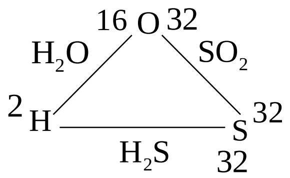
Mole Concept

EXERCISE - 1 [A]

1. **(D)**
None law is applicable in case of isotopes.

2. **(D)**
This is law of reciprocal proportions



3. **(B)**
Molecular formulae is always same law of constant composition.

4. **(A)**
Most stable isotope of carbon

5. **(D)**
The number of difference types of atoms in a molecule.

6. **(C)**
If volume of equal, then number of molecular are also same.

7. **(A)**
Moles of gas = $\frac{5.675}{22.7} = 0.25$

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

Hence NO.

8. **(A)**
Molecular weight of $C_{60}H_{122} = 60 \times 12 + 122 = 842.$

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

9. **(A)**
1 mole contains Avogadro number of particles.

10. **(A)**
Moles of $N_2 = \frac{1.4}{28} = 0.05.$

Number of atoms = $0.05 \times 2 \times 6.02 \times 10^{23}$.
= 6.02×10^{22} .

11. **(D)**

(A) $\frac{22.7\times10^{3}}{22700}\times N_A = 6.022\times10^{23}$

(B) $\frac{22}{44}\times6.022\times10^{23} = 3.011\times10^{23}$

(C) $\frac{11.35}{22.7}\times6.022\times10^{23} = 3.011\times10^{23}$

(D) $0.1\times6.022\times10^{23} = 6.022\times10^{22}$

12. **(C)**

Number of gms of $H_2SO_4 = 0.25\times98 = 24.5$

13. **(D)**

Moles of $H_2 = \frac{1}{2} = 0.5$

Volume of H_2 in l = $0.5\times22.7 = 11.35l$.

14. **(D)**

Moles of Au = $\frac{19.7\times1000}{197} = 100$

Atoms of Au = $100\times6.022\times10^{23} = 6.022\times10^{25}$.

15. **(A)**

Mass of one molecule of CO_2 = $\frac{44}{6.02\times10^{23}}$ = 7.31×10^{-23}

16. **(C)**

Number of moles of $H_2 = \frac{0.227}{22.7} = 0.01$

17. **(B)**

Molar mas is mass of one mole substance.

18. **(B)**

$W_H = 3\times3 = 9\,g$ $\quad$ $W_N = 3\times14 = 42\,g$

19. **(C)**

In one H_2O molecule: 10 proton, 8 neutrons, 10 electrons

Hence in 36 ml, $n_{H_2O} = \frac{36g}{18g/mol} = 2$ mol

$\therefore$ Protons = $2N_A\times10 = 20\,N_A$

20. **(A)**

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

21. **(B)**

no. of moles = $\frac{10^{-3}N_A}{N_A} = 10^{-3}$

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

22. **(A)**

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

23. **(D)**

$A : 2.5 \times 5N_A = 12.5\, N_A\ ;\ B : 10N_A\ ;\ C : 4 \times 3N_A = 12N_A\ ;\ D = 1.8 \times 8N_A = 14.4N_A$.

24. **(C)**

$\frac{52\, amu}{4\, amu} = 13$

25. **(B)**

One ion contains: 7 + 24 + 1 = 32 $\bar{e}$

$\therefore$ total $\bar{e}s = 2\, N_A \times 32 = 64\, N_A$

26. **(D)**

$n_C = 0.5 \times 6 = 3 \qquad \therefore$ wt = 36 g

27. **(C)**

$A : \frac{28}{44};\ B : \frac{46}{46};\ C : \frac{36}{18};\ D : \frac{54}{108}$

28. **(D)**

$n_{H_2O} = \frac{180}{18} = 10$

$\therefore$ no. of $\bar{e}s = 10 \times 10\, N_A = 100\, N_A$

29. **(C)**

$n_{Na_2S_2O_3 \cdot 5H_2O} = \frac{2.48}{248} = 0.01$

$\therefore\ nH_2O = 5 \times 0.01 \Rightarrow molecules = 0.05\, N_A$

30. **(C)**

$n_{Ag} = \frac{90}{100} \times \frac{10}{108} = \frac{1}{12} \Rightarrow atom = \frac{1}{12} N_A = 5 \times 10^{22}$

31. **(B)**

$n_{H_2O} = \frac{18 \times 333}{54 + (96 \times 3) + (18 \times 18)} = 9.$

32. **(C)**

$n_{H_2O} = \frac{0.018}{18} = 10^{-3}$. Hence, molecules = $10^{-3} N_A$

33. **(A)**

$n_{N^{3-}} = \frac{4.2}{14} = 0.3. \qquad \therefore$ total = $0.3 \times 8N_A = 2.4N_A$

34. **(D)**

$$n_C = 12 \times n_{C_{12}H_{22}O_{11}} = 12 \times \frac{3.42}{342} = 0.12$$

$\therefore$ atom = $0.12\,N_A \Rightarrow$

35. **(B)**

$$n_{MgCO_3} = \frac{8.4}{84} = 0.1$$

Each contain (12 + 6 + 24) protons

Hence, total $= 0.1 \times 42 N_A = 2.5 \times 10^{24}$

36. **(B)**

$$n_{total} = \frac{4.4}{44} + \frac{2.27}{22.7} = 0.2 \qquad \therefore \text{ molecules} = 0.2 N_A$$

37. **(D)**

(i) $\frac{1}{1000} \times \frac{14}{58}$

(ii) $\frac{1}{1000} \times \frac{2}{28}$

(iii) $\frac{1}{1000} \times \frac{1}{23}$

(iv) $1\text{ml} \simeq 1\text{g}$ water

$$\frac{1}{18} \times 3$$

38. **(B)**

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

39. **(A)**

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

In 60 g carbon, $n_C = 5$ $\qquad \therefore$ twice = 10 moles

40. **(B)**

Say $n_{Ca_3(PO_4)_2} = n$; then $n_O = 8n$

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

41. **(B)**

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

42. **(C)**

$$\frac{X}{100} \times \ 46 + 96 + 180 \ = 180 \Rightarrow X = 55.9$$

43. **(C)**

$$n_I : n_O = \frac{25.4}{127} : \frac{8}{16} = \frac{1}{5} : \frac{1}{2} = 2:5$$

Hence I_2O_5.

44. **(A)**

mol. Wt = 2 VD = 100

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

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

45. **(D)**

$$\underset{1}{CaCO_3} \xrightarrow{\Delta} \underset{1}{CaO} + \underset{1}{CO_2}$$

Quantity of limes tones = wt. of one mole mole of $CaCO_3$

= 100 kg

46. **(A)**

Moles of $H_2S = 2$

Moles of $SO_2 = \frac{11.35}{22.7} = 0.5$

	SO_2	$+ 2H_2S$	$\rightarrow 3S$	$+ 2H_2O$
moles	1	2	3	2
given	0.5	2	$x = \frac{3 \times 0.5}{1} = 1.5$	
	L.R.			

47. **(C)**

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

Moles $2H_3PO_4 + 3Mg(OH)_2 \rightarrow Mg_3(PO_4)_2 + 6H_2O$

Moles 2 3 1 6

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

Weight of $H_3PO_4 = \frac{2 \times 1.724}{3} \times 98 = 112.6g$

48. **(D)**

$n_{H_2O} = n_{CH_3OH} \times 2 = 4$ $\quad \therefore$ wt $= 4 \times 18 = 72g$

49. **(A)**

$W_O = 3.6769 - 2.0769 = 1.6g$

$$2\,\text{mole}\,X \xrightarrow{\text{with}} 5\,\text{mole}\,'O'$$

$$'n'\,\text{moles} \xrightarrow{\text{with}} \frac{1.6}{16}\,\text{mole}\,'O'$$

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

50. **(A)**

$$Ag_2CO_3 \xrightarrow{\Delta} 2Ag$$

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

51. **(D)** $n_{CO_2} = 2 \times n_{C_2H_5OH} = 2$

$\therefore W_{CO_2} = 2 \times 44 = 88\,g$

52. **(C)**

$$KClO_3 \xrightarrow{\Delta} KCl + \tfrac{3}{2}O_2$$

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

53. **(A)**

$n_{Fe} = \frac{2}{3} \times n_{H_2O} = \frac{2}{3} \quad \therefore W_{iron} = \frac{2}{3} \times 56 = 37.39$

54. **(B)**

$$n_{CaCO_3} = n_{CaO} = \frac{1.62}{56} = n_{CaCl_2} = 0.0289$$

% of $CaCl_2 = \frac{0.0289 \times 111}{10} \times 100 = 32.11\%$

55. **(D)**

$$3BaCl_2 + 2Na_3PO_4 \rightarrow Ba_3(PO_4)_2 + 6NaCl$$

	$3BaCl_2$	$2Na_3PO_4$	$Ba_3(PO_4)_2$	$6NaCl$
Moles	3	2	1	6
	0.5	0.2	$\frac{1 \times 0.2}{2} = 0.1$	
		(L.R.)		

56. **(A)**

$$\underset{\boxed{0.2}\ \text{LR}}{Ca(OH)_2} + \underset{0.5}{H_2SO_4} \longrightarrow CaSO_4 + 2H_2O$$

$$n_{CaSO_4} = n_{Ca(OH)_2} = 0.2$$

57. **(B)**

$$\underset{5}{A} + \underset{\boxed{8}\ \text{LR}}{2B} \longrightarrow C + 3D$$

$n_C = \frac{n_B}{2} = 4;\ n_D = 3 \times \frac{n_B}{2} = 12$

58. **(D)**

$$n: \underset{\frac{1350}{27}=50\ \text{L.R}}{4Al} + \underset{\frac{2400}{12}=200}{3C} \longrightarrow Al_4C_3$$

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

59. **(D)**

$2A \longrightarrow 2B$

$B \longrightarrow 2C$

$3C \longrightarrow 4D$

$\therefore n_D = n_A \times \frac{2}{2} \times \frac{2}{1} \times \frac{4}{3}$

$= \frac{32}{3}$

60. **(C)**

$\text{Mol.wt.} = 0.8 \times 28 + 0.2 \times 32 = 28.8$

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

61. **(A)**

$D_{cl_2 \text{ wrt air}} = \frac{D_{cl_2}}{D_{air}} = \frac{M_{cl_2}}{M_{air}} \approx \frac{71}{29}$

62. **(B)**

Say NO_X. Then $\frac{30.4}{100}(14+16x) = 14 \Rightarrow x = 2$

$\therefore \ D_{\text{oxide wrt } O_2} = \frac{M_{oxide}}{M_{O_2}} = \frac{46}{32} = 1.44$

63. **(B)**

$$\text{molality } = \frac{n}{w_{solvent}} \times 1000 \left(\text{urea} : NH_2\underset{\underset{O}{\|}}{C}NH_2 \right)$$

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

64. **(D)**

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

65. **(A)**

$\left[Al^{3+}\right] = \frac{20 \times 0.2 \times 2}{40} = 0.2M$

66. **(D)**

$1 \text{ mole } KMnO_4 \longrightarrow 5 \text{ moles } FeSO_4$

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

$\Rightarrow V = 10mL$

67. **(B)**

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

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

68. **(A)**

3 molal $\Rightarrow$ 3 mole NaOH in 1000g solvent

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

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

69. **(B)**

Molarity of $NO_2CO_3 = \frac{2.65 \times 1000}{106 \times 250} = 0.1$ M.

