MOLE CONCEPT
SOLUTIONS
LEVEL – 1

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

10. **(D)**

11. **(C)**

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

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

Hence NO.

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

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

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

15. **(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} .

16. **(D)**
(A) $\frac{22.4\times10^3}{22400}\times NA = 6.022\times10^{23}$

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

17. **(C)**
Number of gms of $H_2SO_4 = 0.25\times98 = 24.5$

18. **(D)**
Moles of $H_2 = \frac{1}{2} = 0.5$

Volume of H_2 in l = $0.5\times22.4 = 11.2l$.

19. **(D)**

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

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

20. **(A)**

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

21. **(C)**

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

22. **(B)**

23. **(B)**

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

24. **(C)**

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

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

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

25. **(A)**

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

26. **(B)**

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

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

27. **(A)**

A:12 g ; $B=\frac{1}{2}\times16=8\,g$; C : 10 g ; $D=\frac{16}{2}=8\,g$

28. **(D)**

$A:2.5\times5N_A=12.5\,N_A$; $B:10N_A$; $C:4\times3N_A=12N_A$; $D=1.8\times8N_A=14.4N_A$.

Hence [D]

29. **(C)**

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

30. **(B)**

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

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

31. **(D)**

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

32. **(C)**

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

33. **(D)**

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

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

34. **(C)**

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

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

35. **(C)**

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

36. **(B)**

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

37. **(C)**

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

38. **(A)**

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

39. **(D)**

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

$\therefore$ atom = $0.12N_A \Rightarrow$ [D]

40. **(B)**

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

Each contain (12 + 6 + 24) protons

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

41. (B)

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

42. (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) $1ml \simeq 1g$ water

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

43. (B)

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

44. (A)

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

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

45. (B)

Say $n_{Mg_3(PO_4)_2} = n$; then $n_O = 8n$

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

46. (B)

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

47. (C)

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

48. (C)

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

Hence I_2O_5.

49. (C)

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

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

50. **(A)**

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

51. **C = 75%** **H = 25%**

$C = \frac{75}{12}$: $H = \frac{25}{1}$

3 : 12

1 : 4 CH_4

52. $S = 50\%$ $0 = 50\%$

$S = \frac{50}{32}$: $0 = \frac{50}{16}$

1 : 2

SO_2

53. $C = 80\%$: $H = 20\%$

$C = \frac{80}{12}$: $H = \frac{20}{1}$

1 : 3

$CH_3 \Rightarrow C_2H_6$

54 . **(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

55. **(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.

56. **(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 $H_3PO_4 = \frac{2\times1.724}{3}\times98 = 112.6g$

57. **(D)**

$n_{H_2O} = n_{CH_3OH}\times2 = 4 \qquad \therefore wt = 4\times18 = 72g$

58. **(A)**

$Ag_2CO_3 \xrightarrow{\Delta} 2Ag$

$\therefore W_{Ag} = \frac{2.7}{(216+60)}\times2\times108 = 2.11g$

59. **(D)**

$n_{CO_2} = 2\times n_{C_2H_5OH} = 2$

$\therefore W_{CO_2} = 2\times44 = 88g$

60. **(A)**

$n_{Fe} = \frac{2}{3}\times n_{H_2O} = \frac{2}{3} \qquad \therefore W_{iron} = \frac{2}{3}\times56 = 37.39$

61. **(D)**

	$3BaCl_2$	$+2Na_3PO_4$	$\rightarrow Ba_3(PO_4)_2$	$+6NaCl$
Moles	3	2	1	6
	0.5	0.2	$\frac{1\times0.2}{2} = 0.1$	
		(L.R.)		

