

UNIT # 01

MOLE CONCEPT

EXERCISE # 1

4. No. of molecule (अणुओं की संख्या) = Mole N_A
 $N = nN_A$
5. At STP or NTP volume of any gas (STP या NTP पर किसी गैस का आयतन) = 22.4 L
6. 1 gram ion = 1 mole ion = N_A ion
 1 mol Al^{3+} ion = $N_A \cdot 3$
 Charge (e) on 1 mol Al^{3+} ion = $N_A \cdot 3$ e columb.
 (1 मोल Al^{3+} ion पर आवेश = $N_A \cdot 3$ e columb.)
7. No. of molecules (अणुओं की संख्या) = mole N_A
 i.e., mole is equal then no. of molecules are also equal (अर्थात् मोल बराबर होने पर अणुओं की संख्या भी बराबर होती है)

8. Mole of Al = $\frac{wt}{At\ wt} = \frac{54}{27} = 2\text{mol}$
 that is same for Mg atom (यह Mg परमाणु के लिए भी समान है)

So mol of Mg = $\frac{wt}{24}$
 $wt = 2 \cdot 24 = 48\text{ g.}$

10. No. of oxygen atom = mole N_A atomicity.
 (ऑक्सीजन परमाणु के संख्या = मोल N_A परमाणुकता)

(A) = $\frac{1}{16} \quad N_A \quad 1 = \frac{N_A}{16}$

(B) = $\frac{1}{32} \quad N_A \quad 2 = \frac{N_A}{16}$

(C) = $\frac{1}{48} \quad N_A \quad 3 = \frac{N_A}{16}$

all are same.

11. $(NH_4)_3PO_4$
 12 mol hydrogen atom contain = 4 atom of oxygen
 (12 मोल हाइड्रोजन परमाणु में है = 4 परमाणु ऑक्सीजन के)

1 mol hydrogen atom contain = $\frac{4}{12}$

3.18 mol hydrogen atom contain (3.18 मोल हाइड्रोजन परमाणु में हैं) = $\frac{4}{12} \quad 3.18 = 1.08\text{ mole}$

12. Mass of 1 e^- (1 e^- का द्रव्यमान) = $9.31 \cdot 10^{-31}\text{ kg}$

$1\text{ kg} = \frac{1}{9.31 \times 10^{-31} \times 6.02 \times 10^{23}}$
 $= \frac{10^8}{9.31 \times 6.023}$

13. 100 g compound contain (100 g यौगिक में है) = 5.37 g Nitrogen (नाइट्रोजन)

1 g Nitrogen = $\frac{100}{5.37} \times 14 = 260.7$

15. $H_2 : He : O_2 : O_3$
 no. of atoms = $2N_A : 1N_A : 2N_A : 2N_A$
 (परमाणुओं की संख्या)

= $2 : 1 : 2 : 3$

16. $^{63}\text{Cu} \quad ^{65}\text{Cu}$
 % abundance(% प्राप्ति) $x \quad 100 - x$

Avg. mass (औसत द्रव्यमान) = $\frac{M_1x_1 + M_2x_2}{x_1 + x_2}$

$63.546 = \frac{63 \times x + 65(100 - x)}{100}$

$6354.6 = 63x + 6500 - 65x$

$2x = 145.4 \Rightarrow x = 70\%$

17. % by wt. of H_2O (H_2O के भार %)
 $= \frac{wt. \text{ of } H_2O (H_2O \text{ का भार})}{\text{Total wt. of compound (यौगिक का कुल भार)}} \times 100$

$13 = \frac{18x}{18x + 120} \times 100$

$x = 1$

18. % Mol Simple ratio (सरल अनुपात)
 C 85.7 $85.7/12 = 7.14$ $7.14/7.14 = 1$ 1
 H 14.3 $14.3/1 = 14.3$ $14.3/7.14 = 2$ 2

\therefore Empirical formula (मूलानुपाती सूत्र) = CH_2

\therefore PMw = DRT

$Mw = \frac{DRT}{P} = \frac{2.5 \times .0821 \times 273}{1} = 56$

$n = \frac{\text{Molecular wt. (आण्विक भार)}}{\text{Ewt. (मूलानुपाती भार)}} = \frac{56}{14} = 4$

Molecular formula (आण्विक सूत्र) = $n \cdot \text{E.F.}$

= $4 \cdot CH_2$

= C_4H_8

19. Element % Mole Simplest ratio
 (तत्व) (मोल) (सरल अनुपात)
 C 70.8 $70.8/12 = 6$ $6/03 = 20$ 20
 H 6.2 $6.2/1 = 6$ $6/03 = 20$ 20
 N 4.1 $4.1/14 = .3$ 1 1
 O 18.9 $18.9/16 = 1.2$ 4 4

E.F. = $C_{20}H_{20}NO_4$

21. $M + 6F \longrightarrow MF_6$

Mole of M = Mole of MF_6

$\frac{wt}{\text{Mole wt}} = \frac{wt}{\text{Mol. wt}}$

$\frac{.25}{x} = \frac{.547}{x + 19 \times 6}$

$28.5 + .25x = .547x$

$28.5 = .297x \Rightarrow x = 95.959$

so element (तत्व) is = Mo

22. NaOH contain 3 mole of O atoms (NaOH में O परमाणु के 3 मोल हैं)

so mol of NaOH (अतः NaOH के मोल) = 3 mol
wt. of NaOH (NaOH का भार) = 3 40 = 120 g

$$\% \text{ purity (\% शुद्धता)} = \frac{120}{1000} \times 100 = 12\%$$

23. Molarity of Cl^- (Cl^- की मोलरता)

$$= \frac{M_1 V_1 + M_2 V_2}{\text{Total vol. (कुल आयतन)}}$$

$$= \frac{15 \times .2 \times 2 + 45 \times .45 \times 3}{15 + 45} = \frac{60}{60} = 1M$$

24. $X_{\text{C}_2\text{H}_5\text{OH}} = .25$

$$X_{\text{H}_2\text{O}} = .75$$

$$n_{\text{C}_2\text{H}_5\text{OH}} = .25$$

$$w_{\text{C}_2\text{H}_5\text{OH}} = .25 \times 46 = 11.5g$$

$$n_{\text{H}_2\text{O}} = .75$$

% wt of $\text{C}_2\text{H}_5\text{OH}$ ($\text{C}_2\text{H}_5\text{OH}$ के % भार)

$$= \frac{11.5}{11.5 + 13.5} \times 100 = 45\%$$

25. Mole of NO_3PO_4 (NO_3PO_4 के मोल) = 20 .40

$$= 8 \text{ m mol} = .008 \text{ mol}$$

Na_3PO_4 contain 3Na^+ ion (Na_3PO_4 में 3Na^+ आयन हैं)

$$= 3 .008 = .024 \text{ mol}$$

27. Molality of H_2SO_4 is 9 (H_2SO_4 की मोललता 9 है)

i.e. 9 mole of H_2SO_4 in 1 kg solvent (अर्थात् 1 kg विलायक में 9 मोल H_2SO_4 है)

1 kg solvent contain = 9 mole H_2SO_4 (1 kg विलायक में है = 9 mole H_2SO_4)

1 kg solvent contain = 9 98 wt of H_2SO_4 (1 kg विलायक में है = 9 98 wt H_2SO_4)

1000 kg solvent contain (1000 kg विलायक में हैं)

= 9 98/1000 910

910 kg solvent contain (910 kg विलायक में हैं)

= 802.62 g

wt. of solvent (विलेय का भार) = 910 g

wt. of solution (विलयन का भार) = 802.62 + 910

$$= 1712.62 \text{ g}$$

x% by wt (भार का x%)

$$= \frac{\text{wt of solute (विलेय का भार)}}{\text{wt of solution (विलयन का भार)}} \times 100$$

$$= \frac{802.62}{1712.62} \times 100 = 46.87$$

$$28. \text{ R.D.} = \frac{\text{Density (घनत्व) of } \text{O}_3}{\text{Density (घनत्व) of } \text{O}_2}$$

at same temp. & pressure of density \propto Mw
(घनत्व के समान ताप व दाब पर \propto Mw)

$$= \frac{\text{Mw (आण्विक भार) of } \text{O}_3}{\text{Mw (आण्विक भार) of } \text{O}_2} = \frac{48}{32} = \frac{3}{2} = 1.5$$

