A First Course on Kinetics and Reaction Engineering

Practice Problem 8.1

Problem Purpose

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

Problem Statement

The macroscopically observed reaction between iodine and methyl formate is given by equation (1).

$$I_2 + HCOOCH_3 \rightleftarrows HI + CH_3I + CO_2 \qquad (1)$$

Suppose that the actual reaction takes place according to the mechanism given in equations (2) through (5). First, derive four rate expressions from this mechanism by assuming that each of the four steps is the rate-determining step. Then derive a fifth rate expression using the Bodenstein steady-state approximation with the additional assumption that steps (4) and (5) are effectively irreversible. Comment upon the results.

$$I_2 \rightleftarrows 2\ I\bullet \qquad (2)$$

$$HCOOCH_3 + I\bullet \rightleftarrows CH_3COO\bullet + HI \qquad (3)$$

$$CH_3COO\bullet \rightleftarrows CH_3\bullet + CO_2 \qquad (4)$$

$$CH_3\bullet + I_2 \rightleftarrows CH_3I + I\bullet \qquad (5)$$