

$$(2) \quad \frac{T}{C_{A0}} = \frac{V}{F_{A0}} = \int_{X_{Ai}}^{X_{Af}} \frac{dX_A}{-r_A}$$

(A) solⁿ I

Case I

$$-r_A = k C_A$$

$$\frac{T}{C_{A0}} = \frac{V}{F_{A0}} \int_{X_{Ai}}^{X_{Af}} \frac{dX_A}{k C_{A0} (1 - X_A)}$$

$$E_A = \frac{1-1}{1} = 0$$

$$\frac{V}{F_{A0}} = \frac{1}{k C_{A0}} \int_0^{0.99} \frac{dX_A}{k C_{A0} (1 - X_A)}$$

$$\frac{V_1}{F_{A0}} = -\frac{1}{k C_{A0}} \ln(0.01)$$

$$-\frac{V_1}{\ln(0.01)} = \frac{F_{A0}}{k C_{A0}} = \frac{v_0}{k}$$

$$6.95 = \frac{v_0}{k}$$

Case II

$$-r_A = k C_A$$

$$E = \frac{1-3}{3} = -0.67$$

$$\frac{V_2}{F_{A0}} = \frac{1}{k C_{A0}} \int_{X_{Ai}}^{X_{Af}} \left(\frac{1 + E_A X_A}{1 - X_A} \right) dX_A$$

$$\frac{V_2}{F_{A0}} = \frac{1}{k C_{A0}} \int_{X_{Ai}}^{X_{Af}} \left(\frac{1 - 0.67 X_A}{1 - X_A} \right) dX_A$$

$$V_2 = 6.95 \int_0^{0.99} \left(\frac{1 - 0.67 X_A}{1 - X_A} \right) dX_A$$

$$V_2 = 15.17 L$$

$$(3) \quad K_T = -(1 + \epsilon_A) \ln(1 - X_A) - \epsilon_A X_A$$

Solⁿ 2

Case I

$$C_{A0} X_A = -(1) \ln(0.01) - 0$$

$$C_{A0} X_A (0.99) = 4.60$$

$$X_A (C_{A0} = 4.652)$$

$$4.60 = \frac{K C_{A0} V}{F_{A0}}$$

Case II

$$C_{A0} X_A = K_T = \frac{K C_{A0} V}{F_{A0}}$$

$$\frac{K C_{A0}}{F_{A0}} = \frac{4.60}{32}$$

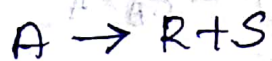
$$Y = \frac{C_{A0} X_A F_{A0}}{K C_{A0}} = X_A$$

$$\left(\frac{K C_{A0}}{F_{A0}} \right) V' = -(1 + \epsilon_A) \ln(1 - X_A) - \epsilon_A X_A$$

$$0.144 V' = -0.33 \ln(0.01) + 0.67 \times 0.99$$

$$V' = 15.2 L$$

0.144 V'

Q4

For mixed reactor

$$\frac{V}{F_{A0}} = \frac{X_A}{-r_A} = \frac{C_{A0} - C_A}{C_{A0}(-r_A)} \quad \tau = \frac{V}{v} = \frac{C_{A0} X_A}{-r_A}$$

let

$$-r_A = k C_A^n \quad C_{A0} = 0.002 \frac{\text{mol}}{\text{L}}$$

Run number	τ (sec)	X_A	$-r_A$ ($\frac{\text{M}}{\text{sec}}$)	C_A (M)
1	0.423	0.22	1.04×10^{-3}	1.56×10^{-3}
2	5.10	0.63	2.47×10^{-4}	7.40×10^{-4}
3	13.5	0.75	1.111×10^{-4}	5.00×10^{-4}
4	44	0.88	4.00×10^{-5}	2.40×10^{-4}
5	192	0.96	1.00×10^{-5}	8.00×10^{-5}

$$\ln(-r_A) = \ln k + n \ln C_A$$

$$\ln(1.04 \times 10^{-3}) = \ln k + n \ln(1.56 \times 10^{-3}) \quad \dots \textcircled{I}$$

$$\ln(1.00 \times 10^{-5}) = \ln k + n \ln(8.00 \times 10^{-5}) \quad \dots \textcircled{II}$$

$$\ln\left(\frac{1.04 \times 10^{-3}}{10^{-5}}\right) = n \ln\left(\frac{1.56}{8} \times 10^2\right)$$

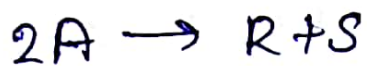
$$n = 1.56$$

$$n \approx 1.6$$

$$\ln k = 3.2 \Rightarrow k = 24.87$$

$$-r_A = 24.87 C_A^{1.6} \approx 25 C_A^{1.6}$$

Q.5



$$E_A = 0$$

Assuming order of r_k^n to be '1'

$$t = \frac{1}{kRT} \int_{P_{A_0}}^{P_A} - \frac{dP_A}{P_A}$$

$$t = \frac{1}{kRT} \ln \left(\frac{P_{A_0}}{P_A} \right)$$

$$20 = \frac{1}{3101.122k} \ln \left(\frac{1}{0.8} \right) \Rightarrow \frac{0.223}{3101.122k}$$

$$k_1 = 3.59 \times 10^{-6}$$

$$40 = \frac{1}{3101.122k} \ln \left(\frac{1}{0.68} \right) \Rightarrow k_2 = 3.10 \times 10^{-6}$$

$$60 = \frac{1}{3101.122k} \ln \left(\frac{1}{0.58} \right) \Rightarrow k_3 = 3.1161 \times 10^{-6}$$

$$k \approx 3.1 \times 10^{-6}$$

$$k_p = (kRT) = 9.61 \times 10^{-3} \text{ sec}^{-1}$$

$$\Rightarrow -r_A = k_p p_A$$

$$\frac{T}{C_{A0}} = \frac{V}{F_{A0}} = \int_{X_{Ai}}^{X_{Af}} \frac{dX_A}{-r_A}$$

$$F_{A0} = \frac{100 \text{ mol}}{\text{hr.}}$$

$$= 0.028 \frac{\text{mol}}{\text{sec.}}$$

$$\frac{V}{0.028} = \int_{X_{Ai}}^{X_{Af}} \frac{dX_A}{k_p p_A}$$

$$p_A = p_{A0} (1 - X_A)$$

$$dp_A = -p_{A0} dX_A$$

$$E_A = 0$$

$$V = (0.028) \int_{0.04 \text{ atm}}^{0.8 \text{ atm}} - \frac{dp_A}{p_{A0} k_p p_A}$$

$$V = + \frac{0.028}{0.8 \times 101.325 \times 10^3 \times 9.61 \times 10^{-3}} \ln\left(\frac{0.8}{0.04}\right)$$

$$= 1.077 \times 10^{-4} \text{ m}^3$$