

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 $C_{60}H_{122} = 60 \times 12 + 122 = 842$.
Weight of a molecule = $\frac{842}{6.022 \times 10^{23}} = 1.39 \times 10^{-21} \text{ g}$.
14. (A)
1 mole contains Avogadro number of atoms.
15. (A)
Moles of $N_2 = \frac{1.4}{28} = 0.05$.
Number of atoms = $0.05 \times 2 \times 6.02 \times 10^{23}$.
 $= 6.02 \times 10^{22}$.
16. (D)
(A) $\frac{22.4 \times 10^3}{22400} \times NA = 6.022 \times 10^{23}$
(B) $\frac{22}{44} \times 6.022 \times 10^{23} = 3.011 \times 10^{23}$
(C) $\frac{11.2}{22.4} \times 6.022 \times 10^{23} = 3.011 \times 10^{23}$
(D) $0.1 \times 6.022 \times 10^{23} = 6.022 \times 10^{22}$
17. (C)
Number of gms of $H_2SO_4 = 0.25 \times 98 = 24.5$
18. (D)
Moles of $H_2 = \frac{1}{2} = 0.5$
Volume of H_2 in $l = 0.5 \times 22.4 = 11.2l$.

19. (D)

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

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

20. (A)

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

21. (C)

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

22. (B)

23. (B)

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

24. (C)

In one H₂O molecule: 10 proton, 8 neutrons, 10 electrons

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

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

25. (A)

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

26. (B)

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

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

27. (A)

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

28. (D)

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

Hence [D]

29. (C)

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

30. (B)

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

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

31. (D)

$$n_C = 0.5 \times 6 = 3 \quad \therefore \text{wt} = 36 \text{ g}$$

32. (C)

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

33. (D)

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

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

34. (C)

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

$$\therefore n_{H_2O} = 5 \times 0.01 \Rightarrow \text{molecules} = 0.05 N_A$$

35. (C)

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

36. (B)

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

37. (C)

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

38. (A)

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

39. (D)

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

$$\therefore \text{atom} = 0.12 N_A \Rightarrow [D]$$

40. (B)

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

Each contain (12 + 6 + 24) protons

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

41. (B)

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

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 \approx 1g water

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

43. (B)

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

44. (A)

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

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

45. (B)

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

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

46. (B)

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

47. (C)

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

48. (C)

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

Hence I_2O_5 .

49. (C)

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

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

50. (A)

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

51. C = 75% H = 25%

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

$$3 : 12$$

$$1 : 4 \quad \text{CH}_4$$

52. S = 50% O = 50%

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

$$1 : 2$$

$$\text{SO}_2$$

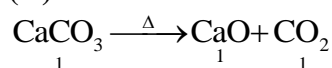
53. C = 80% H = 20%

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

$$1 : 3$$

$$\text{CH}_3 \Rightarrow \text{C}_2\text{H}_6$$

54. (D)

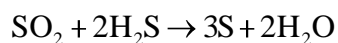


Quantity of limes tones = wt. of one mole mole of CaCO_3
= 100 kg

55. (A)

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

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



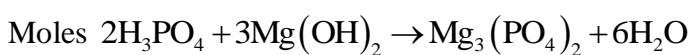
moles 1 2 3 2

given 0.5 2 $x = \frac{3 \times 0.5}{1} = 1.5$

L.R.

56. (C)

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



Moles 2 3 1 6

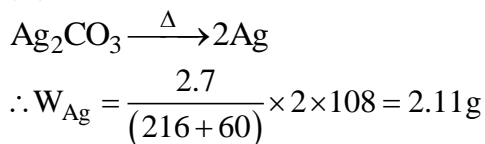
Given $\frac{2 \times 1.724}{3}$

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

57. (D)

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

58. (A)



59. (D)

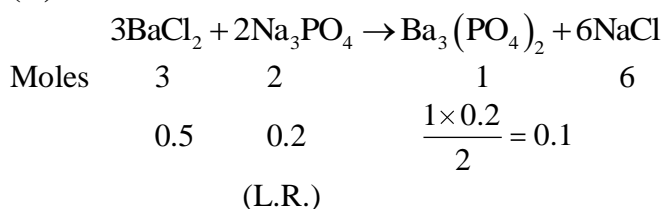
$$n_{\text{CO}_2} = 2 \times n_{\text{C}_2\text{H}_5\text{OH}} = 2$$

