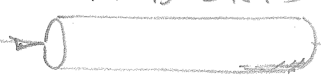
4.1

gas

$A + B \rightarrow R + S$

$C_{A0} = 100$

$C_{B0} = 100$



$X_A = 0.8$

$\begin{cases} \varepsilon_A = 0 \\ \varepsilon_B = 0 \end{cases}$

$$\left.\begin{array}{l} X_B = 0.8 \\ C_A = 0.2 \\ C_B = 0.2 \end{array}\right\} \longleftarrow$$

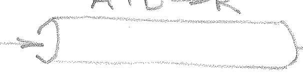
4.3

gas

$A + B \rightarrow R$

$C_{A0} = 200$

$C_{B0} = 100$



$C_A = 50$

Take 300 moles of feed gas. Consider A

$$\left.\begin{array}{ll} \text{at } X_A = 0 & V = 200A + 100B + 0R = 300 \\ \text{at } X_A = 1 & V = 0A - 100B + 200R = 100 \end{array}\right\} \quad \varepsilon_A = \frac{100-300}{300} = -\frac{2}{3}$$

Now consider B

$$\left.\begin{array}{ll} \text{at } X_B = 0 & V = 300 \\ \text{at } X_B = 1 & V = 100A + 0B + 100R = 200 \end{array}\right\} \quad \varepsilon_B = \frac{200-300}{300} = -\frac{1}{3}$$

$\therefore$ from Eq. 5

$$X_A = \frac{200-50}{200-\left(\frac{2}{3}\right)50} = 0.9 \longleftarrow$$

$$X_B = \frac{200 \times 0.9}{100} = 1.8 \ \cdots \text{ impossible} \longleftarrow$$

4.5

$C_{A0} = 100$

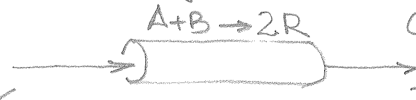
$C_{B0} = 200$

$T_0 = 400\,K$

$\pi_0 = 4\,atm$

gas

$A + B \rightarrow 2R$



$C_A = 20$

$T = 300\,K$

$\pi = 3\,atm$

Since the number of moles is unchanged $\varepsilon_A = 0$ and $\varepsilon_B = 0$

4.5 (continued)

$$X_A = \frac{1 - \frac{C_A}{C_{A0}}\left(\frac{T\pi_0}{T_0\pi}\right)}{1 + \varepsilon_A \frac{C_A}{C_{A0}}\left(\frac{T\pi_0}{T_0\pi}\right)} = \frac{1 + \left(\frac{20}{100}\right)\left(\frac{300\times4}{400\times3}\right)}{1+0} = 0.8$$

$$X_B = \frac{b\,C_{A0}X_A}{C_{B0}} = \frac{(1)(100)(0.8)}{200} = 0.4$$

$$\therefore\ C_B = 200 - 80 = 120$$

4.7

$$A \rightarrow 31R$$

1 lit/min ⟶ [reactor] ⟶ 28 lit/min

Let X be the fraction of popcorn popped, the conversion
1−X is then the fraction unpopped

$$\text{Outlet} = 31X + (1-X)1 = 28 \text{ lit/min}$$

or $X = \frac{27}{30} = 0.9$

the fraction popped.
