4^{2-}} \times n_A = 6 \times 10^{19}$$

46.  $n_{\text{CuSO}_4 \cdot 5\text{H}_2\text{O}} = n_{\text{Cu}^{2+}} = 0.5 \times 0.01 = 5 \times 10^{-3}$

$$\begin{aligned} \text{weight} &= n \times \text{mol. wt} = 5 \times 10^{-3} \times 249.5 \\ &= 1.2475 \text{g} \end{aligned}$$

47.  $M_1V_1 + M_2V_2 = M_3V_3$

$$\begin{aligned} \therefore M_{\text{final}} &= M_3 = \frac{50 \times 0.5 + 75 \times 0.25}{50 + 75} \\ &= 0.35 \text{Molar} \end{aligned}$$

48.  $\text{Molality} = \frac{n}{\omega_{\text{solvent}}} \times 1000$

$$= \frac{3/30}{250} \times 1000 = 0.4 \text{molal}$$

49.  $\frac{n_{\text{I}_2}}{n_{\text{I}_2} + n_{\text{C}_6\text{H}_6}} = 0.2$

Say, we have 1 mole mix.

$$\text{Then, } n_{\text{I}_2} = 0.2 \text{ and } n_{\text{C}_6\text{H}_6} = 0.8$$

$$\begin{aligned} \therefore \text{molality} &= \frac{n_{\text{I}_2}}{\omega_{\text{C}_6\text{H}_6}} \times 1000 \\ &= \frac{0.2}{0.8 \times 78} \times 1000 = 3.205 \text{m.} \end{aligned}$$

50. Consider 1L solution.

$$\omega_{\text{solution}} = 1000 \times 1.06 = 10609.$$

$$\omega_{\text{KCl}} = \frac{10}{100} \times \omega_{\text{solution}} = 106\text{g}$$

$$\begin{aligned} \text{Molality} &= \frac{n_{\text{KCl}}}{V_{\text{solution}}(\text{mL})} \times 1000 \\ &= \frac{106/74.5 \times 1000}{1000} = 1.4228\text{M} \end{aligned}$$

51. 30%  $\text{NH}_3$ .  $\Rightarrow$  70% water.

$$\text{i.e. } \frac{70}{100} \times \omega_{\text{solution}} = \omega_{\text{water}} = 105\text{g}$$

$$\text{i.e. } \omega_{\text{solution}} = \frac{100}{70} \times 150 = 150\text{g}$$

$$V_{\text{solution}} = \frac{\omega}{\text{density}} = \frac{150}{0.9} = 166.67\text{mL}$$

52. Consider 1L of solution,

$$\omega_{\text{solution}} = 1.025 \times 1000 = 1025\text{g}$$

$$n_{\text{ethanol}} = M \times V = 8 \times 1 = 8\text{moles}$$

$$\omega_{\text{ethanol}} = 8 \times 46 = 368$$

$$\begin{aligned} \text{molality} &= \frac{n_{\text{ethanol}}}{\omega_{\text{solvent}}} \times 1000 \\ &= \frac{8}{(1025 - 368)} \times 1000 \\ &= 12.176\text{molal} \end{aligned}$$

53.  $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$

$$n\text{SO}_2 = n\text{SO}_3 \Rightarrow n\text{SO}_3 = 5$$

54.  $4\text{FeS}_2 + 11\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3 + 8\text{SO}_2$

$$\frac{600}{120} = 5 \quad \frac{800}{32} = 23$$

$$\text{So moles of } \text{Fe}_2\text{O}_3 = \frac{1}{2} \times 2.5$$

55.  $n_{\text{NH}_3} = n_{\text{HCl}} = \frac{146}{36.5} = 4$

$$\text{Wt } \text{NH}_3 = 4 \times 17 = 68\text{g}$$

56.  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$

$$\frac{6}{2} = 3 \quad \frac{29}{32} = 0.90625$$

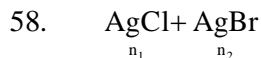
LR

$$\text{wt } \text{H}_2\text{O} \text{ formed} = 0.90625 \times 2 \times 18 = 32.625\text{g}$$

$$\text{wt } \text{H}_2 \text{ left} = (3 - (0.90625 \times 2)) \times 2 = 2.1325\text{g}$$

57.  $\frac{245}{95} \times 3 = \frac{w}{58.5} \times 2$

$$w = 226 \text{ g}$$



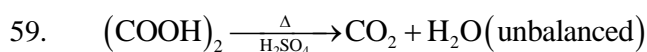
$$\frac{\% \text{Ag}}{100} = \frac{(n_1 + n_2)108}{n_1 \times 143.5 + n_2 \times 188} = \frac{60.94}{100}$$

$$\Rightarrow \frac{n_1}{n_2} = 0.31955$$

$$\% \text{Cl} = \frac{n_1 \times 35.5}{n_1 \times 143.5 + n_2 \times 188} \times 100 = \frac{\left(\frac{n_1}{n_2}\right) \times 35.5 \times 100}{\left(\frac{n_1}{n_2}\right) 143.5 + 188}$$

$$= 4.856\%$$

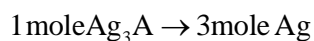
$$\% \text{Br} = 100 - (60.94 + 4.856) = 34.2\%$$



$$\text{POAC}^n \text{C} = {}^n \text{CO}_2 \times 1 = {}^n (\text{COOH}) \times 2 = \frac{10}{90} \times 2 = \frac{2}{9}$$

$$\therefore V \text{ CO}_2 = \frac{2}{9} \times 22.4 \text{ L} = 4.977 \text{ L}$$

