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

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

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

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

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

3. Ans. (4)

Mass	Mole	Number of atoms [n × N_A × 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

$= n \times N_A \times$ (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

$= n \times N_A \times$ number of atoms

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

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

8. Ans. (2)

Number of atoms in [O_3]

$= n \times N_A \times$ 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 of $^{12}_{6}C$ $= n \times N_A \times$ [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 amu = 1.66×10^{-24}g

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

$\simeq 3.94 \times 10^{-22}$g

11. Ans. (2)

1 H_2O molecule = 18 amu

Actual mass of 1 H_2O molecule

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

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

12. Ans. (3)

1 molecule CH_4 = 16 amu

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

mass of 1 molecule of $CH_4 = 16 \times (1.66 \times 10^{-24}\text{g})$

$= 2.66 \times 10^{-23}$g

13. Ans. (1)

1g atom of C = 1 mole of C

= 12g

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)

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

Number of NH_3 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

$B_2A_3 = (2 \times b) + (3 \times a)$

= mass of 1 mole substance

0.05 mol $B_2A_3 \rightarrow 9$g

1 mol of $B_2A_3 = \frac{9}{0.05} = 180$g

$2b + 3a = 180$ ...(1)

molar mass of $B_2A = (2b + a)$

0.1 mol of $B_2A \rightarrow 10$g

1 mol of $B_2A \rightarrow \frac{10}{0.1} = 100$

$\Rightarrow$ $2b + a = 100$ ...(2)

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

17. Ans. (3)

$n_{O_2} = \frac{5.6}{22.4} = \frac{1}{4}$

18. Ans. (4)

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

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

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

CO_2 & N_2O

19. Ans. (1)

Mass	Moles	Number of atoms
1g CO_2	$\frac{1}{44}$	$\frac{1}{44} N_A$
1g N_2	$\frac{1}{28}$	$\frac{1}{28} N_A$
1g O_2	$\frac{1}{32}$	$\frac{1}{32} N_A$
1g H_2	$\frac{1}{2}$	$\frac{1}{2} N_A$

20. Ans. (1)

mass of gas = $w_{(g)}$

Vol. of gas = V mL (at STP)

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

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

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

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

21. Ans. (2)

Initial mass of H_2SO_4 = 98mg = 98 × 10^{-3}g

Initial moles of H_2SO_4 = $\frac{98\times10^{-3}}{98}=10^{-3}$mol

Number of molecules removed = 3.01 × 10^{20}

Number of moles removed

= $\frac{3.01\times10^{20}}{6.02\times10^{23}}=0.5\times10^{-3}$mol

Moles of H_2SO_4 left = 10^{-3} – [0.5 × 10^{-3}]

= 0.5 × 10^{-3}

22. Ans. (3)

Formula of gas = $[CO]_x$

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

= 28x

28x = 2 × V.D.

28x = 2 × 70

28x = 140

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

23. Ans. (4)

Mol. wt. = 2 × 11.2 = 22.4g

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

Vol. of gas (at STP) = moles × 22.42

= $\frac{2.4}{22.4}\times22.4=2.42$

24. Ans. (3)

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

= $\frac{1.12\times10^{-7}}{22400}=\frac{1}{2}\times10^{-11}$

molecules of gas = moles × N_A

= $\frac{1}{2}\times10^{-11}\times6.02\times10^{23}$

= 3.01 × 10^{12}

25. Ans. (3)

Number of electrons in

$NO_3^- = n_{NO_3^-}\times N_A$ (number of electrons)

= $\frac{3.1\times10^{-3}}{62}\times6.022\times10^{23}\times32$

= 9.6 × 10^{20}

26. Ans. (1)

Vol. of 1 mole N_2 [at N.T.P.] = 22.4 L

mass of 1 mole N_2 = 28g

Density of N_2 = $\frac{\text{mass}}{\text{volume}}=\frac{28g}{22.4L}=1.25g\ L^{-1}$

