

Some Basic Concepts of Chemistry-Mole Concept

SOLUTIONS

Exercise-I (Conceptual Questions)

1. Ans. (4)

16 g oxygen (O_2)

$$n_{O_2} = \frac{16}{32} = \frac{1}{2}$$

Number of O-atoms

$$= n_{O_2} \times N_A \times \text{atomicity}$$

$$= \frac{1}{2} \times 6.022 \times 10^{23} \times 2$$

$$= 6.022 \times 10^{23}$$

2. Ans. (4)

$$n_{NH_3} = \frac{4.25}{17} = \frac{1}{4}$$

Number of atoms

$$= n_{NH_3} \times N_A \times \text{atomicity}$$

$$= \frac{1}{4} \times N_A \times 4$$

$$= N_A = 6 \times 10^{23}$$

3. Ans. (4)

Mass	Mole	Number of atoms [$n \times N_A \times \text{atomicity}$]
1 g O	1/16	$\frac{1}{16} \times N_A \times 1 = \frac{N_A}{16}$
1 g O_2	1/32	$\frac{1}{32} \times N_A \times 2 = \frac{N_A}{16}$
1 g O_3	1/48	$\frac{1}{48} \times N_A \times 3 = \frac{N_A}{16}$

All have the same number of atoms.

4. Ans. (3)

Number of atom in 0.5g atom of nitrogen

$$= 0.5 \times N_A \times 2 = N_A$$

Number of atom in 8g oxygen

$$= \frac{8}{16} \times N_A \times 2 = N_A$$

5. Ans. (1)

Mass	Moles	Number of atoms
4g H_2	$\frac{4}{2} = 2$	$2 \times N_A \times 2 = 4N_A$
16g O_2	$\frac{16}{32} = \frac{1}{2}$	$\frac{1}{2} \times N_A \times 2 = N_A$
28g N_2	$\frac{28}{28} = 1$	$1 \times N_A \times 2 = 2N_A$
18g H_2O	$\frac{18}{18} = 1$	$1 \times N_A \times 3 = 3N_A$

6. Ans. (3)

Number of neutrons

$$= n \times N_A \times (\text{number of neutrons})$$

$$= \frac{1.7}{17} \times N_A \times 7$$

$$= \frac{N_A}{10} \times 7$$

7. Ans. (2)

Number of atoms of oxygen

$$= n \times N_A \times \text{number of atoms}$$

$$= \frac{5.6}{22.4} \times 6.022 \times 10^{23} \times 2$$

$$= 3.01 \times 10^{23} \text{ atoms.}$$

8. Ans. (2)

Number of atoms in $[O_3]$

$$= n \times N_A \times \text{number of atoms}$$

$$= \frac{8}{48} \times N_A \times 3$$

$$= \frac{N_A}{2} = \frac{6.022 \times 10^{23}}{2}$$

9. Ans. (3)

Sum of protons, electrons and neutrons in 12g

$$\text{of } {}^{12}_6C = n \times N_A \times [\text{sum of e, p \& n}]$$

$$= \frac{12}{12} \times N_A \times 18$$

$$= 18 \times 6.022 \times 10^{23}$$

$$= 1.08 \times 10^{25}$$

10. Ans. (2)

1 "U" atom = 238 amu

$$1 \text{ amu} = 1.66 \times 10^{-24} \text{g}$$

$$1 \text{ "U" atom} = 238 \times (1.66 \times 10^{-24} \text{g}) \\ \approx 3.94 \times 10^{-22} \text{g}$$

11. Ans. (2)

1 H₂O molecule = 18 amu

Actual mass of 1 H₂O molecule

$$= 18 \times (1.66 \times 10^{-24} \text{g})$$

$$\approx 2.99 \times 10^{-23}$$

12. Ans. (3)

1 molecule CH₄ = 16 amu

$$1 \text{ amu} = (1.66 \times 10^{-24} \text{g})$$

$$\text{mass of 1 molecule of CH}_4 = 16 \times (1.66 \times 10^{-24} \text{g}) \\ = 2.66 \times 10^{-23} \text{g}$$

13. Ans. (1)

1g atom of C = 1 mole of C

$$= 12 \text{g}$$

14. Ans. (4)

Mass	Moles	Number of atoms
4.4g CO ₂	$\frac{4.4}{44} = 0.1$	0.1 N _A
3.4g NH ₃	$\frac{3.4}{17} = 0.2$	0.2 N _A
1.6g CH ₄	$\frac{1.6}{16} = 0.1$	0.1 N _A
3.2g SO ₂	$\frac{3.2}{64} = 0.05$	0.05 N _A