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

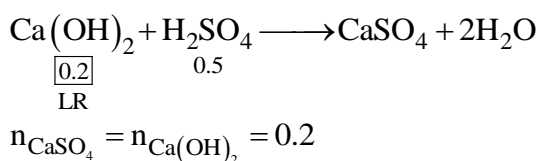
60. (A)

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

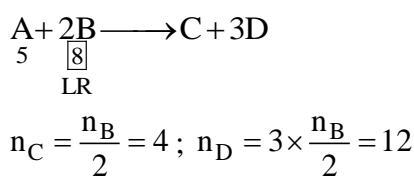
61. (D)



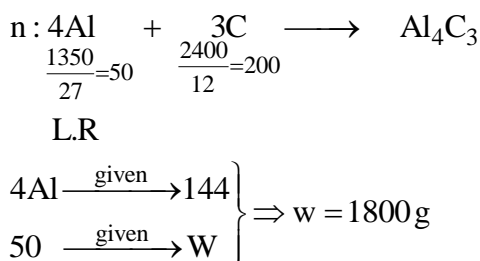
62. (A)



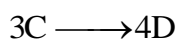
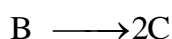
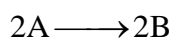
63. (B)



64. (D)



65. (D)



$$\begin{aligned} \therefore n_D &= n_A \times \frac{2}{2} \times \frac{2}{1} \times \frac{4}{3} \\ &= \frac{32}{3} \end{aligned}$$

66. (B)

$$\begin{aligned} \text{molality} &= \frac{n}{w_{\text{solvent}}} \times 1000 \left(\text{urea : } \text{NH}_2 \underset{\text{O}}{\underset{\parallel}{\text{C}}} \text{NH}_2 \right) \\ &= \frac{18/60}{(1500 \times 1.052 - 18)} \times 1000 = 0.192 \end{aligned}$$

67. (D)

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

68. (A)

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

69. (B)

$$\begin{aligned} n_{\text{H}^+} &= \left(\frac{100}{1000} \right) \times 0.001 \times 2 = 2 \times 10^{-4} \\ \therefore \text{no. of H}^+ &= 2 \times 10^{-4} N_A = 1.2 \times 10^{20} \end{aligned}$$

70. (A)

3 molal \Rightarrow 3 mole NaOH in 1000g solvent

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

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

71. (A)

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

LEVEL - 2

1. (A)

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

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

2. (C)

$$\begin{aligned} \text{Total atoms} &= 200 + 0.05 \times N_A + 10^{-20} \times N_A \\ &\approx 0.05 N_A = 3 \times 10^{22} \end{aligned}$$

3. (A)

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

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

Hence [A]

4. (D)

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

5. (A)

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

6. (C)

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

7. (D)

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

8. (A)

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

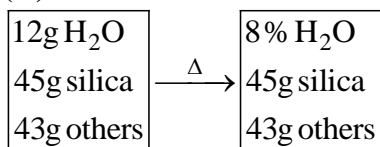
9. (D)

$$\begin{aligned} 1 \text{ gram molecule: } &44g \\ 1 \text{ molecule of } CO_2 &= 44 \text{ amu} \end{aligned}$$

10. (D)

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

11. (D)



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 O₂ = $\frac{2 \times 8}{32} \times 6.022 \times 10^{23} \sim 3 \times 10^{23}$

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

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

(D) atoms of F₂ = $\frac{19}{19} \times 6.022 \times 10^{23} \approx 1 \times 10^{23}$

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 ²¹⁰Po = 4.762×10^{-6} mol
 $= 28.7 \times 10^{17}$

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

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

No. of molecule = $0.05 \times 10^{-10} \times 6.02 \times 10^{23}$
 $= 3 \times 10^{12}$

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}
 $= 6.02 \times 10^{23} \times 1.8 \times 10^{-22}$
 $= 108.36$

22. $\text{CaCO}_3 \Rightarrow \text{proton} = 20 + 6 + 24$

$= 50$

Mole of proton = 0.1×50
 $= 5$

No. of proton = $5 \times 6 \times 10^{23}$
 $= 30 \times 10^{23}$

23. **(D)**

Density = $1 \text{ gm} / 1 \text{ cm}^3$

Molar mass of water = $18 \text{ gm} / \text{mol}$

Volume of 1 molar = $\frac{18 \text{ cm}^3 / \text{mole}}{6.022 \times 10^{23}}$

$= 2.989 \times 10^{-23}$

$3 \times 10^{-23} \text{ am}^3$

24. **(D)**

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

25. **(B)**

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

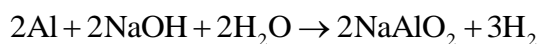
Moles of Ag_2S required = $\frac{1}{107 \times 2}$

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

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

26. **(D)**

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



Moles 2 2 2 2 3

Given 1 excess $\frac{3 \times 1}{2} = 1.5$

(L.R.)