62. **(A)**

$Ca(OH)_2 + H_2SO_4 \longrightarrow CaSO_4 + 2H_2O$

$Ca(OH)_2$: $\boxed{0.2}$ LR; H_2SO_4: 0.5

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

63. **(B)**

$A + 2B \longrightarrow C + 3D$

A: 5; B: $\boxed{8}$ LR

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

64. **(D)**

$n : 4Al + 3C \longrightarrow Al_4C_3$

Al: $\frac{1350}{27} = 50$ (L.R); C: $\frac{2400}{12} = 200$

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

65. (D)

$2A \longrightarrow 2B$

$B \longrightarrow 2C$

$3C \longrightarrow 4D$

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

$= \frac{32}{3}$

66. (B)

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

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

67. (D)

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

68. (A)

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

69. (B)

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

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

70. (A)

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

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

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

71. (A)

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

LEVEL – 2

1. **(A)**

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

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

2. **(C)**

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

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

3. **(A)**

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

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

Hence [A]

4. **(D)**

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

5. **(A)**

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

6. **(C)**

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

7. **(D)**

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

8. **(A)**

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

9. **(D)**

1 gram molecule: 44 g

1 molecule of CO_2 = 44 amu

10. **(D)**

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

11. **(D)**

12g H_2O	$\xrightarrow{\Delta}$	8% H_2O
45g silica		45g silica
43g others		43g others
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 $= \frac{45}{95.65} \times 100 = 47\%$

12. **(B)**

(A) atoms of $O_2 = \frac{2 \times 8}{32} \times 6.022 \times 10^{23} \sim 3 \times 10^{23}$

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

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

(D) atoms of $F_2 = \frac{19}{19} \times 6.022 \times 10^{23} \simeq 1 \times 10^{23}$

13. **(C)**
Avogadro hypothesis

14. **(A)**

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

Number of magnesium atoms = $0.00335 \times 6.022 \times 10^{23}$
$= 2.01 \times 10^{21}$ atoms.

15. **(D)**

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

Number of atoms $= 0.164 \times 10^{-3} \times 6.022 \times 10^{23} \times 27$ (1 Molecule has 27 atoms).
$= 2.67 \times 10^{21}$

16.

17. atomic mass $= \frac{3.98 \times 10^{-23}}{1.66 \times 10^{-24}}$
=24 amu

18. **1 mg of $_{210}$Po =** 4.762×10^{-6} mol
$= 28.7 \times 10^{17}$

$\frac{1}{200}^{th} \approx 1.5 \times 10^{16}$ atoms of lead

19. $\text{mole} = \frac{1.12\times10^{-10}}{22.4}$

No. of molecule = $0.05\times10^{-10}\times6.02\times10^{23}$

$=3\times10^{12}$

20. **All non zero digits are significant hence, there are 6 significant figures in 10.3406**

21. Mass of 1 atom = 1.8×10^{-22}

Mass of 6.02×10^{23}

$= 6.02\times10^{23}\times1.8\times10^{-22}$

$=108.36$

22. $CaCO_3 \Rightarrow \text{proton} = 20+6+24$

=50

Mole of proton $=0.1\times50$

=5

No. of proton $=5\times6\times10^{23}$

$=30\times10^{23}$

23. **(D)**

Density = 1gm / 1 cm^3

Molar mass of water = 18 gm / mol

Volume of 1 molar = $\frac{18cm^3/\text{mole}}{6.022\times10^{23}}$

$=2.989\times10^{-23}$

$3\times10^{-23}am^3$

24. **(D)**

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

25. **(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 = $\frac{1.1495}{1.34}\times100 = 85.78g$

26. **(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			$\frac{3\times1}{2}=1.5$

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

27. **(C)**

M_3N_2. 28 % nitrogen

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

28. **(A)**

$n_H=n\times2+2n\times4=10n$

$n_C=2n\times1=2n$

$\therefore n_C:n_H=1:5$

29. **(D)**

$$\frac{69.98}{100}\times\text{Mol.wt}=21\times12\Rightarrow \text{mol.wt}=360$$

30. **(D)**

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

i.e. $\frac{0.014}{100}\times M=2\times14=28$

$$\Rightarrow M=\frac{2800}{14\times10^{-3}}=2\times10^5$$

31. **(A)**

Average atomic mass = $\frac{90\times20+21x+22\times(10-x)}{100}=20.11$

x = 9%

32. **(B)**

A. A. M = Mole fraction of $O^{18}\times18+$ Mole fraction of $O^{16}\times16$

33. **(C)**

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

34. N = 26% O = 74%

$N=\frac{26}{14}$ $:0=\frac{74}{16}$

N_2O_5

35. (B)

