Assignment 3

(Submission deadline-4 Sept 2020, 5 PM)

1. The gas phase reaction

   $A + B \rightarrow C + D$

   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 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 dm^3/min. The pressure-drop parameter, α, is α = 0.0099 kg^{-1}. If the activation energy is 10,000 cal/mol, what is the specific reaction rate constant at 400 K?

2. The gas-phase reaction

   $A \rightarrow B + C$

   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 dm^3 PFR at 300 K and a volumetric flow rate of 5 dm^3/s, the conversion is 80%. When a mixture of 50% A and 50% inert (I) is fed to a 10 dm^3 CSTR at 320 K and a volumetric flow rate of 5 dm^3/s, the conversion is also 80%. What is the activation energy in cal/mol?

3. The gaseous reaction

   $A \rightarrow B$

   has a unimolecular reaction rate constant of 0.0015 min^{-1} at 80 ^{o}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 ^{o}F. A production rate of 1000 lb/h of B is required. Assuming an activation energy of 25000 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

   $A + B \rightarrow C + D$

   takes place in a plug flow reactor using equimolar quantities of A and B. Conversion is 96%, $C_{A0} = C_{B0}$ = 1 mol/lt. 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?