ChE 4063 **Final** **December 6, 2001**

Open Books and Notes

SOLUTION

I. 60 points

A certain liquid-phase polymerization reaction can be represented:

$$M \rightarrow (1/n)\ P_n$$

where n is the average number of monomer molecules in the polymer chain. The reaction is 3/2 order in monomer (M) concentration. The rate constant at 25°C (298 K) is 0.7 $lt^{1/2}mole^{-1/2}min^{-1}$ and the activation energy is 25,000 cal/mole (note: the gas constant in calories is R=1.987 cal/mole-K). The initial concentration of M is 2.0 moles/lt, and the reaction may assumed to be constant density. An energy balance on an adiabatic flow reactor leads to:

$$T = T_0 + 3180\ f_M / (600 - 35\ f_M)$$

Where f_M is the fractional conversion of monomer.

In all cases, a 1000 lt/min feedstock enters a 2500 lt flow reactor.

A. 10 points
Find the conversion if an **isothermal PFR** at 30°C (303 K) is used.

B. 25 points
Find the conversion if an **adiabatic CSTR** with feedstock temperature T_0 = 25°C (298 K) is used. Look for only one T_{out}, $f_{m,out}$ solution.

C. 25 points
Find the conversion if an **adiabatic PFR** with feedstock temperature T_0 = 25°C (298 K) is used.

II. 40 points

An isothermal 100 lt CSTR is fed with an aqueous solution containing reactant at C_A = 3 moles/lt and flowrate $\mathcal{V}_0$ = 25 lt/min. The following reactions take place:

$$A \rightarrow B \qquad r_1\ (\text{moles/lt-min}) = 0.3\ C_A$$
$$A \rightarrow C \qquad r_2\ (\text{moles/lt-min}) = 0.2\ C_A$$
$$B + C \rightarrow D \qquad r_3\ (\text{moles/lt-min}) = 0.05\ C_B C_C$$

where all concentrations are in moles/lt.

Find the product distribution (C_A, C_B, C_C, and C_D) leaving the reactor given $C_{B0} = C_{C0} = C_{D0} = 0$.