Vol. of H₂ evolved = 1.5 × 22.4 = 33.6 L.

27. (C)

M₃N₂. 28 % nitrogen

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

28. (A)

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

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

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

29. (D)

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

30. (D)

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

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

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

31. (A)

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

$$x = 9\%$$

32. (B)

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

33. (C)

X	Y	X	Y	
$\frac{20}{10}$:	$\frac{80}{200}$	1	:
			2	∴ XY ₂

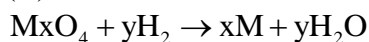
34. N = 26%

O = 74%

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

N₂O₅

35. (B)



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

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

1 mole of metal oxide gives x mole metal m

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

$$64x + 16y = 7x$$

$$x = 2y$$



36. $(\text{NH}_4)_2 \text{Cr}_2\text{O}_7 = 252$

$$\text{NH}_4^+ = 2 \times 18 = 36$$

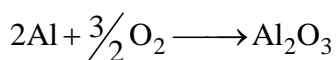
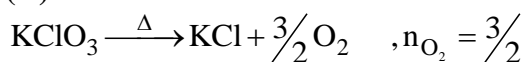
$$\frac{36}{252} \times 100 = 14.24\%$$

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

$$x \times 28 = 140$$

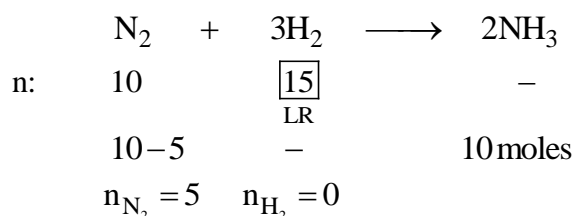
$$x = 5$$

38. (A)

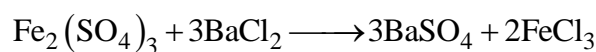


$$n_{\text{Al}_2\text{O}_3} = \frac{n_{\text{O}_2}}{\frac{3}{2}} = 1$$

39. (A)



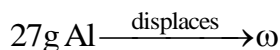
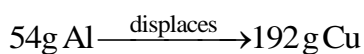
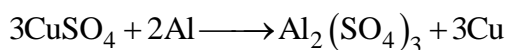
40. (C)



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

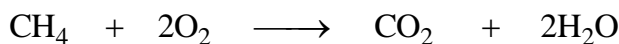
$$\frac{n_{\text{BaCl}_2}}{3} = \frac{n_{\text{FeCl}_3}}{2} \Rightarrow n_{\text{BaCl}_2} = \frac{1}{2} \times 3 = 0.75 \text{ moles}$$

41. (C)



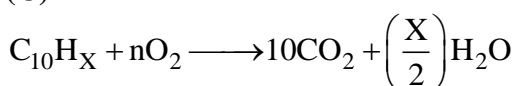
$$\therefore \omega = 96\text{g}$$

42. (A)

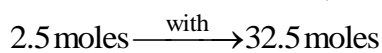
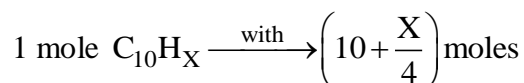


$$\therefore n_{\text{CO}_2} = 4; n_{\text{CH}_4}(\text{remaining}) = 1$$

43. (C)



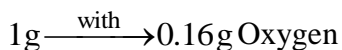
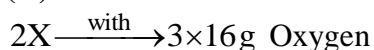
$$\text{Hence, } n = 10 + \frac{X}{4}$$



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

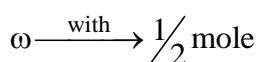
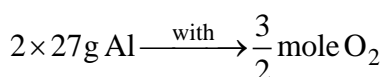
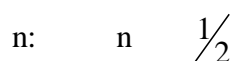
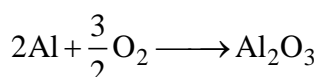
$$\therefore x = (13 - 10) \times 4 = 12$$