$MxO_4 + yH_2 \rightarrow xM + yH_2O$

Mole of metal $= \frac{3.2}{64} = 0.05$

Mole of metal oxide $= \frac{3.6}{64x + 16y}$

1 mole of metal oxide gives x mole metal m

$\frac{0.05}{x} = \frac{3.6}{64x + 16y}$

$64x + 16y = 7$

$x = 2y$

M_2O

36. $(NH_4)_2 Cr_2O_7 = 252$

$NH_4^+ = 2 \times 18 = 36$

$\frac{36}{252} \times 100 = 14.24\%$

37. $VD = \frac{mol\ wt}{2}$ molar mass $= 140$

$x \times 28 = 140$

$x = 5$

38. (A)

$KClO_3 \xrightarrow{\Delta} KCl + {}^{3}\!/_{2} O_2 \quad , n_{O_2} = {}^{3}\!/_{2}$

$2Al + {}^{3}\!/_{2} O_2 \longrightarrow Al_2O_3$

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

39. (A)

	N_2	+	$3H_2$	$\longrightarrow$	$2NH_3$
n:	10		$\boxed{15}$ LR		–
	$10 - 5$		–		10 moles
	$n_{N_2} = 5$		$n_{H_2} = 0$		

40. (C)

$Fe_2(SO_4)_3 + 3BaCl_2 \longrightarrow 3BaSO_4 + 2FeCl_3$

n: ? ${}^{1}\!/_{2}$

$\frac{n_{BaCl_2}}{3} = \frac{n_{FeCl_3}}{2} \Rightarrow n_{BaCl_2} = \frac{{}^{1}\!/_{2}}{2} \times 3 = 0.75$ moles

41. **(C)**

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

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

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

$$\therefore \omega = 96g$$

42. **(A)**

CH_4	+	$2O_2$	$\longrightarrow$	CO_2	+	$2H_2O$
5		$\boxed{8}$		–		–
5 – 4 = 1		–		4		8

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

43. **(C)**

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

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

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

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

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

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

44. **(D)**

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

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

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

45. **(D)**

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

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

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

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

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

46. **(D)**

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

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

47. **(C)**

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

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

48. **(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.)

49. $CuH_{10} + \frac{13}{2}O_2 \rightarrow 4CO_2 + 5H_2O$

1 : $\frac{13}{2}$: 4 : 5

58gm $\frac{13}{2} \times 32 = 208$

$1000gm = \frac{208 \times 1000}{58}$

$= 3.58 \times 10^3 gm$

$= 3.58 kg$

50. $3C + \frac{3}{2}O_2 \rightarrow 3CO$

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

1 mole of Fe_2O_3 = $\frac{3}{2}$ mole of O_2

1.6 kg of Fe_2O_3 require O_2 = 480gm

51. $MCl_4 \rightarrow M + 4Cl$

$1 \quad : \quad 1 \quad : \quad 4$

$\frac{0.5}{4} \quad : \quad 0.5$

Mole of $MCl_4 = \frac{0.5}{4} = 25$ molar mass

52.

$3BaCl_2 + 2Na_2PO_4 \rightarrow Ba_3(PO_4)_2 + 6NaCl$

$3 \quad : \quad 2 \quad : \quad 1 \quad : \quad 6$

$0.3 \quad 0.2 \quad 0.1 \quad 0.6$

$Ba_3(PO_4)_2 = 0.1$

ans (d)

53.

$2H_2 + O_2 \rightarrow 2H_2O$

$2 \quad : \quad 1 \quad : \quad 2$

4 gm 32 gm 36 gm

$\frac{16}{32} = 0.5$ gm 4 gm 4.5 gm

54.

