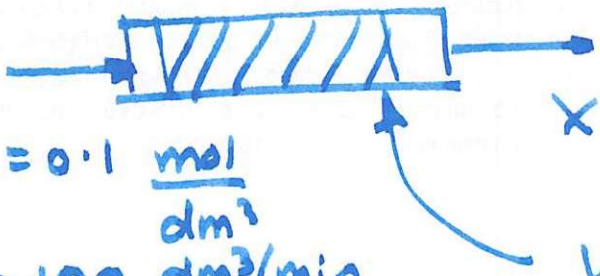
P5-24

The problem is similar to 5.11

$$A + B \longrightarrow C + D$$



$X = 0.5$

$C_{A_0} = 0.1 \ \frac{mol}{dm^3}$

$v_0 = 100 \ dm^3/min$

$T = 300 K$

$W = 100 \ kg$

$\alpha = 9.9 \times 10^{-3} \ 1/kg$

$$-r_A = k C_A^2$$

$$k = k_0 e^{-E/RT}$$

$E = 10000 \ \frac{cal}{mol}$

calculate k @ 400 K

$$\rightarrow \quad \frac{dX}{dW} = \frac{-r_A'}{F_{A0}} = \frac{k C_{A_0}^2 (1-X)^2 y^2}{F_{A0}}$$

$$\frac{dX}{dW} = \frac{k C_{A_0}^2 (1-X)^2}{v_0 C_{A0}} (1 - \alpha W)$$

$$\frac{X}{1-X} = \frac{k C_{A0}}{v_0} \left[W - \frac{\alpha W^2}{2} \right]$$

$$\frac{0.5}{1-0.5} = \frac{k\ 0.1}{100}\left[100 - \frac{9.9\times10^{-3}\times100^2}{2}\right]$$

$$k = \frac{100}{0.1\ (100-49.5)}$$

$$k = 20.2\ \frac{dm^6}{kg\text{-}cat\cdot mol\cdot min}$$

$$\ln\frac{k_2}{k_1} = \frac{E}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\ln\frac{k_2}{20.2} = \frac{20000}{1.987}\left[\frac{1}{300} - \frac{1}{400}\right]$$

$$k_2 = 1338.90\ \frac{dm^6}{kg\text{-}cat\cdot mol\cdot min}$$