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

70. **(A)**

$$X_{NaCl} = \frac{n_{NaCl}}{n_{NaCl} + n_{H_2O}} = \frac{1}{1 + \frac{1000}{18}} = 0.0177$$

EXERCISE - 1 [B]

1. (B)

Moles $= \frac{46\text{ g}}{23\text{ g}} = 2$

2. (A)

Number of atoms $= \frac{1.4}{14} \times 6.02 \times 10^{23} = 6.02 \times 10^{22}$

3. (C)

Moles of Aluminium $= \frac{54}{27} = 2$

$\therefore$ Mass of Magnesium atoms = 2 × 24 = 48 gm

4. (C)

Mass = 0.25 × 98 = 24.5 grams

5. (C)

Moles $= \frac{0.227}{22.7} = 0.01$

6. (A)

Number of atoms in 1 gram C_4H_{10} = $\frac{1}{58} \times 14 \times N_A$

Number of atoms in 1 gram $N_2 = \frac{1}{28} \times 2 \times N_A$

Number of atoms in 1 gram $Ag = \frac{1}{108} \times N_A$

Number of atoms in 1 gram $H_2O = \frac{1}{18} \times 3N_A$

7. (B)

Molecular weight of CO_2 and N_2O are same. So, ratio of molecules and Mass are same.

8. (A)

$n_{O_3} = \frac{3.2}{48} \Rightarrow$ Number of molecules = 4.0×10^{22}

9. (C)

Relative density $= \frac{\text{Ozone}}{\text{Oxygen}} = \frac{48}{32} = 1.5$

10. (A)

Volume can be added, volume $= \frac{\text{Mass}}{\text{density}}$

$$\underbrace{\frac{x}{d_1}}_{\text{Volume of gold}} + \underbrace{\frac{y}{d_2}}_{\text{Volume of quartz}} = \underbrace{\frac{x+y}{d}}_{\text{Total volume}}$$

11. (B)

$2NaOH + CO_2 \rightarrow Na_2CO_3$

Mole of CO_2 = $\frac{1.135}{22.7} = \frac{1}{20}$

So, moles of Na_2CO_3 = $\frac{1}{20}$

Mass of Na_2CO_3 = $\frac{1}{20} \times 106 = 5.3\ g$

12. (D)

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

Mole of O_2 = $\frac{2.27}{22.7} = 0.1$

Mole of H_2O = 0.2

Mass of H_2O = 0.2 × 18 = 3.6 g

Density of H_2O is 1 gm/ml.

So, volume of H_2O is 3.6 ml

13. (C)

$2SO_2 + O_2 \rightarrow 2SO_3$

Volume of SO_2 is 5 L, so volume SO_3 is also 5 L.

14. (A)

$2SO_2 + O_2 \rightarrow 2SO_3$

Mole of SO_2 = $\frac{2}{64} = \frac{1}{32}$

Mole of SO_2 = mole of SO_3

Mass of SO_3 = $80 \times \frac{1}{32}$ = 2.5 gram

15. (C)

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

Mole of $Fe_2O_3 = \frac{16}{160} = 0.1$

Therefore, mole of Fe = 0.2

Mass of Fe = 56 × 0.2 = 11.2 gram

16. (C)

$\underset{8\,\text{mole}}{2P} + \underset{5\,\text{mole}}{Q} \longrightarrow R$

P is limiting reagent. So, mole of R is 4.

17. (B)

Mole of P_4 = $\frac{31}{124} = \frac{1}{4}$

Mole of O_2 = $\frac{32}{32} = 1$

Applying POAC on phosphorous

$\frac{1}{4} \times 4 =$ mole of $P_4O_6 \times 4$ + mole of $P_4O_{10} \times 4$

$\frac{1}{4} =$ mole of P_4O_6 + mole of P_4O_{10} …… (1)

Applying POAC on oxygen

$1 \times 2 =$ mole of $P_4O_6 \times 6 +$ mole of $P_4O_{10} \times 10$ ......(2)

Solving (1) & (2), we get

Mole of $P_4O_6 = \frac{1}{8}$

Mole of P_4O_{10} = $\frac{1}{8}$

$\therefore$ Mass of $P_4O_6 = \frac{1}{8} \times 220 = 27.5$ gram

Mass of $P_4O_{10} = \frac{1}{8} \times 284 = 35.5$ gram

18. (A)

$\underset{1\,\text{mole}}{C} + \underset{0.75\,\text{mole}}{O_2} \rightarrow CO_2$

Mole of CO_2 = 0.75

Volume of CO_2 = 0.75 × 22.4 = 16.8 L

19. (B)

Number of H^+ ions = $0.001\times\frac{100}{1000}\times2\times6.023\times10^{23}$

$=12.046\times10^{49}$

$=1.2\times10^{20}$

20. (C)

Moles of glucose $=\frac{6.02\times10^{22}}{6.02\times10^{23}}=0.1$

Molarity $=\frac{0.1}{0.5}=0.2$ M

21. (D)

Let mass of solvent = 1 kg

So, mole of solute = 0.2

Mass of solute = 0.2 × 98 = 19.6 gm

Therefore, mass of solution = 1019.6 gram

22. (C)

$$0.25=\frac{0.6\times250+0.2\times750}{250+750+V}$$

$$1000+V=\frac{300}{0.25}=1200$$

$$V=200\text{ ml}$$

23. (A)

$$[Ba^{2+}]=\frac{20\times0.6}{40}=0.3$$

24. (A)

$$KClO_3\xrightarrow{\Delta}KCl+\frac{3}{2}O_2\quad,n_{O_2}=\frac{3}{2}$$

$$2Al+\frac{3}{2}O_2\longrightarrow Al_2O_3$$

$$n_{Al_2O_3}=\frac{n_{O_2}}{\frac{3}{2}}=1$$

25. (A)

Consider 1 L solution

$$\frac{29}{100}\times(d\times1000)=\omega_{H_3PO_4}=3.6\times98$$

$\therefore$ d = 1.22 g/mL

26. **(A)**

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

n: 10 $\quad \boxed{15}$ (LR) $\quad -$

$10-5 \quad - \quad 10\,\text{moles}$

$n_{N_2} = 5 \quad n_{H_2} = 0$

27. **(C)** $Fe_2(SO_4)_3 + 3BaCl_2 \longrightarrow 3BaSO_4 + 2FeCl_3$

n: $\quad ? \quad 1/2$

$$\frac{n_{BaCl_2}}{3} = \frac{n_{FeCl_3}}{2} \Rightarrow n_{BaCl_2} = \frac{1/2}{2} \times 3 = 0.75\,\text{moles}$$

28. **(C)**

$3CuSO_4 + 2Al \longrightarrow Al_2(SO_4)_3 + 3Cu$

$54g\,Al \xrightarrow{\text{displaces}} 192\,g\,Cu$

$27g\,Al \xrightarrow{\text{displaces}} \omega$

$\therefore \omega = 96g$

29. **(A)**

$$CH_4 \quad + \quad 2O_2 \longrightarrow CO_2 \quad + \quad 2H_2O$$

$5 \quad \boxed{8} \quad - \quad -$

$5 - 4 = 1 \quad - \quad 4 \quad 8$

$\therefore n_{CO_2} = 4$; nCH_4 (remaining) = 1

30. **(C)**

$$C_{10}H_X + nO_2 \longrightarrow 10CO_2 + \left(\frac{X}{2}\right)H_2O$$

Hence, $n = 10 + \dfrac{X}{4}$

1 mole $C_{10}H_X \xrightarrow{\text{with}} \left(10 + \dfrac{X}{4}\right)$ moles

$2.5\,\text{moles} \xrightarrow{\text{with}} 32.5\,\text{moles}$

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

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

31. **(D)**

$100g\,CaCO_3 \xrightarrow{\text{with}} 2\text{mole}\,HCl$

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

$\therefore \omega = 0.9375\,g$

32. **(B)**

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

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

33. **(D)**

$$2X \xrightarrow{\text{with}} 3 \times 16\,g \text{ Oxygen}$$

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

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

34. **(D)**

$$2Al + \frac{3}{2}O_2 \longrightarrow Al_2O_3$$

n: n $1/2$

$$2 \times 27 g\,Al \xrightarrow{\text{with}} \frac{3}{2}\text{mole}\,O_2$$

$$\omega \xrightarrow{\text{with}} 1/2\,\text{mole}$$

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

35. **(D)**

$n_{BaSO_4} = n_{SO_2} = n_S$ (POAC on S)

$$= \frac{8}{32} = \frac{1}{4}$$

36. **(B)**

$n_{NaBr} = n_1,\ n_{KBr} = n_2\,(\text{say})$

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

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

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

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

37. **(A)**

$$A: n_H = 4 \times \frac{16g}{16g} = 4;\quad B: n_H = 4 \times \frac{31.2}{76} = 1.64$$

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

38. **(C)**

Total atoms $= 200 + 0.05 \times N_A + 10^{-20} \times N_A$

$\approx 0.05\,N_A = 3 \times 10^{22}$

39. **(C)**

Mol. Wt of $A_2B_3 = 150 + 96 = 246$

$\therefore$ For 5 mol, (246×5)g = 1.23 kg

40. **(A)**

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

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

41. **(D)**

(i) 5g (ii) $\frac{60}{106.5} \times 35.5$ (iii) 0.1×35.5 (iv) 0.5×71

42. **(A)**

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

43. **(C)**

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

44. **(D)**

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

45. **(A)**

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

46. **(D)**

1 gram molecule: 44 g

1 molecule of CO_2 = 44 amu

47. **(A)**

$n_H = n \times 2 + 2n \times 4 = 10n$

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

$\therefore n_C : n_H = 1:5$

48. **(D)**

Total charge = $1 \times N_A \times 3e = 3N_Ae$ coulomb

49. **(D)**

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

50. **(D)**

$$\boxed{\begin{matrix}12g\ H_2O\\45g\ silica\\43g\ others\end{matrix}} \xrightarrow{\Delta} \boxed{\begin{matrix}8\%\ H_2O\\45g\ silica\\43g\ others\end{matrix}}$$

100g 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 $= \frac{45}{95.65} \times 100 = 47\%$

51. **(C)**

M_3N_2. 28 % nitrogen

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

52. **(D)**

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

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

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

53. **(A)**

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

x = 9%

54. **(B)**

A. A. M = Mole fraction of $O^{18} \times 18 +$ Mole fraction of $O^{16} \times 16$

55. **(C)**

Moles of $Ca(OH)_2 = \frac{6.023 \times 10^{23}}{6.023 \times 10^{23}} = 1$

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

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

$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$

1 2 1

1 0.05 $\frac{0.05 \times 1}{2} = 0.025$

(L.R.)

