MOLE CONCEPT (ADVANCED)

FOUNDATION BUILDER (OBJECTIVE)

1. **(D)**

2. **(D)**

3. **(B)**

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

5. **(D)**

6. **(C)**

7. **(A)**
Moles of gas = $\frac{5.6}{22.4} = 0.25$

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

Hence NO.

8. **(A)**
Molecular weight of $C_{60}H_{122} = 60\times12+122=842.$

Weight of a molecule = $\frac{842}{6.022\times10^{23}} = 1.39\times10^{-21}\text{g}$.

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

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

Number of atoms = $0.05\times2\times6.02\times10^{23}$.
= 6.02×10^{22} .

11. **(D)**

(A) $\frac{22.4\times10^{3}}{22400}\times \text{NA} = 6.022\times10^{23}$

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

(C) $\frac{11.2}{22.4}\times6.022\times10^{23} = 3.011\times10^{23}$

(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 $l =$ $0.5 \times 22.4 = 11.2l$.

14. **(D)**

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

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

15. **(A)**

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

16. **(C)**

Number of moles of $H_2 = \frac{0.224}{22.4} = 0.01$

17. **(B)**

18. **(B)** $W_H = 3 \times 3 = 9\,g$ $\quad$ $W_N = 3 \times 14 = 42\,g$

19. **(C)**

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

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

$\therefore$ $\quad$ Protons = $2N_A \times 10 = 20\,N_A$

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)**

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

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)**

$n_C = 0.5 \times 6 = 3$ $\therefore$ 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)**

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

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)**

$n_{N^{3-}} = \frac{4.2}{14} = 0.3$. $\therefore$ 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 $= 0.1 \times 42N_A = 2.5 \times 10^{24}$

36. **(B)**

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

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, $n_C = 5$ $\therefore$ twice = 10 moles

40. **(B)**

Say $n_{Mg_3(PO_4)_2} = n$; 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

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

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

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 $SO_2 = \frac{11.2}{22.4} = 0.5$

$$SO_2 + 2H_2S \rightarrow 3S + 2H_2O$$

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)**

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

49. **(A)**

$W_O = 3.6769 - 2.0769 = 1.6g$

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

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

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

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)**

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

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)**

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

Moles	3	2	1	6
	0.5	0.2 (L.R.)	$\frac{1\times 0.2}{2} = 0.1$	

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)**

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

L.R

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

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)**

$$\text{Mol.wt.} = 0.8\times28+0.2\times32 = 28.8$$

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

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)**

$$\text{molality} = \frac{n}{w_{solvent}}\times1000 \left(\text{urea} : NH_2\underset{\underset{O}{\|}}{C}NH_2\right)$$

$$= \frac{18/60}{(1500\times1.052-18)}\times1000 = 0.192$$

64. **(D)**

$$\text{Molarity} = \frac{n}{V(mL)}\times1000 = \frac{1/98}{1000}\times1000 \approx 0.01$$

65. **(A)**

$$\left[Al^{3+}\right] = \frac{20\times0.2\times2}{40} = 0.2M$$

66. **(D)**

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

$$V\times0.01 \longrightarrow 50\times0.01$$
$$\Rightarrow V = 10mL$$

67. **(B)**

$$n_{H^+} = \left(\frac{100}{1000}\right)\times0.001\times2 = 2\times10^{-4}$$

$$\therefore \text{no. of } H^+ = 2\times10^{-4}N_A = 1.2\times10^{20}$$

68. **(A)**

$$3 \text{ molal} \Rightarrow 3 \text{ mole NaOH in 1000g solvent}$$

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

$$\therefore \text{Molarity} = \frac{n}{V(mL)}\times1000 = \frac{3}{1.009} = 2.97$$

69. **(B)**

Molarity of $NO_2CO_3 = \frac{2.65\times1000}{106\times250} = 0.1$ M.

After dilution of 10 mL solution $= \frac{0.1\times10}{1000} = 0.001\,M$

70. **(A)**

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

GET EQUIPPED FOR JEE MAIN

1. **(A)**

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

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

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

2. **(A)**

Consider 1 L solution

$\frac{29}{100}\times(d\times1000) = \omega_{H_2SO_4} = 3.6\times98$

$\therefore$ d = 1.22 g/mL

3. **(A)**

	N_2	+	$3H_2$	$\longrightarrow$	$2NH_3$
n:	10		$\boxed{15}$ LR		–
	$10-5$		–		10 moles

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

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

n: ? (for $BaCl_2$) $\quad$ $\frac{1}{2}$ (for $FeCl_3$)

$$\frac{n_{BaCl_2}}{3} = \frac{n_{FeCl_3}}{2} \Rightarrow n_{BaCl_2} = \frac{1/2}{2}\times3 = 0.75\,\text{moles}$$

5. **(C)**

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

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

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

$\therefore \omega = 96g$

6. **(A)**

CH_4	+	$2O_2$	$\longrightarrow$	CO_2	+	$2H_2O$
5		$\boxed{8}$		–		–

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

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

7. **(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. $10+\dfrac{x}{4}=\dfrac{32.5\times 1}{2.5}=13$