60. acid is  $\text{H}_3\text{A}$ . salt is  $\text{Ag}_3\text{A}$



$$\therefore n_{\text{Ag}_3\text{A}} = \frac{n_{\text{Ag}}}{3} = \frac{0.37/108}{3} = 0.00114$$

$$\therefore \frac{0.607}{\text{mol. wt of Ag}_3\text{A}} = 0.00114$$

$$\Rightarrow \text{mol. wt} = (108 \times 3 + \text{A}) = 531$$

$$\therefore \text{A} = 207$$

$$\therefore \text{wt of H}_3\text{A} = 210$$

### GET EQUIPPED FOR JEE ADVANCE

#### ONE OPTION CORRECT



say, wt:  $14x \quad 3x$

$$t = 0 \quad \frac{14x}{28} = \frac{x}{2} \quad \frac{3x}{2} \quad -$$

$$t = t \quad \frac{x}{2} - y \quad \frac{3x}{2} - 3y \quad 2y$$

$\text{NH}_3$  was 40% by mol.

$$\text{i.e. } 2y = \frac{40}{100} \left( \frac{x}{2} - y + \frac{3x}{2} - 3y + 2y \right)$$

$$\Rightarrow 5y = 2x - 2y \Rightarrow y = \frac{2x}{7} \Rightarrow \frac{x}{y} = 3.5$$





$$n(\text{I}) = \frac{25.4}{127} = n_1 + n_2$$

POAC on Cl

$$n(\text{Cl}) = \frac{14.2}{35.5} = n_1 + 3n_2$$

$$\therefore n_1 : n_2 = 1 : 1$$

(A)

8.  $\text{FeSO}_4 : n_1 \Rightarrow \text{SO}_4^{2-} = n_1$  and  $\text{Fe}^{2+} = n_1$   
 $\text{Fe}_2(\text{SO}_4)_3 : n_2 \Rightarrow \text{SO}_4^{2-} = 3n_2$  and  $\text{Fe}^{3+} = 2n_2$

$$n_1 = 3n_2 \text{ (given)} \Rightarrow \frac{n_1}{n_2} = 3$$

$$\frac{\text{Fe}^{2+}}{\text{Fe}^{3+}} = \frac{n_1}{2n_2} = \frac{n_1/n_2}{2} = 3 : 2$$

(D)

9.  $0.36\text{M} : V_1$  say and  $0.15\text{M} : V_2$  say

$$M_{\text{final}} = 0.24 = \frac{M_1 V_1 + M_2 V_2}{V_1 + V_2}$$

$$\Rightarrow \frac{36V_1 + 0.15V_2}{V_1 + V_2} = 0.24$$

$$\text{or } \frac{0.36 \times \frac{V_1}{V_2} + 0.15}{\frac{V_1}{V_2} + 1} = 0.24$$

$$\therefore 0.36 \left( \frac{V_1}{V_2} \right) + 0.15 = 0.24 \left( \frac{V_1}{V_2} \right) + 0.24$$

$$\Rightarrow \frac{V_1}{V_2} = \frac{0.09}{0.12} = \frac{3}{4}$$

(D)

10. At mass =  $N_A \times$  mass of an atom  
 $= 6 \times 10^{23} \times 3.98 \times 10^{-23} = 24\text{g}$

(C)

11.  $\text{Fe}_2[\text{Fe}(\text{CN})_6]$

$$\frac{\omega_{\text{Fe}}}{\omega_{\text{C}}} = \frac{3 \times 56}{6 \times 12} = \frac{7}{3}$$

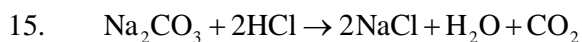
(C)

12. obvious (D)

13. obvious (B)

14.  $1\text{gatom} \Rightarrow 1\text{mole of atom} - 14\text{g}$ .