44. (D)



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

45. (D)



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

46. (D)

$$n_{\text{BaSO}_4} = n_{\text{SO}_2} = n_{\text{S}} \text{ (POAC on S)}$$

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

47. (C)

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

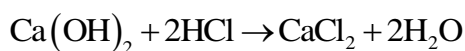
$$\therefore \text{ For 5 mol, } (246 \times 5) \text{g} = 1.23 \text{ kg}$$

48. (C)

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

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

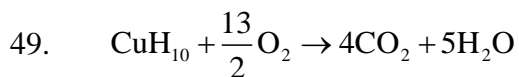
$$\text{HCl} = \frac{3.01 \times 10^{22}}{6.02 \times 10^{23}} = 0.05$$



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

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

(L.R.)



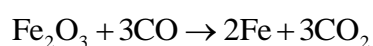
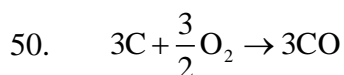
$$1 : \frac{13}{2} : 4 : 5$$

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

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

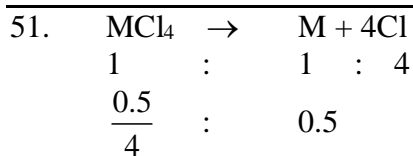
$$= 3.58 \times 10^3 \text{ gm}$$

$$= 3.58 \text{ kg}$$



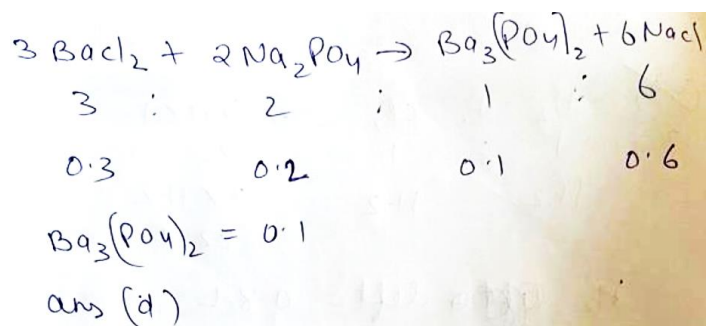
$$1 \text{ mole of } \text{Fe}_2\text{O}_3 = \frac{3}{2} \text{ mole of } \text{O}_2$$

$$1.6 \text{ kg of } \text{Fe}_2\text{O}_3 \text{ require } \text{O}_2 = 480\text{gm}$$

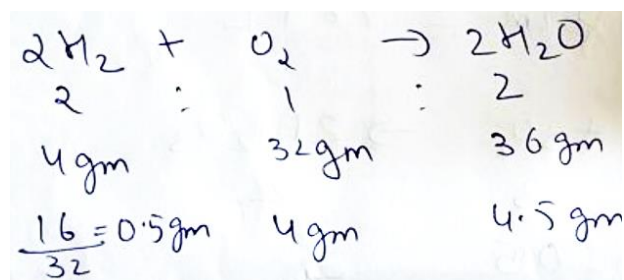


Mole of $MCl_4 = \frac{0.5}{4} = 25$ molar mass

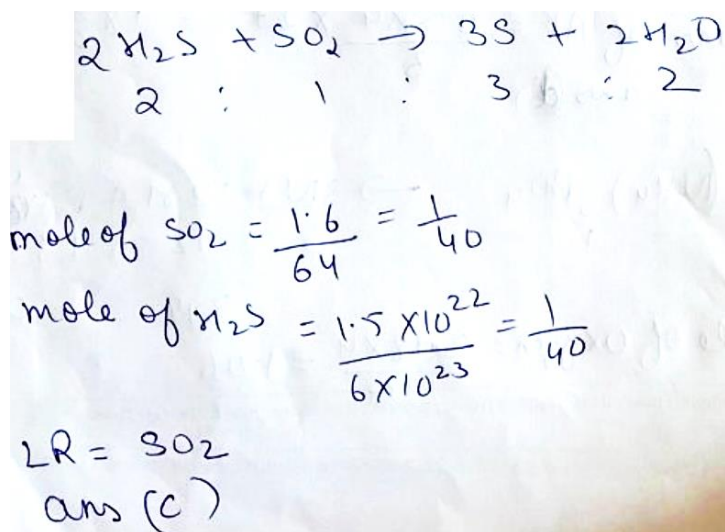
52.