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

8. **(D)**

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

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

$\therefore \omega=0.9375\,g$

9. **(B)**

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

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

10. **(D)**

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

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

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

11. **(D)**

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

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

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

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

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

12. **(D)**

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

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

13. **(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, $n_1\times(103)+n_2\times(119)=0.560$

$\therefore n_2=\frac{0.56-103\times0.00516}{16}=0.00178$

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

14. **(A)**

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

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

15. **(C)**

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

$\approx 0.05\,N_A = 3\times10^{22}$

16. **(C)**

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

$\therefore$ For 5 mol, $(246\times5)g=1.23$ kg

17. **(A)**

$A:10N_A;\ B:11\times\frac{200}{342}=6.43\,N_A;\ C=\frac{144}{48}N_A\times3=9N_A$

$D:2.5\times3N_A=7.5N_A.$

18. **(D)**

(i) 5g (ii) $\frac{60}{106.5}\times35.5$ (iii) 0.1×35.5 (iv) 0.5×71

19. **(A)**

$A:\frac{1}{44}\times3N_A;\ B:\frac{1}{114}\times26N_A;\ C:\frac{1}{30}\times8N_A;\ D:\frac{1}{26}\times2N_A$

20. **(C)**

$\frac{9.2}{46}\times2=n\times1\Rightarrow n=0.4$ $\therefore$ $wt=0.4\times30=12g$

21. **(D)**

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

22. **(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.

23. **(D)**

1 gram molecule: 44 g

1 molecule of CO_2 = 44 amu

24. **(A)**

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

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

$\therefore n_C : n_H = 1:5$

25. **(D)**

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

26. **(D)**

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

27. **(D)**

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

100g original 'w' grams

8 % of w = water

i.e. 92 % of w = silica others

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

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

28. **(C)**

M_3N_2. 28 % nitrogen

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

29. **(D)**

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

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

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

30. **(A)**

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

$x = 9\%$

31. **(B)**

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

32. **(C)**

Moles of $Ca(OH)_2 = \frac{6.023\times10^{23}}{6.023\times10^{23}} = 1$

Moles of HCl = $\frac{3.01\times10^{22}}{6.02\times10^{23}} = 0.05$

$HCl = \frac{3.01\times10^{22}}{6.02\times10^{23}} = 0.05$

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

1	2	1
1	0.05	$\frac{0.05\times1}{2} = 0.025$
	(L.R.)	

33. **(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 $= \frac{0.01}{82\times10^{-3}} = 0.12M$

34. **(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 $F_2 = \frac{19}{19}\times6.022\times10^{23} \simeq 1\times10^{23}$

35. **(C)**

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

36. **(C)**

Avogadro hypothesis

37. **(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.

38. **(D)**

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

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

$= 2.67\times10^{21}$

39. **(D)**

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

40. **(B)**

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

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

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

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

41. **(D)**

Moles of Al = $27/27 = 1$

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

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

FOUNDATION BUILDER (SUBJECTIVE)

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

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

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

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

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

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

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

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

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

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

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

Atomic mass = 40

6. no. of atoms = $\dfrac{\text{wt}}{\text{wt of one atom}} = \dfrac{1}{3.98\times10^{-23}}$
$= 2.5\times10^{22}$

7. $\omega_{\text{removed}} = 10^{21}\times 44\,\text{amu} = 7.35\times10^{-2}\,\text{g}$
$\therefore \omega_{CO_2,\text{remaining}} = 200 - 73.5 = 126.5\,\text{mg}$
$\therefore n_{CO_2} = \dfrac{126.5\times10^{-3}}{44} = 0.002875$

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

9. $n_O = n_{SO_2}\times 2 = \dfrac{3.2\times10^{-3}}{64}\times 2 = 10^{-4}$ moles
$n_S = n_{Na_2S_2O_3.5H_2O}\times 2 = 2\times5\times10^{-3} = 10^{-2}$
$\therefore n_O : n_S = \dfrac{10^{-4}}{10^{-2}} = 0.01$

10. $n_O = 3\times n_{NaNO_3} + 2\times n_{NO_2}$
$= m\times(10m) + 2\times\dfrac{1}{6} = 0.03 + 0.333 = 0.363$
$n_N = n_{NaNO_3} + n_{NO_2} = 10\times10^{-3} + \dfrac{1}{6}$
$= 0.01 + 0.166$
$= 0.176$

11. $t(s) = \dfrac{6\times10^{23}}{10^{6}} = 6\times10^{17}\ \text{s}$
$t(hr) = \dfrac{6\times10^{17}}{3600} = 1.67\times10^{14}$
$t(yr) = \dfrac{1.67\times10^{14}}{24\times365} = 1.9\times10^{10}$ years

12. atomic wt = $6.644\times10^{-23}\times6\times10^{23}$
= 40 g/mol
$\therefore n = \dfrac{40\times1000\,\text{g}}{40\,\text{g/mol}} = 1000\,\text{moles}$

13. $n_C = \dfrac{10^{-6}\,\text{g}}{12\,\text{g/mol}}$
No. of atoms = $n_C\times6\times10^{23} = 5\times10^{16}$

