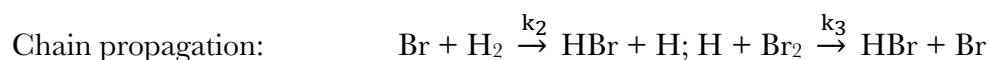


Dynamics and Kinetics. Exercise 6

Problem 1

The reaction between hydrogen and bromine $\text{H}_2 + \text{Br}_2 \rightarrow 2\text{HBr}$ is an example of a chain reaction. It has a composite mechanism:



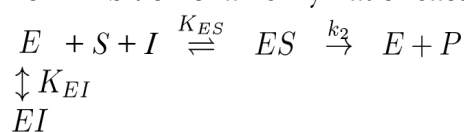
Use the steady-state approximation for intermediates Br and H to derive the overall rate expression:

$$v := -\frac{d[\text{Br}_2]}{dt} = \frac{k[\text{H}_2][\text{Br}_2]^{1/2}}{1 + \frac{m[\text{HBr}]}{[\text{Br}_2]}}$$

How are k and m related to the rate constants $k_1, k_{-1}, \dots, k_3$?

Problem 2

Consider the *competitive* mechanism of inhibition of an enzymatic reaction discussed in lecture:



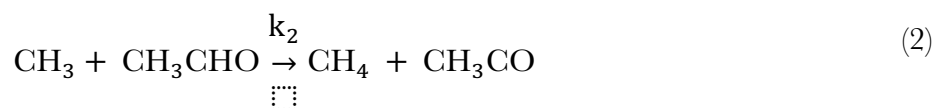
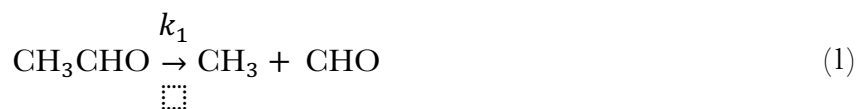
- Assume that the substrate and inhibitor are present in great excess of the enzyme, apply the steady-state treatment, and obtain the rate equation.
- Obtain an expression for the degree of inhibition ϵ , defined as:

$$\epsilon = \frac{v_0 - v}{v_0}$$

where v is the rate in the presence of inhibitor and v_0 is the rate in its absence.

Problem 3

Acetaldehyde has been proposed to decompose according to the following mechanism.



- a) In this radical chain reaction, identify the initiation, propagation, and termination steps.
- b) Derive a rate law for the formation of CH_4 that contains only the concentration of the reactant $[\text{CH}_3\text{CHO}]$. Assume that all radical species are present only in low concentrations in order to make suitable approximations.