29. $x_A = 0.2$

$$x_{\text{H}_2\text{O}} = 1 - 0.2 = 0.8$$

$$\text{wt of } \text{H}_2\text{O} = 0.8 \quad 18 = 14.4 \text{ g}$$

Molality (मोललता)

$$= \frac{\text{moles of solute (विलेय के मोल)}}{\text{wt. of solvent (विलायक) } (\text{H}_2\text{O}) \text{ in kg}}$$

$$= \frac{.2 \times 1000}{14.4} = 13.8$$

30. 2.8 % by mass volume solution of KOH (KOH के द्रव्यमान आयतन विलयन का 2.8 %)

i.e., 2.8 g KOH in 100 ml solution (अर्थात् 100 ml विलयन में 2.8 g KOH)

$$\text{molarity (मोलरता)} = \frac{2.8}{56 \times .1} = .5 \text{ M}$$

31. Molality of H_2SO_4 (H_2SO_4 की मोललता) = .2 mol/kg

.2 mol H_2SO_4 then wt (.2 मोल H_2SO_4 तो भार)

$$= .20 \quad 98 = 19.6 \text{ g}$$

wt. of solvent (विलायक का भार) = 1 kg = 1000 g

wt of solution (विलयन का भार) = 19.6 + 1000

$$= 1019.6 \text{ g}$$

32. Molarity (मोलरता)

$$= \frac{\text{moles of solute (विलेय के मोल)}}{\text{vol of solution (विलयन का आयतन)}}$$

$$\text{mol of solution (विलयन के मोल)} = \frac{100 \times 10^{-3}}{.8}$$

$$= 125 \text{ mL}$$

33. Moles of solute (विलेय के मोल)

$$= \frac{6.02 \times 10^{22}}{N_A} = 0.1 \text{ mol}$$

concentration of solution (विलयन की सान्द्रता)

$$= \frac{\text{moles}}{\text{vol}}$$

$$= \frac{.1 \times 1000}{500} = .2$$

MOLE CONCEPT

EXERCISE # 2

1. $38.5\% \left(\frac{w}{w}\right) \text{Ag}$ i.e. 38.5 g Ag contain in 100 g solution

$$(38.5\% \left(\frac{w}{w}\right) \text{Ag} \text{ अर्थात् } 100 \text{ g विलयन में } 38.5 \text{ g Ag})$$

Molarity (मोलरता)

$$= \frac{\text{moles of solute (विलेय के मोल)}}{\text{Vol. of solution (विलयन का आयतन)}}$$

$$= \frac{38.5 \times 146}{108 \times 1} = 52.1 \text{ mol L}^{-1}$$

2. $\text{ppm} = \frac{\text{moles of solute (विलेय के मोल)}}{\text{mass of solution (विलयन का द्रव्यमान)}} \times 10^6$

$$\frac{400}{100} \times 100 = \frac{\text{moles of solute (विलेय के मोल)}}{\text{mass of solution (विलयन का द्रव्यमान)}} \times 100$$

$$\text{Mass (द्रव्यमान) \%} = 0.04$$

3. Molarity (मोलरता)

$$= \frac{(w/w) \times d \times 10}{\text{Molar mass of solute (विलेय का मोलर द्रव्यमान)}}$$

$$= \frac{12 \times 1.313 \times 10}{40}$$

$$\therefore \frac{\text{mol of solute (विलेय के मोल)}}{\text{Vol (आयतन)}} = \frac{12 \times 1.131 \times 10}{40}$$

$$\text{Vol} = 1.47 \text{ L}$$

4. Molarity (मोलरता) = $\frac{48 \times 1.150 \times 10}{81} = 8.9 \text{ mol L}^{-1}$

5. Molarity (मोलरता) = $\frac{40 \times 1.05 \times 10}{62} = 6.77 \text{ M}$

6. Molality (मोललता)

$$\frac{\text{moles of solute (विलेय के मोल)}}{\text{mass of solvent in kg (विलायक का kg में द्रव्यमान)}}$$

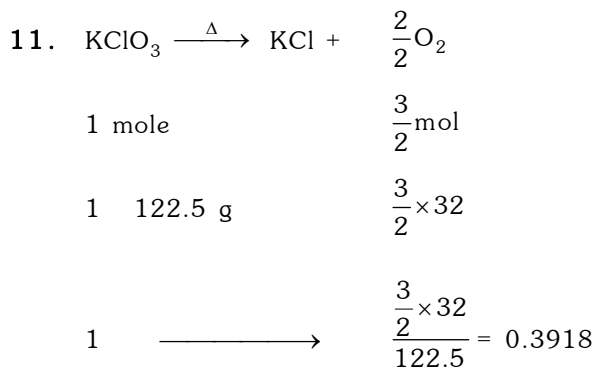
$$= \frac{160 \times 1000}{32 \times 200} = 25 \text{ m}$$

7. $7 \text{ XeF}_6 + 3 \text{ I}_2 \longrightarrow 6 \text{ IF}_7 + 7 \text{ Xe}$

$$7 \text{ mol} \quad 6 \text{ mol}$$

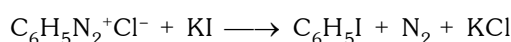
$$1$$

$$210 \quad \frac{6}{7} \times 210 = 180 \text{ m mol}$$



$$\% \text{ Loss (हानि)} = 0.3918 \times 100 = 39.18$$

13. $\text{C}_6\text{H}_5\text{NH}_2 + \text{HNO}_2 + \text{HCl} \longrightarrow \text{C}_6\text{H}_5\text{N}_2^+ \text{Cl}^- + 2\text{H}_2\text{O}$



$$n_p = n_r \quad R_1 \quad R_2$$

$$\text{moles of } \text{C}_6\text{H}_5\text{I} = \text{mole of } \text{C}_6\text{H}_5\text{NH}_2 \quad R_1 \quad R_2$$

$$\frac{\text{wt.}}{204} = \frac{9.3}{93} \times 1 \times 1$$

$$\text{wt.} = 20.4 \text{ g}$$

$$\% \text{ yield of } \text{C}_6\text{H}_5\text{I} (\text{C}_6\text{H}_5\text{I की \% लब्धि})$$

$$= \frac{16.32}{20.4} \times 100 = 80\%$$

14. Let assume % of H is x (H का %, x मानें)

$$\% \text{ of H (H का \%)} = x$$

$$\% \text{ of C (C का \%)} = 6x$$

$$\% \text{ of N (N का \%)} = \frac{7x}{1.5}$$

Element	%	Ratio of mol	Simplest
(तत्व)		(मोल का अनुपात)	(सरलतम)
H	x	$x/1 = 1$	6
C	6x	$6x/12 = 1/2$	3
N	$\frac{7x}{1.5}$	$\frac{7x}{1.5 \times 14} = \frac{1}{3}$	2

$$\therefore \text{F.F} = \text{C}_3\text{H}_6\text{N}_2$$

$$\text{atomic mass (परमाण्विक द्रव्यमान)} = 70$$

$$\text{molar mass (मोलर द्रव्यमान)} = 140$$

		mole	simple ratio
		(मोल)	(सरल अनुपात)
%	X	50	50/10
%	Y	50	50/20
E.F = X ₂ Y			

16. 7 g Na contain salt (7 g Na में उपस्थित लवण)=100g

$$1 \text{ g} \longrightarrow = \frac{100}{7} \times 23$$

$$23 \text{ g} \longrightarrow = 329$$

17. mole (मोल) atom (परमाणु)

$$\% \text{ N} = 12.8 \quad 12.8/14 \quad \frac{12.8}{14} \times N_A$$

$$\% \text{ S} = 9.8 \quad 9.8/32 \quad \frac{9.8}{32} \times N_A$$

$$\% \text{ Na} = 7 \quad 7/23 \quad \frac{7}{23} \times N_A$$

$$\therefore \frac{7}{23} \times N_A \text{ atom of Na contain}$$

$$(\text{Na के } \frac{7}{23} \times N_A \text{ परमाणु में हैं}) = \frac{12.8}{14} \times N_A \text{ of N}$$

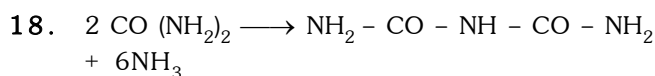
$$\therefore 1 \text{ atom of Na contain (Na के 1 परमाणु में है)} \\ = 3 \text{ atom of N}$$

$$\therefore \frac{7}{23} \times N_A \text{ atom of Na contain} = \frac{9.8}{32} \times N_A \text{ of S}$$

$$(\text{Na के } \frac{7}{23} \times N_A \text{ में है} = \text{S के } \frac{9.8}{32} \times N_A)$$

$$\therefore 1 \text{ atom of Na contain}$$

$$(\text{Na के 1 परमाणु में है}) = \frac{9.8}{32} \times \frac{23}{7} = 1 \text{ atom}$$

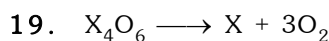


$$2 \text{ molecule} \longleftarrow 1 \text{ molecule}$$

$$\frac{2}{1} \times 10^{22} \text{ molecule} \longleftarrow 10^{22}$$

$$\text{mol} = \frac{2 \times 10^{22}}{6.02 \times 10^{23}}$$

$$\text{mass} = \frac{2 \times 10^{22}}{6.02 \times 10^{23}} \times 60 = 1.99$$



$$4x \text{ n}_x\text{O}_6 = n_x$$

$$4x \frac{10}{4x+96} = \frac{5.72}{x}$$

$$40x = 5.72 \quad 4x + 96 \quad 5.72$$

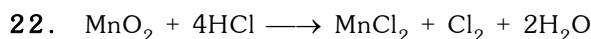
$$17.12 x = 549.12 \quad x = 32 \text{ amu}$$