14. r = 0.1 inch = 0.254 cm
$\omega_{Fe} = \dfrac{85.6}{100}\times\omega_{\text{ball}}$

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

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

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

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

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

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

16. $V_{NH_3} = n_{NH_3} \times 22.7\,L$

$= \frac{3.4}{17} \times 22.7 = 4.54\,L$

17. $n_{O_2} = \frac{PV}{RT} = \frac{1 \times 1}{0.0821 \times 273} = 0.04464$

$\therefore n_{moleculs} = n_{O_2} \times N_A = 2.69 \times 10^{22}$

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

$Vml \;\; (600 - V)\,mL$

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

$\therefore$ 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

$\therefore K_2Mn\,P_2$

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

$$6.02\times10^{23}\xrightarrow{\text{weight}}\text{mol.wt.}$$
$$\therefore \text{mol. wt}=207.33\,\text{g}$$
$$\Rightarrow 131.3+19n=207.3\Rightarrow n=4$$

22. $$\omega_C=\frac{58.97}{100}\times102=59.9\Rightarrow n_C=5$$
$$\omega_H=\frac{13.81}{100}\times102=14.08\Rightarrow n_H=14$$
$$\omega_N=\frac{27.42}{100}\times102=27.97\Rightarrow n_N=2$$
$$\therefore C_5H_{14}N_2$$

23. $$\omega_C=\frac{12}{44}\times\omega_{CO_2}=\frac{12}{44}\times0.9482=0.2586$$
$$\therefore n_C=0.02155$$
$$\omega_H=\frac{2}{18}\times\omega_{H_2O}=0.02154$$
$$\therefore n_H=0.02154$$
$$n_C:n_H=1:1\quad\therefore CH$$

24. $$\omega_{Co}=\frac{12}{100}\times\omega_{cylinder}$$
$$\omega_{cylinder}=\pi r^2h\times\text{density}$$
$$=(3.14\times6.25\times10)\times8.2=1610.7$$
$$\therefore\frac{\omega_{Co}}{58.9}=n_{Co}=\frac{1}{58.9}\times\frac{12}{100}\times1610.7=3.28$$
$$\therefore \text{no.of atoms}=3.28\times6\times10^{23}$$
$$\approx1.98\times10^{24}$$

25. Mol. Wt = wt of 1 mole mix = 2VD = 76.6
(x mol. NO_2 + (1 – x) mol. N_2O_4) = 76.6 g
$$\therefore x\times46+(1-x)\times92=76.6$$
$$x=\frac{15.4}{46}=n_{NO_2}\text{ in 1 mole}=0.335$$
$$n_{mix}\text{ in}100\,\text{g}=\frac{100}{76.6}$$
$$\therefore n_{NO_2}\text{ in}100=0.335\times n_{mix}$$
$$=0.437$$

26. $$\text{molality}=\frac{n}{\omega_{solvent}}\times1000$$

Consider 1L of solvent

C_2H_5OH
mol.wt = 46

n = 8
$$\omega_{solvent}=(1.025\times1000)-(8\times46)=657$$

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

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

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

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

$= 40.816\%$

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

$\omega :$ 20g 10g

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

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

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

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

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

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

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

$= 0.03394 \qquad = 0.08$

L.R.

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

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

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

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

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

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

$n_1 = 0.01$

$n_2 = 0.01$

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

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

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

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

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

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

37. POAC on Cl (eventually on completion)

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

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

$$= 3.5 \text{moles}$$

38. $1g\ KClO_3$ decomposes along two paths:

- n_1 moles $\rightarrow KCl + O_2$
- n_2 moles $\rightarrow KClO_4 + KCl$

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

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

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

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

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

$$= 49.789\%$$

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

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

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

$= 6.125g/L$

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

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

45. $n_{SO_4^{2-}} = n_{H_2SO_4} = \left(\frac{100}{1000}\right) \times 0.001M = 10^{-4}$

$\therefore \text{no. of ion } = n_{SO_4^{-2}} \times n_A = 6 \times 10^{19}$

46. $n_{CuSO_4.5H_2O} = n_{Cu^{2+}} = 0.5 \times 0.01 = 5 \times 10^{-3}$

weight $= n \times \text{mol.wt} = 5 \times 10^{-3} \times 249.5$

$= 1.2475g$

47. $M_1V_1 + M_2V_2 = M_3V_3$

$\therefore M_{final} = M_3 = \frac{50 \times 0.5 + 75 \times 0.25}{50 + 75}$

$= 0.35 \text{Molar}$

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

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

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 $n_{C_6H_6} = 0.8$

$$\therefore \text{molality} = \frac{n_{I_2}}{\omega_{C_6H_6}} \times 1000$$

$$= \frac{0.2}{0.8 \times 78} \times 1000 = 3.205\text{m.}$$

50. Consider 1L solution.

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

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

$$\text{Molailty} = \frac{n_{KCl}}{V_{\text{solution}}^{(mL)}} \times 1000$$

$$= \frac{106/74.5 \times 1000}{1000} = 1.4228\text{M}$$

51. $30\% NH_3. \Rightarrow 70\%$ water.