(A)



$$n_{\text{HCl}} = 2 \times n_{\text{Na}_2\text{CO}_3} = V_{\text{HCl}} \times M_{\text{HCl}}$$

$$\Rightarrow V \times 3 = 2 \times \frac{1.431}{106} \Rightarrow V = 9\text{mL.}$$

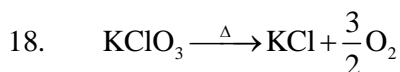
(B)

16. They must have same mol. wt.

(C)

17. 
$$= \frac{V_{2\text{micron sphere}}}{V_{20\text{Asphere}}} = \frac{\frac{4}{3}\pi \times (2 \times 10^{-6})^3}{\frac{4}{3}\pi \times (2 \times 10^{-9})^3} = 10^9$$

(A)



$$n_{\text{KClO}_3} = \frac{n_{\text{O}_2}}{\frac{3}{2}} = \frac{0.1}{\frac{3}{2}} = \frac{2}{30}$$

$$\% \text{ purity} = \frac{\frac{2}{30} \times (122.5)}{10} \times 100 = 81.66\%$$

(B)

19.  $n = \frac{V(\text{ml}) \times m}{1000} = \frac{1 \times 0.65}{1000} = 6.5 \times 10^{-4} \text{ moles}$

$$\therefore \omega_{\text{BaCl}_2 \cdot 2\text{H}_2\text{O}} = (137 + 71 + 36) \times 6.5 \times 10^{-4} = 0.1586\text{g}$$

$$\omega_{\text{BaCl}_2} = (137 + 71) \times 6.5 \times 10^{-4} = 0.1352\text{g}$$

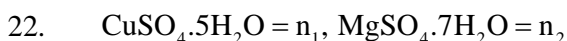
(A)

20. 
$$\frac{1.36 \times V + 200 \times 2.4}{500} = 1.24$$

$$\Rightarrow V = 102.941\text{mL}$$

(B)

21. 
$$\omega t = \frac{11.5}{M_{\text{C}_6\text{H}_5\text{COOK}}} \times \frac{100}{71} \times M_{\text{C}_6\text{H}_5\text{CH}_3} = 9.31\text{g}$$



total  $\omega t = 5\text{g}$  and anhydrous  $3\text{g}$

$$\therefore 249.5n_1 + 246n_2 = 5$$

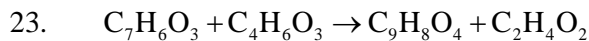
$$\text{and } 159.5n_1 + 120n_2 = 3$$

on solving,  $n_1 = 0.0149$  and  $n_2 = 0.0052$

$$\Rightarrow \omega_{\text{CuSO}_4 \cdot 7\text{H}_2\text{O}} = 3.729\text{g}$$

$$\therefore \% \text{ by wt} = \frac{3.72}{5} \times 100 = 74.4\%$$

(C)



$$\omega : 2\text{g} \quad 4\text{g}$$

$$n : 0.0144 \quad 0.039 \quad 0.01449$$

$$\text{theoretical yield} = 0.01449 \times M_{\text{C}_9\text{H}_8\text{O}_4} \\ = 2.69$$

$$\therefore \% \text{ yeild} = 80.76\%$$

(A)



$$n_{\text{XI}_3} = n_{\text{XCl}_3} \Rightarrow \frac{0.5}{(M+381)} = \frac{0.236}{(M+106.5)}$$

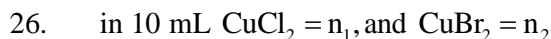
$$\Rightarrow M = 138.88 = 139$$

(B)

25.  $n = \frac{\text{no. of molecules}}{N_A} = \frac{(500\text{cm}^2/0.21\text{nm}^2)}{6 \times 10^{23}} = V \times \text{Molarity}$

$$\text{i.e. } V = \frac{n}{(4.24/256)} = 2.395 \times 10^{-5} \text{L.}$$

(B)



$$n_{\text{AgBr}} = 2n_2 \text{ and } n_{\text{AgCl}} = 2n_1$$

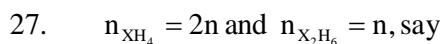
$$\therefore 2n_1(143.5) + 2n_2(188) = 0.9065\text{g}$$

$$\text{and } (2n_1 + 2n_2)188 = 1.005\text{g}$$

$$\text{then } n_1 = 0.00115 \text{ and } \omega_{\text{CuBr}_2} = 0.35\text{g}$$

$$\therefore 25\% \text{ and } 58\%$$

(A)



$$n_x = n_{\text{XH}_4} + (n_{\text{X}_2\text{H}_6} \times 2) = 4n$$

$$\text{i.e. } \frac{5}{X} = 4n \text{ and } (2n)(X+4) + n.(2X+6) = 5.628$$

$$\text{i.e. } \frac{5}{2X}(X+4) + \frac{5}{4X}(2X+6) = 5.628$$

$$\text{or, } \frac{5}{2} + \frac{10}{X} + \frac{5}{2} + \frac{7.5}{X} = 5.628$$

$$\text{or } X = \frac{17.5}{0.628} = 27.86 \approx 28$$

(A)

28.  $M_{\text{AgNO}_3} = \frac{0.0125/(39+80)}{1\text{mL}} = 0.0105\text{M}$

$$\therefore 0.0105 \times \frac{42.5}{1000} = n_{\text{AgNO}_3}$$

$$= 0.00446$$

$$n_{\text{AgNO}_3} = n_{\text{NaBr}} + 2n_{\text{Na}_2\text{SO}_4}$$

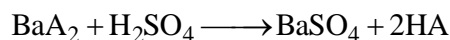
$$\downarrow \qquad \qquad \downarrow$$

$$n_1 \qquad \qquad n_2$$

$$\therefore n_1 + 2n_2 = 0.00446$$

$$\text{also, } n_1 \times 103 + n_2 \times 142 = 2/5 \left( \text{wt of } \frac{1}{5}^{\text{th}} \text{ portion} \right)$$

