



1. In a continuous plug-flow tubular reactor (PFTR), feedstock of pure A is transformed into desired product B in the reaction of $A \rightarrow B$ at the flow-rate of 4 liter/min with $C_{A0} = 2$ moles/liter. However, there is a second reaction $A \rightarrow C$, which can also occur. Both reactions are first order and irreversible with $k_1 = 0.45 \text{ min}^{-1}$ and $k_2 = 0.05 \text{ min}^{-1}$. Find reactor volume (V), concentration of B (C_B), selectivity of B (S_B) and yield of B (Y_B) for 95% conversion of A. (20%)

2. For the reversible reaction $A \leftrightarrow B$, $r = k_f C_A - k_b C_B$, find the residence times for 50% conversion of A in a continuous stirred tank reactor (CSTR) and in a PFTR respectively, if $k_f = 0.7 \text{ min}^{-1}$, $k_b = 0.1 \text{ min}^{-1}$, $C_{A0} = 4$ moles/liter, feedstock flow-rate of 6 liter/min and $C_{B0} = 0$. (20%)

3. In a reaction rate expression, rate constant is usually presented as following:

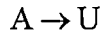
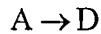
$$k(T) = k_0 \exp(-E/RT)$$

where E is the activation energy and k_0 is the pre-exponential factor.

Please make descriptions to obtain E and k_0 using "differential reactor" method. (10%)



4. The parallel reactions



react in a CSTR. The entering molar flow rates are $F_{A0}=5$ mol/min and $F_{D0}=F_{U0}=0$. The effluent molar flow rates are $F_A=1$ mol/min, $F_D=3$ mol/min, and $F_U=1$ mol/min. Determine (10%)

(a) instantaneous selectivity $S_{D/U}$ and overall selectivity $\tilde{S}_{D/U}$

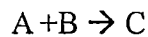
(b) instantaneous Yield Y_D and overall Yield \tilde{Y}_D

5. The following liquid-phase reactions were carried out in a CSTR with the space time τ . (20%)

(a) What are the net rates of reaction for A, B, C, D, and E?

(b) If the inlet feed only includes species A (C_{A0}), what is the exit concentration of C?

6. The irreversible elementary reaction



reacts in two CSTRs in series ($\tau_1 = 2.5$ min, $\tau_2 = 5$ min). The influent and effluent volumetric flow rate keep the same (change in volumetric flow rate is negligible). The feed ($C_{A0} = 1.0$ M, $C_{B0} = 1.6$ M) enters the first CSTR and the compositions in the first reactor are $C_{A1} = 0.4$ M. Find the C_{B1} , C_{A2} and C_{B2} (20%)