56. (A)

Moles of $CuSO_4 = \frac{1.595}{1595} = 0.01$

Weight of solvent = 100 – 1.595 = 98.505

Volumes of solvent $= \frac{98.505}{1.2\times1000} = 82\times10^{-3}L$

Molarity $= \frac{0.01}{82\times10^{-3}} = 0.12M$

57. (B)

(A) atoms of $O_2 = \frac{2\times8}{32}\times6.022\times10^{23} \sim 3\times10^{23}$

(B) atoms of $Be = \frac{3}{9}\times6.022\times10^{23} \sim 2\times10^{23}$

(C) atoms of $C = \frac{8}{12}\times6.022\times10^{23} \simeq 4\times10^{23}$

(D) atoms of $F_2 = \frac{19}{19}\times6.022\times10^{23} \simeq 1\times10^{23}$

58. (C)

X		Y	X		Y	
$\frac{20}{10}$	:	$\frac{80}{200}$	1	:	2	$\therefore\ XY_2$

59. (C)

Avogadro hypothesis $\Rightarrow$ If volumes are equal, then moles and number of molecules of gas are also same.

60. (A)

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

Number of magnesium atoms = $0.00335\times6.022\times10^{23} = 2.01\times10^{21}$ atoms.

61. (D)

Moles of comphon $= \frac{25\times10^{-3}}{10\times12+16+16} = 0.164\times10^{-3}$

Number of atoms $= 0.164\times10^{-3}\times6.022\times10^{23}\times27$ (1 Molecule has 27 atoms).

$= 2.67\times10^{21}$

62. (D)

Moles of $e^- = 52+2 = 54$.

63. (B)

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

Moles of Ag_2S required = $\frac{1}{107\times2}$

Mass of $Ag_2S = \frac{(107\times2+32)}{107\times2} = 1.1495$

Mass of ore required = $\frac{1.1495}{1.34}\times100=85.78g$

64. **(D)**

Moles of Al = $27/27=1$

$$2Al+2NaOH+2H_2O\rightarrow2NaAlO_2+3H_2$$

	$2Al$	$2NaOH$	$2H_2O$	$2NaAlO_2$	$3H_2$
Moles	2	2	2	2	3
Given	1 (L.R.)	excess			$\frac{3\times1}{2}=1.5$

Vol. of H_2 evolved = $1.5\times22.4=33.6\ L$.

JEE Main : PYQ

1. **(A)**

$$Molarity=\frac{n_{solute}}{V_{solution}\ Lt}$$

$V_{solution}$ is affected by Temperatuere.

2. **(C)**

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

No. of atoms = 10 N_A

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

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

3. **(A)**

Mole ratio of	C	:	H	:	N
	$\frac{9}{12}$	:	$\frac{1}{1}$	:	$\frac{3.5}{14}$
	$\frac{3}{4}$	:	$\frac{1}{1}$	:	$\frac{1}{4}$
	3	:	4	:	1

Empirical formula $=C_3H_4N$

Empirical formula mass $=36+4+14$
$=54$

$$n=\frac{108}{54}=2$$

Molecular formula $=C_3H_4N\times2$
$=C_6H_8N_2$

4. **(D)**

$$2BCl_3+3H_2\rightarrow2B+6HCl$$

$$\frac{\text{no. of moles of }H_2}{\text{no. of moles of }B}=\frac{3}{2}$$

No. of moles of $H_2 = \frac{3}{2} \times \frac{21.6}{10.8} = 3$

Volume of $H_2 = 3 \times 22.4\,L = 67.2L$ (Molar volume of any gas at N.T.P = 22.4 L)

5. **(B)**

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

6. **(C)**

1 mole is defined as number of atoms present in 12 g C and i.e. 6.022×10^{23}.
Since this number remains unchanged, mass of 1 mole substance will remain unchanged.

7. **(C)**

V = 1 L

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

N_{solute} = 2.05

W_{SOLUTE} = $2.05 \times 60 = 123$

$W_{solvent}$ = 1020 – 123 = 897 g

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

8. **(B)**

$$\frac{\text{no. of moles of oxygen atom}}{\text{no. of moles of } Mg_3(PO_4)_2} = \frac{8}{1}$$

No. of moles of $Mg_3(PO_4)_2 = \frac{0.25}{8}$

$= 0.03125$

9. **(A)**

V = 1L

N_{solute} = 3.6

$W_{solute} = 3.6 \times 98 = 352.8$

$$w_{total} = \frac{352.8}{29} \times 100 = 1216.55\,g$$

$$\text{density} = \frac{1216.55}{1000}$$

= 1.22 g/ml

10. **(C)**

$$2Al(s) + 6HCl(aq) \rightarrow 2Al^{3+}(aq) + 6Cl^-(aq) + 3H_2(g)$$

Per mole of HCl, no. of moles of

H_2 formed $= \frac{1}{2}$

Volume of H_2 at STP $= \frac{1}{2} \times 22.4$ (Old data NTP)

$= 11.2L$

11. **(B)**

Molality $= 5.2\,m$.

i.e. if wt. of $H_2O = 1000gm$

then no. of moles of $CH_3OH = 5.2$

$$X_{CH_3OH} = \frac{5.2}{5.2 + \frac{1000}{18}} = 0.0856$$

12. **(C)**

Volume of solution $= \frac{(1000+120)}{1.15} m\ell$

$= \frac{1120}{1.15} m\ell$

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

13. **(C)**

Molarity$= \frac{(750 \times 0.5) + (250 \times 2)}{750 + 250} = 0.875M$

14. **(A)**

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

$\therefore$ In 4 g of hydrogen

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

[Here species = 2 because hydrogen is present as H_2]

In 70 g of chlorine = $2N_A$

Number of atoms $= \frac{70}{71} \times N_A \times 2 \simeq 2N_A$

[Here chlorine is taken as Cl_2]

In 127 g of iodine,

Number of atoms $= \frac{127}{254} \times N_A \times 2 = N_A$

[Here iodine is taken as I_2]

In 48 g of magnesium,

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_2O

In it,

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

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

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

($\because$ D has 1 n^0 because it is actually, ${}_1H^2$)

16. **(D)**

18 g H_2O contains 2 g H

$\therefore$ 0.72 g H_2O contains 0.08 g H.

44 g CO_2 contains 12 g C

$\therefore$ 3.08 g CO_2 contains 0.84 g C

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

$\therefore$ Empirical formula = C_7H_8

17. **(C)**

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

Mass of solution = volume of solution $\times$ density

$= 1000 \times 1.252$

= 1252 g

Mass of solute = No. of mole $\times$ molar mass of NaCl

$= 3 \times 58.5\,g$

= 175.5 g

Mass of solvent = (1252 – 175.5)g

= 1076.5 g

= 1.076 kg

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

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

18. **(A)**

Final concentration, $M = \frac{M_1V_1 + M_2V_2}{V_1 + V_2}$

$$= \frac{10 \times 2 + 200 \times 0.5}{200 + 10}$$

$$= \frac{20 + 100}{210}$$

$$= \frac{120}{210} = 0.57\,M$$

19. **(B)**

$$\frac{N_{O_2}}{N_{N_2}} = \frac{n_{O_2}}{n_{N_2}} = \frac{W_{O_2}/M_{O_2}}{W_{N_2}/M_{N_2}} = \frac{W_{O_2}}{W_{N_2}} \times \frac{M_{N_2}}{M_{O_2}} = \frac{1}{4} \times \frac{28}{32}$$

$$= \frac{7}{32}$$

20. **(B)**

$BaCl_2$ +	$H_2SO_4 \rightarrow$	$BaSO_4 + 2HCl$
20.8gm	4.9gm	0.05 mole
$= \frac{20.8}{208}$ mole	$= \frac{4.9}{98}$ mole	$= 0.05 \times 233$gm
= 0.1mole	= 0.05mole	= 11.65gm

21. **(B)**

Volume of solution $= \frac{1000 + 120}{1.12}$ ml

$= 1000$ml

Molarity $= \frac{120 \times 1000}{60 \times 1000} = 2M$

22. **(D)**

Molecular mass of compound $=16\times 2=32\text{gm}$

% of H in $N_2H_4=\frac{4}{32}\times 100$

12.5%

23. **(A)**

No. of moles of acetic acid adsorbed by 3gm charcoal

$=\left(0.6-0.042\right)\times 50\times 10^{-3}$

$=9\times 10^{-4}\text{mole}$

Wt. adsorbed by $=9\times 10^{-4}\times 60\,\text{gm}$

3gm $=0.054\text{gm}$

Wt. adsorbed per gram $=\frac{0.054}{3}=0.018\text{gm}$

$=18\text{mg}$

24. **(C)**

$$A + 2B + 3C \rightleftharpoons AB_2C_3$$

$=\frac{6}{60}\text{mole}$ 1mole 0.036 mole

$=0.1\text{mole}$

C is limiting reagent

No. of moles of AB_2C_3 formed $=0.012$

Wt. of AB_2C_3 formed $=4.8\text{gm}$

Molecular wt. of $AB_2C_3=\frac{4.8}{0.012}=400$

$60+2x+\left(3\times 80\right)=400$

$x=50$

25. **(B)**

$BaCl_2.xH_2O$

$\frac{18x}{208+18x}=\frac{9}{61}$

$208+18x=122x$

$x=2$

26. **(B)**

$8=\frac{1\times 32}{x}\times 100$

$x=400$

27. **(B)**

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

5 25

$\frac{x+\frac{y}{4}}{1}=\frac{25}{5}=5$

$x+\frac{y}{4}=5$

C_3H_8

28. (C)
No. of Fe atoms in 3.3 g of haemoglobin
$\frac{0.34}{100}\times\frac{3.3}{56}\times 6.022\times 10^{23}=1.206\times 10^{20}$

29. (D)

C	74%	$\frac{74}{12}=6.16$	$\frac{6.16}{1.23}=5$
N	17.3%	$\frac{17.3}{14}=1.23$	$\frac{1.23}{1.23}=1$
H	8.7%	$\frac{8.7}{1}=8.7$	$\frac{8.7}{1.23}=7$

Empirical formula $=C_5NH_7$
Empirical weight $=(12\times 5)+(14\times 1)+(1\times 7)=81\text{amu}$
Multiplying factor $=\frac{\text{Molecular weight}}{\text{Empirical weight}}=\frac{162}{81}=2$
Molecular formula $=2\times$ (Empirical formula) $C_{10}N_2H_{14}$

30. (C)
Let total volume $=1000\,\text{mL}=1\text{L}$
Total mass of solution $=1460\,\text{g}$
Mass of $HCl=\frac{35}{100}\times 1460$
Moles of $HCl=\frac{35\times 1460}{100\times 36.5}$
So molarity $=\frac{35\times 1460}{100\times 36.5}=14\text{M}$

31. (C)
Except(C) all postulates were given by Dalton.