29. Let acid be HA  
Salt:  $\text{BaA}_2 \cdot 2\text{H}_2\text{O}$



$$\therefore \frac{4.29}{137 + 2A + 36} = \frac{21.64}{1000} \times 0.477$$

$$\therefore A = 121 \qquad \qquad \qquad \therefore \text{HA} = 122$$

30. total moles = n (say)  
 $0.15n = \text{moles of } \text{CH}_3\text{COOH}$

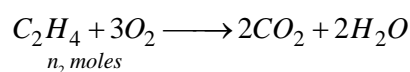
$$\therefore 0.15n \times 60 + 0.85n \times 18 = 30$$

$$\therefore n = \frac{30}{9 + 15.3} = 1.234$$

$$\therefore {}^n \text{NaOH} = {}^n \text{CH}_3\text{COOH} = 0.15n = 0.18519$$

$$\therefore V_{\text{NaOH}} = 18.5 \text{ L} [B]$$

31.  $\text{C}_2\text{H}_6 + 3.5\text{O}_2 \longrightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$   
 $n_1 \text{ moles}$



$$n_1 + n_2 = \frac{PV}{RT} = \frac{1 \times 40}{0.0821 \times 400} = 1.218$$

$$\text{also } 3.5n_1 + 3n_2 = n_{\text{O}_2} = \frac{130}{32} = 4.06$$

$$\therefore n_1 = 0.817$$

$$n_2 = 0.401$$

$$\therefore \% \text{C}_2\text{H}_4 = 33\% \text{ and } \text{C}_2\text{H}_6 = 67\% [A]$$

| 32.       | %    | no. of atom | ratio |
|-----------|------|-------------|-------|
| <i>Al</i> | 10.5 | 0.3889      | 1     |
| <i>K</i>  | 15.1 | 0.388       | 1     |
| <i>S</i>  | 24.8 | 0.775       | 2     |
| <i>O</i>  | 49.6 | 3.1         | 8     |

33.  $V_{\text{molecule}} = \frac{\sqrt{3}}{4} \left( 100 \text{ \AA} \right)^2 \times 300 \text{ \AA}$

$$= 1.299 \times 10^{-24}$$

$$\therefore \text{mol. Wt} = N_A \times V_{\text{mol}} \times \text{density}$$

$$= 6 \times 10^{23} \times 1.299 \times 10^{-24} \times 1.2 \times 10^3 \text{ kg/m}^3$$

$$= 939 \text{ kg (B)}$$

**More than one correct**

1. 3 moles in 1L (1250 g)

$$w_{\text{Na}_2\text{S}_2\text{O}_3} = 3 \times (46 + 64 + 48) = 474$$

$$\text{(A) \% by weight} = \frac{474}{1250} \times 100 = 37.92\%$$

$$\text{(B) } x = \frac{3}{3 + \left( \frac{1250 - 474}{18} \right)} = \frac{3}{46.11} = 0.065$$

$$\text{(C) molality of } \text{Na}^+ = \frac{n}{w_{\text{solvent}}} \times 1000$$

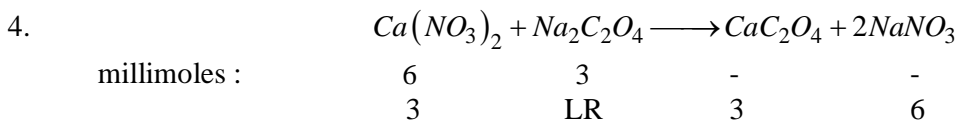
$$= \frac{3 \times 2}{(1250 - 474)} \times 1000 = 7.73$$

2. mol. wt = wt of 22.4 L = 28.896 g

$$V_D = \frac{\text{mol. wt}}{2} = 14.48$$

(A) and (B)

3. [A] : 32 g                      [ B ]  $\frac{1}{2} \times 64 = 32 \text{ g}$                       [ D ] : 32 g



[A],[C],[D]

5.  ${}^n \text{CaO} = {}^n \text{CaCO}_3 = \frac{1.12}{56} = 0.02$

$$w_{\text{CaCO}_3} = 0.02 \times 100 = 2 \text{ g}$$

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

$$\therefore w_{\text{NaCl}} = 2.22 \text{ g}$$

[ A, C ]