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

$2 \quad : \quad 1 \quad : \quad 3 \quad : \quad 2$

mole of $SO_2 = \frac{1.6}{64} = \frac{1}{40}$

mole of $H_2S = \frac{1.5 \times 10^{22}}{6 \times 10^{23}} = \frac{1}{40}$

$LR = SO_2$

ans (c)

55.

$H_2 + Cl_2 \longrightarrow 2HCl$

$1 : 1$

$12 - 11.2 = 0.8\ L$ $\quad 11.2 \quad$ $2 \times 11.2 = 22.4$

56.

$4Al + 3O_2 \longrightarrow 2Al_2O_3$

$4 : 3 : 2$

$\frac{0.5 \times 4}{3} \quad 0.5$

$\text{mole} = \frac{2}{3}$ $\quad$ mass of $Al = 27 \times \frac{2}{3} = 18\ gm$

57.

$(NH_4)_2PO_4 \longrightarrow N = 2 \quad H = 8 \quad P = 1 \quad O = 4$

$1 : 2 : 8 : 1 : 4$

$3.18 \quad 1.06$

$O = 1.06$ mole

58. **(A)**

Consider 1 L solution

$$\frac{29}{100} \times (d \times 1000) = \omega_{H_2SO_4} = 3.6 \times 98$$

$\therefore$ d = 1.22 g/mL

59. **(D)**

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

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

$$\therefore \omega = 0.9375\ g$$

60. **(B)**

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

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

61. **(A)**

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

Weight of solvent = 100 – 1.595 = 98.505

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

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

62.

mole of H_2SO_4 = 3.6 mole/litre

V = 1 litre

mass of $H_2SO_4 = 3.6 \times 98$
$= 352.8$ gm

if density is d

mass of solution = 1000 ml × d

mass % of $H_2SO_4 = \dfrac{352.8}{1000 \times d} \times 100$

$29 = \dfrac{35.28}{d}$ g/ml

$d = 1.22$ gm/ml

ans (a)

63.

% by mass $= \dfrac{\text{mass of solute}}{\text{mass of solution}} \times 100$

$20 = \dfrac{\text{mass of KCl} \times 100}{\text{mass of KCl} + \text{mass of water}}$

$20 = \dfrac{100x}{x+60}$ $x = 15$ gm

ans (a)

64. (A)

mass of Cyclohexene

$= 100 \times \dfrac{82.1}{100.2} \times \dfrac{75}{100} = 61.5\text{gm}$

65. % Loss of H_2O

$= \dfrac{18n \times 100}{142 + 18n} = 55.9$

n = 10

PREVIOUS YEAR QUESTIONS

1.

mole of $BaCO_3 = \frac{9.85}{197}$

Volume at STP $= \frac{9.85}{197} \times 22.4$

$= 1.12$

ans (d)

2.

mole of $Na_2SO_4 \cdot 10H_2O$

$= \frac{32.2}{322} = 0.1$

mole of oxygen $= 0.1 \times 14$

mass of oxygen $= 0.1 \times 14 \times 16$

$= 22.4$

3.

Density of HCl = 1.17 gm/cc

molar mass of HCl = 1 + 35.5

= 36.5

molarity of HCl $= \frac{\text{Density}}{\text{molar mass}} \times 1000$

$= \frac{1.17 \times 1000}{36.5}$

ans (c) $= 32.05$ M

4.

molar mass $= \frac{100 \times 78.4}{0.5}$

ans (a) $= 1.568 \times 10^4$

5.

Molecular mass $= \frac{100 \times 32}{8}$

$= 400$ gm

(b)

6.

Sucrose $= C_{12}H_{22}O_{11}$

1 mole $= 45 \times 6.02 \times 10^{23}$

ans (a)

7.

Law of constant composition states that a pure compound contains the same elements in same proportion irrespective of its source.

Hence the given case can be explained by this law.

8.

