CHEM106 PS7

1. The K_M for an enzyme catalyzed reaction at a temperature of 310 K was found to be 10 mM. Determine the substrate concentration at which 80% of the enzyme molecules have their active sites occupied by the substrate.

2. A recent enzyme-catalyzed reaction study revealed the following reaction rates for various substrate concentrations. An enzyme concentration of 10 mM was used for all runs. Using the data listed in the table below, answer each of these questions:

[S] (mM)	*Velocity (M/min)*
0.10	***3.33***
0.20	***4.98***
0.50	***7.14***
0.80	***8.02***
1.00	***8.33***
2.00	***9.09***

   a. Use a spreadsheet to construct a Lineweaver-Burk plot of these data; show both the data and the plot.

   b. Do a linear fit to these data; determine the slope and intercept.

   c. Determine K_M and V_{max}

   d. Determine the turnover number for the enzyme used in this reaction.

3. The acid hydrolysis of sucrose into glucose and fructose is a first order reaction in terms of sucrose concentration.

   a. Write the rate law for this reaction.

   b. Laboratory experiments revealed that the rate constant for this reaction was 7.8×10^{-3} sec^{-1} at a temperature of 28°C and was 3.2×10^{-2} sec^{-1} at 40°C. Calculate the activation energy for this reaction.

   c. Determine the value of the rate constant k at a temperature of 37°C.

   d. For each of the two temperatures above, use your calculated activation energy to determine the fraction of molecular collisions with sufficient kinetic energy to react.

   e. Calculate the collision frequency factor A for a temperature of 40°C.

4. Draw a diagram of the active site in the cyclooxygenase enzyme with an arachidonic acid molecule occupying this region. Clearly show and explain the key interactions between the enzyme and the substrate.

5. Discuss how the chemical reaction involving arachidonic acid proceeds after binding to the active site. Identify the key amino acid side-chain involved, what it does, and what happens when this residue is mutated.

6. Outline the similarities and the major differences between the two isoforms of the COX enzyme, to include the shape of the active sites. Discuss their respective functions.

7. Discuss and fully explain the differences between nonselective COX inhibitors and selective COX-2 inhibitors. Why are pharmaceutical companies investing so many resources into developing selective COX-2 inhibitors?

8. Outline the mechanism of action through which aspirin inhibits the COX enzyme. Be very specific