20. wt. of 1 molecule (1 अणु का भार) = $\frac{6 \times 10^3}{6.02 \times 10^{23}}$

volume occupied by its (इसके द्वारा घेरा गया आयतन)

$$= \frac{\text{mass (द्रव्यमान)}}{\text{density (घनत्व)}} = \frac{6 \times 10^3 / 6.02 \times 10^{23}}{1.1} \text{ mL}$$

$$= 9.1 \times 10^{-21} \text{ cc}$$



L.G

$$4 \quad 36.5 \longrightarrow 71$$

$$1 \longrightarrow \frac{71}{4 \times 36.5} = 0.486 \text{ g}$$

23. molality (मोललता)

$$= \frac{M \times 1000}{1000 d - M M_w} = \frac{18 \times 1000}{1000 \times 1.8 - 18 \times 98} = 500$$



$$3 \longrightarrow 4$$

$$1 \longrightarrow \frac{4}{3} \times \frac{3}{2}$$

$$\frac{3}{2} \longrightarrow = 2 \text{ mol} \quad 27 = 54 \text{ g}$$

25. % by wt. of H_2O (H_2O के भार का %)

$$= \frac{\text{wt. of } \text{H}_2\text{O} (\text{H}_2\text{O का भार})}{\text{Total wt. (कुल भार)}} \times 100$$

$$50 = \frac{18x}{142 + 18x} \times 100$$

$$71 + 9x = 18x$$

$$x = 71/9 = 7.88 \approx 8$$

26. wt. of carbon = 21 12 g

\therefore 69.98 g carbon contain 100 g cortisone (69.98 g कार्बन में 100 g कार्टिसोन है)

\therefore 1 g carbon contain 100 g cortisone (1 g कार्बन में 100 g कार्टिसोन है) = $\frac{100}{69.98}$

$$\therefore 21 \quad 12 \text{ g} \longrightarrow = \frac{100}{69.98} \quad 21 \quad 12 = 360.10$$

27. no. of mol = $\frac{4}{3} \pi r^3 \times \frac{56}{100} \times 1.4$
 $\frac{56}{56}$

$$= \frac{4}{3} \times 3.14 \times (7)^3 \times \frac{1.4}{100} \approx 20$$

30. 10% (v/v) HCl

100 ml contain 10 ml HCl (100 ml में 10 ml HCl)

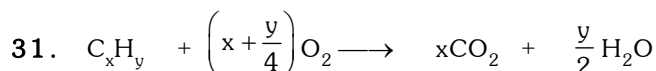
10% (v/v) NaOH i.e. 100 ml contain 10 mL NaOH

density (घनत्व) of NaOH = 1.5 density of HCl

$$\left(\frac{M}{V}\right)_{\text{NaOH}} = 1.5 \left(\frac{M}{V}\right)_{\text{HCl}}$$

Resultant = Basic

(परिणामतः) = क्षारीय



$$a \left(x + \frac{y}{4}\right) a \quad ax \quad \frac{ay}{2}$$

$$a + \left(x + \frac{y}{4}\right) a = 600$$

$$ax + a \frac{y}{2} = 700$$

$$6x + 3y = 7 + 7x + 7y/4$$

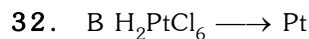
$$\boxed{7 + x = 5y/4}$$

$$x < 5$$

put the value (मान रखने पर)

$$\text{if } x = 3 \quad 10 = 5y/4 \quad y = 8$$

Ans is C_3H_8



POAc on Pt

$$M_B = \left[\frac{w_1}{w_2} \times 195 - 410 \right] \frac{n}{2},$$

n = diacidic org. base (द्विअम्लीय कार्बनिक क्षार) = 2

$$= \left(\frac{12}{5} \times 195 - 410 \right) = 58$$

33. (a) In 100 mL (140 g) solution mass of solute (100 mL (140 g) विलयन में विलेय का द्रव्यमान) = 70

$$= \frac{70}{140} \times 46 = 23 \text{ g}$$

$$(b) 10 M = \frac{\text{Mass of solute (विलेय का द्रव्यमान)} / 46}{\frac{50}{1 \times 1000}}$$

$$\text{Mass of solute (विलेय का द्रव्यमान)} = 23 \text{ g}$$

(c) 100 g solution contain 25 g of solute mass of solute = $\frac{25}{100} \times 50 = 12.5$

(100 g विलयन में 25 g विलेय है विलेय का द्रव्यमान)

$$(d) 5 M = \frac{\text{Mass of solute (विलेय का द्रव्यमान)} / 46}{46 / 1000}$$

$$\text{Mass of solute (विलेय का द्रव्यमान)} = 10.58 \text{ g}$$

34. Molarity (मोलरता)

$$= \frac{X(\text{volume (आयतन)})}{11.2} = \frac{28}{11.2} = 2.5$$

$$m = \frac{M \times 1000}{d \times 1000 - MM_w}$$

$$m_{H_2O_2} = 13.8$$

2.5 moles in 1 L solution (1 L विलयन में 2.5 मोल)

d = 265 g/L, mass (द्रव्यमान) = 265 solution (विलयन)

$$n_{H_2O} = 10 = \frac{2.5}{10 + 2.5} = 0.2$$

$$\% \frac{w}{V} = \frac{\text{wt. of solute (विलेय का भार)}}{\text{volume of solution (विलयन का आयतन) (mL)}}$$

$$= \frac{10 \times 18}{1000} \times 100$$

$$= \% \frac{w}{V} = 18\%$$

MOLE CONCEPT**EXERCISE # 3****COMPREHENSION # 1**

- The cost of 1000 gm KCl is 50 kg
(1000 gm KCl की कीमत 50 kg है)
The cost of 74.5 g KCl is (74.5 g KCl की कीमत)
$$= \frac{50}{1000} \times 74.5 \Rightarrow 3.73 \text{ mol}^{-1}$$
- the price of K_2SO_4 (K_2SO_4 की कीमत)
$$= \frac{50}{174} \times 74.5 \times 2 \Rightarrow \text{Rs. } 42.82 \text{ kg}^{-1}$$
- mole of K in KCl (KCl में K के मोल) $= \frac{1000}{74.5}$
$$\Rightarrow 13.42$$

mole of K_2O form 13.42 mole of K (K_2O के मोल)
K के 13.42 मोल बनाते हैं $= \frac{13.42}{2} = 6.71$
mass of K_2O (K_2O का द्रव्यमान)
 $= 6.71 \times 94 = 630.8 \text{ gm} = 0.631 \text{ kg}$

COMPREHENSION # 2

- | | amt | mole
(मोल) | fraction
(भिन्न) | |
|----|--------|---------------|---------------------|----|
| C | 0.2732 | 0.0227 | 1 | 6 |
| H | 0.0382 | 0.0382 | 1.68 | 10 |
| Ca | 0.152 | 0.0038 | 0.167 | 1 |
| O | 0.3540 | 0.0227 | 1 | 6 |

Simplest formula (सरलतम सूत्र)
 $C_6H_{10}CaO_6$
 $CaO_6C_6H_{10}$
- Formula weight (सूत्र भार)
- The molecular mass of lactate pentahydrate = 308
(लेक्टेट पेन्टाहाइड्रेट का आणविक द्रव्यमान = 308)
218 gm anhydrous salt recovered = 308 g lactate pentahydrate
$$1 \text{ gm anhydrous salt recovered} = \frac{308}{218} = 1.41 \text{ gm}$$

COMPREHENSION # 3

- 8 mole NaBr obtain from (8 मोल NaBr प्राप्त होता है)
= 3 mole Fe (Fe के 3 मोल से)
mole of Fe = mole NaBr $= \frac{2.06 \times 10^3}{103 \times 8} \times 3$
mass of Fe $= \frac{2.06 \times 10^3}{103} \times 56 \times \frac{3}{8} = 420 \text{ kg}$

- mole of Fe_3Br_8 (Fe_3Br_8 के मोल) $= \frac{100 \times 2.06 \times 10^6}{103 \times 70 \times 8}$
mole of Fe = mole $FeBr_2 = \frac{2.06 \times 10^3 \times 100 \times 100}{103 \times 70 \times 60 \times 8} \times 3$
mass of Fe $= \frac{2.06 \times 10^3 \times 100 \times 100}{103 \times 70 \times 60} \times 56 \times \frac{3}{8}$
mass of Fe = 10^3 kg
- mole of CO_2 (CO_2 के मोल) $= \frac{\text{mole of NaBr}}{2}$
$$= \frac{2.06 \times 10^3}{103 \times 2} = 10$$

COMPREHENSION # 4

- $CO_2 = 22 \text{ g} = 0.5 \text{ mol}$
 $H_2O = 13.5 \text{ g} = \frac{13.5}{18} \text{ mol}$
 $C = 0.5 \text{ mol} = 6 \text{ g}$
 $H = 1.5 \text{ mol} = 1.5 \text{ g}$
 $O = 8 \text{ gm} = 0.5 \text{ mol}$
 $E.F. = CH_3O$
 let molar mass = M

$$\frac{27}{108} = \frac{41.75}{M - 1 + 108}$$

 $\Rightarrow M = -107 + 167 = 60$
 $E.F. \text{ mass} = 12 + 3 + 16 = 31$

$$n = \frac{274}{31} \approx 2$$

 $M.F. = (CH_3O)_2$
 $= C_2H_6O_2$

COMPREHENSION # 5

- $Ba(OH)_2 + 2HNO_3 \longrightarrow Ba(NO_3)_2 + 2H_2O$
 0.4 mole 0.4 mole
 In resultant sol. $Ba(OH)_2$ is remaining, therefore nature of sol. basic.
 (परिमाणी विलयन में $Ba(OH)_2$ शेष रहता है, तो विलयन की प्रकृति क्षारीय)
- Vol. of $Ba(OH)_2$ ($Ba(OH)_2$ का आयतन)
$$= \frac{342}{0.57} = 600 \text{ mL}$$

