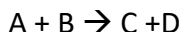


**Assignment 3**

(Submission deadline-4 Sept 2020, 5 PM)

## 1. The gas phase reaction



Takes place isothermally at 300 K in a packed-bed reactor in which the feed is equal in A and B with  $C_{A0} = 0.1 \text{ mol/dm}^3$ . The reaction is second order in A and zero order in B. Currently, 50% conversion is achieved in a reactor with 100 kg catalysts for a volumetric flow rate  $100 \text{ dm}^3/\text{min}$ . The pressure-drop parameter,  $\alpha$ , is  $\alpha = 0.0099 \text{ kg}^{-1}$ . If the activation energy is  $10,000 \text{ cal/mol}$ , what is the specific reaction rate constant at 400 K?

## 2. The gas-phase reaction



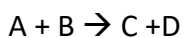
Follows an elementary rate law and is to be carried out first in a PFR and then in a separate experiment in a CSTR. When pure A is fed to a  $10 \text{ dm}^3$  PFR at 300 K and a volumetric flow rate of  $5 \text{ dm}^3/\text{s}$ , the conversion is 80%. When a mixture of 50% A and 50% inert (I) is fed to a  $10 \text{ dm}^3$  CSTR at 320 K and a volumetric flow rate of  $5 \text{ dm}^3/\text{s}$ , the conversion is also 80%. What is the activation energy in cal/mol?

## 3. The gaseous reaction



has a unimolecular reaction rate constant of  $0.0015 \text{ min}^{-1}$  at  $80^\circ\text{F}$ . This reaction is to be carried out in parallel tubes 10 ft long and 1 in. inside diameter, under a pressure of 132 psig at  $260^\circ\text{F}$ . A production rate of 1000 lb/h of B is required. Assuming an activation energy of  $25000 \text{ cal/mol}$ , how many tubes are needed if the conversion of A is to be 90%? Assume perfect gas laws. A and B each have molecular weights of 58.

## 4. At present the elementary liquid-phase reaction



takes place in a plug flow reactor using equimolar quantities of A and B. Conversion is 96%,  $C_{A0} = C_{B0} = 1 \text{ mol/lit}$ . If a CSTR ten times as large as the plug flow reactor were hooked up in series (downstream) with the existing unit, what fraction could production be increased for that setup?