32. (D)
CH_4 has one atom of carbon among 5 atoms $(1C+4H)$.
$\therefore$ Mole % of $C=\frac{1}{5}\times 100=20\%$

33. (D)
Given percentage of chlorine in chlorohydrocarbon $=3.55\%$ i.e. 100 g of chlorohydrocarbon has 3.55g of chlorine. 1 g of chlorohydrocarbon will have $\frac{3.55}{100}=0.0355\text{g}$ of chlorine
Atomic wt. of $Cl=35.5\,\text{g/mol}$
Number of moles of $Cl=\frac{0.0355\,\text{g}}{35.5\,\text{g/mol}}=0.001\,\text{mol}$
Number of atoms of $Cl=0.001\text{mol}\times 6.023\times 10^{23}\text{mol}^{-1}$
$=6.023\times 10^{20}$

34. (B)

In 100g solution, mass of carbon =10.8 g

250 g solution, mass of carbon $= \frac{10.8 \times 250}{100} = 27\text{g}$

Mass of C in one mole of glucose $(C_6H_{12}O_6) = 12 \times 6 = 72\text{g}$

72 g of C is present in $= 180\text{g}$ glucose

27 g of C is present in $= \frac{180}{72} \times 27 = 67.5\,\text{g}$ glucose

Mass of solvent(water) $= 250 - 67.5 = 182.5\,\text{g}$

Molality of solution $= \frac{(67.5/180)\,\text{mol}}{(182.5/1000)\,\text{kg}} = 2.05\,\text{m}$

35. (C)

16 moles of NaOH neutralizes 16 moles of H^+ Source of $H^+ \rightarrow 2$ moles of $HCl + 1$ mol H_2SO_4.

$\therefore$ 1mol SO_2Cl_2 is producing $4\,\text{mol}\,H^+$ ions

$\therefore$ No. of moles of $SO_2Cl_2 = \frac{16}{4} = 4\,\text{moles}$

36. (C)

Molecular weight of $Fe_3O_4 = 232\,\text{g/mol}$

Moles of $Fe_3O_4 = \frac{4.640 \times 10^3}{232} = 20$

Moles of $CO = \left[\frac{\text{given mass}}{\text{molar mass}}\right] = \frac{2.52 \times 10^3}{28} = 90$

So limiting Reagent

$= Fe_3O_4\,(20\,\text{mole}\,Fe_3O_4\ \text{required}\ 80\,\text{mole}\,CO)$

So moles of Fe formed $= 60$

Weight of $Fe = (\text{moles} \times \text{molar mass}) = 60 \times 56 = 3360$

37. (C)

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

$$C_{15}H_{30} + \frac{45}{2}O_2 \rightarrow 15CO_2 + 15H_2O$$

Mass of fuel $= 0.756 \times 1000\text{g}$

No. of moles of fuel $= \frac{0.756 \times 1000}{210}$

Wt. of oxygen $= \frac{0.756 \times 1000}{210} \times \frac{45}{2} \times 32 = 2592\,\text{g}$

Wt. of $CO_2 = \frac{0.756 \times 1000}{210} \times 15 \times 44 = 2376\,\text{g}$

38. (B)

44g of CO_2 contains 12 g of C

So, 2.64 of CO_2 contains $\frac{12}{44} \times 2.64 = 0.72\,\text{gC}$

1.08 g of H_2O contains $\frac{2}{18}\times 1.08 = 0.12\,gH$

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

% of $O = \frac{0.96}{1.80}\times 100 = 53.33\%$

39. (D)

5 mol AB_2 weighs 125g

$\therefore AB_2 = 25g/mol \Rightarrow M_A + 2M_B = 25$

10 mol A_2B_2 weighs 300g

$\therefore A_2B_2 = 30\,g/mol \Rightarrow 2M_A + 2M_B = 30$

$\therefore$ Molar mass if $A(M_A) = 5g$ or $5\times 10^{-3}kg$

Molar mass of $B(M_B) = 10\,g$ or $10\times 10^{-3}kg$

40. (A)

(A) $4Fe + 3O_2 \longrightarrow 2Fe_2O_3$

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

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

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

(C) $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

1g of C_3H_8 requires $= \frac{5\times 32}{44} = 3.6\,g$ of O_2

(D) $2Mg + O_2 \longrightarrow 2MgO$

1g of Mg requires $= \frac{32}{2\times 24}g = 0.66\,g$ of O_2

41. (D)

No. of moles of oxygen in 0.16 g of oxygen molecule $= \frac{0.16g}{32\,g/mol} = 0.005\,mol$

$2NaClO_3 \xrightarrow{\Delta} 2NaCl + 3O_2$

According to the reaction

3 moles of $O_2 = 2$ moles of $NaCl = 2$ moles of $AgCl$

Molar mass of $AgCl = 143.5g/mol$

0.005 moles of O_2 will ppt. $= 0.005\times\frac{2}{3}$ moles AgCl

$= 0.0033$ moles of AgCl

$\therefore$ Mass of AgCl (in g) obtained will be

$= 143.5h/mol \times 0.0033\,moles = 0.48g$

42. (B)

Given chemical equation:

$\underset{1g}{M_2CO_3} + 2HCl \rightarrow 2MCl + H_2O + \underset{0.01186\,mol}{CO_2}$

Moles of M_2CO_3 = moles of CO_2

$$\frac{1}{\text{Molar mass of } M_2CO_3} = 0.01186$$

$\therefore$ Molar mass of $M_2CO_3 = \frac{1}{0.01186}$

Molar mass $= 84.3 g/mol$

43. (2)

$$\underset{1mol}{X} + \underset{1mol}{Y} + + \underset{0.05mol}{3Z} \rightleftharpoons XYZ_3$$

Z is a act as a limiting reagent

$1mol$ of $XYZ_3 = \frac{0.05}{3}$ mol of Z

Mass of $XYZ_3 = \frac{0.05}{3} \times (10 + 20 + 30 \times 3) = 2g$

44. (24)

Let the weight of Mg in the extract $= x$ g

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

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

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

Number of Mg atom $= 0.004 \times 6.02 \times 10^{23}$

$= 24.08 \times 10^{20} \approx 24 \times 10^{20}$

45. (46)

	N_2	$+3H_2$	$\longrightarrow$	$2NH_3$
Initial	56L			–
	$-10L$			$+20L$
final	46L			20L

From the stoichiometry for 2L production of ammonia 1L of N_2 gas is used

Final volume of $N_2 = 56 - 10 = 46L$

46. (46)

Mole of CO_2 =Moles of C

$$\frac{\text{Weight of } CO_2}{\text{Molar mass of } CO_2} = \frac{0.793}{44}$$

Weight of 'C' = moles $\times$ molar mass of carbon

$$\frac{0.793}{44} \times 12 = 0.216g$$

$$1H_2O \longrightarrow [2H + O]$$

1 mole of $H_2O = 2$ moles of hydrogen

Moles of $H_2O = \frac{\text{Weight}}{\text{Molar mass}} = \frac{0.442}{18}$

Moles of 'H' $= \frac{0.442}{18} \times 2$

Weight of 'H' $= \frac{0.442}{18} \times 2 \times 1 = 0.049 g$

$\therefore$ Weight of $'O' = 0.492 - 0.216 - 0.049 = 0.227g$

% of 'O' $= \dfrac{0.227}{0.492} \times 100 = 46.13\%$

47. (2)

Moles of A_2B = Moles of $AB_3 = 0.15$

$\dfrac{w}{2a+b} = \dfrac{w}{a+3b} \Rightarrow 2a+b = a+3b \Rightarrow a = 2b$

48. (5418)

M.M of $C_7H_5N_3O_6$ is $84+5+42+96 = 227$

Moles of $C_7H_5N_3O_6 = \dfrac{681}{227} = 3$

Moles of N atoms $= 3 \times 3 = 9$

Number of N atoms $= 9 \times 6.02 \times 10^{23} = 5418 \times 10^{21}$

49. (2)

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

$= 2 \times 10^{23}$

50. (14.00)

Mass percent of $HNO_3 = 63$

Thus, 100 g of nitric acid solution contains 63 g of nitric acid by mass.

No. of moles $= \dfrac{63\,g}{63\,g\,mol^{-1}} = 1$

Volume of 100 g of nitric acid solution

$= \dfrac{Mass}{Density} = \dfrac{100g}{1.4\,g/mL} = 71.4\,mL$

Molarity $= \dfrac{\text{No.of moles}}{\text{volume}(mL)} \times 1000 = \dfrac{1}{71.4} \times 1000 = 14M$

51. (46)

0.492 g of $C_xH_yO_z$

The moles are calculated as shown below:

Moles of $CO_2 = \dfrac{0.7938\,g}{44g\,mol^{-1}} = 0.018\,mol$

Moles of $H_2O = \dfrac{0.4428g}{18\,g\,mol^{-1}} = 0.246\,mol$

Mass of $C = 0.018 \times 12 = 0.216\,g$

Mass of $H = 0.049 \times 1 = 0.049g$

$\therefore$ wt of Oxygen =Mass of sample $-$mass of C $-$ mass of H

$= 0.492 - 0.216 - 0.049 = 0.227\,g$

% of Oxygen $= \dfrac{0.227}{0.492} \times 100 = 46$ (approx.).

52. (25)

There will be min. one molecule of glycine.

$0.30\%\text{glycine} = 75g$

1% of protein $= \frac{75}{0.30} g$

100% of protein $= \frac{75}{0.30} \times 100g = 25000g = 25 \times 10^3 g$

53. (13)

$Na_2O + H_2O \rightarrow 2NaOH$

Moles of $Na_2O = \frac{20}{62}$ moles

Moles of NaOH formed $= \frac{20}{62} \times 2 = \frac{40}{62}$

$[NaOH] = \frac{40 \times 1000}{62 \times 500} = 1.29M = 13 \times 10^{-1} M$

54. (4)

Concentration of glucose in blood $= 0.72 g/L$

$= \frac{0.72}{180} = 4 \times 10^{-3} mol/L$.