15. Ans. (1)

$$n_{\text{NH}_3} = \frac{4.25}{17} = \frac{1}{4}$$

Number of NH₃ molecules

$$= \frac{1}{4} \times 6.022 \times 10^{23}$$

$$= 1.505 \times 10^{23}$$

16. Ans. (3)

Let atomic wt. of A = a

Atomic wt. of B = b

Molar mass of

$$\text{B}_2\text{A}_3 = (2 \times b) + (3 \times a)$$

= mass of 1 mole substance

$$0.05 \text{ mol B}_2\text{A}_3 \rightarrow 9 \text{g}$$

$$1 \text{ mol of B}_2\text{A}_3 = \frac{9}{0.05} = 180 \text{g}$$

$$2b + 3a = 180 \quad \dots(1)$$

$$\text{molar mass of B}_2\text{A} = (2b + a)$$

$$0.1 \text{ mol of B}_2\text{A} \rightarrow 10 \text{g}$$

$$1 \text{ mol of B}_2\text{A} \rightarrow \frac{10}{0.1} = 100$$

$$\Rightarrow 2b + a = 100 \quad \dots(2)$$

$$\text{On solving } \boxed{a = 40, b = 30}$$

17. Ans. (3)

$$n_{\text{O}_2} = \frac{5.6}{22.4} = \frac{1}{4}$$

18. Ans. (4)

$$n_{\text{gas}} = \frac{2.24}{22.4} = 0.1$$

$$\text{Molar mass} = \frac{w_{\text{gas}}}{n_{\text{gas}}}$$

$$= \frac{4.4}{0.1} = 44$$

CO₂ & N₂O

19. Ans. (1)

Mass	Moles	Number of atoms
1g CO ₂	$\frac{1}{44}$	$\frac{1}{44} \text{N}_A$
1g N ₂	$\frac{1}{28}$	$\frac{1}{28} \text{N}_A$
1g O ₂	$\frac{1}{32}$	$\frac{1}{32} \text{N}_A$
1g H ₂	$\frac{1}{2}$	$\frac{1}{2} \text{N}_A$

20. Ans. (1)

mass of gas = w_(g)

Vol. of gas = V mL (at STP)

$$\text{moles of gas} = \frac{\text{mass}}{\text{mol.wt.}} = \frac{w}{\text{mol.wt.}}$$

$$\text{moles of gas} = \frac{V_{\text{STP}}(\text{ml})}{22400}$$

$$\frac{w}{\text{mol.wt.}} = \frac{V_{\text{STP}}(\text{ml})}{22400}$$

$$\text{Mol. wt.} = \frac{w}{V_{\text{(ml)}}} \times 22400$$

21. Ans. (2)

Initial mass of $\text{H}_2\text{SO}_4 = 98\text{mg} = 98 \times 10^{-3}\text{g}$

Initial moles of $\text{H}_2\text{SO}_4 = \frac{98 \times 10^{-3}}{98} = 10^{-3}\text{mol}$

Number of molecules removed $= 3.01 \times 10^{20}$

Number of moles removed

$$= \frac{3.01 \times 10^{20}}{6.02 \times 10^{23}} = 0.5 \times 10^{-3}\text{mol}$$

$$\text{Moles of } \text{H}_2\text{SO}_4 \text{ left} = 10^{-3} - [0.5 \times 10^{-3}] \\ = 0.5 \times 10^{-3}$$

22. Ans. (3)

Formula of gas $= [\text{CO}]_x$

Mol. wt. of gas $= [12 + 16]_x \\ = 28x$

$$28x = 2 \times \text{V.D.}$$

$$28x = 2 \times 70$$

$$28x = 140$$

$$x = \frac{140}{28} = 5$$

23. Ans. (4)

Mol. wt. $= 2 \times 11.2 = 22.4\text{g}$

$$\text{moles of gas} = \frac{2.4}{22.4}$$

$$\text{Vol. of gas (at STP)} = \text{moles} \times 22.42 \\ = \frac{2.4}{22.4} \times 22.4 = 2.42$$

24. Ans. (3)

$$n_{\text{gas}} = \frac{V_{\text{STP}}(\text{ml})}{22400}$$

$$= \frac{1.12 \times 10^{-7}}{22400} = \frac{1}{2} \times 10^{-11}$$

molecules of gas $= \text{moles} \times N_A$

$$= \frac{1}{2} \times 10^{-11} \times 6.02 \times 10^{23}$$

$$= 3.01 \times 10^{12}$$

25. Ans. (3)

Number of electrons in

$\text{NO}_3^- = n_{\text{NO}_3^-} \times N_A$ (number of electrons)

$$= \frac{3.1 \times 10^{-3}}{62} \times 6.022 \times 10^{23} \times 32$$

$$= 9.6 \times 10^{20}$$

26. Ans. (1)

Vol. of 1 mole N_2 [at N.T.P.] $= 22.4\text{L}$

mass of 1 mole $\text{N}_2 = 28\text{g}$

$$\text{Density of } \text{N}_2 = \frac{\text{mass}}{\text{volume}} = \frac{28\text{g}}{22.4\text{L}} = 1.25\text{g L}^{-1}$$