27. Ans. (2)

number of carbon atoms

= n_c × N_A × atomicity

= $\frac{1.2\times10^{-3}}{12}$ × 6.022 × 10^{23} × 1

= 6.022 × 10^{19}

28. Ans. (3)

	X	Y
mass	w	w
moles	$\frac{w}{30}$	$\frac{w}{20}$
simple ratio × 60	$\frac{1}{30}\times60$	$\frac{w}{20}\times60$
	2	3

Molecular formula = X_2Y_3

29. Ans. (1)

	mass	moles	simples ratio
S	50	$\frac{50}{32}=1.5$	$\frac{1.5}{1.5}=1$
O	50	$\frac{50}{16}=3.125$	$\frac{3.125}{1.5}\simeq2$

Empirical formula = 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	$\frac{20}{1}=20$	$\frac{20}{6.66}\simeq3$

C_1 H_3

1 : 3

C_2 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	$\frac{40}{16}=2.5$	$\frac{2.5}{2.5}=1$

$\boxed{\text{E. F} = \text{MO}}$

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	$\frac{16}{1}=16$	$\frac{16}{3.23}\simeq 5$
N	45.2	$\frac{45.2}{14}\simeq 3.23$	$\frac{3.23}{3.23}=1$

$\boxed{\text{E.F.} = CH_5N \text{ or } CH_3NH_3}$

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

$\boxed{\text{E.F.} = P_4S_3}$

37. Ans. (4)

	Mass%	Atomic ratio	simple ratio
I	254	$\frac{254}{127}=2$	2
O	80	$\frac{80}{10}=5$	5

$\boxed{\text{Formula} = I_2O_5}$

38. Ans. (2)

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

Gives Cr = 4.8×10^{10} , 0 = 9.6×10^{10}

Simplest ratio 1 : 2

Empirical formula = CrO_2

39. Ans. (1)

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

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

40. Ans. (3)

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

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

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	$\frac{51.62}{16}=3.22$	$\frac{3.22}{3.22}=1$