Volume of O_2 $= 0.21$ litre

mole of O_2 at STP $= \frac{0.21}{22.4} = 0.009375$

ans (d)

9.

$2H_2$	+ O_2	$\rightarrow 2H_2O$
2 :	1 :	2
4gm	32gm	36 gm
	64gm	36×2
		= 4 mole

ans (b)

10.

1 u (amu) = mc^2

= 1.492×10^{-19} J.

(a)

11.

$C = \frac{24}{12} = 2$

$H = \frac{4}{1} = 4$

$O = \frac{32}{16} = 2$

$C_2H_4O_2 \longrightarrow CH_2O$

12.

mole of O_2 = $\frac{1}{22.4}$

mass of O_2 = $\frac{1}{22.4} \times 32$

= 1.43 gm

ans (a)

13.

mole of H_2 = $\frac{0.224}{22.4} = 0.01$

ans (b)

14.

X_3 = 0.1 mole

mole of X = 0.3

Total number = 0.3 N_A

= $0.3 \times 6.02 \times 10^{23}$

= 1.806×10^{23}

ans (b)

15.

mole of NH_3 = $\frac{4.25}{17}$ = 0.25

no. of atom = $4 \times 0.25 \times N_A$

= 6.023×10^{23}

ans (A)

16.

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

1 : 3 : 2

28 gm   6 gm   34 gm

14 Kg   3 Kg   17 Kg

ans (a)

17.

mole of HNO_3 = $M \times V$

$= \frac{250}{1000} \times 2 = 0.5$

HNO_3 required $= 0.5 \times 63 \times \frac{100}{70}$

$= 45$ gm

ans (b)

18.

$[Cr(H_2O)_4Cl_2]Cl \rightarrow Cl^-$

0.1×0.01 0.001

ans (b)

19.

mole of urea $= \frac{6.02 \times 10^{20}}{6.02 \times 10^{23}}$

$= 10^{-3}$

molarity $= \frac{10^{-3}}{0.1}$

$= 10^{-2}$ ans (c)

20.

$$2Mg + O_2 \rightarrow 2MgO$$

2 : 1 : 2

2×24 32

$\frac{2 \times 24 \times 0.56}{32}$ 0.56

$= .84$

Mg left $1 - 0.84 = 0.16$ gm

ans (c)

21.

$H_2 + Cl_2 \rightarrow 2HCl$

1 : 1 : 2

11.2   11.2 2×11.2

$= 22.4$ litre

$=$ 1 mole

ans (c)

22.

(a) 18 gram of H_2O

$\frac{18}{18} = 1$ mole

(b) 18 mole

(c) 18 molecule

(d) $\frac{1.8}{18} = 0.1$ mole

ans (b)

23.

(23) If Avogadro number N_A is changed from 6.022×10^{23} mole^{-1} to 6.022×10^{20} mole^{-1}, this would change the mass of one mole of carbon from 12 g to 12 mg. However the following will remain unchanged.

(A) The ratio of chemical species to each other in a balanced equation

(B) The ratio of elements to each other in a compound.

(C) The definition of mass in units of grams.

ans (d)

24.

$MgCO_3 \rightarrow MgO + CO_2$

mole ratio 1 : 1 : 1

mass ratio 84 gm 40 gm 44 gm

$x = \frac{84 \times 8}{40}$ 8 gm

$= 16.8$ gm

% purity $= \frac{16.8}{20} \times 100 = 84\%$

25.

(25) 16.9 gm $AgNO_3$ is present in 100 ml Solution

8.45 gm $AgNO_3$ is present in 50 ml Solution.

5.8 gm NaCl is present in 100 ml Solution.

2.9 gm NaCl is present in 50 ml Solution.

$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

$\frac{8.45}{170} = 0.0497$ $\frac{2.9}{58.5} = 0.049$

mass of AgCl $= 0.049 \times 143.5$

$= 7$ gm AgCl.

ans (a)

27.