27. Ans. (2)

number of carbon atoms

$= n_c \times N_A \times \text{atomicity}$

$$= \frac{1.2 \times 10^{-3}}{12} \times 6.022 \times 10^{23} \times 1$$

$$= 6.022 \times 10^{19}$$

28. Ans. (3)

	X	Y
mass	w	w
moles	$\frac{w}{30}$	$\frac{w}{20}$
simple ratio $\times$ 60	$\frac{1}{30} \times 60$	$\frac{w}{20} \times 60$
	2	3

Molecular formula $= \text{X}_2\text{Y}_3$

29. Ans. (1)

	mass	moles	simples ratio
S	50	$\frac{50}{32} = 1.5$	$\frac{1.5}{1.5} = 1$
O	50	$\frac{50}{16} = 3.125$	$\frac{3.125}{1.5} \approx 2$

Empirical formula $= \text{SO}_2$

30. Ans. (3)

	Mass%	atomic ratio	simples ratio
C	80	$\frac{80}{12} = 6.66$	$\frac{6.66}{6.66} = 1$
H	20	$\frac{20}{1} = 20$	$\frac{20}{6.66} \approx 3$

$\text{C}_1 \quad \text{H}_3$

1 : 3

$\text{C}_2 \quad \text{H}_6$

31. Ans. (4)

Molecular formula of glucose = $C_6H_{12}O_6$

C H O

6 : 12 : 6

1 : 2 : 1

E. F. of glucose = CH_2O

32. Ans. (3)

	Mass%	atomic ratio	simplest ratio
M	60	$\frac{60}{24} = 2.5$	$\frac{2.5}{2.5} = 1$
O	40	$\frac{40}{16} = 2.5$	$\frac{2.5}{2.5} = 1$

E. F. = MO

33. Ans. (1)

	Mass%	atomic ratio	simples ratio
C	38.8	$\frac{38.8}{12} = 3.23$	$\frac{3.23}{3.23} = 1$
H	16	$\frac{16}{1} = 16$	$\frac{16}{3.23} \approx 5$
N	45.2	$\frac{45.2}{14} \approx 3.23$	$\frac{3.23}{3.23} = 1$

E. F. = CH_5N or CH_3NH_3

34. Ans. (2)

	Mass%	atomic ratio	simplest ratio
X	50	$\frac{50}{10} = 5$	$\frac{5}{2.5} = 2$
Y	50	$\frac{50}{20} = 2.5$	$\frac{2.5}{2.5} = 1$

Simplest formula = X_2Y

35. Ans. (2)

E. F. of glucose = $C_6H_{12}O_6$

$\downarrow \div 6$

E. F. = CH_2O

$CH_3COOH \Rightarrow C_2H_4O_2$

$\downarrow \div 2$

E. F. CH_2O

36. Ans. (4)

	Mass%	atomic ratio	simple ratio
P	1.24g	$\frac{1.24}{31} = 0.04$	4
S	$(2.2 - 1.24) = 0.96$	$\frac{0.96}{32} = 0.03$	3

E. F. = P_4S_3

37. Ans. (4)

	Mass%	Atomic ratio	simple ratio
I	254	$\frac{254}{127} = 2$	2
O	80	$\frac{80}{16} = 5$	5

Formula = I_2O_5

38. Ans. (2)

E. f. $\Rightarrow$ obtain from simplest ratio of atom

Gives Cr = 4.8×10^{10} , O = 9.6×10^{10}

Simplest ratio 1 : 2

Empirical formula = CrO_2

39. Ans. (1)

% of S $\Rightarrow 3.4 = \frac{1 \times 32}{\text{Min.mol.wt.}} \times 100$

Minimum molecular wt. = $\frac{32 \times 100}{3.4} \approx 941.176$

40. Ans. (3)

% of N = $\frac{\text{mass of N} \times \text{no. of atoms}}{\text{molecular wt. of Insulin}} \times 100$

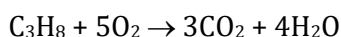
$28.9 = \frac{14 \times n}{194} \times 100 \Rightarrow n = \frac{28.9 \times 194}{14 \times 100} \approx 4$

41. Ans. (3)

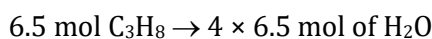
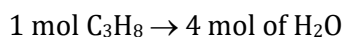
	Mass	atomic ratio	simples ratio
C	38.71	$\frac{38.71}{12} = 3.22$	$\frac{3.22}{3.22} = 1$
H	9.67	$\frac{9.67}{1} = 9.67$	$\frac{9.67}{3.21} = 3$
O	51.62	$\frac{51.62}{16} = 3.22$	$\frac{3.22}{3.22} = 1$

E. f. = CH_3O

42. Ans. (3)



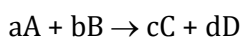
$$n = \frac{286}{44} = 6.5$$



$$n_{\text{H}_2\text{O}} = 26$$

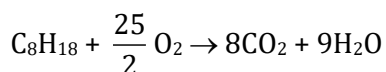
$$w_{\text{H}_2\text{O}} = 26 \times 18 = 468\text{g}$$

43. Ans. (3)



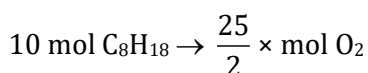
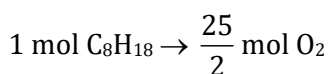
mass ratio is not same as coffi. Ratio so statement is wrong statement for this reaction.

