MOLE CONCEPT

1. A 10 mg effervescent tablet containing sodium bicarbonate and oxalic acid releases 0.25 ml of CO_2 at T = 298.15 K and p = 1 bar. If molar volume of CO_2 is 25.0 L under such condition, what is the percentage of sodium bicarbonate in each tablet ? [Molar mass of $NaHCO_3$ = 84 g mol^{-1}]

(1) 16.8 (2) 8.4
(3) 0.84 (4) 33.6

2. For the following reaction, the mass of water produced from 445 g of $C_{57}H_{110}O_6$ is :

$$2C_{57}H_{110}O_6(s) + 163O_2(g) \rightarrow 114CO_2(g) + 110\ H_2O(l)$$

(1) 495 g (2) 490 g (3) 890 g (4) 445 g

3. An organic compound is estimated through Dumas method and was found to evolve 6 moles of CO_2. 4 moles of H_2O and 1 mole of nitrogen gas. The formula of the compound is

(1) $C_{12}H_8N$ (2) $C_{12}H_8N_2$
(3) C_6H_8N (4) $C_6H_8N_2$

4. The percentage composition of carbon by mole in methane is :

(1) 80% (2) 25%
(3) 75% (4) 20%

5. For a reaction,

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$;

identify dihydrogen (H_2) as a limiting reagent in the following reaction mixtures.

(1) 14g of N_2 + 4g of H_2
(2) 28g of N_2 + 6g of H_2
(3) 56g of N_2 + 10g of H_2
(4) 35g of N_2 + 8g of H_2

6. What would be the molality of 20% (mass/mass) aqueous solution of KI?

(molar mass of KI = 166 g mol^{-1})

(1) 1.08 (2) 1.48
(3) 1.51 (4) 1.35

7. At 300 K and 1 atmospheric pressure, 10 mL of a hydrocarbon required 55 mL of O_2 for complete combustion and 40 mL of CO_2 is formed. The formula of the hydrocarbon is :

(1) C_4H_8 (2) C_4H_7Cl
(3) C_4H_{10} (4) C_4H_6

8. The minimum amount of $O_2(g)$ consumed per gram of reactant is for the reaction :

(Given atomic mass : Fe = 56, O = 16, Mg = 24, P = 31, C = 12, H = 1)

(1) $C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(l)$
(2) $P_4(s) + 5\ O_2(g) \rightarrow P_4O_{10}(s)$
(3) $4\ Fe(s) + 3\ O_2(g) \rightarrow 2\ FeO_3(s)$
(4) $2\ Mg(s) + O_2(g) \rightarrow 2\ MgO(s)$

9. 5 moles of AB_2 weigh 125×10^{-3} kg and 10 moles of A_2B_2 weigh 300×10^{-3} kg. The molar mass of A(M_A) and molar mass of B(M_B) in kg mol^{-1} are :

(1) $M_A = 50 \times 10^{-3}$ and $M_B = 25 \times 10^{-3}$
(2) $M_A = 25 \times 10^{-3}$ and $M_B = 50 \times 10^{-3}$
(3) $M_A = 5 \times 10^{-3}$ and $M_B = 10 \times 10^{-3}$
(4) $M_A = 10 \times 10^{-3}$ and $M_B = 5 \times 10^{-3}$

10. 25 g of an unknown hydrocarbon upon burning produces 88 g of CO_2 and 9 g of H_2O. This unknown hydrocarbon contains.

(1) 20g of carbon and 5 g of hydrogen
(2) 24g of carbon and 1 g of hydrogen
(3) 18g of carbon and 7 g of hydrogen
(4) 22g of carbon and 3 g of hydrogen

SOLUTION

1. Ans. (2)

$2NaHCO_3 + H_2C_2O_4 \rightarrow Na_2C_2O_4 + 2H_2O + 2CO_2$ moles of $CO_2 = \frac{0.25\times10^{-3}}{25} = 10^{-5}$

moles of $NaHCO_3 = 10^{-5}$ mol

mass of $NaHCO_3 = 10^{-5} \times 84$ gm

% of $naHCO_3 = \frac{84\times10^{-5}}{10\times10^{-3}} = 100$

$= 8.4\%$

2. Ans. (1)

moles of $C_{57}H_{110}O_6(s) = \frac{445}{890} = 0.5$ moles

$2C_{57}H_{110}O_6(s) + 163\,O_2(g) \rightarrow 114\,CO_2(g) + 110\,H_2O(l)$

$n_{H_2O} = \frac{110}{4} = \frac{55}{2}$

$m_{H_2O} = \frac{55}{2}\times18$

$= 495$gm

3. Ans. (4)

$[C_xH_yN_z] \xrightarrow[\text{Method}]{\text{Duma}} 6CO_2 + 4H_2O + N_2$

Hence, $C_6H_8N_2$

4. Ans. (4)

CH_4

% by mole of carbon $= \frac{1\,\text{mol atom}}{5\,\text{mol atom}}\times100$

$= 20\%$

5. Ans. (3)

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

(1) $\underset{(LR)}{0.5\text{ mol}}$ 2 mol

(2) 1 mol 3 mol (completion)

(3) 2 mol $\underset{(LR)}{5\text{ mol}}$

(4) $\underset{(LR)}{1.25\text{ mol}}$ 4 mol

$\therefore$ Ans.(3)

6. Ans. (3)

$\frac{w}{w}\% = 20$

100 gm solution has 20 gm KI

80 gm solvent has 20 gm KI

$m = \frac{\frac{20}{166}}{\frac{80}{1000}} = \frac{20\times1000}{166\times80} = 1.506 \simeq 1.51$ mol/kg

7. Ans. (4)

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

$10 \quad 10\left(x+\frac{y}{4}\right) \quad 10x$

By given data, $10\left(x+\frac{y}{4}\right) = 55$ .... (1)

$10x = 40$ .... (2)

$\therefore x = 4, y = 6 \Rightarrow C_4H_6$

8. Ans. (3)

Sol. $C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$

Each 1g of C_3H_8 requires 3.63 g of O_2

$P_4(s) + 5O_2(g) \longrightarrow P_4O_{10}(s)$

Each 1g of P_4 requires 1.29 g of O_2

$4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(s)$

Each 1g of Fe requires 0.428 g of O_2

$2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$

Each 1g of Mg requires 0.66 g of O_2

therefore least amount of O_2 is required in option (3).

9. Ans. (3)

$5[M_A + 2M_B] = 125$

$M_A + 2M_B = 25$ ....(1)

$2M_A + 2M_B = 30$ ....(2)

from eq. (1) & (2)

$M_A = 5$

$M_B = 10$

10. Ans. (2)

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

$$\left(\frac{25}{M}\right) \qquad x \times \frac{25}{M} = 2 \qquad \frac{y}{2} \times \frac{25}{M} = 0.5$$

C $\quad x \times \frac{25}{M} = 2$

H $\quad y \times \frac{25}{M} = 1$

$C_{2y}H_y \equiv$ 24y gm C + y gm H

or

24 : 1 ratio by mass