Let atomic masses of X and Y be A_X and A_Y, respectively

For XY_2, $n_{XY_2} = 0.1 = \frac{10}{A_X + 2A_Y}$

or $A_X + 2A_Y = 100$ ...(i)

For X_3Y_2, $n_{X_3Y_2} = 0.05 = \frac{9}{3A_X + 2A_Y}$

or $3A_X + 2A_Y = 180$ ...(ii)

On solving Eqs. (i) and (ii), we get,

$A_X = 40\text{ g mol}^{-1} \Rightarrow A_Y = 30\text{ g mol}^{-1}$

28.

Molarity and normality are temperature dependent because they involve volume of solutions. Volume is dependent on temperature.

$$\text{Molarity}\,(M) = \frac{\text{Moles of solute}}{\text{Volume of solution (in L)}}$$

Molality, mole fraction and weight percentage does not depend on temperature because they involve masses of solute and solvent.

29.

Number of molecules = Mole × Avogadro's number (N_A)

The number of molecules of water in each of the given options is calculated as

(i) 18 mL of water

Number of moles (n_{H_2O})

$$= \frac{\text{Mass of substance in } g\ (w_{H_2O})}{\text{Molar mass in g mol}^{-1}\ (M_{H_2O})}$$

$w_{H_2O} = 18g$

[∵Density of water (d_{H_2O}) = 1 g L^{-1}]

$$\therefore \quad n_{H_2O} = \frac{18}{18} = 1$$

Number of molecules of water $= 1 \times N_A$

(ii) 0.18 g of water

$$n_{H_2O} = \frac{w_{H_2O}}{M_{H_2O}} = \frac{0.18}{18} = 0.01$$

Number of molecules of water $= 0.01 \times N_A$

(iii) 0.00224 L of water vapours at 1 atm and 273 K. At STP [1 atm and 273 K], Number of moles [with reference to volume]

$$= \frac{\text{Volume of gas in litres}}{22.4}$$

$$= \frac{0.00224}{22.4} = 0.0001$$

Number of molecules of water $= 0.0001 \times N_A$

(iv) 10^{-3} mol of water

Number of molecules of water $= 10^{-3} \times N_A$

∴ Among the given options, option (i) contains the maximum number of water molecules.

30.

According to Haber's process,

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Now, according to above equations
2 moles of ammonia (NH_3) require = 3 moles of H_2
$\therefore$ 1 mole of NH_3 require = 3/2 moles of H_2
or, 20 moles of NH_3 require $= \frac{3}{2} \times 20$
moles of H_2 = 30 moles of H_2.

Note Involvement of any limiting reagent is not mentioned in question.

31.

In $^{175}_{71}Lu$,

Mass number $(A) = 175 = n + p$
Atomic number $(Z) = 71 = p = e^-$
$\therefore$ Number of protons = 71
Number of neutrons
$= A - Z = 175 - 71 = 104$
Number of electrons = 71

32.

1 mole of carbon atoms weight 12 g, its contains Avogadro number of carbon atoms, i.e. 6.022×10^{23} number of carbon atoms.

33.

Number of atoms (n)

$$= \frac{\text{Mass in g (1 g)} \times \text{Atomicity of the molecule}}{\text{Gram molar mass } (M)} \times N_A$$

$[\because N_A = \text{Avogadro's number}]$

$$\Rightarrow \quad n \propto \frac{\text{Atomicity}}{M}$$

(a) $n_{Mg} = \frac{1}{24}$

(b) $n_O = \frac{2}{32} = \frac{1}{16}$

(c) $n_{Li} = \frac{1}{7}$

(d) $n_{Ag} = \frac{1}{108}$

So, $n_{Li} > n_O > n_{Mg} > n_{Ag}$

34.

Element	%	Atomic mass	Relative number of moles	Simple ratio of moles	Simplest whole number ratio
C	78	12	$\frac{78}{12} = 6.5$	$\frac{6.5}{6.5} = 1$	1
H	22	1	$\frac{22}{1} = 22$	$\frac{22}{6.5} = 3.3$	3

The empirical formula of the organic compound is CH_3.