44. Ans. (3)



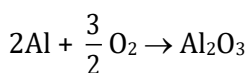
$$\text{Mass of C}_8\text{H}_{18} = 0.8 \times 1.425 \\ = 1140\text{g}$$

$$n_{\text{C}_8\text{H}_{18}} = \frac{1140}{114} = 10$$

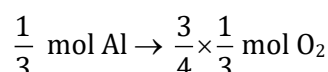
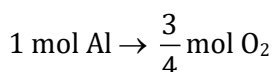
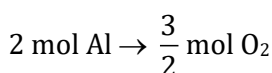


$$n_{\text{O}_2} = \frac{250}{2} = 125$$

45. Ans. (2)



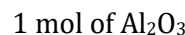
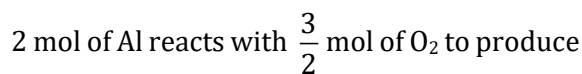
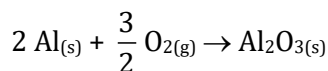
$$n = \frac{9}{27} = \frac{1}{3}$$



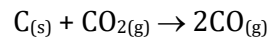
$$n_{\text{O}_2} = \frac{1}{4}$$

$$\text{wt. of O}_2 = \frac{1}{4} \times 32 = 8\text{g}$$

46. Ans. (4)



47. Ans. (3)



$$t = 0 \quad - \quad 1 \quad -$$

$$t = t \quad - \quad 1 - x \quad 2x$$

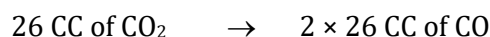
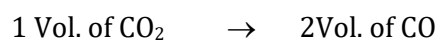
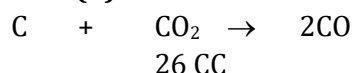
$$\text{Vol. after} = 1 - x + 2x = 1.4$$

$$\text{reaction } \boxed{x=0.4}$$

$$V_{\text{CO}_2} \text{ left} = 1 - 0.4 = 0.6 \text{ L}$$

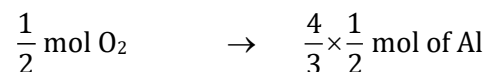
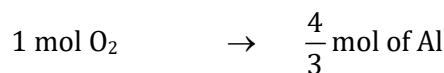
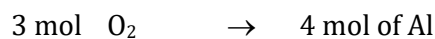
$$V_{\text{CO}} \text{ prepared} = 2 \times 0.4 = 0.8 \text{ L}$$

48. Ans. (4)



$$\boxed{V_{\text{CO}} = 52\text{CC}}$$

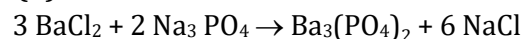
49. Ans. (2)



$$n_{\text{Al}} = \frac{4}{6}$$

$$w_{\text{Al}} = \frac{\cancel{4}^2}{\cancel{6}_3} \times \frac{\cancel{27}^9}{\cancel{27}_3} = 18\text{g}$$

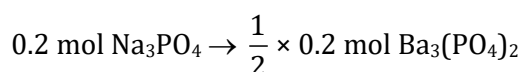
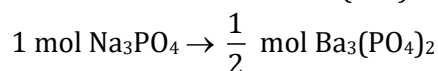
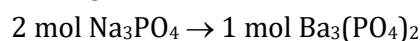
50. Ans. (4)



$$0.5 \quad 0.2$$

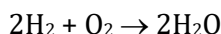
$$\frac{0.2}{2} = 0.1$$

$$\text{L.R. } \frac{0.5}{3} = 0.16 \quad \frac{0.2}{2} = 0.1$$



$$\boxed{n_{\text{Ba}_3(\text{PO}_4)_2} = 0.1}$$

51. Ans. (3)



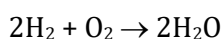
2 vol. H_2 react with 1 vol. of O_2

4 ml H_2 will react with 2 ml of O_2

Total vol. of $\text{O}_2 = \text{VO}_{2(\text{reacted})} + \text{VO}_{2(\text{unreacted})}$

$$\text{VO}_{2(\text{total})} = 2 \text{ ml} + 8 \text{ ml} = 10 \text{ ml}$$

52. Ans. (3)



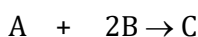
$$\text{moles } \frac{4}{2} = 2 \quad \frac{4}{32} = \frac{1}{8}$$

$$\text{L. R. } \frac{2}{2} = 1 \quad \frac{\frac{1}{8 \times 1}}{\text{L. R.}} = \frac{1}{8}$$