55. (3)

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

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

56. (2)

$M = \frac{4.5/90}{250/1000} = 0.2 = 2 \times 10^{-1}$

57. (47)

Let total mole of solution $= 1$

So, mole of glucose $= 0.1$

Mole of $H_2O = 0.9$

% (w/w) of $H_2O = \left[\frac{0.9 \times 18}{0.9 \times 18 + 0.1 \times 180}\right] \times 100$

$= 47.368 = 47.37$

58. (10.00)

$ppm = \frac{10.3 \times 10^{-3}}{1.03 \times 1000g} \times 10^6 = 10$

1. **(A)**

$$N_2 \quad + \quad 3H_2 \quad \rightarrow \quad 2NH_3$$

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

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

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

NH_3 was 40% by mol.

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

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

$$X_{N_2} = \frac{(x/2 - y)}{(2x - 2y)} = \frac{\left[\frac{x/y}{2} - 1\right]}{2[x/y - 1]}$$

$$= \frac{1.75 - 1}{2(2.5)} = \frac{0.75}{5}$$

$$= 0.15$$

2. **(C)**

$n(A) = n(B)$

$\therefore M_A \times n(A) = 1.4g$ and $M_B \times n(B) = 0.8$

$\therefore \frac{M_B}{M_A} = \frac{0.8}{1.4} = 0.57.$

3. **(B)**

$3.2g$ metal $\xrightarrow{\text{with}}$ $0.4g$ oxygen

$64g$ metal $\rightarrow \omega_g$ oxygen

$\omega = \frac{64}{3.2} \times 0.4 = 8g$

$\therefore 128g$ metal with $16g$ O

i.e. M_2O

4. **(A)**

$4M \times \xrightarrow{\text{with}} 96g$ O. (since X_4O_6)

$5.72g \times \xrightarrow{\text{with}} 4.28g$ O

$\therefore M_X = \frac{5.72 \times 6 \times 16}{4 \times 4.28} = 32$

5. **(C)**

$n = \frac{\omega}{\text{mol.wt}} = \frac{224}{22400} = 0.01$

$\text{mol.wt} = \frac{\text{wt}}{n} = \frac{1}{0.01} = 100$

$\Rightarrow 3\times \text{at.wt.}=100\Rightarrow \text{at.wt}=33.3\text{g}$

mass of one atom $=\frac{33.3}{6.02\times 10^{23}}=5.53\times 10^{-23}\text{g}$

6. **(C)**

$$n=\frac{\omega}{\text{mol.wt}}=\frac{PV}{RT}=\frac{2\times 0.35}{0.0821\times 273}=3.123\times 10^{-2}$$

$$\text{i.e.}\frac{1}{2\times \text{At.wt}}=3.123\times 10^{-2}$$

wt of one atom $=\frac{\text{at.wt}}{N_A}=\frac{16}{N_A}.$

7. **(A)**

$$I_2+Cl_2\rightarrow \underset{n_1}{ICl},\underset{n_2}{ICl_3}$$

<u>POAC on I</u>

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

POAC on Cl

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

$$\because n_1:n_2=1:1$$

8. **(D)**

$FeSO_4:n_1\Rightarrow SO_4^{2-}=n_1 \text{ and } Fe^{2+}=n_1$

$Fe_2\left(SO_4\right)_3:n_2\Rightarrow SO_4^{2-}=3n_2 \text{ and } Fe^{3+}=2n_2$

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

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

9. **(D)**

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

$$M_{final}=0.24=\frac{M_1V_1+M_2V_2}{V_1+V_2}$$

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

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

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

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

10. **(C)**

At mass $= N_A \times$ mass of an atom

$$= 6\times10^{23}\times3.98\times10^{-23} = 24g$$

11. **(C)**

$Fe_2\left[Fe(CN)_6\right]$

$$\frac{\omega_{Fe}}{\omega_C} = \frac{3\times56}{6\times12} = \frac{7}{3}$$

12. **(D)**

(i) 12g (ii) 13g (iii) $9\times17g$

(iv) 80 g-molecule = 80 Moles

$= 80\times98$

$= 7840g$

13. **(B)**

6 : 4

14. **(A)**

$1g\,atom \Rightarrow 1\,mole\,of\,atom - 14g.$

15. **(B)**

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

$$n_{HCl} = 2\times n_{Na_2CO_3} = V_{HCl}\times M_{HCl}$$

$$\Rightarrow V\times3 = 2\times\frac{1.431}{106} \Rightarrow V = 9mL.$$

16. **(C)**

They must have same mol. wt.

17. **(A)**

$$= \frac{V_{2\,micron\,sphere}}{V_{20\overset{0}{A}\,sphere}} = \frac{\frac{4}{3}\pi\times\left(2\times10^{-6}\right)^3}{\frac{4}{3}\pi\times\left(2\times10^{-9}\right)^3} = 10^9$$

18. **(B)**

$$KClO_3 \xrightarrow{\Delta} KCl + \frac{3}{2}O_2$$

$$n_{KClO_3} = \frac{n_{o_2}}{3/2} = \frac{0.1}{3/2} = \frac{2}{30}$$

$$\%\,purity = \frac{\frac{2}{30}\times(122.5)}{10}\times100 = 81.66\%$$

19. **(A)**

$$n = \frac{V(ml)\times m}{1000} = \frac{1\times0.65}{1000} = 6.5\times10^{-4}\,moles$$

$$\therefore \omega_{BaCl_2.2H_2O} = (137+71+36)\times6.5\times10^{-4} = 0.1586g$$

$\omega_{BaCl_2} = (137+71)\times 6.5\times 10^{-4} = 0.1352g$

20. **(B)**

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

$\Rightarrow V = 102.941mL$

21. **(B)**

$\omega t = \frac{11.5}{M_{C_6H_5COOK}} \times \frac{100}{71} \times M_{C_6H_5CH_3} = 9.31g$

22. **(C)**

$CuSO_4.5H_2O = n_1,\ MgSO_4.7H_2O = n_2$

total $\omega t = 5g$ and anhydrous $3g$

$\therefore 249.5n_1 + 246n_2 = 5$

and $159.5n_1 + 120n_2 = 3$

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

$\Rightarrow \omega_{CuSO_4.7H_2O.} = 3.729g$

$\therefore \%\text{by}\,\omega t = \frac{3.72}{5}\times 100 = 74.4\%$

23. **(A)**

$C_7H_6O_3 + C_4H_6O_3 \rightarrow C_9H_8O_4 + C_2H_4O_2$

$\omega : 2g \qquad 4g$

$n : \underset{L.R}{0.0144} \quad 0.039 \qquad 0.01449$

theoretical yield $= 0.01449\times M_{C_9H_8O_4}$

$= 2.69$

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

24. **(B)**

$2XI_3 + 3Cl_2 \rightarrow 2XCl_3 + 3I_2$

$n_{XI_3} = n_{XCl_3} \Rightarrow \frac{0.5}{(M+381)} = \frac{0.236}{(M+106.5)}$

$\Rightarrow M = 138.88 = 139$

25. **(B)**

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

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

26. **(A)**

$n_{XH_4} = 2n$ and $n_{X_2H_6} = n$, say

$n_x = n_{XH_4} + (n_{X_2H_6}\times 2) = 4n$

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

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

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

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

27. **(A)**

Let acid be HA

Salt: $BaA_2.2H_2O$

$BaA_2+H_2SO_4\longrightarrow BaSO_4+2HA$

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

$\therefore A=121$ $\therefore HA=122$

28. **(B)**

total moles =n (say)

$0.15n = moles\,of\ CH_3COOH$

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

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

$\therefore {}^{n}NaOH={}^{n}CH_3COOH=0.15n=0.18519$

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

29. **(A)**

$\underset{n_1\,moles}{C_2H_6}+3.5O_2\longrightarrow 2CO_2+3H_2O$

$\underset{n_2\,moles}{C_2H_4}+3O_2\longrightarrow 2CO_2+2H_2O$

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

also $3.5n_1+3n_2=n_{O_2}=\frac{130}{32}=4.06$

$\therefore\ n_1=0.817$

$n_2=0.401$

$\therefore \%C_2H_4=33\%$ and $C_2H_6=67\%[A]$

30. **(A)**

	%	no. of atom	ratio
Al	10.5	0.3889	1
K	15.1	0.388	1
S	24.8	0.775	2
O	49.6	3.1	8

31. **(B)**

$$V_{molecule} = \frac{\sqrt{3}}{4}\left(100\overset{\circ}{A}\right)^2 \times 300\overset{\circ}{A}$$

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

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

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

$= 939\,kg$ (B)

EXERCISE - 2 [B]

More than one correct

1. (A,C,D)

Vapour density, specific gravity and mass fraction are dimensions quantity.

2. (A,B)

(A) Volume of solution $= \frac{46\text{ g}}{1.4\text{ g/ml}} = \frac{46}{1.4}\text{ml}$

$$70 = \frac{\text{Wt. of solute}}{\text{Volume of solution}} \times 100$$

$\Rightarrow$ Wt. of solute $= \frac{70}{100} \times \frac{46}{1.4} = 23\text{ g}$

(B) d = 1 g/ml $\Rightarrow$ Volume = 50 ml

Mole of solute $= 10 \times \frac{50}{1000} = 0.5$ mole

Mass of solute $= 0.5 \times 46 = 23$ gram

(C) Mass of solute $= 50 \times \frac{25}{100} = 12.5\text{ g}$

(D) Volume of solution = 46 ml

Mole of solute $= 5 \times \frac{46}{1000} = 0.23$ mole

Mass $= 0.23 \times 46 = 10.58\text{ g}$

3. (A,B,C,D)

Mass of one drop $= \frac{2.4}{35} = 0.0685\text{ g}$

Volume of one drop $= \frac{0.0685\text{ g}}{1.2\text{ g/ml}} = 0.057$ ml

Mole of one drop $= \frac{0.068}{70}$

Number of molecules $= \frac{0.068}{70} \times 6.023 \times 10^{23}$

$= 5.85 \times 10^{20}$

Number of molecules in 35 drops $= 35 \times 5.85 \times 10^{20}$

$= 2.05 \times 10^{22}$

4. (D)

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

Mole = 2 × 0.1 = 0.2   2 × 0.1 = 0.2   0.1 mole

NaOH is limiting reagent.

Molarity of $Na_2SO_4 = \frac{0.1}{4} = 0.025\text{ M}$

Molarity of $SO_4^{2-} = \frac{0.1+0.1}{4} = 0.05\text{ M}$

Mass of Na_2SO_4 = 0.1 × 142 = 14.2 gram

Strength = Molarity × M.W.

= 0.025 × 142 = 3.55 g/litre

5. (AD)

100×0.05

$=200\times0.025$

6. (CD)

Hence

Mol. Wt $=\frac{14}{11.2}\times22.4=28$

7. (A,C)

Al is excess

Mole of Al consumed = 2 mole

Mass of Al consumed = 2 × 27 = 54 gram

8. (A,C,D)

In first reaction, O_2 is in excess.

