A First Course on Kinetics and Reaction Engineering

Problem 15.3

Problem Purpose

This problem will help you determine whether you have mastered the learning objectives for this unit.

Problem Statement

Suppose you are studying gas phase reaction (1) using a laboratory PFR with an inside diameter of 2.2 cm and a length of 30 cm. The reactor operates isothermally, at steady state and at constant pressure. A series of experimental runs were made at 723 K using different combinations of feed flow rate and reactor pressure. In each run, the feed consisted of pure A and the mole fraction of A was measured at the reactor outlet. The experimental data are presented in Table 1. Determine whether the reaction rate can be accurately modeled using the rate expression given in equation (2), and if it can, compute the best value for the rate coefficient along with its uncertainty.

$$A \rightarrow Y + Z \tag{1}$$

$$r_1 = k_1 P_A \tag{2}$$

Table 1.

Feed Flow Rate ***($cc_{STP}\,s^{-1}$)***	***Pressure (atm)***	***Outlet Mole Fraction of A***
2	1	0.82
4	1	0.91
6	1	0.92
8	1	0.96
2	3	0.59
4	3	0.73
6	3	0.79
8	3	0.85
2	5	0.46
4	5	0.62
6	5	0.72
8	5	0.76
2	10	0.27
4	10	0.44
6	10	0.56
8	10	0.64