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

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,

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

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

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

$$\text{molality} = \frac{n_{\text{ethanol}}}{\omega_{\text{solvent}}} \times 1000$$

$$= \frac{8}{(1025 - 368)} \times 1000$$

$$= 12.176\text{molal}$$

53. $$2SO_2 + O_2 \rightarrow 2SO_3$$

$$nSO_2 = nSO_3 \Rightarrow nSO_3 = 5$$

54. $$4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$$

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

So moles of $Fe_2O_3 = \frac{1}{2} \times 2.5$

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

Wt $NH_3 = 4 \times 17 = 68\,g$

56. $2H_2 + O_2 \rightarrow 2H_2O$

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

LR

$wt\,H_2O$ formed $= 0.90625 \times 2 \times 18 = 32.625\,g$

$wt\,H_2$ left $= (3 - (0.90625 \times 2)) \times 2 = 2.375\,g$

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

$w = 226\,g$

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

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

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

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

$= 4.856\%$

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

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

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

$\therefore ^{V} CO_2 = \frac{2}{9} \times 22.4L = 4.977L$

60. acid is H_3A. salt is Ag_3A

$1\,mole\,Ag_3A \rightarrow 3\,mole\,Ag$

$\therefore n_{Ag_3A} = \frac{n_{Ag}}{3} = \frac{0.37/108}{3} = 0.00114$

$\therefore \frac{0.607}{mol.wt\,of\,Ag_3A} = 0.00114$

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

$\therefore A = 207$

$\therefore wt\,of\,H_3A = 210$

GET EQUIPPED FOR JEE ADVANCE

ONE OPTION CORRECT

1. **(A)**

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

say, wt : 14x   3x

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

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

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)**

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

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

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

5. **(C)**

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

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

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

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

6. **(C)**

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

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

$$\text{wt of one atom } = \frac{\text{at.wt}}{\text{N}_\text{A}} = \frac{16}{\text{N}_\text{A}}.$$

7. **(A)**

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

POAC on I

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

POAC on Cl

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

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

8. **(D)**

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

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

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

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

9. **(D)**

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

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

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

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

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

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

10. **(C)**

At mass $= N_A \times \text{mass of an atom}$

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

11. **(C)**

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

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

12. **(D)**

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

(iv) 80 g-molecule = 80 Moles

$= 80\times98$

$= 7840g$

13. **(B)**

6 : 4

14. **(A)**

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

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)**

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

18. **(B)**

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

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

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

19. **(A)**

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

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

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

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 $n_2 = 0.0052$

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

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

23. **(A)**

$C_7H_6O_3 + C_4H_6O_3 \rightarrow C_9H_8O_4 + C_2H_4O_2$

$\omega : 2g \quad 4g$

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

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

$= 2.69$

$\therefore \%yeild = 80.76\%$

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)**

in 10 mL $CuCl_2 = n_1$, and $CuBr_2 = n_2$

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

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

and $(2n_1 + 2n_2)188 = 1.005g$

then $n_1 = 0.00115$ and $\omega_{cuBr_2} = 0.35g$

$\therefore 25\%$ and 58%

27. **(A)**

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

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

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

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

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

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

28. **(B)**

$M_{AgNO_3} = \dfrac{0.0125/(39+80)}{1mL} = 0.0105M$

$\therefore 0.0105 \times \dfrac{42.5}{1000} = n_{AgNO_3}$

$= 0.00446$

$n_{AgNO_3} = n_{\underset{n_1}{\underset{\downarrow}{NaBr}}} + 2n_{\underset{n_2}{\underset{\downarrow}{Na_2SO_4}}}$

$\therefore n_1 + 2n_2 = 0.00446$

also, $n_1 \times 103 + n_2 \times 142 = 2/5\left(\omega t \text{ of } {}^1\!/\!_5{}^{th} \text{ portion}\right)$

29. **(A)**

Let acid be HA

Salt: $BaA_2.2H_2O$

$BaA_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HA$

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

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

30. **(B)**

total moles =n (say)

$0.15n = moles\ of\ CH_3COOH$

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

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

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

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

31. **(A)**

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

$$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$$
$\quad n_2\ moles$

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

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 $C_2H_6 = 67\%[A]$

32. **(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

33. **(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 $= N_A \times V_{mol} \times desnity$

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

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

<u>More than one correct</u>

1. **(ABD)**

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

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

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

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

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

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

2. **(AB)**

mol. wt = wt of 22.4 L=28.896 g

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

3. **(ABD)**

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

4. **(ACD)**

	$Ca\left(NO_3\right)_2$ +	$Na_2C_2O_4 \longrightarrow$	CaC_2O_4 +	$2NaNO_3$
millimoles :	6	3	-	-
	3	LR	3	6

5. **(AC)**

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

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

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

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

6. **(AC)**

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

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

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

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

7. **(ABD)**

Obvious A,B,D $\left(n_H=4\right)$

8. **(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 $=4\times 3\times N_A=72\times 10^{23}$

9. **(AB)**

Obvious :

