**10.542 – Biochemical Engineering**
Spring 2005

Problem Set #1
Solutions should be written and submitted on your own paper. All pages should be stapled together.

1) Suppose that an enzyme has two active sites so that substrate is converted to product via the following reaction sequence:

$$E + S \underset{k_{-1}}{\overset{k_1}{\Leftrightarrow}} E \cdot S \qquad\qquad E \cdot S + S \underset{k_{-2}}{\overset{k_2}{\Leftrightarrow}} E \cdot S \cdot S$$

$$E \cdot S \cdot S \xrightarrow{k_3} E \cdot S + P \qquad\qquad E \cdot S \xrightarrow{k_4} E + P$$

Derive a rate expression for product (P) formation assuming quasi-steady for E·S and for E·S·S.

2) An enzyme with a $K_M$ of $1 \times 10^{-3}$ M was assayed using an initial substrate concentration of $3 \times 10^{-5}$ M. After 2 min, 5 percent of the substrate was converted. How much substrate will be converted after 10 min, 30 min, 60 min? How long must the reaction be run to achieve 99% conversion? (Assume that the enzyme follows Michaelis-Menten kinetics.)

3) Shuler & Kargi, Problem 3.3

4) Shuler & Kargi, Problem 3.4

5) Shuler & Kargi, Problem 3.7