$\boxed{\text{E.f.} = CH_3O}$

42. Ans. (3)

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

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

1 mol $C_3H_8 \rightarrow 4$ mol of H_2O

6.5 mol $C_3H_8 \rightarrow 4 \times 6.5$ mol of H_2O

$n_{H_2O} = 26$

$w_{H_2O} = 26 \times 18 = 468g$

43. Ans. (3)

$aA + bB \rightarrow cC + dD$

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

44. Ans. (3)

$C_8H_{18} + \frac{25}{2} O_2 \rightarrow 8CO_2 + 9H_2O$

Mass of $C_3H_{18} = 0.8 \times 1.425$

$= 1140g$

$n_{C_3H_8} = \frac{1140}{114} = 10$

1 mol $C_8H_{18} \rightarrow \frac{25}{2}$ mol O_2

10 mol $C_8H_{18} \rightarrow \frac{25}{2} \times$ mol O_2

$n_{O_2} = \frac{250}{2} = 125$

45. Ans. (2)

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

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

2 mol Al $\rightarrow \frac{3}{2}$ mol O_2

1 mol Al $\rightarrow \frac{3}{4}$ mol O_2

$\frac{1}{3}$ mol Al $\rightarrow \frac{3}{4} \times \frac{1}{3}$ mol O_2

$n_{O_2} = \frac{1}{4}$

wt. of $O_2 = \frac{1}{4} \times 32 = 8g$

46. Ans. (4)

$2 Al_{(s)} + \frac{3}{2} O_{2(g)} \rightarrow Al_2O_{3(s)}$

2 mol of Al reacts with $\frac{3}{2}$ mol of O_2 to produce 1 mol of Al_2O_3

47. Ans. (3)

	$C_{(s)} + CO_{2(g)} \rightarrow$	$2CO_{(g)}$
t = 0	1	–
t = t	1 – x	2x

Vol. after = 1 – x + 2x = 1.4

reaction $\boxed{x = 0.4}$

V_{CO_2} left = 1 – 0.4 = 0.6 L

V_{CO} prepared = 2 × 0.4 = 0.8 L

48. Ans. (4)

$C + CO_2 \rightarrow 2CO$

26 CC

1 Vol. of $CO_2 \rightarrow$ 2Vol. of CO

26 CC of $CO_2 \rightarrow 2 \times 26$ CC of CO

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

49. Ans. (2)

$4Al + 3O_2 \rightarrow 2Al_2O_3$

3 mol $O_2 \rightarrow$ 4 mol of Al

1 mol $O_2 \rightarrow \frac{4}{3}$ mol of Al

$\frac{1}{2}$ mol $O_2 \rightarrow \frac{4}{3} \times \frac{1}{2}$ mol of Al

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

$w_{Al} = \frac{\cancel{4}^{2}}{\cancel{6}_{3}} \times \cancel{27}^{9} = 18g$

50. Ans. (4)

$3 BaCl_2 + 2 Na_3 PO_4 \rightarrow Ba_3(PO_4)_2 + 6 NaCl$

0.5 0.2

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

2 mol $Na_3PO_4 \rightarrow 1$ mol $Ba_3(PO_4)_2$

1 mol $Na_3PO_4 \rightarrow \frac{1}{2}$ mol $Ba_3(PO_4)_2$

0.2 mol $Na_3PO_4 \rightarrow \frac{1}{2} \times 0.2$ mol $Ba_3(PO_4)_2$

$\boxed{n_{Ba_3(PO_4)_2} = 0.1}$

51. Ans. (3)

$2H_2 + O_2 \rightarrow 2H_2O$

2vol. H_2 react with 1 vol. of O_2

4 ml H_2 will react with 2 ml of O_2

Total vol. of $O_2 = VO_{2(reacted)} + VO_{2(unreacted)}$

$VO_{2(total)}$ = 2 ml + 8 ml = 10 ml

52. Ans. (3)

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

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

L. R. $\frac{2}{2}=1 \quad \underset{\text{L.R.}}{\frac{\frac{1}{8\times1}=\frac{1}{8}}}$

$$n_{H_2O}=\frac{1}{8}\times2=\frac{1}{4}$$

$$w_{H_2O}=\frac{1}{4}\times18=4.5$$

53. Ans. (2)

$$A + 2B \rightarrow C$$

moles 5 8

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

n_C = 4 × 1 = 4

54. Ans. (3)

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

Moles $\frac{1.6}{34}=0.04; \quad \frac{1.5\times10^{22}}{6\times10^{23}}=0.025$

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

SO_2 will remain in excess

55. Ans. (3)

$$H_2 + Cl_2 \rightarrow 2HCl$$

Vol. 12 L 11.2 L

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

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

Remaining H_2 = 12 – 11.2 = 0.8 L

56. Ans. (4)

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

10ml - 40ml 50ml

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

Which means C_4H_{10}

57. Ans. (2)

Dalton

58. Ans. (4)

$SnCl_2$, $SnCl_4$ $\Rightarrow$ show law of multiple proportions.

59. Ans. (4)

Gaseous volumes

60. Ans. (2)

Multiple proportions.

61. Ans. (2)

Nuclear reaction

62. Ans. (3)

Number of molecule = n × N_A

n is same for all O_2, NH_3 & CO_2.

63. Ans. (1)

volume ∝ moles

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

M. F. = 2 × CH_2 = C_2H_4

64. Ans. (3)

$H_2 : He : O_2 : O_3$

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

moleculs $\frac{1}{22.4}N_A:\frac{1}{22.4}N_A:\frac{1}{22.4}N_A:\frac{1}{22.4}N_A$

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)

$$\frac{M_{gas}}{M_{N_2}}=\frac{0.44}{0.28}$$

$$M_{gas}=\frac{0.44}{0.28}\times28$$

= 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.	$\frac{x}{2}\times22.4$		$\frac{x}{32}\times22.4$		$\frac{x}{16}\times22.4$
	$\frac{1}{2}$		$\frac{1}{32}$		$\frac{1}{16}$
	16	:	1	:	2

2. Ans. (1)

	H_2	+	Cl_2	$\rightarrow$	2HCl
moles	$\frac{22.4}{22.4}=1$		$\frac{11.2}{22.4}=\frac{1}{2}$		

