$\boxed{\text{sol}^n \text{ I}}$

(3) $$\frac{\tau}{C_{A0}} = \frac{V}{F_{A0}} = \int_{x_{Ai}}^{x_{Af}} \frac{dX_A}{-r_A}$$

Case I

$$-r_A = kC_A$$

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

$$\frac{\tau}{C_{A0}} = \frac{V}{F_{A0}} \int_{x_{Ai}}^{x_{Af}} \frac{dX_A}{kC_{A0}(1-X_A)}$$

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

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

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

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

Case II

$$-r_A = kC_A$$

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

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

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

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

$$V_2 = 15.17L$$

(3) $k\tau = -(1+\varepsilon_A)\ln(1-X_A) - \varepsilon_A X_A$

Soln 2

<u>Case I</u>

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

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

$\cancel{X_A}\ C_{A0} = 4.652$

$4.60 = \dfrac{k C_{A0} V}{F_{A0}}$

<u>Case II</u>

$C_{A0} X_A = k\tau = \dfrac{k C_{A0} V}{F_{A0}}$

$\dfrac{k C_{A0}}{F_{A0}} = \dfrac{4.60}{32}$

$V = \dfrac{\cancel{C_{A0}} X_A F_{A0}}{k \cancel{C_{A0}}}$

$= X_A$

$\left(\dfrac{k C_{A0}}{F_{A0}}\right) V' = -(1+\varepsilon_A)\ln(1-X_A) - \varepsilon_A X_A$

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

$V' = 15.2L$

Q4

$A \rightarrow R + S$

For mixed reactor

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

let

$$-r_A = k C_{A_0}^n \quad \cancel{-k C_A} \qquad C_{A0} = 0.002 \ \frac{mol}{L}$$

Run number	τ (sec)	X_A	$-r_A$ $\left(\frac{M}{sec}\right)$	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}

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

$$\ln(1.04 \times 10^{-3}) = \ln k + n \ln(1.56 \times 10^{-3}) \quad \text{--- (1)}$$

$$\ln(1.00 \times 10^{-5}) = \ln k + n \ln(8.00 \times 10^{-5}) \quad \text{--- (11)}$$

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

$$n = 1.56 \qquad \boxed{n \simeq 1.6}$$

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

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

Q.5 $\quad 2A \rightarrow R+S \qquad \varepsilon_A = 0$

Assuming order of rxn to be '1'

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

$$t = \frac{1}{KRT} \ln\left(\frac{P_{A0}}{P_A}\right)$$

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

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

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

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

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

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

$$\Rightarrow -r_A = k_p p_A$$

$$\frac{\tau}{C_{A_0}} = \frac{V}{F_{A_0}} = \int_{X_{Ai}}^{X_{Af}} \frac{dX_A}{-r_A}$$

$$F_{A_0} = 100 \ \frac{mol}{hr.}$$

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

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

$$p_A = p_{A_0}(1 - X_A)$$

$$dp_A = -p_{A_0} dX_A$$

$$\varepsilon_A = 0$$

$$V = (0.028) \int_{0.8\,atm}^{0.04\,atm} - \frac{dp_A}{p_{A_0} k_p p_A}$$

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

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