$$n_{\text{H}_2\text{O}} = \frac{1}{8} \times 2 = \frac{1}{4}$$

$$w_{\text{H}_2\text{O}} = \frac{1}{4} \times 18 = 4.5$$

53. Ans. (2)

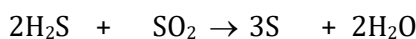


$$\text{moles } 5 \quad 8$$

$$\text{L.R. } \frac{5}{1} \quad \frac{8}{2} = 4$$

$$n_{\text{C}} = 4 \times 1 = 4$$

54. Ans. (3)



$$\text{Moles } \frac{1.6}{34} = 0.04; \quad \frac{1.5 \times 10^{22}}{6 \times 10^{23}} = 0.025$$

$$\text{L. R. } \frac{0.04}{2} = 0.02 \quad \frac{0.025}{1} = 0.025$$

SO_2 will remain in excess

55. Ans. (3)



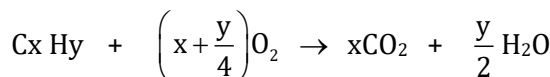
$$\text{Vol. } 12 \text{ L} \quad 11.2 \text{ L}$$

$$\text{L.R. } \frac{12}{1} \quad \frac{11.2}{1}$$

11.2 L of Cl_2 will react with 11.2 L H_2 to product 22.4 L HCl.

$$\text{Remaining } \text{H}_2 = 12 - 11.2 = 0.8 \text{ L}$$

56. Ans. (4)



$$10 \text{ ml} \quad - \quad 40 \text{ ml} \quad 50 \text{ ml}$$

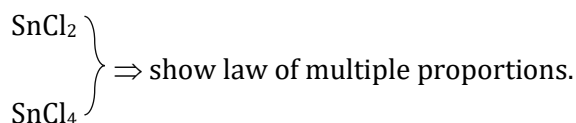
From stoichiometry, $x = 4$, $\frac{y}{2} = 5 \Rightarrow y = 10$

Which means C_4H_{10}

57. Ans. (2)

Dalton

58. Ans. (4)



59. Ans. (4)

Gaseous volumes

60. Ans. (2)

Multiple proportions.

61. Ans. (2)

Nuclear reaction

62. Ans. (3)

Number of molecule = $n \times N_A$

n is same for all O_2 , NH_3 & CO_2 .

63. Ans. (1)

volume $\propto$ moles

$$n = \frac{\text{molecular mass}}{\text{Empirical mass}} = \frac{28}{14} = 2$$

$$\text{M. F.} = 2 \times \text{CH}_2 = \text{C}_2\text{H}_4$$

64. Ans. (3)



$$\text{moles } \frac{1}{22.4} : \frac{1}{22.4} : \frac{1}{22.4} : \frac{1}{22.4}$$

$$\text{molecules } \frac{1}{22.4} N_A : \frac{1}{22.4} N_A : \frac{1}{22.4} N_A : \frac{1}{22.4} N_A$$

$$\text{atoms } \frac{2 N_A}{22.4} : \frac{N_A}{22.4} : \frac{2 N_A}{22.4} : \frac{3 N_A}{22.4}$$

65. Ans. (2)

$$\frac{M_{\text{gas}}}{M_{\text{N}_2}} = \frac{0.44}{0.28}$$

$$M_{\text{gas}} = \frac{0.44}{0.28} \times 28$$

$$= 44$$

66. Ans. (2)

Entire mass of ethylene is converted to polyethylene so according to LOMA 100 g

67. Ans. (4)

Conservation of mass

68. Ans. (3)

	A	B
	NH ₃	SO ₂
Moles	$\frac{x}{22.4}$	$\frac{x}{22.4}$

Same moles.

Exercise-II (Previous Year Questions)

1. Ans. (3)

	H ₂	O ₂	CH ₄
moles	$\frac{x}{2}$	$\frac{x}{32}$	$\frac{x}{16}$
Vol.	$\frac{x}{2} \times 22.4$	$\frac{x}{32} \times 22.4$	$\frac{x}{16} \times 22.4$
	$\frac{1}{2}$	$\frac{1}{32}$	$\frac{1}{16}$
	16	1	2

2. Ans. (1)

	H ₂	+	Cl ₂	→	2HCl
moles	$\frac{22.4}{22.4} = 1$		$\frac{11.2}{22.4} = \frac{1}{2}$		
			$\frac{1}{2 \times 1}$		
L.R. x ₁	$= \frac{1}{1}$		x ₂ = $\frac{1}{\text{L.R.}}$		
n _{HCl}	$= \frac{1}{2} \times 2 = 1$				

3. Ans. (1)

	2Mg	+	O ₂	→	2MgO
moles	$\frac{1}{24}$		$\frac{0.56}{32}$		
	= 0.041		= 0.0175		
			$\frac{0.0175}{1}$		
L.R. x ₁	$= \frac{0.041}{2}$		x ₂ = $\frac{1}{\text{L.R.}}$		
	= 0.02				
n _{HCl}	$= \frac{1}{2} \times 2 = 1$				
Mg left in excess = 0.0416 - (0.0175) × 2					
wt. = 0.0066 × 24 = 0.16g					