2^{nd} second reaction, Cl_2 is in excess 7.45 gram KCl is formed in second reaction.

9. (ABD)

3 moles in 1L $(1250\,g)$

$w_{Na_2S_2O_3} = 3\times(46+64+48) = 474$

(A) % by weight $=\frac{474}{1250}\times100 = 37.92\%$

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

(C) molality of $Na^+ = \frac{n}{w_{solvent}}\times1000$

$= \frac{3\times2}{(1250-474)}\times1000 = 7.73$

10. (AB)

mol. wt = wt of 22.4 L=28.896 g

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

11. (ABD)

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

12. (ACD)

$$Ca\left(NO_3\right)_2 + Na_2C_2O_4 \longrightarrow CaC_2O_4 + 2NaNO_3$$

millimoles :	6	3	-	-
	3	LR	3	6

13. (AC)

$^{n}CaO = ^{n}CaCO_3 = \frac{1.12}{56} = 0.02$

$w_{CaCO_3} = 0.02\times 100 = 2g$

$w_{CaCl_2} = 0.02\times 111 = 2.22\,g$

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

14. (AC)

$n_{NaCl} = 100\,m\,moles\,;\ ^{n}HCl = 300\,m\,moles$

$n_{CaCl_2} = 200\,m\,moles\left(200\,Ca^{2+}, 400\,Cl^{-}\right)$

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

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

15. (ABD)

4 mole atoms of Hydrogen are present in A, B, D.

16. (ABCD)

3 mole NH_3

$w_H = 3\times 14 = 42\,g$

$W_N = 3\times 14 = 42\,g$

Molecule $= 3\times N_a = 18\times 10^{23}$

Atoms $= 4\times 3\times N_A = 72\times 10^{23}$

17. (AB)

1 gram molecule means one mole V_2O_5.
Which contain 5 mole oxygen & 2 mole V atom.

18. (BC)

Mole fraction & molarity are independent of temperature.

19. (CD)

$$\begin{array}{lll} HCl & + \quad NaOH \longrightarrow NaCl + H_2O \\ 50\times 0.1 & 50\times 0.1 \end{array}$$

Final conc. Of NaCl

$= \frac{50\times 0.1}{100}$

$= 0.05M$

Solutions is neural so

$\left[H^+\right] = 10^{-7}$

20. (BC)

Mass of one molecule $= \dfrac{MM}{N_A}$

NO of Mole $= \dfrac{\text{No of molecules}}{N_A}$

Match the following

1. I – P, II – A, III - C, IV – E

(I) wt % of C $= \dfrac{13\times12}{407}\times100 = 38.33\%$ (P)

(II) wt % of H $= \dfrac{6}{407}\times100 = 1.47\%$ (A)

(III) wt of H: wt of $Cl = 6 : 6\times35.5$ (C)

(IV) mo. of C: O =13:2 (E)

2. a – S, b – S, c- Q, d – R

(a) $\dfrac{w_{SO_2}}{W_{O_2}} = 2(s)$

(b) $d = 10/5 = 2g/cc \therefore sp.gr = 2(s)$

(c) $M = 2VD = 32(Q)$

(d) molecular $= \dfrac{132}{44} = 3$ $\therefore$ at anons = 9(R)

3. a – PS, b – S, c – PQ, d – R

(a) $\left[Al^{3+}\right] = \dfrac{20}{400} = 0.04M$

$\left[H^+\right] = \dfrac{40}{500} = 0.084$

Total =0.12 M

$\left[Cl^-\right] = \dfrac{60+40}{500} = 0.2M$

(P), (S)

(b) $\left[K^+\right] = \dfrac{20}{100} = 0.2M$

$\left[Cl^-\right] = \dfrac{20}{100} = 0.2M$

(S)

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

[P], [Q]

$\left[SO_4^{2-}\right] = \dfrac{6}{100} = 0.06M$

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

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

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

[R]

4. **A- p ,r,s B-p, C- p,q,r, D-s**

(A) $V_{SO_2} = 11.2\,L$

$w_{SO_2} = 32\,g$

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

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

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

(C) no. of atoms $= 0.5\times 3\times N_A = 1.5\,N_A$

[P], [Q], [R]

(D) $1 mole\, O_2 \therefore V = 22.4\,L$

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

$wt = 32\,g$ [S]

COMPREHENSION TYPE

Passage 1

1. **(C)**

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

2. **(A)**

$n_S = n_{H_2SO_4} = 100 \therefore \text{wt} = 3200\text{g}.$

3. (B)

$\frac{3.4}{100}\times(\text{M}) = \omega_s = 2\times 32 \Rightarrow \text{M} = 1882.3$

4. **(B)**

$C + O_2 \rightarrow n_C = n_C = n_{O_2} = 1$

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

Passage – 2

5. **(A)**

Consider 1 L.

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

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

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

6. **(C)**

$$\frac{134}{1000}\times M_{H_2SO_4}\times 2 = n_{NH_3} = \frac{PV}{RT} = \frac{0.2\times 2}{0.0821\times 303}$$

$$\Rightarrow M_{H_2SO_4} = 0.06$$

7. **(A)**

$$\frac{1600\times 0.205}{1600+V} = 0.2 \Rightarrow V = 40mL$$

8. **(A)**

$$\frac{n_{H_2S}}{1} = \frac{n_{H_2SO_4}}{5} \Rightarrow n_{H_2SO_4} = \frac{5\times 34}{34} = 5$$

$$\therefore V\times 0.2 = 5 \Rightarrow V = 25L$$

Passage – 3

9. **(D)**

$$m_{H_2O} = \frac{18g}{6\times 10^{23}} = 3\times 10^{-23}g$$

10. **(A)**

Avogadro's law.

11. **(C)**

Mass of one oxygen atom = 16 amu.

12. **(A)**

Moles of He is maximum.

Passage – 4

13. **(A)**

$$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$$

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

$$= 0.0339 \qquad = 0.081 \qquad \therefore wt = 4.88g$$

14. **(A)**

$$\therefore \omega_{H_2SO_4} = 0.12\times 98 = 11.7g$$

<u>INTEGER</u>

1. **(5)**

0.5 mole $N^{3-}.N^{-3}$ has $10\bar{e}$.

$\therefore 5$ moles.

2. **(3)**

$$^{n}CO_2 = \frac{132}{44} = 3 \; ^{n}CO_2 = \frac{132}{44} = 3$$

$$n_C = 3$$

3. **(3)**

MCl_X : say. mol.wt $= (M + 106.5)$

$$n_{Cl^-} = \left(n_{MCl_X}\right) \times (X) = \frac{0.22x}{(M + 106.5x)}$$

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

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

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

4. **(4)**

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

5. **(5)**

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

6. **(2)**

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

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

7. **(2)**

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

8. **(6)**

$$\frac{5}{100} \times \omega_{solu} = 0.3g \Rightarrow \omega_{solu} = 6g$$

9. **(4)**

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

10. **(8)**

$$CO_2 \rightarrow C_6H_{10}O_5$$

$$1g \text{ algae} \xrightarrow[+1g \text{ strach}]{} 2g \text{ algae}$$

1g strach

POAC on carbon

$$n_{CO_2} \times 1 = n_{(C_6H_{10}O_5)_n} \times 6n$$

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

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

EXERCISE - 2 [C]

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

2. $n_{CH_4} = \frac{1.6}{16} = 0.1\,\text{moles} = 6\times10^{22}$ molecules

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

$\therefore$ total $\bar{e}s = 6\times10^{23}$

3. $n_{H_2O} = \frac{18\,g}{18\,g/mol} = 1\,\text{mole}$

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

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

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

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

5. Gram atomic mass = $N_A \times \text{mass of one atom}$

$= 6\times10^{23}\times6.64\times10^{-23}\,g = 40\,g$

Atomic mass = 40

6. no. of atoms = $\frac{\text{wt}}{\text{wt of one atom}} = \frac{1}{3.98\times10^{-23}}$

$= 2.5\times10^{22}$

7. $\omega_{\text{removed}} = 10^{21}\times44\,\text{amu} = 7.35\times10^{-2}\,g$

$\therefore \omega_{CO_2,\text{remaining}} = 200 - 73.5 = 126.5\,\text{mg}$

$\therefore n_{CO_2} = \frac{126.5\times10^{-3}}{44} = 0.002875$

8. $1\,\text{mole}\,N^{3-}\ \ \therefore \text{charge} = N_A \times 3e = 2.88\times10^{5}\,C$

9. $n_O = n_{SO_2}\times2 = \frac{3.2\times10^{-3}}{64}\times2 = 10^{-4}$ moles

$n_S = n_{Na_2S_2O_3.5H_2O}\times2 = 2\times5\times10^{-3} = 10^{-2}$

$\therefore n_O : n_S = \frac{10^{-4}}{10^{-2}} = 0.01$

10. $n_O = 3\times n_{NaNO_3} + 2\times n_{NO_2}$

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

$n_N = n_{NaNO_3} + n_{NO_2} = 10\times10^{-3} + \frac{1}{6}$

$= 0.01 + 0.166$
$= 0.176$

11. $t(s) = \frac{6\times10^{23}}{10^6} = 6\times10^{17}$ s

$t(hr) = \frac{6\times10^{17}}{3600} = 1.67\times10^{14}$

$t(yr) = \frac{1.67\times10^{14}}{24\times365} = 1.9\times10^{10}$ years

12. atomic wt = $6.644\times10^{-23}\times6\times10^{23}$
= 40 g/mol

$\therefore n = \frac{40\times1000\,g}{40\,g/mol} = 1000$ moles

13. $n_C = \frac{10^{-6}g}{12g/mol}$

No. of atoms = $n_C\times6\times10^{23} = 5\times10^{16}$

14. r = 0.1 inch = 0.254 cm

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

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

$= \frac{4}{3}\pi\times(0.254)^3\times7.75 = 0.532\,g$

$\omega_{Fe} = \frac{85.6}{100}\times0.532\,g = 0.455\,g$

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

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

$\therefore \omega_{starch} = \frac{3100}{0.086} = 3.6\times10^4$

16. $V_{NH_3} = n_{NH_3}\times22.7\,L$

$= \frac{3.4}{17}\times22.7 = 4.54\,L$

17. $n_{O_2} = \frac{PV}{RT} = \frac{1\times1}{0.0821\times273} = 0.04464$

$\therefore n_{moleculs} = n_{O_2}\times N_A = 2.69\times10^{22}$

18. $O_3 \quad + \quad O_2 \longrightarrow 600\,mL$

Vml $(600 - V)\,mL$

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

$\therefore$ V = 200 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

$\therefore K_2MnP_2$

20. Say $n_O = n$

Then $n_H = 15n$

And $n_C = \frac{70}{100}\times 15n = 10.5n$

$\therefore C_{10.5}H_{15}O$ or $C_{21}H_{30}O_2$ is empirical formula

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

$\therefore C_{21}H_{30}O_2$

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

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

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

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

22. $\omega_C=\frac{58.97}{100}\times 102=59.9\Rightarrow n_C=5$

$\omega_H=\frac{13.81}{100}\times 102=14.08\Rightarrow n_H=14$

$\omega_N=\frac{27.42}{100}\times 102=27.97\Rightarrow n_N=2$

$\therefore C_5H_{14}N_2$

23. $\omega_C=\frac{12}{44}\times\omega_{CO_2}=\frac{12}{44}\times 0.9482=0.2586$