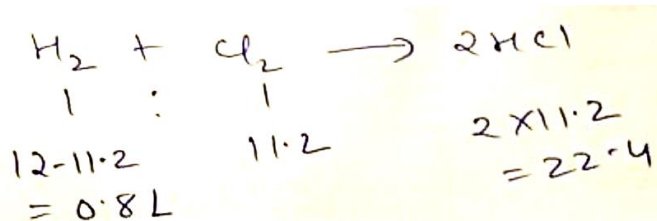
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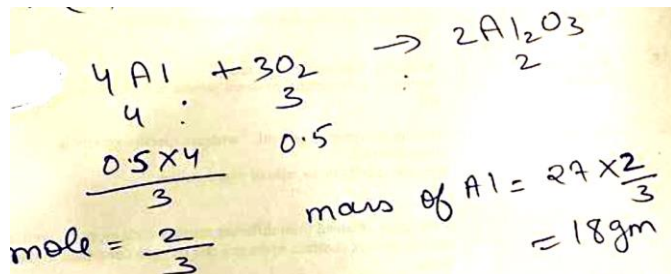
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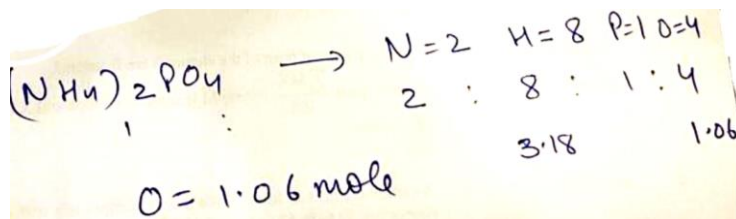
55.



56.



57.



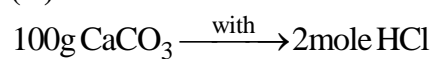
58. (A)

Consider 1 L solution

$$\frac{29}{100} \times (d \times 1000) = \omega_{\text{H}_2\text{SO}_4} = 3.6 \times 98$$

$$\therefore d = 1.22 \text{ g/mL}$$

59. (D)



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

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

60. (B)

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

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

61. (A)

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

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

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

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

62.

$$\text{mole of } \text{H}_2\text{SO}_4 = 3.6 \text{ mole/litre}$$

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

$$\begin{aligned} \text{mass of } \text{H}_2\text{SO}_4 &= 3.6 \times 98 \\ &= 352.8 \text{ gm} \end{aligned}$$

if density is d

$$\text{mass of solution} = 1000\text{ml} \times d$$

$$\text{mass \% of } \text{H}_2\text{SO}_4 = \frac{352.8}{1000 \times d} \times 100$$

$$29 = \frac{35.28}{d} \text{ g/ml}$$

$$d = 1.22 \text{ gm/ml}$$

ans (a)

63.

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

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

$$20 = \frac{100x}{x+60} \quad x = 15 \text{ gm}$$

ans (a)

64. (A)

mass of Cyclohexene

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

65. % Loss of H_2O

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

$$n = 10$$

PREVIOUS YEAR QUESTIONS

1.

$$\text{mole of BaCO}_3 = \frac{9.85}{197}$$

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

$$= 1.12$$

ans (d)

2.

$$\begin{aligned} \text{mole of Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O} \\ = \frac{32.2}{322} = 0.1 \end{aligned}$$

$$\text{mole of oxygen} = 0.1 \times 14$$

$$\begin{aligned} \text{mass of oxygen} &= 0.1 \times 14 \times 16 \\ &= 22.4 \end{aligned}$$

3.

$$\text{Density of HCl} = 1.17 \text{ gm/cc}$$

$$\begin{aligned} \text{molar mass of HCl} &= 1 + 35.5 \\ &= 36.5 \end{aligned}$$

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

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

ans (c)

$$= 32.05 \text{ M}$$

4.

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

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

5.

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

$$= 400 \text{ gm}$$

(b)

6.

$$\text{Sucrose} = \text{C}_{12}\text{H}_{22}\text{O}_{11}$$

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

ans (a)

7.

Law of constant composition states that a pure compound contains the same elements in same proportions irrespective of its source. Hence the given case can be explained by this law.