4. Ans. (1)

$$\begin{array}{ccc} \text{H}_2 & + & \text{O}_2 \\ \text{moles } \frac{100}{2} = 50 & & \frac{400}{32} = 12.5 \\ \text{molar ratio} = & 50 : 12.5 & \\ & 4 : 1 & \end{array}$$

5. Ans. (2)

number of molecules = n × N_A

$$(1) \frac{18}{18} \times N_A = N_A$$

$$(2) 18N_A$$

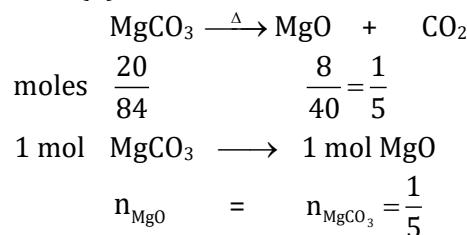
$$(3) 18$$

$$(4) \frac{1.8}{1.8} \times N_A = \frac{N_A}{10}$$

6. Ans. (4)

If N_A change from 6.022 × 10²³ to 6.027 × 10²⁰ then the mass of 1 mole of carbon will also change.

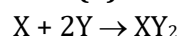
7. Ans. (2)



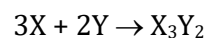
$$\text{Mass of MgCO}_3 = \frac{1}{5} \times 84 = \frac{84}{5} = 16.8$$

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

8. Ans. (3)



$$0.1 \rightarrow 10\text{g mass of 1 mol XY}_2 = 100\text{g}$$



$$0.05 \rightarrow 9\text{g mass of 1 mol X}_3\text{Y}_2 = 180\text{g}$$

$$\text{X} + 2\text{Y} = 100$$

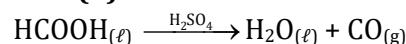
$$3\text{X} + 2\text{Y} = 180$$

$$- 2\text{X} = - 80 \Rightarrow \text{X} = 40$$

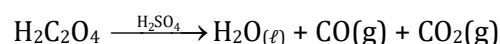
$$40 + 2\text{Y} = 100$$

$$2\text{Y} = 60 \Rightarrow \text{Y} = 30$$

9. Ans. (3)



$$n = \frac{2.3}{46} = \frac{1}{20}$$



$$n = \frac{4.5}{90} = \frac{1}{20}$$

$\frac{1}{20}$ mole HCOOH produce $\frac{1}{20}$ mole CO_(g)
 $\frac{1}{20}$ mole H₂C₂O₄ produce $\frac{1}{20}$ mole CO & $\frac{1}{20}$ mole CO₂.

KOH consume CO₂, So gas left are

$$\left(\frac{1}{20} + \frac{1}{20}\right) \text{CO}$$

$$n_{\text{CO}} = \frac{1}{10}$$

$$\text{mass of CO} = \frac{1}{10} \times 28 = 2.8\text{g}$$

10. Ans. (1)

Number of molecules = $n \times N_A$

$$(1) \frac{18}{18} \times N_A = N_A$$

$$(2) \frac{0.18}{18} \times N_A = \frac{N_A}{100}$$

$$(3) \frac{0.00224}{22.4} \times N_A = \frac{N_A}{10000}$$

$$(4) 10^{-3} N_A$$

11. Ans. (3)



2 mole NH₃ produce by 3 mole H₂

so 20 mole NH₃ will produce by $\frac{60}{2}$ mole of H₂.

$$n_{\text{H}_2} = 30$$

12. Ans. (4)

$$P_V = nRT$$

$$v = \frac{1.8 \times 0.083 \times 647}{18 \times 1} = 5.372$$

13. Ans. (1)

Number of atoms = $n \times N_A \times \text{atomicity}$

$$(1) \frac{1}{7} \times N_A \times 1 = \frac{N_A}{7}$$

$$(2) \frac{1}{108} \times N_A \times 1 = \frac{N_A}{108}$$

$$(3) \frac{1}{24} \times N_A \times 1 = \frac{N_A}{24}$$

$$(4) \frac{1}{32} \times N_A \times 2 = \frac{N_A}{16}$$

14. Ans. (4)

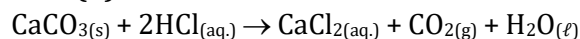
$$\begin{aligned} \text{Number of C-atom} &= \frac{12}{12} \times N_A \times 1 \\ &= N_A = 6.022 \times 10^{23} \end{aligned}$$

15. Ans. (3)

$$\begin{array}{lll} \text{C} & 78 & \frac{78}{12} = 6.5 \quad \frac{6.5}{6.5} = 1 \\ \text{H} & 22 & \frac{22}{1} = 22 \quad \frac{22}{6.5} = 3.3 \approx 3 \end{array}$$