6.  $n_{\text{NaCl}} = 100 \text{ mmoles}$  ;  $n_{\text{HCl}} = 300 \text{ mmoles}$

$$n_{\text{CaCl}_2} = 200 \text{ mmoles} \left( 200 \text{ Ca}^{2+}, 400 \text{ Cl}^- \right)$$

$$\frac{\text{cation}}{\text{anions}} = \frac{600}{800} = \frac{3}{4}$$

$$\left[ \text{Cl}^- \right] = \frac{800}{400} = 2 \text{ M}$$

$$\therefore [A], [C]$$

7. Obvious A,B,D ( $n_H = 4$ )
8. 3 mole  $NH_3$   
 $w_H = 3 \times 14 = 42 \text{ g}$   
 $w_N = 3 \times 14 = 42 \text{ g}$   
molecule =  $3 \times N_A = 18 \times 10^{23}$   
atoms =  $4 \times 3 \times N_A = 72 \times 10^{23}$   
[A], [B], [C], [D]
9. Obvious : [A], [B]
10. [B],[C]: obvious others depend on volume
14. Hence [C], [D]  
Mol. Wt =  $\frac{14}{11.2} \times 22.4 = 28$

**Match the following**

1. (I) wt % of C =  $\frac{13 \times 12}{407} \times 100 = 38.33\%$  (P)  
(II) wt % of H =  $\frac{6}{407} \times 100 = 1.47\%$  (A)  
(III) wt of H: wt of Cl =  $6 : 6 \times 35.5$  (C)  
(IV) mo. of C: O = 13:2 (E)
2. (a)  $\frac{w_{SO_2}}{W_{O_2}} = 2(s)$   
(b)  $d = 10/5 = 2 \text{ g/cc} \therefore sp. gr = 2(s)$   
(c)  $M = 2VD = 32(Q)$   
(d) molecular =  $\frac{132}{44} = 3 \quad \therefore \text{at anons} = 9(R)$
3. (a)  $[Al^{3+}] = \frac{20}{400} = 0.04M$   
 $[H^+] = \frac{40}{500} = 0.084$   
Total = 0.12 M  
 $[Cl^-] = \frac{60 + 40}{500} = 0.2M$   
(P), (S)  
(b)  $[K^+] = \frac{20}{100} = 0.2M$

$$[Cl^-] = \frac{20}{100} = 0.2M$$

(S)

$$(c) [K^+] = \frac{12}{100} = 0.12M$$

[P], [Q]

$$[SO_4^{2-}] = \frac{6}{100} = 0.06M$$

$$(d) w_{H_2SO_4} = 200 \times \frac{24.5}{100} = 49 \Rightarrow {}^n H_2SO_4 = 1/2$$

$$[H^+] = \frac{1}{200} \times 1000 = 5M$$

$$[SO_4^{2-}] = \frac{1/2}{200} \times 1000 = 2.5M$$

[R]

$$4. (A) V_{SO_2} = 11.2L$$

$$w_{SO_2} = 32g$$

$$\text{total atoms} = \frac{1}{2} \times 2 \times N_A$$

$$(B) {}^n H_2 = 1/2 \therefore V_{H_2} = 11.2L$$

$$w_{H_2} = 1g, \text{ , total atoms} = N_A [P]$$

$$(C) \text{ no. of atoms} = 0.5 \times 3 \times N_A = 1.5 N_A$$

[P], [Q], [R]

$$(D) 1 \text{ mole } O_2 \therefore V = 22.4L$$

$$\text{Atoms} = 12 \times 10^{23}$$

$$wt = 32g \quad [S]$$

### COMPREHENSION TYPE

#### Passage 1

$$1. \text{ wt of 1 atom} = 1 \text{ amu} = 1.66 \times 10^{-24} \text{ g. (C)}$$

$$2. n_s = n_{H_2SO_4} = 100 \therefore \text{wt} = 3200 \text{ g. (A)}$$

$$3. \frac{3.4}{100} \times (M) = w_s = 2 \times 32 \Rightarrow M = 1882.3 \text{ (B)}$$

$$4. C + O_2 \rightarrow n_c = n_c = n_{O_2} = 1$$

$$\Rightarrow V_{O_2} = \frac{20}{100} \times V_{\text{air}} = 22.4C \Rightarrow V_{\text{air}} = 112L \text{ (B)}$$

#### Passage – 2

$$1. \text{ Consider 1 L.}$$



$$n_{\text{KOH}} = 6.9 \Rightarrow \omega_{\text{KOH}} = 6.9 \times 56 = 386.4$$

$$\frac{30}{100} \times \omega_{\text{solu}} = 386.4 \Rightarrow \omega_{\text{solu}} = 1288\text{g}$$

$$\therefore d = 1.2889\text{g/mL. (A)}$$

$$2. \quad \frac{134}{1000} \times M_{\text{H}_2\text{SO}_4} \times 2 = n_{\text{NH}_3} = \frac{PV}{RT} = \frac{0.2 \times 2}{0.0821 \times 303}$$

$$\Rightarrow M_{\text{H}_2\text{SO}_4} = 0.06 \text{ (C)}$$

$$3. \quad \frac{1600 \times 0.205}{1600 + V} = 0.2 \Rightarrow V = 40\text{mL (A)}$$

$$4. \quad \frac{n_{\text{H}_2\text{S}}}{1} = \frac{n_{\text{H}_2\text{SO}_4}}{5} \Rightarrow n_{\text{H}_2\text{SO}_4} = \frac{5 \times 34}{34} = 5$$

$$\therefore V \times 0.2 = 5 \Rightarrow V = 25\text{L (A)}$$

Passage – 3

$$1. \quad m_{\text{H}_2\text{O}} = \frac{18\text{g}}{6 \times 10^{23}} = 3 \times 10^{-23}\text{g (D)}$$

