Chemistry

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(Chapter - 3) (Chemical Kinetics) (Exercises)

(Class 12)

Question 3.1:

From the rate expression for the following reactions, determine their order of reaction and the dimensions of the rate constants.

- (i) 3 NO (g) → N₂O (g) Rate = k[NO]²
- (ii) $H_2O_2(aq) + 3I^-(aq) + 2H^* \rightarrow 2H_2O(1) + I_3^- Rate = k[H_2O_2][I^-]$
- (iii) $CH_3CHO(g) \rightarrow CH_4(g) + CO(g)$ Rate = $k[CH_3CHO]^{\frac{d}{2}}$
- (iv) $C_2H_5Cl(g) \rightarrow C_2H_4(g) + HCl(g)$ Rate = $k[C_2H_5Cl]$

Answer 3.1:

(i) Given rate = k[NO]²

Therefore, order of the reaction = 2

Dimension of $k = \frac{Rate}{|NO|^2} \Longrightarrow \frac{\text{mol } L^{-1}s^{-1}}{(\text{mol } L^{-1})^2} = \frac{\text{mol } L^{-1}s^{-1}}{\text{mol}^2L^{-2}} = L \text{ mol}^{-1}s^{-1}$

(ii) Given rate = $k[H_2O_2][I^-]$

Therefore, order of the reaction = 2

Dimension of $k = \frac{\text{Rate}}{[H_2O_2][[1^-]} \Longrightarrow \frac{\text{mol } L^{-1}g^{-1}}{(\text{mod } L^{-1})(\text{mol } L^{-1})} = L \text{ mol}^{-1}s^{-1}$

(iii) Given rate = $k[CH_3CHO]^{3/2}$

Therefore, order of reaction= 3/2

Dimension of $k = \frac{\text{Rate}}{[\text{CH}_3\text{CHO}]^{3/2}} \Longrightarrow \frac{\text{mol } L^{-1}s^{-1}}{(\text{mol } L^{-1})^{3/2}} = \frac{\text{mol } L^{-1}s^{-1}}{\text{mol}^{3/2}L^{3/2}} = L^{3/2}\text{mol}^{1/2}s^{-1}$

(iv) Given rate = $k[C_2H_5Cl]$

Therefore, order of the reaction = 1

Dimension of $k = \frac{Rate}{[C_2H_3Cl]} \Rightarrow \frac{mol L^{-1}s^{-1}}{mol L^{-1}} = s^{-1}$

Question 3.2:

For the reaction:

 $2A + B \rightarrow A_2B$

The rate= $k[A][B]^2$ with $k=2.0 \times 10^{-6} \text{mol}^{-2} \text{L}^2 \text{s}^{-1}$. Calculate the initial rate of reaction when

 $[A] = 0.1 \text{ mol L}^{-1}$, $[B] = 0.2 \text{mol L}^{-1}$. Calculate the rate of reaction after [A] is reduced to 0.06 mol L⁻¹

Answer 3.2:

The initial rate of reaction is

 $Rate = k[A][B]^2 \implies (2.0 \times 10^{-6} \text{mol}^{-2} \text{L}^2 \text{s}^{-1})(0.1 \text{ mol L}^{-1})(0.2 \text{ mol L}^{-1})^2 = 8.0 \times 10^{-9} \text{mol}^{-2} \text{L}^2 \text{s}^{-1}$

When [A]is reduced from 0.1 mol L-1 to 0.06 mol-1,

The concentration of A reacted = (0.1 - 0.06) mol L⁻¹ = 0.04 mol L⁻¹

Therefore, concentration of B reacted = $\frac{1}{2} \times 0.04 \text{ mol L}^{-1}$

Then concentration of B available, [B] = (0.2 - 0.02) mol L⁻¹ = 0.18 mol L⁻¹

After [A]is reduced to 0.06 mol L-1, the rate of reaction is given by,

 $Rate = k[A][B]^2 \Longrightarrow (2.0 \times 10^{-6} \text{mol}^{-2} L^2 s^{-1})(0.06 \text{ mol } L^{-1})(0.18 \text{ mol } L^{-1})^2 = 3.89 \text{ mol } L^{-1} s^{-1} = 3.89 \text{ mol } L^{-$

Question 3.3:

The decomposition of NH₃ on platinum is zero order reaction. What are the rates of production of N₂ and H₂ if $k=2.5~\times~10^{-4}~mol^{-1}~L~s^{-1}$?

Answer 3.3:

The decomposition of NH3 on platinum surface is represented by the following equation.

$$2 \text{ NH}_{3(g)} \xrightarrow{\text{Pt}} N_{2(g)} + 3 \text{ H}_{2(g)}$$

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