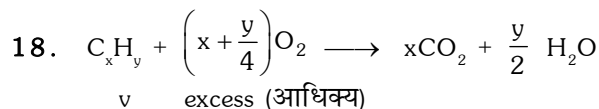
mole of OH^- (OH^- के मोल) $= 0.2 \times 2 = 0.4$
molarity of OH^- (OH^- के मोलरता) $= \frac{0.4}{0.8} = 0.5$

MOLE CONCEPT

EXERCISE # 4[A]

- Ist exp. CuO = 1.375 gm
Cu = 1.098 gm
O = 0.277 gm
IInd exp. Cu = 1.179gm
CuO = 1.4476 gm
O = 0.2686 gm
 $\frac{\text{Cu}}{\text{O}} = 3.9638 \approx 4$ $\frac{\text{Cu}}{\text{O}} \approx 4$
In both the cases ratio of Cu/O is same
(दोनों स्थितियों में Cu/O का अनुपात समान है)
- $\left(\frac{Y}{X}\right) = \frac{0.471}{0.324} = 1.4537 = r_1$
 $\left(\frac{Y}{X}\right) = \frac{0.509}{0.117} = 4.350 = r_2$
 $\frac{r_2}{r_1} = 2.9926 \approx 3$
so satisfy law of multiple proposition.
(अतः गुणित अनुपात के नियम को सन्तुष्ट करता है)
- = 35.125 28 = 983.5 gm
- molecular (आण्विक) = $\left(\frac{0.07}{18}\right) \times N_A \times 3 = 2.34 \times 10^{21}$
- $n_{\text{NaClO}_3} = \frac{106.5}{106.5} = 1 \text{ mole}$
NO. of atom of (NO के परमाणु की संख्या)
Na = 1 N_A
Cl = 1 N_A
O = 1 N_A
- $n_{\text{P}_4} = \frac{92.9}{4 \times 31} = 0.75 \text{ mole}$
 $N_{\text{P}_4} = 0.75 \times N_A = 4.52 \times 10^{23} \text{ molecules}$
 $N_{\text{P}} = 18.04 \times 10^{23} \text{ molecules}$
- $n_{\text{Na}} = \frac{5.75}{23} = 0.25 \text{ mole}$
- (a) 1 23 gm (b) 1 35.5 gm
(c) 1 63.5 gm
- $m_{\text{Hg}} = 13.6 \text{ 1000 gm}$
 $n_{\text{Hg}} = m_{\text{Hg}}/200 = 68 \text{ mole}$
- $3\text{CaCO}_3 + 2\text{H}_3\text{PO}_4 \longrightarrow \text{Ca}_3(\text{PO}_4)_2 + 3\text{H}_2\text{O} + 3\text{CO}_2$
50/100mole 70/98 mole
= 0.5 0.7142
-- 0.7142 - $\frac{2}{3} \times 0.5 = 0.3808 \left(\frac{0.5}{3}\right)$
Limiting reactant (सीमान्त अभिकारक)
 $m_{\text{CaCO}_3} = \frac{0.5}{3} \times M_{\text{Ca}_3(\text{PO}_4)_2} = 51.66 \text{ gm}$
 $m_{\text{H}_3\text{PO}_4} = 0.3808 \times M_{\text{H}_3\text{PO}_4} = 31.31 \text{ gm}$

- $\text{ClNH}_2 + 2\text{NH}_3 \longrightarrow \text{N}_2\text{H}_4 + \text{NH}_4\text{Cl}$
 $\frac{1000}{51.5} \text{ mole excess (आधिक्य)}$
= 19.417
19.417 mole
% yield (प्राप्ति) = $\frac{14.781}{19.417} \times 100 = 76.125\%$
- $5\text{C} + 2\text{SO}_2 \xrightarrow{82\%} \text{CS}_2 + 4\text{CO}$
excess(आधिक्य) $\frac{450}{64} = 7.03 \text{ Kmole}$
 $0.82 \times \frac{7.03}{2} = 2.88 \text{ Kmole} = 219.09 \text{ kg}$
- $\text{BaO} + \text{CaO}$
 $x \quad [153] + y \quad [56] = 28 \quad \dots\dots(I)$
 $\text{BaO} + 2\text{HCl} \longrightarrow \text{BaCl}_2 + \text{H}_2\text{O}$
 $x \quad 2x$
 $\text{CaO} + 2\text{HCl} \longrightarrow \text{CaCl}_2 + \text{H}_2\text{O}$
 $y \quad 2y$
 $2x + 2y = 6 \quad 0.1008 = 0.6048 \quad \dots\dots(II)$
% of BaO = $\frac{x \times 153}{29} \quad 100 = 65.65\%$
- $\frac{x \times 0.95}{106} = 5 \times 0.5$
 $x = \frac{2.5 \times 106}{0.95} = 278.947 \text{ gm}$
- $M = \frac{(27/98)}{(100/1.2)} \times 1000 = 3.8$
- $\text{C}_n\text{H}_{2n+2} + \frac{(3n+1)}{2} \text{O}_2 \longrightarrow n\text{CO}_2 + (n+1) \text{H}_2\text{O}$
 $\frac{(3n+1)/2}{n} = \frac{7}{4} \Rightarrow 6n+2=7n \Rightarrow n=2 \quad \text{C}_2\text{H}_6$
- $\text{C}_4\text{H}_8 + 6\text{O}_2 \longrightarrow 4\text{CO}_2 + 4\text{H}_2\text{O}$
 $x \quad 4x \quad 5x$
 $\text{C}_4\text{H}_{10} + \frac{13}{2} \text{O}_2 \longrightarrow 4\text{CO}_2 + 5\text{H}_2\text{O}$
 $y \quad 4y \quad 5y$
 $(4x+5y) \quad 44 = 8.8$
 $x+y = 0.05 \quad \dots\dots(I)$
 $(4x+5y) \quad 18 = 4.14$
 $4x+5y = 0.23 \quad \dots\dots(II)$
 $4x+4y = 0.2 \quad \dots\dots(III)$
 $y = 0.03$
% by mass of C_4H_{10} (C_4H_{10} के द्रव्यमान का %)
= $\frac{0.03 \times 58}{2.86} \times 100 = 60.8\%$



$$\left(x + \frac{y}{4}\right)v \quad xv \quad \frac{y}{2}v$$

$$+v - \left(x + \frac{y}{4}\right)v + xv + \frac{y}{2}v = 2.5v$$

$$\frac{y}{4} = 1.5 \Rightarrow y = 6$$

$$xv = 2v \Rightarrow x = 2 \quad C_2H_6$$

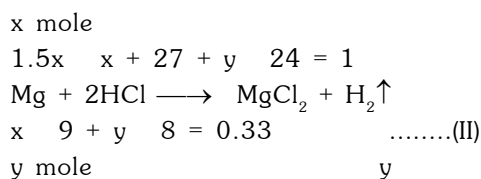
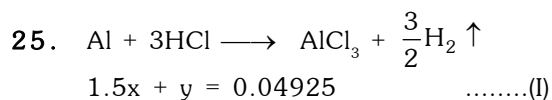
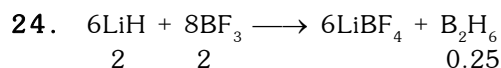
19. Molar mass (मोलर द्रव्यमान)
 $= 3.2707 \times 10^{-22} \times 6.023 \times 10^{23} = 196.99426 \text{ gm}$

20. $M = \pi (75 \times 10^{-8} \text{ cm})^2 (5000 \times 10^{-8} \text{ cm})$
 $\frac{1}{0.75 \text{ cm}^3 / \text{gm}} \times 6.023 \times 10^{23} = 7.09 \times 10^7 \text{ gm}$

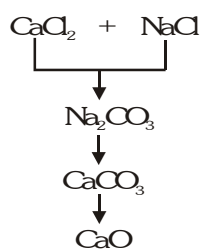
21. $\frac{M_{\text{gas}}}{M_{\text{air}}} = 1.17 \Rightarrow M_{\text{gas}} = 1.17 \times 29 = 33.93 \text{ gm}$

22. $Y_3A_5O_{12}$
 $200 \quad 200 \quad 10^{-3}$
 (a) $y = 44.95\%$, $Al = 22.73\%$, $O = 32.32\%$
 (b) 17.98 gm

23. $n = \frac{28.3 \times 10^{-4}}{[12 \times 12 + 4 + 35.5 \times 4 + 16 \times 2]} = 8.8 \times 10^{-8} \text{ mole}$