10. **(BC)**

obvious others depend on volume

11. **(CD)**

$\text{HCl} + \text{NaOH}\longrightarrow \text{NaCl}+\text{H}_2\text{O}$

50×0.1 $\quad 50\times 0.1$

Final conc. Of NaCl

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

$=0.05\text{M}$

Solutions is neural so

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

12. **(BC)**

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

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

13. **(AD)**

100×0.05

$=200\times 0.025$

14. **(CD)**

Hence

Mol. Wt $=\frac{14}{11.2}\times 22.4=28$

<u>Match the following</u>

1. **I – P, II – A, III - C, IV – E**

(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 – S, b – S, c- Q, d – R**

(a) $\frac{w_{SO_2}}{W_{o_2}}=2(s)$

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

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

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

3. **a – PS, b – S, c – PQ, d – R**

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

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

Total =0.12 M

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

(P), (S)

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

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

(S)

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

[P], [Q]

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

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

$\left[H^{+}\right]=\frac{1}{200}\times1000=5M$

$\left[SO_4{}^{2-}\right]=\frac{1/2}{200}\times1000=2.5M$

[R]

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

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

$w_{SO_2}=32g$

total atoms $=\frac{1}{2}\times2\times N_A$

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

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

(C) no. of atoms $=0.5\times3\times N_A=1.5N_A$

[P], [Q], [R]

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

Atoms $=12\times10^{23}$

$wt=32g$ [S]

COMPREHENSION TYPE

Passage 1

1. **(C)**

wt of 1 atom $=1\text{amu}=1.66\times10^{-24}\text{g}.$

2. **(A)**

$\text{n}_\text{S}=\text{n}_{\text{H}_2\text{SO}_4}=100\therefore\text{ wt}=3200\text{g}.$

3. (B)

$\frac{3.4}{100}\times(\text{M})=\omega_\text{s}=2\times32\Rightarrow\text{M}=1882.3$

4. **(B)**

$\text{C}+\text{O}_2\rightarrow\text{n}_\text{C}=\text{n}_\text{C}=\text{n}_{\text{O}_2}=1$

$\Rightarrow\text{V}_{\text{O}_2}=\frac{20}{100}\times\text{V}_\text{air}=22.4\text{C}\Rightarrow\text{V}_\text{air}=112\text{L}$

Passage – 2

1. **(A)**

Consider 1 L.

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

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

$\therefore d = 1.2889 g/mL.$

2. **(C)**

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

$\Rightarrow M_{H_2SO_4} = 0.06$

3. **(A)**

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

4. **(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

1. **(D)**

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

2. **(A)**

Avogadro's law.

3. **(C)**

obvious Mass is 16amu.

4. **(A)**

obvious

Passage – 4

1. **(A)**

$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

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

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

2. **(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 $10\bar{e}$.

$\therefore 5\,\text{moles.}$

2. **(3)**

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

$n_C = 3$

3. **(3)**

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

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

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

$M \approx \frac{6.4}{0.57} = 112s$ (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)**

$CO_2 \rightarrow C_6H_{10}O_5$

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

$1 g\,strach$

POAC on carbon

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

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

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

EXPERTISE ATTAINERS

1. $(0.156\,g)$,**(1.172 g)**

POAC on Co

$n_{Co_3O_4} \times 3 = n_{Co} \times 1$

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

$n_{PPt} \times 1 = n_{Co}$

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

2. **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) $0.5g\,Fe \longrightarrow Fe_2O_3\,(n)$

$n \times 2 = \frac{0.5}{56} \Rightarrow n = 4.46 \times 10^{-3}$

$\Rightarrow\ \omega_{Fe_2}O_3 = 0.7142\,g$

3. **(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, $n_1 \times 58.5 + n_2 \times M = 1\,\text{gram}$

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

4. $(C_2H_4Cl_2)$

$C_xH_yCl_z + O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O + \frac{z}{2}Cl_2$

$\left(\dfrac{0.22}{12x+y+35.5Z}\right)\times(x) = {}^{n}CO_2 = \dfrac{0.195}{44}$ ....(1)

$\left(\dfrac{0.22}{12x+y+35.5z}\right)\times\left(\dfrac{y}{2}\right) = {}^{n}H_2O = \dfrac{0.0804}{18}$ .....(2)

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

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

$C_2H_4Cl_2$

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

$\underset{n_1}{N_2}, \underset{n_2}{NO_2}, \underset{n_3}{N_2O_4}$

$n_1 + n_2 + n_3 = 1$

Now, after heating, ${}^{n}NO_2 = n_2 + 2n_3$

$\left(N_2O_4 \xrightarrow{\Delta} 2NO_2\right)$

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

New Average mol. Wt $= 39.57$

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

$\therefore\ n_3 = 0.4$

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

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

also $n_1 + n_2 + n_3 = 1$

$\therefore\ n_1 + n_2 = 0.6$ ....(2)

Solving (1) and (2),

$n_1 = 0.5$, and $n_2 = 0.1$

$\therefore\ 5:1:4$

6. $\dfrac{{}^{n}IO_3^-}{1} = \dfrac{{}^{n}HSO_3^-}{3} \Rightarrow {}^{n}HSO_3^- = \dfrac{3\times 5.8}{(23+127+48)} = 0.8788$

