CHEM106 PS7

1. The K_M for an enzyme catalyzed reaction at a temperature of 310K 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] (nM)	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 and units of the rate constant k at a temperature of 37°C.
    d. For each of the two temperatures in part b 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. For an enzyme-catalyzed reaction, calculate the fraction of enzyme sites filled with substrate when the substrate concentration is 2/3 of the Michaelis constant (K_M).

5. ~~To prepare a dog for surgery, phenobarbital is intravenously administered at a dose of 30 mg phenobarbital per kg of body mass. Phenobarbital is metabolized via a first order kinetic process and has a half-life of 4.5 hours. After 2 hours, the anesthetic has lost some of its effect. For a 15.0 kg dog, calculate the amount of phenobarbital (in mg) that must be injected into the 15.0 kg dog to restore the original level of anesthetic in the dog.~~