L.R. $x_1=\frac{1}{1}$ $\quad x_2=\frac{1}{\frac{2\times1}{\text{L.R.}}}$

$n_{HCl}=\frac{1}{2}\times2=1$

3. Ans. (1)

	2Mg	+	O_2	$\rightarrow$	2MgO
moles	$\frac{1}{24}$		$\frac{0.56}{32}$		
	$=0.041$		$=0.0175$		

L.R. $x_1=\frac{0.041}{2}$ $\quad x_2=\frac{\frac{0.0175}{1}}{\text{L.R.}}$

$=0.02$

$n_{HCl}=\frac{1}{2}\times2=1$

Mg left in excess = 0.0416 – (0.0175) × 2

wt. = 0.0066 × 24 = 0.16g

4. Ans. (1)

	H_2	+	O_2
moles	$\frac{100}{2}=50$		$\frac{400}{32}=12.5$
molar ratio =	50	:	12.5
	4	:	1

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 6.022×10^{23} to 6.027×10^{20} then the mass of 1 mole of carbon will also change.

7. Ans. (2)

	$MgCO_3$	$\xrightarrow{\Delta}$	MgO	+	CO_2
moles	$\frac{20}{84}$		$\frac{8}{40}=\frac{1}{5}$		

1 mol $MgCO_3$ $\longrightarrow$ 1 mol MgO

$n_{MgO}=n_{MgCO_3}=\frac{1}{5}$

Mass of $MgCO_3=\frac{1}{5}\times84=\frac{84}{5}=16.8$

% Purity $=\frac{16.8}{20}\times100=84\%$

8. Ans. (3)

$X + 2Y \rightarrow XY_2$

$0.1 \rightarrow$ 10g mass of 1 mol XY_2 = 100g

$3X + 2Y \rightarrow X_3Y_2$

$0.05 \rightarrow$ 9g mass of 1 mol X_3Y_2 = 180g

$X + 2Y = 100$

$3X + 2Y = 180$

$-2X = -80 \Rightarrow X = 40$

$40 + 2Y = 100$

$2Y = 60 \Rightarrow Y = 30$

9. Ans. (3)

$HCOOH_{(\ell)} \xrightarrow{H_2SO_4} H_2O_{(\ell)} + CO_{(g)}$

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

$H_2C_2O_4 \xrightarrow{H_2SO_4} H_2O_{(\ell)} + CO(g) + CO_2(g)$

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

$\frac{1}{20}$ mole HCOOH produce $\frac{1}{20}$ mole $CO_{(g)}$

$\frac{1}{20}$ mole $H_2C_2O_4$ produce $\frac{1}{20}$ mole CO & $\frac{1}{20}$ mole CO_2.

KOH consume CO_2, So gas left are

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

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

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

10. Ans. (1)

Number of molecules = n × 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)

$N_2 + 3H_2 \rightarrow 2NH_3$

2 mole NH_3 produce by 3 mole H_2

so 20 mole NH_3 will produce by $\frac{60}{2}$ mole of H_2.

$n_{H_2} = 30$

12. Ans. (4)

$P_V = nRT$

$v = \frac{1.8\times0.083\times647}{18\times 1} = 5.372$

13. Ans. (1)

Number of atoms = n × N_A × 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)

Number of C–atom = $\frac{12}{12}$ × N_A × 1

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

15. Ans. (3)

C	78	$\frac{78}{12}=6.5$	$\frac{6.5}{6.5}=1$
H	22	$\frac{22}{1}=22$	$\frac{22}{6.5}=3.3\simeq3$

CH_3

16. Ans. (1)

$CaCO_{3(s)} + 2HCl_{(aq.)} \rightarrow CaCl_{2(aq.)} + CO_{2(g)} + H_2O_{(\ell)}$