16. Ans. (1)



$$\frac{50 \times 0.5}{1000} = 0.025$$

1 mol CaCO₃ react with 2 mole HCl

0.025 mol HCl react with $\frac{1}{2} \times 0.025$ mol CaCO₃

$$n_{\text{CaCO}_3} = 0.0125$$

$$\begin{aligned} \text{mass of CaCO}_3 &= 0.0125 \times 100 \\ &= 1.25 \text{ g} \end{aligned}$$

$$95 = \frac{1.25}{w} \times 100$$

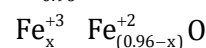
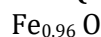
$$w = \frac{125}{95} = 1.32\text{g}$$

17. Ans. (2)

$$\text{mass} = \text{Vol.} \times \text{density}$$

$$\begin{aligned} \text{mass} &= 2.5 \times 2.15 \\ &= 5.375 \\ &= 5.4\text{g} \end{aligned}$$

18. Ans. (1)



$$3x \times 2(0.96 - x) - 2 = 0$$

$$3x + 1.92 - 2x - 2 = 0$$

$$x = 0.08$$

$$\text{fraction of Fe} = \frac{0.08}{0.96} = 0.083 = \frac{1}{12}$$

19. Ans. (1)

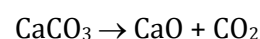
Weight of impure limestone = 20 g

Weight of pure limestone (CaCO₃) = 20% of 20 g

$$= \frac{20}{100} \times 20$$

$$= 4\text{g}$$

$$n_{\text{CaCO}_3} = \frac{4}{100} = 0.04$$



$$n = 0.04 \quad n = 0.04$$

$$n_{\text{CO}_2} = 0.04$$

$$\begin{aligned} W_{\text{CO}_2} &= 0.04 \times 44 \\ &= 1.76 \text{ g} \end{aligned}$$

20. Ans. (1)

- (1) 4 mol of He ; Number of He atom = $4 \times N_A$
 (2) 4u of He ; Number of He atom = 1
 (3) 4 g of He ; Number of He atom = N_A
 (4) 0.1 mol of He ; Number of He atom = $0.1 N_A$

21. Ans. (2)

$\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
 Given $\Rightarrow$ 1g (0.75 M, 25 ml)
 moles of NaOH = $\frac{1}{40} \text{ mol} = 0.025 \text{ mol}$
 moles of HCl = $\frac{0.75 \times 25}{1000} = 0.01875 \text{ mol}$
 now find the L.R. $\Rightarrow$ Value = $\frac{\text{given amount}}{\text{S.C}}$

NaOH ;	HCl
$\frac{0.025}{1}$	$\frac{0.01875}{1}$
>	

So, L.R will be HCl
 Unreacted moles of NaOH = $0.025 - 0.01875$
 = 0.00625 mol
 Unreacted mass = $0.00625 \times 40 \text{ g}$
 = 0.25 g
 = 250 mg

22. Ans. (2)

Element	%	Moles	Simple Ratio
A	32	$\frac{32}{64} = \frac{1}{2}$	1
B	20	$\frac{20}{40} = \frac{1}{2}$	1
C	48	$\frac{48}{32} = \frac{3}{2}$	3

Empirical formula = ABC_3

23. Ans. (1)

1g of $\text{H}_2 = \frac{1}{2} \text{ mol H}_2 = \frac{N_A}{2} \text{ molecules}$
 similarity, 14 g $\text{N}_2 = \frac{14}{28} \text{ mol} = \frac{N_A}{2} \text{ molecules}$

24. Ans. (2)

$\text{C}\% = \frac{12}{44} \times \frac{0.2}{0.3} \times 100 = 18.18\%$
 $\text{H}\% = \frac{2}{18} \times \frac{0.1}{0.3} \times 100 = 3.70\%$

Exercise-III (Analytical Questions)

1. Ans. (2)

Mass of 1 butane (C_4H_{10}) molecule is 58 amu.
 Mass of 1 mole butane = $58 \text{ amu} \times N_A$
 = $N_A \times \text{amu} = 1 \text{ g} = 58 \text{ g}$
 1 mole has = 6.022×10^{23} molecules.

2. Ans. (1)

$\rightarrow n_c = \frac{12}{12} = 1$ & $n_{\text{Al}} = \frac{27}{27} = 1$
 Moles are same so number of atoms also same number of atoms
 $n \times N_A \times 1$
 $1 \times N_A \times 1 = N_A \text{ atoms.}$
 $\rightarrow$ Gram atomic mass represents mass of 1 mole of atoms & 1 mol has 6.022×10^{23} atoms.

3. Ans. (2)

$\rightarrow 2A + 3B \rightarrow C$
 $n = 3 \quad 4$
 L.R. $\frac{3}{2} = 1.5$ $\frac{4}{3} = 1.33$
 L.R.
 $n_c = \frac{4}{3} \times 1 = \frac{4}{3}$

B is L.R. & A. is E. R.
 Ist correct, IInd incorrect.