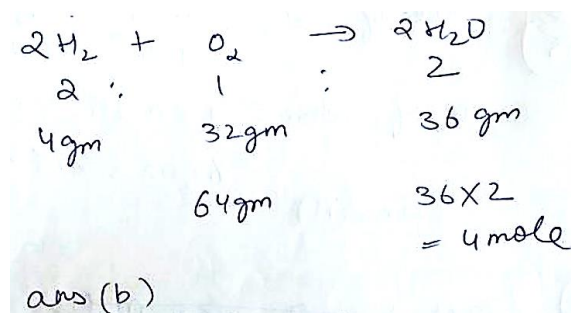
8.

$$\text{Volume of } \text{O}_2 = 0.21 \text{ litre}$$

$$\text{mole of } \text{O}_2 \text{ at STP} = \frac{0.21}{22.4} = 0.009375$$

ans (d)

9.



10.

$$1 \text{ u (amu)} = m c^2$$

$$= 1.492 \times 10^{-19} \text{ J.}$$

(a)

11.

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

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

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

$$2 \text{H}_4\text{O}_2 \rightarrow \text{CH}_2\text{O}$$

12.

$$\text{mole of O}_2 = \frac{1}{22.4}$$

$$\text{mass of O}_2 = \frac{1}{22.4} \times 32$$

$$= 1.43 \text{ gm}$$

ans (a)

13.

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

ans (b)

14.

$$X_3 = 0.1 \text{ mole}$$

$$\text{mole of X} = 0.3$$

$$\text{Total number} = 0.3 \text{ NA}$$

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

$$= 1.806 \times 10^{23}$$

ans (b)

15.

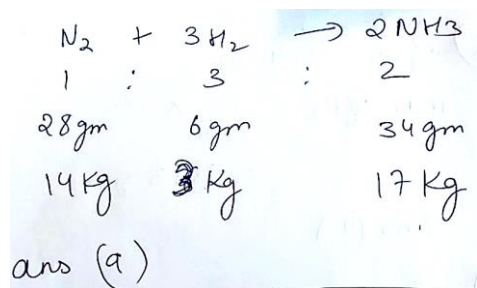
$$\text{mole of NH}_3 = \frac{4.25}{17} = 0.25$$

$$\text{no. of atom} = 4 \times 0.25 \times \text{NA}$$

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

ans (A)

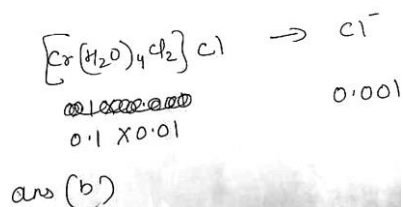
16.



17.

$$\begin{aligned}
 \text{mole of HNO}_3 &= M \times V \\
 &= \frac{250}{1000} \times 2 = 0.5 \\
 \text{HNO}_3 \text{ required} &= 0.5 \times 63 \times \frac{100}{70} \\
 &= 45\text{gm} \\
 \text{ans (b)} &
 \end{aligned}$$

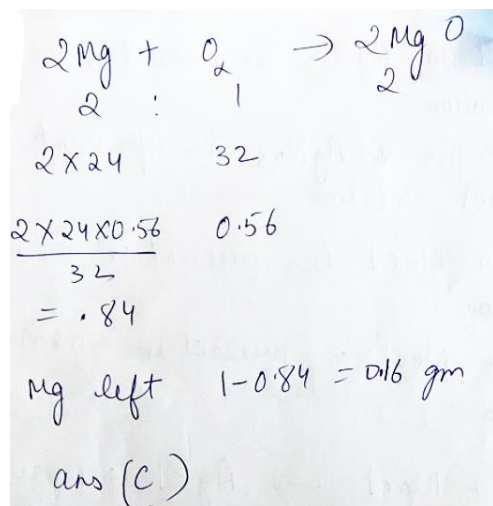
18.