2. Avogadro's law. (A)

3. obvious Mass is 16amu. (C)

4. obvious (A)

Passage – 4

$$1. \quad \text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$$

$$n: \frac{5.77}{170} \quad \frac{4.77}{58.5} \quad n_{\text{AgCl}} = 0.0339$$

$$= 0.0339 \quad = 0.081 \quad \therefore \text{wt} = 4.88\text{g}$$

L.R (A)

$$2. \quad \therefore \omega_{\text{H}_2\text{SO}_4} = 0.12 \times 98 = 11.7\text{g (A)}$$

## INTEGER

1. 0.5 mole  $\text{N}^{3-} \cdot \text{N}^{-3}$  has  $10e^-$ .  
 $\therefore$  5 moles.

$$2. \quad n_{\text{CO}_2} = \frac{132}{44} = 3$$

$$n_{\text{C}} = 3$$

3.  $\text{MCl}_x$ : say. mol.wt =  $(M + 106.5)$

$$n_{\text{Cl}^-} = (n_{\text{MCl}_x}) \times (X) = \frac{0.22x}{(M + 106.5x)}$$

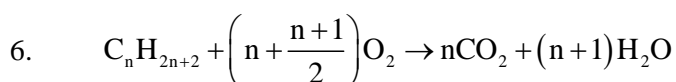
$$n_{\text{Cl}^-} = n_{\text{Ag}} = \frac{0.51}{(170)} = 3 \times 10^{-3}$$

$$M \approx \frac{6.4}{0.57} = 112 \text{ s (Dulong petite's law)}$$

$$\therefore \frac{0.22 \times x}{(112 + 106.5x)} = 3 \times 10^{-3} \therefore x = 3$$

$$4. \quad n_{\text{Fe}} = \frac{8}{100} \times \frac{2800}{56} = 4$$

$$5. \quad \frac{x \times 5 + 20 \times 2}{x + 20} = 2.6 \Rightarrow 5x + 40 = 2.6x + 52$$

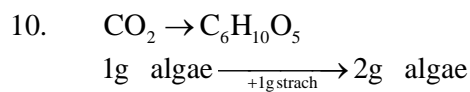


$$\frac{n + \frac{n+1}{2}}{n} = \frac{7}{4} \Rightarrow 4n + 3n + 2 = 7n \quad \text{or} \quad n = 2$$

$$7. \quad n = \frac{\omega}{\text{mol.wt}} = \frac{1440}{60 \times 12} = 2$$

$$8. \quad \frac{5}{100} \times \omega_{\text{solu}} = 0.3 \text{g} \Rightarrow \omega_{\text{solu}} = 6 \text{g}$$

$$9. \quad \frac{0.25}{100} \times 89600 = \omega_{\text{Fe}} = n \times 56 \Rightarrow n = 4$$



1g strach

POAC on carbon

$$n_{\text{CO}_2} \times 1 = n_{(\text{C}_6\text{H}_{10}\text{O}_5)_n} \times 6n$$

$$= \frac{1}{162n} \times 6n = \frac{1}{27}$$

$$\therefore \text{time} = \frac{1/27}{4.7 \times 10^{-3}} = 8$$

### EXPERTISE ATTAINERS

1. POAC on Co

$$n_{\text{Co}_3\text{O}_4} \times 3 = n_{\text{Co}} \times 1$$

$$\Rightarrow n_{\text{Co}} = \frac{0.2125 \times 3}{(177 + 64)} \therefore \omega_{\text{Co}} = n_{\text{Co}} \times 59 = 0.156 \text{g}$$

$$n_{\text{ppt}} \times 1 = n_{\text{Co}}$$

$$\therefore \omega_{\text{ppt}} = n_{\text{ppt}} \times \text{mol.wt} = 1.52 \text{g}$$

2. (a)  $\frac{90}{100} \times 0.5 \text{ g Fe} \rightarrow \text{Fe}_2\text{O}_3 (n_1)$   
 $\frac{10}{100} \times 0.5 \text{ g Fe} \rightarrow \text{Fe}_3\text{O}_4 (n_2)$   
 $n_1 \times 2 = \frac{0.45}{56} \Rightarrow n_1 = 0.04$   
 $n_2 \times 3 = \frac{0.05}{56} \Rightarrow n_2 = 0.0003$   
 $\therefore \text{wt of mix} = (160) \times n_1 + (232)n_2 = 0.71 \text{ g}$

