BIE/CEE 5810/6810 PROBLEM SET 2

Given: Class 7
Due: Class 11

1. Enzyme kinetics. Consider the following enzyme reaction sequence:

$$S + E \underset{k_2}{\overset{k_1}{\rightleftharpoons}} (ES)_1 \underset{k_4}{\overset{k_3}{\rightleftharpoons}} (ES)_2 \xrightarrow{k_5} P + E$$

   Develop a suitable rate expression for product formation [$v = k_5(ES)_2$] by using:
   (a) the equilibrium approach, and
   (b) the quasi-steady-state approach

2. Solve problem 3.3, page 98 of the textbook
   a. What is the function of fumarase?

3. Solve problem 3.6, page 99 of the textbook

4. Solve problem 3.9, page 100 of the textbook

5. Solve problem 3.16, page 102 of the textbook
   a. What type of inhibition is this?
   b. Determine the constants Vm, K'm, and K_I
   c. Could you modify the operation of a biochemical reactor in order to minimize the effect of the inhibitor? If so, how?

6. *Serratia marcescens* is cultured in a minimal medium reactor. Oxygen consumption is measured at a cell concentration of 22.7 g/L dry weight.

Time (min)	Oxygen Conc. (mmol/L)	Time (min)	Oxygen Conc. (mmol/L)
0	0.25	10	0.18
2	0.23	12	0.16
5	0.21	15	0.15
8	0.20		

   a. Determine the best kinetic model fit to the data
   b. Determine the rate constant

7. An enzyme is immobilized on a flat sheet of polymer and placed in a stirred reactor. The enzyme intrinsic maximum reaction rate is $6x10^{-6}$ mol/s-mg enzyme. The amount of enzyme bound to the surface is $1x10^{-4}$ mg enzyme/cm^2 of support. The K_m value in solution is $2x10^{-3}$ mol/L. The mass transfer coefficient is $4.3x10^{-5}$. (A) What is the reaction rate when the bulk concentration of substrate is $4x10^{-3}$ mol/L? (B) What is the substrate surface concentration? (C) What is the Da value for this system?