$\therefore n_C=0.02155$

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

$\therefore n_H=0.02154$

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

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

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

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

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

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

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

25. Mol. Wt = wt of 1 mole mix = 2VD = 76.6

(x mol. NO_2 + (1 – x) mol. N_2O_4) = 76.6 g

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

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

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

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

$$= 0.437$$

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

Consider 1L of solvent $\boxed{\frac{C_2H_5OH}{\text{mol.wt} = 46}}$

n = 8

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

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

27. $$2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + CO_2 \uparrow + H_2O \uparrow$$

$$Na_2CO_3 \xrightarrow{\Delta} \text{no effect}$$

$$2 \times (84\,g)\, NaHCO_3 \xrightarrow{\text{loses}} 62g\,(CO_2 + H_2O)$$

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

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

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

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

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	$\frac{4.95}{16} = 0.309$	$\frac{0.309}{0.309} = 1$

$$C_{20}H_{25} = N_3O$$

% of C atoms $= \frac{20}{49} \times 100$

$= 40.816\%$

29. $$2CH_3CHO + O_2 \rightarrow 2CH_3COOH$$

ω: 20g 10g

n: $\frac{20}{44} = 0.45$ $\frac{10}{32} = 0.31$

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

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

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

$\therefore n_1 = 0.193$ 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

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

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

33. $n_{Cu} = n_{Cu(NO_3)_2.3H_2O}$ (POAC on Cu)

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

$= 38.03g$

34. $AgNO_3 + NaCl \rightarrow AgCl\downarrow + NaNO_3$

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

$= 0.03394$ $= 0.08$

L.R.

$n_{AgCl} = n_{AgNO_3} = 0.03394$

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

35. $\underset{n_1}{CaCO_3} \xrightarrow{\Delta} \underset{n_1}{CaO} + CO_2 \downarrow$

$MgCO_3 \xrightarrow{\Delta} \underset{n_2}{MgO} + CO_2 \downarrow$

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

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

$n_1 = 0.01$

$n_2 = 0.01$

$\therefore \%CaCO_3 = \dfrac{0.01 \times 100}{1.84} \times 100 = 54.35\%$

36. $Cl_2 + 2KOH \rightarrow KCl + \underline{KClO} + H_2O$

$3\underline{KCl}O \rightarrow 2KCl + \underline{KClO}_3$

$n_{KClO_4} = n_{Cl_2} \times \dfrac{1}{1} \times \dfrac{1}{3} \times \dfrac{3}{4} = \dfrac{n_{Cl_2}}{4}$

$\Rightarrow n_{Cl_2} = 4 \times \dfrac{1385}{(39 + 35.5 + 64)} = 40$

$\Rightarrow \omega_{Cl_2} = 40 \times 71 = 2840g$

37. POAC on Cl (eventually on completion)

$n_{Cl_2} \times 2 = n_{KCl} \times 1 + n_{KClO_4}$

$\Rightarrow n_{KCl} = \dfrac{142}{71} \times 2 - \dfrac{n_{Cl_2}}{4} = 4 - 0.5$

$= 3.5 moles$

38. $1g\ KClO_3$ → (n_1 moles) $KCl + O_2$; → (n_2 moles) $KClO_4 + KCl$

$n_{O_2} = \dfrac{3}{2} \times n_1 = \dfrac{146.8}{22400} \Rightarrow n_1 = 0.00437$

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

$n_{KClO_4} = \dfrac{3}{4} n_2 = 0.00284$

$\omega_{resiude} = 1g - \omega_{O_2} = 0.79029g$

$\therefore \%KClO_4 = \dfrac{0.00284(39 + 35.5 + 64)}{0.79} \times 100$

$= 49.789\%$

39. $(CH_3)_x AlCl_y \rightarrow xCH_4 + yCl^-$

$Cl^- + AgNO_3 \rightarrow AgCl \downarrow + NO_3^-$

1. $n_{CH_4} = x.n_{(CH_3)_x AlCl_y}$

$$\Rightarrow \frac{0.222}{16} = x.\frac{0.643}{(15x+27+35.5y)}$$

2. $n_{AgCl} = n_{Cl^-} = y.n_{(CH_3)_x AlCl_y}$

$$\Rightarrow \frac{0.996}{(108+35.5)} = y.\frac{0.643}{(15x+27+35.5y)}$$

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

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

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

40. $KClO_3 \xrightarrow{\Delta} KCl + \frac{3}{2}O_2$ (1)

6.125g

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$ (2)

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O$ (3)

in (1),

$n_{O_2} = \frac{3}{2} \times n_{KClO_3} = 0.075$

in (3),

$n_{H_2} = 2 \times n_{O_2} = 0.15$

in (2),

$n_{Zn} = n_{H_2} = 0.15$

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

41. (A): B,

(B): A,

(C): $n_C = \frac{7}{2} \times n_B = \frac{7}{2}.$

42. $C + O_2 \rightarrow \underset{n_1}{CO}, \underset{n_2}{CO_2}$

POAC on C

$n_C = \frac{12}{12} = n_1 + n_2 = 1$

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

$\Rightarrow n_2 = 1.25 - 1 = 0.25$

and $n_1 = 0.75$

$\therefore n_{CO} : n_{CO_2} = n_1 : n_2 = 3:1$

43. $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

$\frac{n_{NaOH}}{2} = n_{H_2SO_4} = \left(\frac{15}{1000}\right) \times \frac{1}{10} \times \frac{1}{2} = 7.5 \times 10^{-4}$

$$\therefore \text{strength} = \frac{\omega_{H_2SO_4}}{V_{H_2SO_4}(mL)} \times 1000$$
$$= 6.125 g/L$$

44. $$\text{Molarity} = \frac{n}{V(mL)} \times 1000 = \frac{10\times10^{-3}}{100} \times 10^{-3} = 0.1M$$
$$\text{in gram}/L = 0.1\times(39+16+1) = 5.6 g/L$$

45. $$n_{SO_4^{2-}} = n_{H_2SO_4} = \left(\frac{100}{1000}\right)\times 0.001M = 10^{-4}$$
$$\therefore \text{no. of ion } = n_{SO_4^{-2}} \times n_A = 6\times10^{19}$$

46. $$n_{CuSO_4.5H_2O} = n_{Cu^{2+}} = 0.5\times0.01 = 5\times10^{-3}$$
$$\text{weight } = n\times \text{mol.wt} = 5\times10^{-3}\times 249.5$$
$$= 1.2475g$$

47. $$M_1V_1 + M_2V_2 = M_3V_3$$
$$\therefore M_{final} = M_3 = \frac{50\times0.5 + 75\times0.25}{50+75}$$
$$= 0.35\text{Molar}$$

48. $$\text{Molality } = \frac{n}{\omega_{solvent}}\times 1000$$
$$= \frac{3/30}{250}\times1000 = 0.4\text{molal}$$

49. $$\frac{n_{I_2}}{n_{I_2} + n_{C_6H_6}} = 0.2$$

Say, we have 1 mole mix.

Then, $n_{I_2} = 0.2$ and $n_{C_6H_6} = 0.8$

$$\therefore \text{molality} = \frac{n_{I_2}}{\omega_{C_6H_6}}\times1000$$
$$= \frac{0.2}{0.8\times78}\times1000 = 3.205m.$$

50. Consider 1L solution.

$$\omega t_{solution} = 1000\times1.06 = 10609.$$
$$\omega_{KCl} = \frac{10}{100}\times\omega_{solution} = 106g$$
$$\text{Molailty } = \frac{n_{KCl}}{V_{solution}^{(mL)}}\times1000$$
$$= \frac{106/74.5\times1000}{1000} = 1.4228M$$

51. $30\%NH_3. \Rightarrow 70\%\text{water}.$

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

i.e. $\omega_{\text{solution}}=\frac{100}{70}\times150=150\text{g}$

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

52. Consider 1L of solution,

$\omega_{\text{solution}}=1.025\times1000=1025\text{g}$

$n_{\text{ethanol}}=M\times V=8\times1=8\text{moles}$

$\omega_{\text{ethanol}}=8\times46=368$

$$\text{molality}=\frac{n_{\text{ethanol}}}{\omega_{\text{solvent}}}\times1000$$

$$=\frac{8}{(1025-368)}\times1000$$

$$=12.176\text{molal}$$

53. $2SO_2+O_2\rightarrow2SO_3$

$nSO_2=nSO_3\Rightarrow nSO_3=5$

54. $4FeS_2+11O_2\rightarrow2Fe_2O_3+8SO_2$

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

So moles of $Fe_2O_3=\frac{1}{2}\times2.5$

55. $n_{NH_3}=n_{HCl}=\frac{146}{36.5}=4$

Wt $NH_3=4\times17=68\text{g}$

56. $2H_2+O_2\rightarrow2H_2O$

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

LR

$\text{wt}\,H_2O$ formed $=0.90625\times2\times18=32.625\text{g}$

$\text{wt}\,H_2$ left $=(3-(0.90625\times2))\times2=2.375\text{g}$

57. $\frac{245}{95}\times3=\frac{w}{58.5}\times2$

$w=226\text{g}$

58. $\underset{n_1}{\text{AgCl}}+\underset{n_2}{\text{AgBr}}$

$$\frac{\%Ag}{100}=\frac{(n_1+n_2)108}{n_1\times143.5+n_2\times188}=\frac{60.94}{100}$$

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

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

$= 4.856\%$

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

59. $(COOH)_2 \xrightarrow[H_2SO_4]{\Delta} CO_2 + H_2O (\text{unbalanced})$

$POAC^nC =^n CO_2 \times 1 =^n (COOH) \times 2 = \frac{10}{90} \times 2 = \frac{2}{9}$