$\frac{50\times0.5}{1000}=0.025$

1 mol $CaCO_3$ react with 2 mole HCl

0.025 mol HCl react with $\frac{1}{2}$ × 0.025 mol $CaCO_3$

n_{CaCO_3} = 0.0125

mass of $CaCO_3$ = 0.0125 × 100

= 1.25 g

$95 = \frac{1.25}{w}\times100$

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

17. Ans. (2)

mass = Vol. × density

mass = 2.5 × 2.15

= 5.375

= 5.4g

18. Ans. (1)

$Fe_{0.96}O$

$Fe_x^{+3}\ Fe_{(0.96-x)}^{+2}O$

3x × 2(0.96 – x) – 2 = 0

3x + 1.92 – 2x –2 = 0

x = 0.08

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 ($CaCO_3$) = 20% of 20 g

= $\frac{20}{100}\times20$

= 4g

$n_{CaCO_3} = \frac{4}{100}$ = 0.04

$CaCO_3 \rightarrow CaO + CO_2$

n=0.04 n=0.04

n_{CO_2} = 0.04

W_{CO_2} = 0.04 × 44

= 1.76 g

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)

$NaOH + HCl \rightarrow NaCl + H_2O$

Given $\Rightarrow$ 1g (0.75 M, 25 ml)

moles of NaOH = $\frac{1}{40}$ mol = 0.025 mol

moles of HCl = $\frac{0.75 \times 25}{1000} = 0.01875$ 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 × 40 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 H_2 = $\frac{1}{2}$ mol H_2 = $\frac{N_A}{2}$ molecules

similarity, 14 g N_2 = $\frac{14}{28}$ mol = $\frac{N_A}{2}$ molecules

24. Ans. (2)

$C\% = \frac{12}{44} \times \frac{0.2}{0.3} \times 100 = 18.18\%$

$H\% = \frac{2}{18} \times \frac{0.1}{0.3} \times 100 = 3.70\%$

Exercise-III (Analytical Questions)

1. Ans. (2)

Mass of 1 butane (C_4H_{10}) molecule is 58 amu.

Mass of 1 mole butane = 58 amu × N_A

= N_A × amu = 1 g = 58g

1 mole has = 6.022×10^{23} molecules.

2. Ans. (1)

→ $n_C = \frac{12}{12} = 1$ & $n_{Al} = \frac{27}{27} = 1$

Moles are same so number of atoms also same number of atoms

$n \times N_A \times 1$

$1 \times N_A \times 1 = N_A$ atoms.

→ Gram atomic mass represents mass of 1 mole of atoms & 1 mol has 6.022×10^{23} atoms.

3. Ans. (2)

→ $2A + 3B \rightarrow C$

n = 3 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)

$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$

→ 1mole CH_4 reacts with 2mole O_2 to produce 1 mole CO_2 & 2 mole H_2O.

→ Coefficients ratio will not be same as mass ratio.

Ist correct, IInd incorrect.

5. Ans. (4)

$2H_2 + O_2 \rightarrow 2H_2O$

10L 10L

L.R. $\frac{10}{2} = 5$ $\frac{10}{1} = 1$

V_{H_2O} $\frac{10}{2} \times 2 = 10L$

O_2 will also left as excess reagent.

Stoichiometric coefficients ratio is same as volume ratio.

Ist incorrect, IInd correct.

6. Ans. (1)

$2H_2 + O_2 \rightarrow 2H_2O$

$H_2 + O_2 \rightarrow H_2O_2$

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 $12.011 \times 1.67 \times 10^{-24}$g.

→ Average mass can be calculate by the help of taking Average of Isotopes mass. ^{12}C, ^{13}C, ^{14}C.

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

8. Ans. (3)

→ Equal volume of gas.

$n = \frac{v}{22.4(L)}$ 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)

$[NH_4]_3 PO_4$.

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

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

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

(d) total number of atom is 1 mol $(NH_4)_3PO_4$

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

A, B both are correct.

10. Ans. (1)

(A) number of atoms = $n \times N_A \times$ atomicity

Atomicity for substance can be different.

(B) $H_2 + Cl_2 \longrightarrow 2HCl$

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

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

Mass of HCl = $2 \times 36.5 = 71$ g

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

(D) [A, B, C]

11. Ans. (1)

(A) $n_{H_2SO_4} = 20$

Mass = $20 \times 98 = 1960$ (S)

(B) $n_{H_2O} = \frac{540}{18} = 30$ (R)

(C) Number of atoms

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

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

(D) Number of amu in 20g

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

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

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

$= 20\ N_A$ (P)

12. Ans. (3)

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

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

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

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

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

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 N_2H_4 = 4.