$\therefore\ w_{NaHSO_3} = 9.139\,g$

${}^{n}I^-$ in $1^{st} = {}^{n}IO_3^- = \dfrac{5.8}{198}$

$\dfrac{{}^{n}IO_3^-}{1} = \dfrac{{}^{n}I^-}{5} \Rightarrow {}^{n}IO_3^- = 0.00586$

$M_{NaIO_3} = 5.8/(198)$

$\therefore V = \frac{^{n}IO_3^-}{M_{IO_3^-}} = 0.2L = 200\,mL$

7. $AgNO_3 + KI \rightarrow KNO_3 + AgI$

$2KI + KIO_3 + 6HCl \rightarrow 3ICl + 3KCl + 3H_2O$

$\frac{M_{KI} \times V_{KI}}{2} = \frac{^{n}KIO_3}{1} \Rightarrow \frac{M_{KI} \times 20}{2} = \frac{30 \times \frac{1}{10}}{1}$

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

Now, $\frac{^{n}KI, excess}{2} = \frac{^{n}KIO_3}{1} \Rightarrow ^{n} KI, excess = 10\,m\,mole$

Original KI $= 50 \times 0.3 = 15\,m\,mole$

$\therefore KI(used) = 5\,m\,mole$

$\therefore {}^{n}AgNO_3 = {}^{n} KI(used) = 5mmole \Rightarrow w\,(AgNO_3) = 0.85\,g$

$\therefore$ purity $= 85\%$

8. Let % of boron will at. Wt. 10.0 = x
Let % of boron will at. Wt. 11.01 = (100 – x)

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

$\Rightarrow \quad x = 20\%$

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

$\frac{w}{M_{Nacl}} + \frac{0.118 - w}{M_{kCl}} = \frac{0.2451}{M_{Agcl}}$

$\frac{w}{58.5} + \frac{0.118}{74.5} = \frac{w}{74.5} = \frac{0.2451}{143.5}$

w = 0.0338 gm
Nacl = 0.0338 gm   kcl = 0.0842 gm

$n_{nacl} = 5.777 \times 10^{-4}$

$n_{kcl} = 1.13 \times 10^{-3}$

POAC on Na; moles of $Na_2O \times 2$
= moles of $NaCl \times 1$

$\Rightarrow \quad n_{Na_2O} = \left(\frac{5.777 \times 10^{-4}}{2}\right); \qquad n_{k_2O} = \left(\frac{1.13 \times 10^{-3}}{2}\right)$

Weight of $Na_2O = \frac{5.777 \times 10^{-4}}{2} \times 62 = 0.01\,gm$

Weight of $k_2o = \frac{1.13 \times 10^{-3}}{2} \times 94 = 0.1062$

% Na_2O = 3.58%.   % k_2o = 10.62 %

10. C_xH_y

$$C_xH_y + (x + y/x)o_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$$

POAC on carbon

$5 \times x = (\text{vol.of } CO_2) \times 1$

Now 1 vol. of CO_2 = 10 mL (that obtained by kOH)

$\Rightarrow \quad x = 2$

Vol. of O_2 reactionary = 15 ml

Vol. of O_2 reacted = 15 ml

$\Rightarrow$ 1 ml of C_xH_y react with (2 + y/x) ml O_2

$\Rightarrow$ 5 ml of C_xH_y react with (2 + y/x) = ml 15 (given)

$\Rightarrow$ y = 4

$\therefore$ formula = C_2H_4

11. (a)

$CO_2 + C \longrightarrow 2CO$

POAC on carbon

Let CO = x l

CO_2 = (1 – x) l

$\Rightarrow \quad x \times 1 + 2(1 - x) = 1.6 \times 1$

$\Rightarrow$ 2 – x = 1.6 = 1

x = 0.4 l & (1 – x)0.6 L

(b)

The molecular formula = M_3N_2

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

Where x = atomic wt of metal

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

12. $C_2H_5 \xrightarrow[90\% \text{ yield}]{\text{monobromination}} \text{pat1} \longrightarrow 85\% \text{yeild} C_4H_{10}(55\text{gm})$

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 gms

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

13. (1.7 g)

Heating below 600^0C converts $Pb(NO_3)_2$ into PbO but to

$NaNO_3$ into $NaNO_2$ as:

$$Pb(NO_3)_2 \xrightarrow{\Delta} PbO(s) + 2NO_2 \uparrow + \frac{1}{2}O_2 \uparrow$$

MW: 330 222

$$NaNO_3 \xrightarrow{\Delta} NaNO_2(s) + \frac{1}{2}O_2 \uparrow$$

MW: 85 69

Weight loss $=5\times\frac{28}{100}=1.4g$

$\Rightarrow$ Weight of residue left $=5-1.4=3.6g$

Now, let the original mixture contain x g of $Pb(NO_3)_2$

$\because$ 330g $Pb(NO_3)_2$ gives 222g PbO

$\therefore$ x g $Pb(NO_3)_2$ will give $\frac{222x}{330}$ g PbO

Similarly, 85g $NaNO_3$ gives 69g $NaNO_2$

$\Rightarrow (5-x)$ g $NaNO_3$ will give $\frac{69(5-x)}{85}$ g $NaNO_2$

$\Rightarrow$ Residue : $\frac{222x}{330}+\frac{69(5-x)}{85}=3.6g$

Solving for x gives, $x=3.3\,g\ Pb(NO_3)_2$

$NaNO_3=\mathbf{1.7\,g}$.

