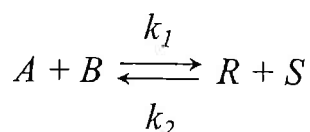




- The reaction $A \rightarrow 2B$ is carried out isothermally in a continuous-flow reactor. The entering volumetric flow rate and molar rate are $20 \text{ dm}^3 \text{ h}^{-1}$ and 10 mol h^{-1} , respectively. Assume the reaction rate is $-r_A = kC_A$ with $k = 0.0001 \text{ s}^{-1}$.
 - Calculate both the CSTR and PFR reactor volumes necessary to consume 90% of A. (16%)
 - Calculate the time necessary to consume 99% of species A in a 1000 dm^3 constant volume batch reactor with $C_{A0} = 0.5 \text{ mol dm}^{-3}$. (8%)
- The space time necessary to achieve 70% conversion in a CSTR is 4 h. The entering volumetric flow rate and concentration of reactant A are $1.5 \text{ dm}^3 \text{ min}^{-1}$ and 2.0 mol dm^{-3} , respectively.
 - Determine the rate of reaction. (5%)
 - Determine the reactor volume. (5%)
 - Determine the exit concentration of A. (4%)
- The rate law for the reaction $A + 2B \rightarrow C$ is $-r_A = kC_A C_B^2$ with $k_A = 24 \text{ dm}^6 \text{ mol}^{-2} \text{ s}^{-1}$. What are k_B and k_C ? (12%)
- For a liquid-phase reaction operating in a 40 L CSTR, the concentrations of the A and B feed streams are 3.2 and 2.4 M before mixing, respectively. The volumetric flow rate of each stream is equal. It is known that k_1 and k_2 are 9 and $1.5 \text{ L mol}^{-1} \text{ min}^{-1}$, respectively. Determine the total flow rate of A and B, if 75% conversion of the entering species B is required. (25%)





5. Suppose a liquid-phase reaction ($A \rightarrow B + C$) is carried out isothermally and the data are as following:

Conversion, X	0	0.2	0.4	0.45	0.5	0.6	0.8	0.9
$-r_A$ (mol L ⁻¹ min ⁻¹)	13	21.7	65	65	65	65	16.3	11.8

The molar flow rate of A is 0.5 kmol min⁻¹.

- For a single CSTR, what is the volume necessary to achieve 80% conversion of the entering species A? (7%)
- For a single PFR, what is the volume necessary to achieve 80% conversion of the entering species A? (8%)
- To achieve 80% conversion of the entering species A, how to arrange the reactors to minimize the total volume of reactors? (10%)