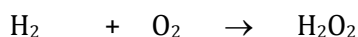
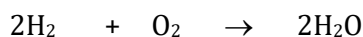
4. Ans. (2)

$\text{CH}_{4(g)} + 2\text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + 2\text{H}_2\text{O}_{(g)}$
 $\rightarrow$ 1mole CH_4 reacts with 2mole O_2 to produce 1 mole CO_2 & 2 mole H_2O .
 $\rightarrow$ Coefficients ratio will not be same as mass ratio.
 Ist correct, IInd incorrect.

5. Ans. (4)

$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
 10L 10L
 L.R. $\frac{10}{2} = 5$ $\frac{10}{1} = 1$
 $V_{\text{H}_2\text{O}} \frac{10}{2} \times 2 = 10\text{L}$
 O_2 will also left as excess reagent.
 Stoichiometric coefficients ratio is same as volume ratio.
 Ist incorrect, IInd correct.

6. **Ans. (1)**

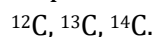


Both reaction follows law of multiple proportion A & R both are correct & R is correct explanation of A.

7. **Ans. (1)**

→ Average mass of C atom is 12.011 amu & actual mass of C is $12.011 \times 1.67 \times 10^{-24}\text{g}$.

→ Average mass can be calculate by the help of taking Average of Isotopes mass.



A & R both are correct also R is correct explanation of A.

8. **Ans. (3)**

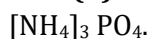
→ Equal volume of gas.

$$n = \frac{V}{22.4(\text{L})} \text{ moles are same for all gases.}$$

But number of atoms can be different for different gases.

→ atom is fundamental quantity which take in chemical reaction.

9. **Ans. (1)**



$$(a) \frac{\text{number of O-atom}}{\text{number of H atom}} = \frac{4}{12} = \frac{1}{3}$$

$$(b) \frac{\text{number of cation}}{\text{number of anion}} = \frac{3}{1}$$

$$(c) \frac{\text{g-atom of N}}{\text{g-atom of O}} = \frac{3}{4}$$

$$(d) \text{total number of atom is } 1 \text{ mol } (\text{NH}_4)_3\text{PO}_4$$

$$(5 \times 3) + 1 + 4 = 20 N_A$$

A, B both are correct.

10. **Ans. (1)**

(A) number of atoms = $n \times N_A \times \text{atomicity}$
Atomicity for substance can be different.



$$n = \frac{2}{2} = 1 \quad \frac{71}{71} = 1$$

1 mol H_2 react with 1 mol Cl_2 to produce 2 mol HCl $n_{\text{HCl}} = 2$

Mass of $\text{HCl} = 2 \times 36.5 = 71 \text{ g}$

(C) Reactant which completely consume in reaction will act as L.R.

(D) [A, B, C]

11. **Ans. (1)**

$$(A) n_{\text{H}_2\text{SO}_4} = 20$$

$$\text{Mass} = 20 \times 98 = 1960 \text{ (S)}$$

$$(B) n_{\text{H}_2\text{O}} = \frac{540}{18} = 30 \text{ (R)}$$

(C) Number of atoms

$$= \frac{10^{-10}}{2} \times 6.022 \times 10^{23} \times 2$$

$$= 6.022 \times 10^{13} \text{ (Q)}$$

(D) Number of amu in 20g

$$1 \text{ g} = \frac{1}{1.67 \times 10^{-24} \text{ g}}$$

$$20 \text{ g} = 20 \times \frac{1}{1.67 \times 10^{-24} \text{ g}}$$

$$\frac{1}{\text{amu}} = N_A$$

$$= 20 N_A \text{ (P)}$$

12. **Ans. (3)**

$$\text{Number of } N_A \text{ atoms} = \frac{5.3}{106} \times N_A \times 2 = \frac{N_A}{10}$$

$$(a) \text{Number of } N_A \text{ atoms} = \frac{4}{40} \times N_A \times 1 = \frac{N_A}{10}$$

$$(b) \text{Number of } N_A \text{ atoms} = \frac{5.85}{58.5} \times N_A \times 1 = \frac{N_A}{10}$$

$$(c) \text{Number of } N_A \text{ atoms} = 0.25 \times N_A \times 2 = \frac{N_A}{2}$$

$$(d) \text{Number of } N_A \text{ atoms} = \frac{5.6}{164} \times N_A \times 3 = 0.1 N_A$$

A & B are correct.

13. **Ans. (2)**

(A) Number of moles of Hydrogen = 8

P → 2 moles of C_3H_4 has 8 mol H atoms.

R → 4 moles of N_2H_2 has 8 mol H atoms.

(B) Number of moles of carbon = 6

P → 2 moles of C_3H_4 has 6 mol C atoms.

Q → 3 moles of CH_3COOH has 6 mol C atoms.

(C) Number of moles of oxygen = 6

Q → 3 moles CH_3COOH has = 6 mole O atoms.

S → 2 moles N_2O_3 has = 6 mole O atoms.

(D) Number of moles of N_2 molecule = 4

R → number of molecule of N in $\text{N}_2\text{H}_4 = 4$.