(b)  $0.5 \text{ g Fe} \rightarrow \text{Fe}_2\text{O}_3 (n)$   
 $n \times 2 = \frac{0.5}{56} \Rightarrow n = 4.46 \times 10^{-3}$   
 $\Rightarrow \omega_{\text{Fe}_2\text{O}_3} = 0.7142 \text{ g}$

3. (i)  ${}^n \text{AgNO}_3 = {}^n \text{AgCl} = {}^n \text{NaCl} + {}^n \text{HCl}$   
 $(n_1) \quad (n_2)$   
 $\therefore \frac{2.567}{143.5} = n_1 + n_2 = 0.0179$

(ii) NaCl is not affected  
 ${}^n \text{Cl} = {}^n \text{AgCl} = n_2 = \frac{1.341}{143.5}$

$\Rightarrow n_2 = 0.009345$

$\therefore n_1 = 0.0856$

Now,  $n_1 \times 58.5 + n_2 \times M = 1 \text{ gram}$

$\therefore M = \frac{0.5}{0.009345} = 53.5$

4.  $\text{C}_x\text{H}_y\text{Cl}_z + \text{O}_2 \rightarrow x\text{CO}_2 + \frac{y}{2}\text{H}_2\text{O} + \frac{z}{2}\text{Cl}_2$

$\left( \frac{0.22}{12x + y + 35.5z} \right) \times (x) = {}^n \text{CO}_2 = \frac{0.195}{44} \dots\dots\dots(1)$

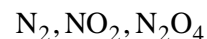
$\left( \frac{0.22}{12x + y + 35.5z} \right) \times \left( \frac{y}{2} \right) = {}^n \text{H}_2\text{O} = \frac{0.0804}{18} \dots\dots(2)$

$\left( \frac{0.12}{12x + y + 35.5z} \right) = n = \frac{PV}{RT} = \frac{\left( \frac{768}{760} \right) \times \left( \frac{37.24}{1000} \right)}{0.0821 \times 382} = 0.0012 \dots\dots(3)$

Solving,  $x = 2; y = 4$  and  $z = 2$



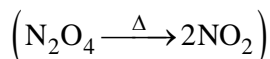
5. Consider 1 mole mix ( $\omega_t = 55.4$ )



$n_1 \quad n_2 \quad n_3$

$n_1 + n_2 + n_3 = 1$

Now, after heating,  ${}^n \text{NO}_2 = n_2 + 2n_3$



$$\therefore \text{no. of moles} = n_1 + n_2 + 2n_3 = 1 + n_3$$

New Average mol. Wt = 39.57

$$\frac{55.4}{1 + n_3} = 39.57$$

$$\therefore n_3 = 0.4$$

$$\text{Now, } n_1 \times 28 + n_2 \times 46 + n_3 \times 92 = 55.4$$

$$\therefore 28n_1 + 46n_2 = 18.6 \quad \dots\dots(1)$$

$$\text{also } n_1 + n_2 + n_3 = 1$$

$$\therefore n_1 + n_2 = 0.6 \quad \dots\dots(2)$$

Solving (1) and (2),

$$n_1 = 0.5, \text{ and } n_2 = 0.1$$

$$\therefore 5:1:4$$

$$6. \quad \frac{{}^n\text{IO}_3^-}{1} = \frac{{}^n\text{HSO}_3^-}{3} \Rightarrow {}^n\text{HSO}_3^- = \frac{3 \times 5.8}{(23 + 127 + 48)} = 0.8788$$

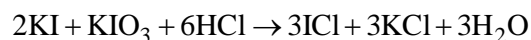
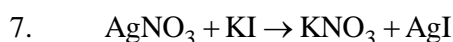
$$\therefore w_{\text{NaHSO}_3} = 9.139 \text{ g}$$

$${}^n\text{I}^- \text{ in } 1^{\text{st}} = {}^n\text{IO}_3^- = \frac{5.8}{198}$$

$$\frac{{}^n\text{IO}_3^-}{1} = \frac{{}^n\text{I}^-}{5} \Rightarrow {}^n\text{IO}_3^- = 0.00586$$

$$M_{\text{NaIO}_3} = 5.8 / (198)$$

$$\therefore V = \frac{{}^n\text{IO}_3^-}{M_{\text{IO}_3^-}} = 0.2 \text{ L} = 200 \text{ mL}$$



$$\frac{M_{\text{KI}} \times V_{\text{KI}}}{2} = \frac{{}^n\text{KIO}_3}{1} \Rightarrow \frac{M_{\text{KI}} \times 20}{2} = \frac{30 \times \frac{1}{10}}{1}$$

$$\therefore M_{\text{KI}} = 0.3 \text{ M}$$

$$\text{Now, } \frac{{}^n\text{KI, excess}}{2} = \frac{{}^n\text{KIO}_3}{1} \Rightarrow {}^n\text{KI, excess} = 10 \text{ mmole}$$

$$\text{Original KI} = 50 \times 0.3 = 15 \text{ mmole}$$

$$\therefore \text{KI(used)} = 5 \text{ mmole}$$

$$\therefore {}^n\text{AgNO}_3 = {}^n\text{KI(used)} = 5 \text{ mmole} \Rightarrow w(\text{AgNO}_3) = 0.85 \text{ g}$$