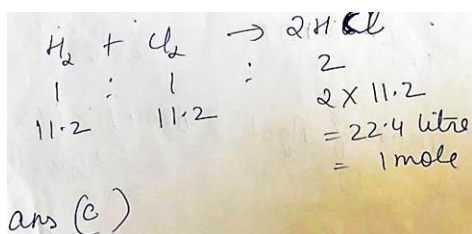
19.

$$\begin{aligned}
 \text{mole of urea} &= \frac{6.02 \times 10^{20}}{6.02 \times 10^{23}} \\
 &= 10^{-3} \\
 \text{molarity} &= \frac{10^{-3}}{0.1} \\
 &= 10^{-2} \quad \text{ans (c)}
 \end{aligned}$$

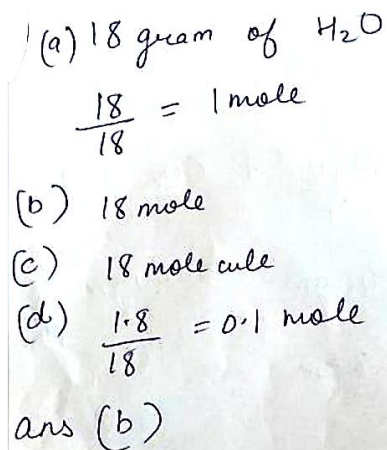
20.



21.



22.



23.

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

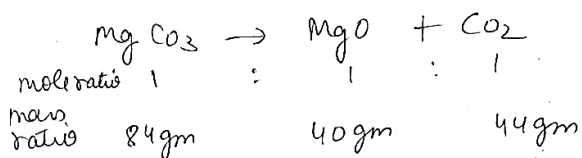
(A) The ratio of chemical species to each other in a balanced equation

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

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

ans (d)

24.



$$x = \frac{84 \times 8}{40} = 16.8 \text{ gm}$$

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

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.



$$\frac{8.45}{170} = 0.0497$$

$$\frac{2.9}{58.5} = 0.049$$

$$\begin{aligned} \text{mass of AgCl} &= 0.049 \times 143.5 \\ &= 7 \text{ gm AgCl} \end{aligned}$$

ans (a)

27.

Let atomic masses of X and Y be A_x and A_y , respectively

$$\text{For } \text{XY}_2, n_{\text{XY}_2} = 0.1 = \frac{10}{A_x + 2A_y}$$

$$\text{or } A_x + 2A_y = 100 \quad \dots(i)$$

$$\text{For } \text{X}_3\text{Y}_2, n_{\text{X}_3\text{Y}_2} = 0.05 = \frac{9}{3A_x + 2A_y}$$

$$\text{or } 3A_x + 2A_y = 180 \quad \dots(ii)$$

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 \times 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

$$\begin{aligned} \text{Number of moles } (n_{\text{H}_2\text{O}}) &= \frac{\text{Mass of substance in g } (w_{\text{H}_2\text{O}})}{\text{Molar mass in g mol}^{-1} (M_{\text{H}_2\text{O}})} \end{aligned}$$

$$w_{\text{H}_2\text{O}} = 18\text{g}$$

$$[\because \text{Density of water } (d_{\text{H}_2\text{O}}) = 1\text{ g L}^{-1}]$$

$$\therefore n_{\text{H}_2\text{O}} = \frac{18}{18} = 1$$

$$\begin{aligned} \text{Number of molecules of water} &= 1 \times N_A \end{aligned}$$

(ii) 0.18 g of water

$$n_{\text{H}_2\text{O}} = \frac{w_{\text{H}_2\text{O}}}{M_{\text{H}_2\text{O}}} = \frac{0.18}{18} = 0.01$$

$$\begin{aligned} \text{Number of molecules of water} &= 0.01 \times N_A \end{aligned}$$

(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]

$$\begin{aligned} &= \frac{\text{Volume of gas in litres}}{22.4} \\ &= \frac{0.00224}{22.4} = 0.0001 \end{aligned}$$

$$\begin{aligned} \text{Number of molecules of water} &= 0.0001 \times N_A \end{aligned}$$

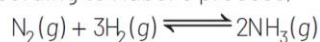
(iv) 10^{-3} mol of water

$$\begin{aligned} \text{Number of molecules of water} &= 10^{-3} \times N_A \end{aligned}$$

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

30.

According to Haber's process,



Now, according to above equations

2 moles of ammonia (NH_3) require = 3 moles of H_2

\therefore 1 mole of NH_3 require = $\frac{3}{2}$ 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 ${}_{71}^{175}\text{Lu}$,

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)

Mass in g (1 g) \times Atomicity of

$$= \frac{\text{the molecule}}{\text{Gram molar mass (M)}} \times N_A$$

[$\therefore N_A$ = Avogadro's number]

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

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

$$(b) n_{\text{O}} = \frac{2}{32} = \frac{1}{16}$$

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

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

So, $n_{\text{Li}} > n_{\text{O}} > n_{\text{Mg}} > n_{\text{Ag}}$

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 .