Chemistry 24b (Spring term 2004)
Problem Set #3
Due: 4/26/04, 11AM, in class

Part I

From Tinoco, Sauer, Wang and Puglisi: Chapter 7, Problems 24, 30.
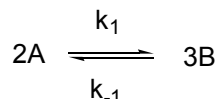
Part II

Problem A
Calculate the factor by which a reaction rate is increased by an enzyme at 37 °C if it lowers the reaction activation energy from 15 kcal·mol^{-1} to 10 kcal·mol^{-1}.

Problem B
Suppose that the reaction

$$2A \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} 3B$$

is second-order in the forward direction and third-order in reverse. Derive an expression for the equilibrium constant in terms of the concentrations of A and B by equating the forward and reverse rates.
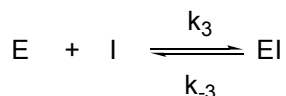
Problem C
A reaction rate increases by a factor of 10 when the temperature is increased from 30 °C to 37 °C. Estimate the Arrhenius activation energy.

Problem D
Let an enzyme inhibitor I be present in the reaction mixture so that to the reactions

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES \overset{k_2}{\longrightarrow} P$$
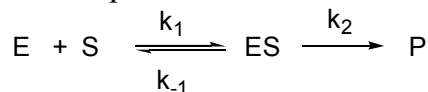
there is added the reaction

$$E + I \underset{k_{-3}}{\overset{k_3}{\rightleftharpoons}} EI$$

in which EI cannot react with substrate (competitive inhibition). Use the steady-state assumption on ES and EI to show that the reaction velocity is given by

$$v = \frac{k_2[E_0][S]}{\dfrac{k_{-1} + k_2}{k_1}\left(1 + \dfrac{k_3}{k_{-3}}[I]\right) + [S]}$$