$$\therefore \text{purity} = 85\%$$

8. Let % of boron will at. Wt. 10.0 = x

Let % of boron will at. Wt. 11.01 = (100 - x)

$$\frac{(x \times 10.01 + (100 - x) \times 100.01)}{100} = 10.81$$

$$\Rightarrow x = 20\%$$

9. Let NaCl = w gms  
 $\Rightarrow$  kCl = (118 - w) gms  
 POAC on Cl  

$$\frac{w}{M_{\text{NaCl}}} + \frac{0.118 - w}{M_{\text{kCl}}} = \frac{0.2451}{M_{\text{AgCl}}}$$

$$\frac{w}{58.5} + \frac{0.118 - w}{74.5} = \frac{w}{74.5} = \frac{0.2451}{143.5}$$
 w = 0.0338 gm  
 NaCl = 0.0338 gm      kCl = 0.0842 gm  
 $n_{\text{NaCl}} = 5.777 \times 10^{-4}$   
 $n_{\text{kCl}} = 1.13 \times 10^{-3}$

POAC on Na; moles of Na<sub>2</sub>O × 2  
 = moles of NaCl × 1  
 $\Rightarrow n_{\text{Na}_2\text{O}} = \left( \frac{5.777 \times 10^{-4}}{2} \right); \quad n_{\text{k}_2\text{O}} = \left( \frac{1.13 \times 10^{-3}}{2} \right)$   
 Weight of Na<sub>2</sub>O =  $\frac{5.777 \times 10^{-4}}{2} \times 62 = 0.01$  gm  
 Weight of k<sub>2</sub>O =  $\frac{1.13 \times 10^{-3}}{2} \times 94 = 0.1062$   
 % Na<sub>2</sub>O = 3.58%.      % k<sub>2</sub>O = 10.62 %

10. C<sub>x</sub>H<sub>y</sub>  

$$\text{C}_x\text{H}_y + (x + y/x)\text{O}_2 \longrightarrow x\text{CO}_2 + \frac{y}{2}\text{H}_2\text{O}$$
 POAC on carbon  
 $5 \times x = (\text{vol. of CO}_2) \times 1$   
 Now 1 vol. of CO<sub>2</sub> = 10 mL (that obtained by KOH)  
 $\Rightarrow x = 2$   
 Vol. of O<sub>2</sub> reactionary = 15 ml  
 Vol. of O<sub>2</sub> reacted = 15 ml  
 $\Rightarrow$  1 ml of C<sub>x</sub>H<sub>y</sub> react with (2 + y/x) ml O<sub>2</sub>  
 $\Rightarrow$  5 ml of C<sub>x</sub>H<sub>y</sub> react with (2 + y/x) = ml 15 (given)  
 $\Rightarrow y = 4$   
 $\therefore$  formula = C<sub>2</sub>H<sub>4</sub>

11. (a)  

$$\text{CO}_2 + \text{C} \longrightarrow 2\text{CO}$$
 POAC on carbon  
 Let CO = x l  
 CO<sub>2</sub> = (1 - x) l  
 $\Rightarrow x \times 1 + 2(1 - x) = 1.6 \times 1$   
 $\Rightarrow 2 - x = 1.6 = 1$   
 x = 0.4 l & (1 - x) 0.6 L
- (b)  
 The molecular formula = M<sub>3</sub>N<sub>2</sub>  

$$\% \text{ Nitrogen} = \left( \frac{2 \times 14}{3x + 14 \times 2} \right) \times 100 = 28$$

Where  $x$  = atomic wt of metal

$$x = \left( \frac{100 - 28}{3} \right) = 24$$



POAC on carbon

$$\left( \frac{x}{2 \times 12 + 6 \times 1} \right) \times 2 = \frac{90}{100} \times \frac{85}{100} = \left( \frac{55}{4 \times 12 + 10 \times 1} \right) \times 4 = 1$$

$$x = 74.37 \text{ gms}$$

$$\Rightarrow V = \frac{74.37}{30} \times 22.4 \text{ L} = 55.53 \text{ L}$$

## WINDOW TO JEE ADVANCED

### INTEGER TYPE

2. (4)

$$\text{Boltzmann constant, } k = \frac{R}{N_A} \text{ or } R = k \times N_A$$

$$= 1.380 \times 10^{-23} \times 6.023 \times 10^{23}$$

$$= 8.31174 \text{ J K}^{-1} \approx 8.312$$

Hence, no. of significant figures is 4

3. (8)

$$\text{Mass of 1 L solvent} = 0.4 \text{ g mL}^{-1} \times 10^3 \text{ mL}$$

$$= 400 \text{ g} = 0.4 \text{ kg}$$

$$\text{So molality } (m) = \frac{\text{Mole of solute}}{\text{Mass of solvent (kg)}} = \frac{3.2}{0.4} \\ = 8 \text{ m}$$