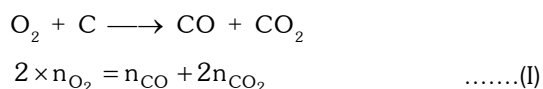


$\% Al = \frac{x \times 27}{1} \times 100 = 54.6\%$
 $Mg = 45.4\%$



$n_{CaCl_2} = n_{CaO} = \frac{1.62}{56} = 0.02892$
 $m_{CaCl_2} = 0.02892 \times 111 = 3.211 \text{ g}$
 $m_{NaCl} = 6.7889 \text{ gm}$
 $\% NaCl = 67.9\%$

27. $n_{O_2} = 625$
 $n_C = 1 \text{ mole}$
 $\frac{n_{O_2}}{n_C} = 0.625$



$2 \times n_C = n_{CO} + n_{CO_2} \quad \dots\dots(II)$
 $\Rightarrow \frac{n_{CO} \times 28}{n_{CO_2} \times 44} = \frac{21}{11}$

element	mass per 100 gm	mole	simplest ratio
C	58.77	58.77 / 12	5
H	13.81	13.81 / 1	14
N	27.42	27.14 / 2	2

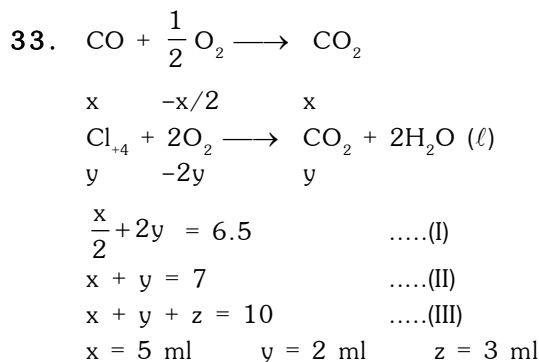
28. E.F. = $C_5H_{14}N_2 = 102 = M.F.$

30. $n_{N_2} = \frac{(774.5 - 14.5)}{760} \times \frac{82.1}{1000} = 3.3786 \times 10^{-3} \text{ mole}$
 0.081×300

$m_{N_2} = 0.0946 \text{ gm}$
 $\% N_2 = \frac{0.0946}{0.14} \times 100 = 66.7\%$

31. (a) $M = \frac{4/40}{0.2} = 0.5$
 (b) $M = \frac{5.3/106}{0.1} = 0.5$
 (c) $M = \frac{0.365/36.5}{0.05} = 0.2$

32. $X_{\text{ethanol}} = \frac{46/46}{46/46 + 54/18} = 0.25$



34. $O_3 \longrightarrow \frac{3}{2}O_2$
 $20 \quad 80$
 $\frac{3}{2} \times 20 + 80 = 110$
 Increase in volume (आयतन में वृद्धि) = $110 - 100 = 10 \text{ ml}$

MOLE CONCEPT

EXERCISE # 4[B]

1. Empirical formula (मूलानुपाती सूत्र):

= KAIS_2O_8	Al	K	S	O	Elements (तत्व)
	10.5	15.1	24.8	49.6	Mass percentage (द्रव्यमान प्रतिशत)
	0.388	0.387	0.775	3.1	Mole ratio (मोल अनुपात)
	1	1	2	8	Simple ratio (सरलतम अनुपात)

Empirical formula weight (मूलानुपाती सूत्र भार) = 258

From weight loss information : 54.4 g anhydrous salt \equiv 45.6 g H_2O

(भार में कमी की सूचना से : 54.4 g निर्जलीय लवण \equiv 45.6g H_2O)

\Rightarrow 258 g anhydrous salt \equiv 216.26 g = 12 mol H_2O
(258 g निर्जलीय लवण \equiv 216.26 g = 12 मोल H_2O)

\Rightarrow Empirical formula of hydrated salt = $\text{KAIS}_2\text{O}_8 \cdot 12 \text{H}_2\text{O}$
(जलयोजित लवण का मूलानुपाती सूत्र = $\text{KAIS}_2\text{O}_8 \cdot 12 \text{H}_2\text{O}$)

2. 1.0 mole of $\text{KClO}_3 = 3.0$ mole of Zn

$$\frac{5.104}{122.5} \text{ mole } \text{KClO}_3 = \frac{3 \times 5.104}{122.5}$$

$$\text{mole of Zn} = \frac{3 \times 5.104 \times 65}{122.5} = 8.124 \text{ g Zn}$$

3. Apply conservation of moles of silver before and after precipitate exchange reaction as :

(अवक्षेपण विनिमय अभिक्रिया के पहले तथा बाद में सिल्वर मोलों का संरक्षण इस प्रकार लागू किया जाता है :)

$$\frac{1.8}{143.5} = \frac{x}{188} + \frac{2.052 - x}{143.5}$$

where, x is mass of AgBr in mixed precipitate.
(जहाँ, x मिश्रित अवक्षेप में AgBr का द्रव्यमान)

$$\Rightarrow x = 1.064$$

$$\text{Also, moles of } \text{CuBr}_2 = \frac{1}{2} \text{ moles of AgBr} = \frac{1}{2} \times \frac{x}{188}$$

$$(\text{और, } \text{CuBr}_2 \text{ के मोल} = \frac{1}{2} \text{ AgBr के मोल} = \frac{1}{2} \times \frac{x}{188})$$

$$\Rightarrow \text{Mass of } \text{CuBr}_2 = \frac{1}{2} \times \frac{x}{188} \times 223.5 = 0.6324$$

(on substituting x)

$$(\text{CuBr}_2 \text{ का द्रव्यमान} = \frac{1}{2} \times \frac{x}{188} \times 223.5 = 0.6324)$$

(x का मान रखने पर)

$$\text{Mass \% of } \text{CuBr}_2 (\text{CuBr}_2 \text{ का द्रव्यमान \%}) = 34.18$$

4. Moles of NaCl in sample = 0.01 = moles of AgCl from NaCl in precipitate (नमूने में NaCl का मोल = 0.01 = अवक्षेप में NaCl से प्राप्त AgCl के मोल)

Total moles of AgCl precipitate (अवक्षेपित हुए AgCl

$$\text{के कुल मोल}) = \frac{2}{143.5} = 0.01393$$

\Rightarrow Moles of AgCl from KCl = 0.00393 = moles of KCl
(KCl से प्राप्त AgCl के मोल = 0.00393 = KCl के मोल)

\Rightarrow Mass of KCl in sample = 0.00393 \times 74.5 = 0.2928g
(नमूने में KCl का द्रव्यमान = 0.00393 \times 74.5 = 0.2928g)

$$\text{Mass \% of KCl in the sample} = 29.28$$

(नमूने में KCl का द्रव्यमान %)

5. Let the mixture contain x g $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.

(माना कि मिश्रण में x g $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ उपस्थित है।)

$$\Rightarrow \frac{x}{249} \times 159 + \frac{5-x}{246} \times 120 = 3 \Rightarrow x = 3.72$$

\Rightarrow Mass percentage of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ का द्रव्यमान प्रतिशत) = 74.4

6. Mass % of Ca (Ca का द्रव्यमान %)

$$= \frac{0.16}{100} \times 40 \times \frac{100}{0.25} = 25.6$$

Mass % of S (S का द्रव्यमान %)

$$= \frac{0.344}{233} \times \frac{32 \times 100}{0.115} = 41$$

Mass % of N (N का द्रव्यमान %)

$$= \frac{0.155}{17} \times \frac{14 \times 100}{0.712} = 17.9$$

\Rightarrow Mass % of C (C का द्रव्यमान %) = 15.48

Now :

Elements (तत्व)	Ca	S	N	C
Mass % (द्रव्यमान %)	25.6	41	17.9	15.48
Mol ratio (मोल अनुपात)	0.64	1.28	1.28	1.29
Simple ratio (सरल अनुपात)	1	2	2	2

Empirical formula (मूलानुपाती सूत्र) = $\text{CaC}_2\text{N}_2\text{S}_2$,

Empirical formula weight (मूलानुपाती सूत्र भार) = 156

Hence, molecular formula (इस प्रकार, आणविक सूत्र) = $\text{CaC}_2\text{N}_2\text{S}_2$

7. Working in backward direction (प्रतीप दिशा में कार्य करने पर)

In the last step moles of (AgBr + AgI) = moles of AgI
(अन्तिम पद में (AgBr + AgI) के मोल = AgI के मोल)

$$\Rightarrow \frac{0.4881 - x}{188} + \frac{x}{235} = \frac{0.5868}{235} \Rightarrow x = 0.0933 \text{ g}$$

Mass % of NaI (NaI का द्रव्यमान प्रतिशत)

$$= \frac{0.0933}{235} \times 150 \times \frac{100}{0.2} = 29.77$$

Now subtracting mass of AgI from 1st and 2nd precipitate gives (अब 1st व 2nd अवक्षेप से AgI के द्रव्यमान को घटाने पर प्राप्त होता है।) :

