1. When aqueous A and aqueous B ($C_{Ao} = C_{Bo}$) are brought together they react in two possible ways:

$$A+B \begin{array}{l} \nearrow \quad R+T, \qquad r_R = 50C_A \text{ mol/m3.hr} \\ \\ \searrow \quad S+U, \qquad r_S = 100C_B \text{ mol/m3.hr} \end{array}$$

to give a mixture whose concentration of active components (A, B, R, S, T, U) is $C_{TOTAL} = C_A + C_B, = 60$ mol/m^3. Find the size of reactor needed and the R/S ratio produced for 90% conversion of an equimolar feed of $F_{Ao} = F_{Bo} =$ 300 mol/hr:

1.1. in a mixed flow reactor;
1.2. in a plug flow reactor;
1.3. which reactor gives more C_R.

2. The elementary liquid-phase-series reaction

$$A \xrightarrow{K_1} B \xrightarrow{K_2} C$$

is carried out in a 500-dm^3 batch reactor. The initial concentration of A is 1.6 mol/dm^3. The desired product is B. and separation of the undesired product C is very difficult and costly. Because the reaction is carried out at a relatively high temperature, the reaction is easily quenched.

$K_1 = 0.4\ h^{-1}$

$K_2 = 0.01\ h^{-1}$ at 100°C

a) Assuming that each reaction is irreversible, plot the concentrations of A, B and C as a function of time.

(b) For a CSTR space time of 0.5 h, what temperature would you recommend to maximize B? (E_1 = 10,000 cal/mol, E_2 = 20,000 cal/mol)

(c) Assume that the first reaction is reversible with $K_{-1} = 0.3\ h^{-1}$. Plot the concentrations of A, B and C as a function of time.

(d) Plot the concentrations of A, B and C as a function of time for the case where both reactions are reversible with $K_{-2} = 0.005\ h^{-1}$.

(e) Vary K_1, K_2, K_{-1} and K_{-2}. Explain the consequence of $K_1 > 100$ and $K_2 < 0.1$ with $K_{-1} = K_{-2} = 0$ and with $K_{-2} = 1$, $K_{-1} = 0$. And $K_{-2} = 0.25$.

3. The elementary liquid phase series parallel reaction scheme

$$A \longrightarrow B \longrightarrow C$$

$$A \longrightarrow R$$

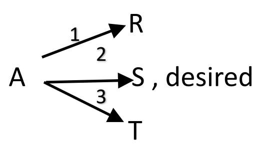
is to be carried out in an isothermal CSTR. The rate laws are given by

$$r_R = k'C_A$$

$$r_B = kC_A - kC_B$$

Feed is pure A. Find the space time of the CSTR which results in the maximum exit concentration of B.

4. For a given feed stream having C_{Ao} should we use a PFR or a MFR and should we use a high or low or some intermediate conversion level for the exit stream if we wish to maximize $\phi(S/A)$? The reaction system is



where n_1, n_2, and n_3, are the reaction orders of reactions 1, 2, and 3.

(a) $n_1 = 1$, $n_2 = 2$, $n_3 = 3$

(b) $n_1 = 2$, $n_2 = 3$, $n_3 = 1$

(c) $n_1 = 3$, $n_2 = 1$, $n_3 = 2$