14. Molarity of solution = 0.25 M molality = 0.24 m Mole fraction of Na_2SO_4= 4.3×10^{-3}

Molar mass of Glauber salt $(Na_2SO_4.10H_2O)$

$=23\times2+32+64+10\times10\times18=322\,g$

$\Rightarrow$ mole of $Na_2SO_4.10H_2O$ in 1.0 L solution

$=\frac{80.575}{322}=0.25$

$\Rightarrow$ molarity of solution $=0.25M$

Also, weight of 1.0 L solution $=1077.2\,g$

Weight of Na_2SO_4 in 1.0 L solution $=0.25\times142=35.5\,g$

$\Rightarrow$ weight of water in 1.0 L solution $=1077.2-35.5$

$=1041.7\,g$

$\Rightarrow$ molality $=\frac{0.25}{1041.7}\times1000=\mathbf{0.24\,m}$

15. $0.5\times10^{-18}\ m^2$

Initial millimol of $CH_3COOH=100\times0.5=50$

Millimol of CH_3COOH remaining after adsorption

$=100\times0.49=49$

$\Rightarrow$ millimol of CH_3COOH adsorbed $=50-49=1$

$\Rightarrow$ number of molecules of CH_3COOH adsorbed

$=\frac{1}{1000}\times6.023\times10^{23}$

$= 6.023 \times 10^{20}$

$\Rightarrow$ area covered up by one molecule $= \dfrac{3.01 \times 10^{2}}{6.02 \times 10^{20}}$

$= \mathbf{5 \times 10^{-19}\, m^2}$

16. **(2)**

Partial pressure of $N_2 = 0.001$ atm,

$T = 298K,\ V = 2.46\ dm^3$

From ideal gas law: $pV = nRT$

$$n(N_2) = \frac{pV}{RT} = \frac{0.001 \times 2.46}{0.082 \times 298} = 10^{-7}$$

$\Rightarrow$ No. of molecules of $N_2 = 6.023 \times 10^{23} \times 10^{-7}$

$= 6.023 \times 10^{16}$

Now, total surface sites available $= 6.023 \times 10^{14} \times 1000$

$= 6.023 \times 10^{17}$

Surface sites used in adsorption $= \dfrac{20}{100} \times 6.023 \times 10^{17}$

$= 2 \times 6.023 \times 10^{16}$

$\Rightarrow$ Sites occupied per molecules $= \dfrac{\text{Number of sites}}{\text{Number of molecules}}$

$= \dfrac{2 \times 6.023 \times 10^{16}}{6.023 \times 10^{16}} = \mathbf{2}$

WINDOW TO JEE MAIN

1. **(A)**

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

$V_{solution}$ is affected by Temperatuere.

2. **(C)**

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

No. of atoms = 10 N_A

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

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

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 $= C_3H_4N \times 2$

$= C_6H_8N_2$

4. **(D)**

$$2BCl_3 + 3H_2 \rightarrow 2B + 6HCl$$

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

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 $e^- = 1\times2+8=10$
Number of $n^0 = 1\times2+8=10$
($\because$ 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
$=1000\times1.252$
= 1252 g
Mass of solute = No. of mole $\times$ molar mass of NaCl
$=3\times58.5\text{g}$
= 175.5 g
Mass of solvent = (1252 – 175.5)g
= 1076.5 g
= 1.076 kg

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

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

18. **(A)**

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

$$=\frac{10\times2+200\times0.5}{200+10}$$

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

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

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
$=\dfrac{20.8}{208}\text{mole}$	$=\dfrac{4.9}{98}\text{mole}$	$=0.05\times233\text{gm}$
$=0.1\text{mole}$	$=0.05\text{mole}$	$=11.65\text{gm}$

21. **(B)**

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

$= 1000\text{ml}$

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

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

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

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

Wt. adsorbed by 3gm $= 9 \times 10^{-4} \times 60\text{ gm}$

$= 0.054\text{gm}$

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

$= 18\text{mg}$

24. **(C)**

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

= $\frac{6}{60}$ 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 $AB_2C_3 = \frac{4.8}{0.012} = 400$

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

$x = 50$

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

WINDOW TO JEE ADVANCED

1. **(C)**

$$\frac{\text{Weight of a compound in gram}(w)}{\text{Molar mass}(M)} = \text{Number of moles}(n)$$

$$= \frac{\text{Number of molecules}(N)}{\text{Avogadro number}(N_A)}$$

$\Rightarrow$ $\frac{w(O_2)}{32} = \frac{N(O_2)}{N_A}$ .... (i)

And $\frac{w(N_2)}{28} = \frac{N(N_2)}{N_A}$ .... (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