Mass of (AgCl + AgBr) = 0.3187 g
 ((AgCl + AgBr) का द्रव्यमान = 0.3187 g)
 and mass of AgBr = 0.3948 g
 (और AgBr का द्रव्यमान = 0.3948 g)

$$\text{Again } \frac{y}{143.5} + \frac{0.3187 - y}{188} = \frac{0.3948}{188} \Rightarrow y = 0.245g$$

$$\Rightarrow \text{Mass \% of NaCl (NaCl का द्रव्यमान प्रतिशत)} \\ = \frac{0.245}{143.5} \times 58.5 \times \frac{100}{0.2} = 50$$

Mass % of NaBr (NaBr का द्रव्यमान प्रतिशत) = **20.23**

8. Weight loss is due to conversion of NaHCO_3 into Na_2CO_3 : 31 g weight is lost per mole of NaHCO_3 .
 (NaHCO_3 के Na_2CO_3 में परिवर्तन के कारण भार में कमी : NaHCO_3 के प्रति मोल 31 g भार में कमी होती है।)

$$\Rightarrow 0.3 \text{ g wt. loss from } \frac{0.3}{31} \text{ mol of } \text{NaHCO}_3 \text{ producing } \\ \frac{0.3}{62} \text{ moles of } \text{Na}_2\text{CO}_3. \\ \left(\frac{0.3}{31} \text{ मोल } \text{NaHCO}_3 \text{ से } 0.3 \text{ g भार में कमी द्वारा } \frac{0.3}{62} \text{ मोल } \text{Na}_2\text{CO}_3 \text{ उत्पन्न होते हैं।} \right)$$

Total moles of carbonate (कार्बोनेट के कुल मोल) = 15×10^{-3}

$$\Rightarrow \text{Moles of carbonate in original sample (वास्तविक मिश्रण में कार्बोनेट के मोल)} = 0.015 - \frac{3}{620} = 0.01$$

Mass of Na_2CO_3 in original sample (वास्तविक नमूने में Na_2CO_3 का द्रव्यमान) = 1.06 \Rightarrow **42.4 % Na_2CO_3**

9. If M is molar mass of $(\text{CH}_3)_x \text{AlCl}_y$ (यदि M, $(\text{CH}_3)_x \text{AlCl}_y$ का मोलर द्रव्यमान है।)

$$m(\text{CH}_4) = \frac{0.643x}{M} \times 16 = 0.222$$

$$\text{and } m(\text{AgCl}) = \frac{0.643y}{M} \times 143.5 = 0.996$$

$$\text{dividing (भाग देने पर)} : \frac{x}{y} = 2,$$

$$\text{Also } M = 15x + 27 + 35.5y = 15x + 27 + \frac{35.5x}{2} = 32.75x + 27$$

$$\Rightarrow \frac{0.643x \times 16}{32.75x + 27} = 0.222 \Rightarrow x = 1.98 \approx 2 \Rightarrow y = 1$$

10. Mass of AgCl = 0.09 \times 143.5 = 12.915 g which is 95.77 % of total ppt.

(AgCl का द्रव्यमान = 0.09 \times 143.5 = 12.915 g जो कुल अवक्षेप का 95.77 % है।)

$$\Rightarrow \text{Total mass of precipitate (अवक्षेप का कुल द्रव्यमान)} \\ = 13.485g \text{ and mass of impurity (व अशुद्धियों का द्रव्यमान)} = 0.57 g$$

$$\Rightarrow \text{Mass of NaCl + KCl} = 5.9 g \\ (\text{NaCl + KCl का द्रव्यमान} = 5.9 g)$$

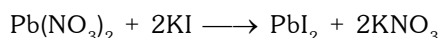
$$\Rightarrow \frac{x}{58.5} + \frac{5.9 - x}{74.5} = 0.09$$

$$\Rightarrow x = 2.94 g \text{ NaCl, } 2.96 g \text{ KCl}$$

$$m(\text{Na}_2\text{O}) = 1.558 g \Rightarrow m\%(\text{Na}_2\text{O}) = \mathbf{31.16}$$

$$m(\text{K}_2\text{O}) = 1.867 g \Rightarrow m\%(\text{K}_2\text{O}) = \mathbf{37.34}$$

11. In order to obtain maximum yield from a reaction, the reactants must be supplied in stoichiometric amount so that no reactant should be left unreacted. (अभिक्रिया से अधिकतम लब्धि प्राप्त करने के लिए, क्रियाकारकों की पूर्ति रससमीकरणमितीय मात्रा में होनी चाहिए ताकि कोई भी क्रियाकारक अनअभिकृत नहीं रहना चाहिए।) The balanced chemical reaction is, (सन्तुलित रासायनिक समीकरण है,)



Let x g of KI is taken (माना कि x g KI लेते हैं)

$$\Rightarrow \text{moles of KI} = \frac{x}{166} \Rightarrow \text{moles of } \text{Pb}(\text{NO}_3)_2 \text{ present}$$

$$= \frac{x}{2 \times 166}$$

$$\Rightarrow \frac{x}{2 \times 166} = \frac{5 - x}{330} \Rightarrow x = 2.5 g \Rightarrow \text{mass of } \text{PbI}_2$$

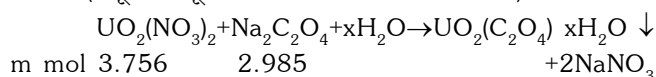
$$= \frac{x}{332} \times 460 = \mathbf{3.464 g}$$

12. Mass of uranium in the sample (नमूने में यूरेनियम का

$$\text{द्रव्यमान}) = \frac{1.48}{394} \times 238 = 0.894 g$$

Mass % of uranium in the sample = 89.4

(नमूने में यूरेनियम का द्रव्यमान % = 89.4)



Here $\text{Na}_2\text{C}_2\text{O}_4$ is the limiting reagent, therefore, m mol of $\text{UO}_2(\text{C}_2\text{O}_4) \cdot x\text{H}_2\text{O}$ formed is 2.985.

(यहाँ $\text{Na}_2\text{C}_2\text{O}_4$ सीमान्त अभिकर्मक है, इस प्रकार निर्मित $\text{UO}_2(\text{C}_2\text{O}_4) \cdot x\text{H}_2\text{O}$ के m mol 2.985 है।)

$$\Rightarrow M(\text{UO}_2(\text{C}_2\text{O}_4) \cdot x\text{H}_2\text{O}) = \frac{1.23}{2.985} \times 1000 = 412$$

$$= 238 + 32 + 88 + 18x$$

$$\Rightarrow x = \frac{54}{18} = 3$$

13. Volume of smallest cell = $\pi r^2 l = \pi (60 \times 10^{-8} \text{ cm})^2 (6000 \times 10^{-8} \text{ cm}) = 6.785 \times 10^{-17} \text{ cm}^3$

$$(\text{छोटी कोशिका का आयतन} = \pi r^2 l = \pi (60 \times 10^{-8} \text{ cm})^2 (6000 \times 10^{-8} \text{ cm}) = 6.785 \times 10^{-17} \text{ cm}^3)$$

$$\text{mass of one smallest cell (एक छोटी कोशिका का द्रव्यमान)} = 7.6 \times 10^{-17} g$$

$$\Rightarrow \text{Molar mass of mother cell (मातृ कोशिका का मोलर द्रव्यमान)} = 7.6 \times 10^{-17} \times \frac{24 \times 60 \times 6.023 \times 10^{23}}{1} = \mathbf{6.6 \times 10^{10} \text{ amu}}$$

14. Let the sample contain (माना कि नमूने में) x g Mohr's salt (मोहर लवण) $[\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}]$ उपस्थित है।

$$\Rightarrow \frac{x}{392} \times 2 \times \frac{0.5 - x}{132} = \frac{0.75}{233}$$

$$\text{Solving } x = 0.23 \text{ g} \Rightarrow \text{Mohr's salt} = \frac{0.23}{0.50} \times 100 = 46\%, (\text{NH}_4)_2\text{SO}_4 = 54\%$$

$$(\text{हल करने पर } x = 0.23 \text{ g} \Rightarrow \text{मोहर लवण} = \frac{0.23}{0.50} \times 100 = 46\%, (\text{NH}_4)_2\text{SO}_4 = 54\%)$$

$$\text{Also moles of Fe in 0.2g sample} = \frac{x}{392} \times \frac{0.2}{0.5} = 2.347 \times 10^{-4}$$

$$(\text{और 0.2 g नमूने में Fe के मोल} = \frac{x}{392} \times \frac{0.2}{0.5})$$

$$= 2.347 \times 10^{-4}$$

$$\Rightarrow \text{mass of Fe}_2\text{O}_3 \text{ obtained on ignition of 0.2 sample} = \frac{2.347 \times 10^{-4}}{2} \times 160 = 18.77 \text{ mg}$$

(0.2 नमूने को जलाने पर Fe_2O_3 का द्रव्यमान)

15. Smallest volume of AgNO_3 would be required when the entire mass is due to highest molecular weight constituent.

(AgNO_3 का न्यूनतम आयतन आवश्यक होगा जब सम्पूर्ण द्रव्यमान अधिकतम आण्विक भार वाले घटक के कारण होता है।)

Hence, for smallest volume, the whole mass should be of $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$

(अतः न्यूनतम आयतन के लिए, $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ का सम्पूर्ण द्रव्यमान होना चाहिए।)

$$\text{m mol of BaCl}_2 \cdot 2\text{H}_2\text{O} = \frac{0.3}{244} \times 1000 = 1.229 \text{ m mol}$$

$$\text{m mol of AgNO}_3 \text{ required} = 2 \times 1.229 = 2.458 \text{ (आवश्यक AgNO}_3 \text{ के m mol)}$$

$$\text{Volume of AgNO}_3 \text{ required} = \frac{2.458}{0.15} = 16.38 \text{ mL (smallest)}$$

$$(\text{आवश्यक AgNO}_3 \text{ का आयतन} = \frac{2.458}{0.15} = 16.38 \text{ mL (न्यूनतम)})$$

Largest volume of AgNO_3 would be required when entire mass is due to lowest molecular weight constituent, i.e., NaCl .