$\therefore ^V CO_2 = \frac{2}{9} \times 22.4L = 4.977L$

60. acid is H_3A. salt is Ag_3A

$1 \text{mole} Ag_3A \rightarrow 3 \text{mole} Ag$

$\therefore n_{Ag_3A} = \frac{n_{Ag}}{3} = \frac{0.37/108}{3} = 0.00114$

$\therefore \frac{0.607}{\text{mol.wt of } Ag_3A} = 0.00114$

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

$\therefore A = 207$

$\therefore \text{wt of } H_3A = 210$

61. $(0.156\,g)$, **(1.172 g)**

POAC on Co

$n_{Co_3O_4} \times 3 = n_{Co} \times 1$

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

$n_{PPt} \times 1 = n_{Co}$

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

62. **a) (0.712),**

(a) $\frac{90}{100} \times 0.5\,g\,Fe \rightarrow Fe_2O_3 (n_1)$

$\frac{10}{100} \times 0.5_g\,Fe \longrightarrow Fe_3O_4 (n_2)$

$n_1 \times 2 = \frac{0.45}{56} \Rightarrow n_1 = 0.04$

$n_2 \times 3 = \frac{0.05}{56} \Rightarrow n_2 = 0.0003$

$\therefore$ wt of mix= $(160) \times n_1 + (232) n_2 = 0.71\,g$

b) (0.714)

(b) $0.5g\,Fe \longrightarrow Fe_2O_3 (n)$

$$n \times 2 = \frac{0.5}{56} \Rightarrow n = 4.46 \times 10^{-3}$$

$$\Rightarrow \omega_{Fe_2}O_3 = 0.7142\,g$$

63. **(53.5)**

(i) $^{n}AgNO_3 = ^{n}{}_{AgCl} = ^{n}\ \underset{(n_1)}{NaCl} + ^{n}\ \underset{(n_2)}{HCl}$

$$\therefore \frac{2.567}{143.5} = n_1 + n_2 = 0.0179$$

(ii) NaCl is not affected

$$^{n}Cl = ^{n}\ AgCl = n_2 = \frac{1.341}{143.5}$$

$$\Rightarrow n_2 = 0.009345$$

$$\therefore n_1 = 0.0856$$

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

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

64. **(**$C_2H_4Cl_2$**)**

$$C_xH_yCl_z + O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O + \frac{z}{2}Cl_2$$

$$\left(\frac{0.22}{12x + y + 35.5Z}\right) \times (x) = ^{n}\ CO_2 = \frac{0.195}{44} \ \ldots\ldots\ldots(1)$$

$$\left(\frac{0.22}{12x + y + 35.5z}\right) \times \left(\frac{y}{2}\right) = ^{n}\ H_2O = \frac{0.0804}{18} \ \ldots\ldots(2)$$

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

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

$C_2H_4Cl_2$

65. 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%

JEE Advanced : PYQ

1. **(C)**

$$\frac{\text{Weight of a compound in gram}(w)}{\text{Molar mass}(M)} = \text{Number of moles}(n)$$

$$= \frac{\text{Number of molecules}(N)}{\text{Avogadro number}(N_A)}$$

$\Rightarrow \quad \frac{w(O_2)}{32} = \frac{N(O_2)}{N_A}$ .... (i)

And $\quad \frac{w(N_2)}{28} = \frac{N(N_2)}{N_A}$ .... (ii)

Dividing Eq. (i) by Eq. (ii) gives

$$\frac{N(O_2)}{N(N_2)} = \frac{w(O_2)}{w(N_2)} \times \frac{28}{32} = \frac{1}{4} \times \frac{28}{32} = \frac{7}{32}$$

2. **(A)**

In a neutral atom, atomic number represents the number of protons inside the nucleus and equal number of electrons around it. Therefore, the number of total electrons in molecule of CO_2,

$=$ electrons present in one carbon atom

$+2\times$ electrons present in one oxygen atom.

$= 6 + 2 \times 8 = 22$

3. **(A)**

Number of molecules present in 36g of water

$$= \frac{36}{18} \times N_A = 2N_A$$

Number of molecules present in 28g of CO

$$= \frac{28}{28} \times N_A = N_A$$

Number of molecules present in 46g of C_2H_5OH

$$= \frac{46}{46} \times N_A = N_A$$

Number of molecules present in 54g of N_2O_5

$$\frac{= 54}{108} \times N_A = 0.5N_A$$

Here N_A is Avogadro's number. Hence, 36 g of water contain the largest $(2N_A)$ number of molecules.

4. **(A)**

The balanced chemical reaction of zinc with sulphuric acid and $NaOH$ are

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2(g)\uparrow$$

$$Zn + 2NaOH + 2H_2O \rightarrow Na_2[Zn(OH)_4] + H_2(g)\uparrow$$

Since one mole of $H_2(g)$ is produced per mole of zinc with both sulphuric acid and NaOH respectively, hydrogen gas is produced in the molar ratio of 1 : 1 in the above reactions.

5. **(A)**

Unlike other metal carbonates that usually decomposes into metal oxides liberating carbon dioxide, silver carbonate on heating decomposes into elemental silver liberating mixture of carbon dioxide and oxygen gas as

$$Ag_2CO_3(s) \xrightarrow{\text{Heat}} 2Ag(s) + CO_2(g) + \frac{1}{2}O_2(g)$$

$MW = 276g \qquad 2 \times 108 = 216g$

Hence, $2.76g$ of Ag_2CO_3 on heating will give

$\frac{216}{276} \times 2.76 = 2.16g$ Ag as residue.

6. **(D)**

The balanced chemical reaction is

$$3BaCl_2 + 2Na_3PO_4 \rightarrow Ba_3(PO_4)_2 + 6NaCl$$

In this reaction, 3 moles of $BaCl_2$ combines with 2 moles of Na_3PO_4. Hence, 0.5 mole of $BaCl_2$ require

$\frac{2}{3} \times 0.5 = 0.33$ mole of Na_3PO_4

Since available Na_3PO_4 $(0.2\,\text{mole})$ is less than required mole (0.33), it is the limiting reactant and would determine the amount of product $Ba_3(PO_4)_2$

$\because$ 2 moles of Na_3PO_4 gives 1 mole $Ba_3(PO_4)_2$

$\therefore$ 0.2 mole of Na_3PO_4 would give $\frac{1}{2} \times 0.2$

$= 0.1$ mole $Ba_3(PO_4)_2$

7. **(A)**

Molality of a solution is defined as number of moles of solute present in 1.0kg (1000 g) of solvent.

8. **(D)**

Molality is defined in terms of weight, hence independent of temperature. Remaining three concentration units are defined in terms of volume of solution, they depends on temperature.

9. **(D)**

Mass of an electron $= 9.108 \times 10^{-31}\text{kg}$

$\because 9.108 \times 10^{-31}\text{kg} = 1.0$ electron

$\therefore \quad 1\text{kg} = \frac{1}{9.108 \times 10^{-31}}$ electrons

$= \frac{10^{31}}{9.108} \times \frac{1}{6.023 \times 10^{23}}$

$= \frac{1}{9.108 \times 6.023} \times 10^{8}$ mole of electrons.

10. **(A)**

Number of atoms = number of moles

$\times$Avogadro's number (N_A)

$\Rightarrow$Number of atoms in 24 g $C = \frac{24}{12} \times N_A = 2N_A$

Number of atoms in 56 g of $Fe = \frac{56}{56} N_A = N_A$

Number of atoms in 27 g of $Al = \frac{27}{27} N_A = N_A$

11. **(B)**

From the given relative abundance, the average atomic weight of Fe can be calculated as

$$A = \frac{54 \times 5 + 56 \times 90 + 57 \times 5}{100} = 55.95$$

12. **(C)**

$$M = \frac{\text{Moles of solute}}{\text{Vol of solution}(m\ell)} \times 1000$$

Moles of solute $= \frac{120}{60} = 2$

Vol. of solution $= \frac{\text{mass of solution}}{\text{density}}$

$$= \frac{120 + 1000}{1.15} = 973.913$$

$$M = \frac{2}{973.913} \times 1000 = 2.053$$

13. **(C)**

$$\frac{W_{O_2}}{W_{N_2}} = \frac{1}{4}$$

$$\frac{n_{O_2}}{n_{N_2}} = \frac{\frac{w_{O_2}}{32}}{\frac{w_{N_2}}{28}}$$

$$= \frac{28}{32} \times \frac{1}{4} = 7/32$$

$$N_{O_2} : N_{N_2} = n_{O_2} : n_{N_2} = 7 : 32$$

14. (B,C)

Let M represents the respective molecular mass.

(A) If empirical formula of compound 3 is P_3O_4.

$$\frac{3M_P}{3M_P + 4M_Q} = \frac{40}{100} \Rightarrow 9M_P = 8M_Q$$

If empirical formula compound 2 is P_3O_5.

$$\% \text{ of } P = \frac{3M_P}{3M_P + 5M_Q} \times 100 = \frac{8/3M_Q}{8/3M_Q + 5M_Q} \times 100$$

$= 34.78$

Hence, option (A) is incorrect

(B) If empirical formula of compound 3 is P_3O_2.

$$\frac{3M_P}{3M_P 2M_Q} = \frac{40}{100} \Rightarrow 4M_Q = 9M_P$$

$$\Rightarrow M_Q = \frac{9}{4} \times 20 = 45$$

Hence, option (B) is correct

(C) If empirical formula of compound 2 is PQ.

$$\frac{M_P}{M_P + M_Q} = \frac{44.4}{100} \Rightarrow 5M_P = 4M_Q$$

If empirical formula of compound 1 is P_5O_4 then weight % of P:Q=1:1

Hence, option (C) is correct

(D) If empirical formula of compound 1 is P_2O,

$$\% \ P = \frac{2M_P}{2M_P + M_Q} \times 100 = 50 \Rightarrow 2M_P = M_Q$$

Hence, atomic weight of P and Q cannot be 70 and 35, respectively.

INTEGER TYPE

1. **(8)**

% by mass $= 29.2$

$$M = \frac{\text{Moles of solute}}{\text{Vol. of solution}(m\ell)} \times 1000$$

$$= \frac{29.2 \times 1.25}{36.5 \times 100} \times 1000 = 10$$

$$M_1V_1 = M_2V_2$$

$10 \times V = 0.4 \times 200 \qquad \Rightarrow V = 8 m\ell$.

2. **(4)**

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

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

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

Hence, no. of significant figures is 4

3. **(8)**

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

= 400 g = 0.4 kg

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

= 8 m

4. **(9)**

$$m(\text{molality}) = M(\text{molarity})$$

$$\frac{0.1}{\left(\frac{0.9M_{solvent}}{1000}\right)} = \frac{0.1}{\left(\frac{0.1M_{solute} + 0.9M_{solvent}}{2 \times 1000}\right)}$$

$$\frac{1}{9M_{solvent}} = \frac{2}{M_{solute} + 9M_{solvent}}$$

$$\frac{M_{solute}}{M_{solvent}} = 9$$