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2(g)\uparrow$$

$$Zn + 2NaOH + 2H_2O \rightarrow Na_2\left[Zn(OH)_4\right] + H_2(g)\uparrow$$

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

$$Ag_2CO_3(s) \xrightarrow{\text{Heat}} 2Ag(s) + CO_2(g) + \frac{1}{2}O_2(g)$$

$$MW = 276g \qquad\qquad 2\times108 = 216g$$

Hence, $2.76g$ of Ag_2CO_3 on heating will give

$$\frac{216}{276}\times2.76 = 2.16g \text{ Ag as residue.}$$

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

$$\frac{2}{3}\times0.5 = 0.33 \text{ mole of } Na_3PO_4$$

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 $\frac{1}{2}\times0.2$

$= 0.1$ 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 $= 9.108\times10^{-31}\text{kg}$

$\because 9.108\times10^{-31}\text{kg} = 1.0$ electron

$\therefore \quad 1\text{kg} = \dfrac{1}{9.108\times10^{-31}}$ electrons

$= \dfrac{10^{31}}{9.108}\times\dfrac{1}{6.023\times10^{23}}$

$= \dfrac{1}{9.108\times6.023}\times10^{8}$ mole of electrons.

10. **(A)**

Number of atoms = number of moles

$\times$ Avogadro's number $\left(N_A\right)$

$\Rightarrow$ Number of atoms in 24 g $C = \dfrac{24}{12}\times N_A = 2N_A$

Number of atoms in 56 g of $Fe = \dfrac{56}{56}N_A = N_A$

Number of atoms in 27 g of $Al = \dfrac{27}{27}N_A = N_A$

11. **(B)**

From the given relative abundance, the average atomic weight of Fe can be calculated as

$$A = \frac{54\times5+56\times90+57\times5}{100} = 55.95$$

12. **(C)**

$$M = \frac{\text{Moles of solute}}{\text{Vol of solution}\left(m\ell\right)}\times1000$$

Moles of solute $= \dfrac{120}{60} = 2$

Vol. of solution $= \dfrac{\text{mass of solution}}{\text{density}}$

$= \dfrac{120+1000}{1.15} = 973.913$

$$M = \frac{2}{973.913}\times1000 = 2.053$$

13. **(C)**

$$\frac{W_{O_2}}{W_{N_2}} = \frac{1}{4}$$

$$\frac{n_{O_2}}{n_{N_2}} = \frac{\dfrac{w_{O_2}}{32}}{\dfrac{w_{N_2}}{28}}$$

$= \dfrac{28}{32}\times\dfrac{1}{4} = 7/32$

$$N_{O_2} : N_{N_2} = n_{O_2} : n_{N_2} = 7:32$$

FILL IN THE BLANKS

1. **(C-12 isotope)**

Carbon -12 isotope. According to modern atomic mass unit, one atomic mass unit (amu) is defined as one – twelfth of mass of an atom of C – 12 isotope, ie,

$$1 \text{ amu } (u) = \frac{1}{12} \times \text{weight of an atom of C} - 12 \text{ isotope.}$$

2. **(6.023×10^{24})**

Considering density of water to be $1.0\,g/mL$, 18mL of water is 18 g (1.0 mol) of water and it contain Avogadro number of molecules. Also one molecule of water contain

2 (one from each H atom) + 8 (from oxygen atom)

$= 10$ electrons.

$\Rightarrow$ 1.0mole of H_2O contain $= 10 \times 6.023 \times 10^{23}$

$= 6.023 \times 10^{24}$ electrons.

3. **(0.4 m)**

$$\text{Molarity} = \frac{\text{Number of moles of solute}}{\text{Volume of solution in litre}}$$

$$= \frac{\text{Weight of solute}}{\text{Molar mass}} \times \frac{1000}{\text{Volume in mL}}$$

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

4. **(4.14g)**

Molar mass of $CuSO_4.5H_2O$

$= 63.5 + 32 + 4 \times 16 + 5 \times 18$

$= 249.5\,g$

Also, molar mass represents mass of Avogadro number of molecules in gram unit, therefore,

$\because 6.023 \times 10^{23}$ molecules of $CuSO_4.5H_2O$ weigh 249.5 g

$\therefore 10^{22}$ molecules will weigh $\dfrac{249.5}{6.023 \times 10^{23}} \times 10^{22} = 4.14g$

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, $k = \dfrac{R}{N_A}$ 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 = $0.4\,\text{g}\,\text{mL}^{-1} \times 10^3\,\text{mL}$

$= 400$ g $= 0.4$ kg

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

$= 8$ m

4. **(9)**

$$\text{m}\left(\text{molality}\right) = \text{M}\left(\text{molarity}\right)$$

$$\frac{0.1}{\left(\frac{0.9\text{M}_{\text{solvent}}}{1000}\right)} = \frac{0.1}{\left(\frac{0.1\text{M}_{\text{solute}} + 0.9\text{M}_{\text{solvent}}}{2 \times 1000}\right)}$$

$$\frac{1}{9\text{M}_{\text{solvent}}} = \frac{2}{\text{M}_{\text{solute}} + 9\text{M}_{\text{solvent}}}$$

$$\frac{\text{M}_{\text{solute}}}{\text{M}_{\text{solvent}}} = 9$$