(AgNO_3 के अधिकतम आयतन की आवश्यकता होगी जब सम्पूर्ण द्रव्यमान न्यूनतम आण्विक भार वाले घटक अर्थात् NaCl के कारण होता है।)

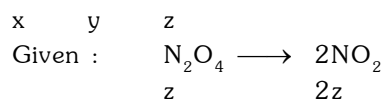
$$\text{m mol of NaCl} = \frac{0.3}{58.5} \times 1000 = 5.128 = \text{m mol of AgNO}_3 \text{ required}$$

$$(\text{NaCl के m mol} = \frac{0.3}{58.5} \times 1000 = 5.128 = \text{आवश्यक AgNO}_3 \text{ के m mol})$$

$$\Rightarrow \text{Volume of AgNO}_3 \text{ required} = \frac{5.128}{0.15} = 31.18 \text{ mL (largest)}$$

$$(\text{आवश्यक AgNO}_3 \text{ का आयतन} = \frac{5.128}{0.15} = 31.18 \text{ mL (अधिकतम)})$$

16. Mixture ($\text{N}_2, \text{NO}_2, \text{N}_2\text{O}_4$) has mean molar mass = 55.4. (मिश्रण ($\text{N}_2, \text{NO}_2, \text{N}_2\text{O}_4$) का माध्य मोलर द्रव्यमान = 55.4.)



$$\therefore 55.4 = \frac{28x + 46(y + 2z)}{x + y + z}$$

$$\left\{ \text{mean molar mass} = \frac{\text{wt.} \times \text{mole}}{\text{Total mole}} \right\}$$

$$\left\{ \text{माध्य मोलर द्रव्यमान} = \frac{\text{भार} \times \text{मोल}}{\text{कुल मोल}} \right\}$$

$$\text{Given : } x + y + z = 1 \text{ (mole)}$$

$$\text{so } 55.4 = 28x + 46(y + 2z) \quad \dots(1)$$

$$\therefore 39.3 = \frac{28x + 46(y + 2z)}{x + y + 2z}$$

$$\therefore 39.6(x + y + 2z) = 28x + 46(y + 2z)$$

$$\text{From eq (1) \& } x + y + z = 1$$

$$\text{or } 39.6(1 + z) = 59.4$$

$$\text{or } 1 + z = \frac{59.4}{39.6}$$

$$\text{or } z = 0.4$$

$$\text{from eq. (1)}$$

$$55.4 = 28x + 46(y + 2z)$$

$$\boxed{z = 0.4} \text{ put (रखने पर)}$$

$$55.4 = 28x + 46y + 36.8$$

$$28x + 46y = 18.6 \quad \dots(2)$$

$$\therefore x + y + z = 1$$

$$x + y + 0.4 = 1 \quad (\because z = 0.4)$$

$$x + y = 0.6 \quad \dots(3)$$

$$\text{eq. (2) } 1 \dots \text{eq. (3) } 28$$

$$28x + 46y = 18.6$$

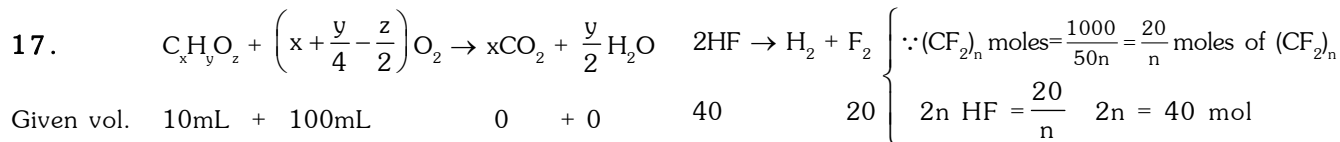
$$28x + 28y = 16.8$$

$$\begin{array}{r} - \\ - \\ - \\ \hline 18y = 1.8 \end{array}$$

$$\boxed{y = 0.1}$$

$$\therefore x + y + z = 1$$

$$\boxed{x = 0.5}$$



Given vol. 10mL + 100mL 0 + 0 40 20

(दिया आयतन)

After reaction - + 100-10 $\left(x + \frac{y}{4} - \frac{z}{2}\right)10x$ -

(अभिक्रिया के पश्चात्)

$$100 - 10 \left(x + \frac{y}{4} - \frac{z}{2}\right) + 10x = 90$$

$$\frac{y}{4} - \frac{z}{2} = 1$$

$$y - 2z = 4 \quad \dots(1)$$

Property of KOH has to absorb all CO_2 .

(KOH का गुण सम्पूर्ण CO_2 को अवशोषित करना होता है।)

$$\therefore 10x = 20$$

$$\boxed{x=2}$$

$$\text{V.D. of compound } (C_xH_yO_z) = 23 \quad \therefore \text{V.D.} = \frac{M_w}{2}$$

(यौगिक का वाष्प घनत्व $(C_xH_yO_z) = 23$)

$$M_w = 46 \quad M_w = 2 \quad 23 = 46$$

$$12x + y + 16z = 46$$

$$12 \cdot 2 + y + 16z = 46$$

$$y + 16z = 22 \quad \dots(2)$$

from eq. (1) & (2)

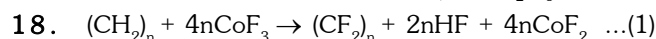
$$y - 2z = 4$$

$$\begin{array}{r} y + 16z = 22 \\ - y - 2z = 4 \\ \hline -18z = -18 \end{array}$$

$$-18z = -18$$

$$\boxed{z=1}, \boxed{y=6}$$

Molecular formula (आण्विक सूत्र) = C_2H_6O .



$$\text{wt.} \Rightarrow F = 19, C = 12, Co = 59, M_{wt.} (CF_2)_n = 50n$$

$$\text{from eq. (1)} \quad (CF_2)_n = 4nCoF_2$$

$$\frac{w}{E}$$

$$\frac{1000}{50n}$$

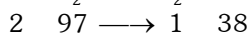
$$=$$

$$\frac{w}{E}$$

$$\frac{w}{4n \times 97}$$

$$w = \frac{1000}{50n} \times 4n \times 97$$

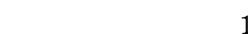
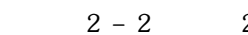
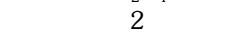
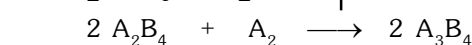
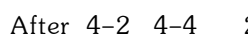
$$w = 80 \cdot 97 \text{ g } (CoF_2)$$



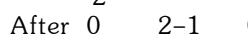
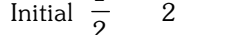
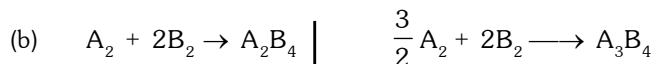
$$= 80 \cdot 97 \rightarrow \frac{1 \times 38}{2 \times 97} \cdot 80 \cdot 97 = 1520 \text{ g} = 1.52 \text{ kg.}$$

$$1 \rightarrow \frac{20}{40} \times 1.52$$

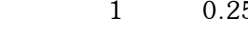
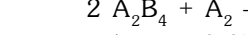
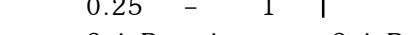
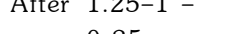
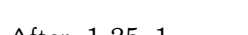
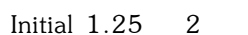
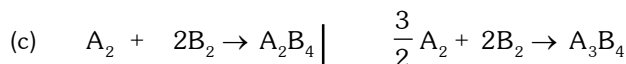
$$1.52 = 0.76 \text{ kg}$$



$$\therefore A_2 = 1, A_2B_4 = 2$$



$$\therefore A_2B_4 = 0.5, B_2 = 1$$



$$\therefore A_2B_4 = A_3B_4 = 0.5$$

20.(a) 1L $KMnO_4 \rightarrow 79\%$ (w/v) i.e. 100 mL solution contain 79 g $KMnO_4$

(1L $KMnO_4 \rightarrow 79\%$ (w/v) अर्थात् 100 mL विलयन में 79 g $KMnO_4$ उपस्थित है।)

$$\text{moles of } KMnO_4 = \frac{\text{wt.}}{M_w} = \frac{79}{158} = 0.5$$

$$(KMnO_4 \text{ के मोल} = \frac{\text{भार}}{M_w} = \frac{79}{158} = 0.5)$$

$$\text{Molarity (मोलरता) (M)} = \frac{0.5}{100} \times 1000 = 5M$$

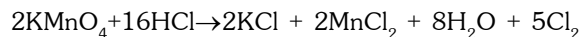
$HCl \rightarrow 10\%$ (w/w) i.e. 100 g solution contain 10g HCl

($HCl \rightarrow 10\%$ (w/w) अर्थात् 100 g विलयन में 10 g HCl उपस्थित है।)

$$D = 1.825 \text{ g/mL}$$

$$V = \frac{M}{D} = \frac{100}{1.825 \times 1000}$$

$$\text{Molarity (मोलरता)} = \frac{10 \times 1.825 \times 1000}{36.5 \times 100} = 5 \text{ M}$$

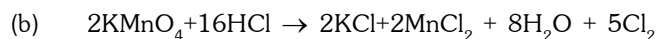


$$\begin{array}{cc} \text{M} & \text{V}_1 \\ 5 & 1 \end{array} \quad \begin{array}{cc} \text{M} & \text{V}_1 \\ 5 & 9 \end{array}$$

$$\begin{array}{cc} 5 & 45 \\ - & 5 \end{array}$$

$$12.5$$

$$\text{Cl}_2 = 12.5 \times \frac{80}{100} = 10 \text{ mol.}$$



$$1 \times \frac{710}{28.4} = 25\text{L}$$

(c) $\eta = \frac{\text{vol. of water treated}}{\text{vol. of total feed}}$

$$= \frac{25}{\text{vol. of KMnO}_4 + \text{HCl}} = \frac{25}{1+9} = 2.5$$

21. $D = 1.03 \text{ g/cm}^3$

2.8% NaCl \rightarrow 100 g solution contain 2.8 g NaCl.

(2.8% NaCl \rightarrow 100 g विलयन में 2.8 g NaCl है।)

$$V = \frac{100}{1.03 \times 1000} \text{L}$$

$$1 \text{ L} \rightarrow \frac{2.8 \times 1.03 \times 1000}{100} \text{g}$$

$$\text{moles} = \frac{2.8 \times 10.3}{58.5} = 0.493$$

$$\begin{array}{ccc} M_2 V_2 & = & M_1 V_1 \\ 0.493 & 10^6 & = & 5.45 & V_1 \\ V_1 & = & 9 & 10^4 \end{array}$$

so water evaporated (अतः वाष्पित जल) $= 10^6 - 9 \times 10^4$

$$= 9.095 \times 10^5 \text{ L}$$

22. Let free $\text{SO}_3 \rightarrow \text{xg}$ (माना कि मुक्त $\text{SO}_3 \rightarrow \text{xg}$)

SO_3 in form of H_2SO_4 (H_2SO_4 के रूप में SO_3)

$$\rightarrow \frac{\text{x}}{80} \times 98 = 1.225 \text{ x}$$

so total (अतः कुल)

$$\text{x} + 1.225 \text{ x} = 100$$

$$\text{x} = 44.94$$

$$\text{water required} = \frac{44.94}{80} \times 18 = 10.11 \text{ g \% oleum}$$

$$= 100 + 10.11 = 110.11\%$$

$$(\text{आवश्यक जल} = \frac{44.94}{80} \times 18 = 10.11 \text{g} \Rightarrow \% \text{ ओलियम})$$

$$= 100 + 10.11 = 110.11\%$$

23. 100 mL milk \rightarrow 4mL fat (100mL दूध \rightarrow 4 mL वसा)

1 L milk \rightarrow 40 mL fat (1 L दूध \rightarrow 40 mL वसा)

density of fat $= 875 \text{ kg/m}^3 = 0.875 \text{ g/mL}$

(वसा का घनत्व $= 875 \text{ kg/m}^3 = 0.875 \text{ g/mL}$)

$$\text{mass of fat} = 40 \times 0.875 = 35\text{g}$$

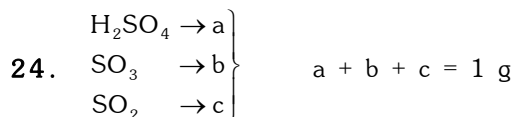
$$(\text{वसा का द्रव्यमान} = 40 \times 0.875 = 35 \text{ g})$$

$$\text{fat free milk mass} = 1035 - 35 = 1000\text{g}$$

$$(\text{वसा रहित दूध का आयतन} = 1035 - 35 = 1000 \text{ g})$$

$$\text{Vol. (आयतन)} = 1000 - 40 = 960 \text{ mL}$$

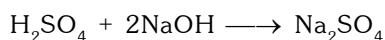
$$\rho = \frac{1000}{960} = 1.0416 \text{ g/mL}$$



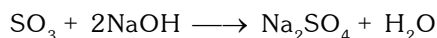
$\text{SO}_2 \rightarrow 1.5\%$

so, $\text{C} = 0.015 \text{ g} \rightarrow \text{SO}_2$

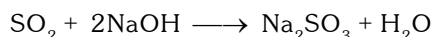
$$\text{a} + \text{b} = 0.985 \text{ g}$$



$$\frac{\text{a}}{98}$$



$$\frac{\text{b}}{80}$$



$$\frac{0.015}{64}$$

$$\left(\frac{\text{a}}{98} + \frac{\text{b}}{80} + \frac{0.015}{64} \right) = 23.47 \times 10^{-3}$$

$$0.0102 \text{ a} + 0.0125 \text{ b} + 0.00234 = 0.011735$$

$$\text{a} + 1.225 \text{ b} = 1.1275$$

$$\text{a} + \text{b} = 0.985$$

$$0.225 \text{ b} = 0.1425$$

$$\text{b} = 0.633 \text{ g} \rightarrow \text{SO}_3$$

$$\text{a} = 0.35 \text{ M g} \rightarrow \text{H}_2\text{SO}_4$$

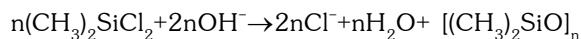
$$\text{Combined (संयुक्त) SO}_3 = \frac{0.3514}{98} \times 80 = 0.2868\text{g}$$

25. Volume(आयतन) = 1.3×10^{-10}

$$= 5.4 \times 10^{-7} \text{ m}^3 = 0.54 \text{ cm}^3$$

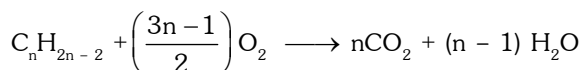
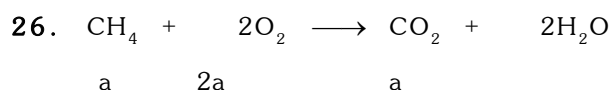
$$\rho = 1 \text{ g/cm}^3$$

$$\text{mass (द्रव्यमान)} = 0.54 \text{ g}$$



$$\frac{w}{129} \quad \frac{w}{129n} \times \{74n\}$$

$$\frac{74w}{129} = 0.54 \Rightarrow w = 0.9413 \text{ g}$$



$$(20-a) \quad \left(\frac{3n-1}{2}\right)(20-a) \quad n(20-a)$$

For methane(मेथेन के लिए) $a + n(20-a) = 40 \dots(1)$

For oxygen(ऑक्सीजन के लिए)

$$\left[100 - 2a - \left(\frac{3n-1}{2}\right)(20-a)\right] = 40$$

$$2a + \left(\frac{3n-1}{2}\right)(20-a) = 60$$

$$2a + 30n - 1.5na - 10 + 0.5a = 60$$

$$2.5a - 1.5na + 30n = 70$$

$$2.5a - 1.5n(a-20) = 70$$

$$2.5a + 1.5n(20-a) = 70 \dots(2)$$

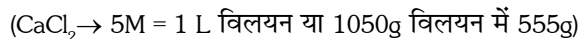
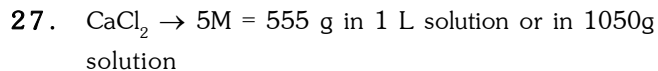
from (1) & (2)

$$a = 10$$

$$n = 3$$

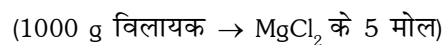
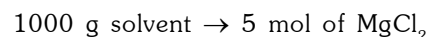
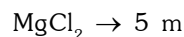


% composition (% संघटन) $\rightarrow 50\%$

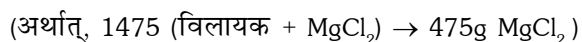


$$\text{wt. of (solvent + MgCl}_2) = 1050 - 555 = 495 \text{ g}$$

$$((\text{विलायक} + \text{MgCl}_2) \text{ का भार} = 1050 - 555 = 495\text{g})$$

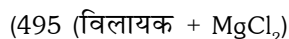


$$= 5 \times 95 = 475 \text{ g MgCl}_2$$

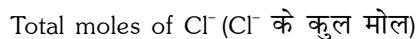


$$495 (\text{solvent} + \text{MgCl}_2) \rightarrow \frac{475}{1475} \times 495$$

$$= 159.4 \text{ g MgCl}_2$$



$$\text{moles of MgCl}_2 (\text{MgCl}_2 \text{ के मोल}) = \frac{159.4}{95} = 1.678$$



$$= (5 + 1.678) \times 2 = 13.356$$

