Exam 3 Fall 2011 Dr. Stone Name_____

$$V_0 = \frac{V_{max} \times [S]}{K_m + [S]} \qquad k_{cat} = \frac{kT}{h} \times e^{\frac{-G^{\ddagger}}{RT}} \qquad V_{max} = k_{cat} \times E_t \qquad \Delta G^{\circ\prime} = -RT \ln K'_{eq}$$

$rate_{forward} = k_{forward}[reactants]$ $K_{eq} = \frac{[products]}{[reactants]}$ CH_3COOH Ka = 1.78×10^{-5} $H_2P0_4^{-2} = 3.98 \times 10^{-13}$

$rate_{reverse} = k_{reverse}[products]$ H_3P0_4 Ka = 7.25×10^{-3} H_2CO_3 Ka = 1.6×10^{-4}

$H_2P0_4^-$ Ka = 1.38×10^{-7} HCO_3^- Ka = 4.68×10^{-11}

For the reaction of water with carbon dioxide: $K_{eq} = 1.69 \times 10^{-3}$

Remember: at constant enzyme concentration under saturation conditions, $k_{cat} \propto V_{max}$

R = 8.315 J/mole*K k = 1.381×10^{-23} J/K h= 6.636×10^{-34} J*sec.

1. (6 points) Draw the three possible structures for D-glucose. Label them as D-glucose, α-D-glucose, or β-D-glucose.

2. (12 points) Fill in this table:

Disaccharide	monomers	Linkage	Enzyme that cleaves	Where is the sugar found? What is its function?
Lactose				
Trehalose				
Sucrose				

3. (6 points) Why do plants and animals store sugar energy as high molecular weight polymers?

4. (6 points) Compare and contrast glycogen and cellulose. They have different linkages and structures and functions. Relate the linkages to the structures and the structures to the functions.

5. (2 points) Lectins are proteins that are important in the process of cell to cell recognition. The biochemical property of lectins that is the basis for most of their biological effects is their ability to bind to:

A) amphipathic molecules.
B) hydrophobic molecules.
C) specific lipids.
D) specific oligosaccharides.
E) specific peptides.

6. (2 points) The steady state of an enzyme-catalyzed reaction is reached when

A.) the rate of appearance of product over time is constant.
B.) the rate of enzyme-substrate formation is constant.
C.) the concentration of enzyme-substrate complex equals the concentration of product.
D.) the concentration of the enzyme-substrate complex is constant over time.
E.) None of these

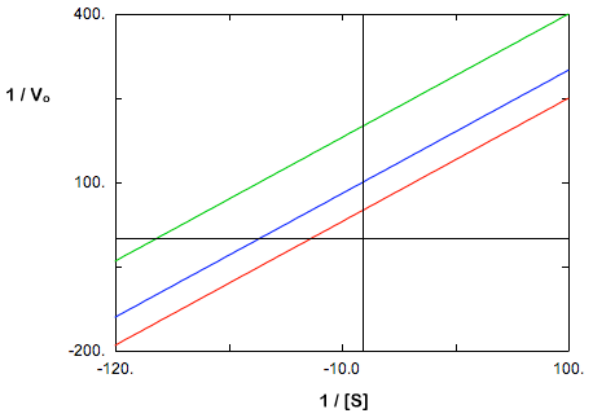
7. (4 points) An enzyme-catalyzed reaction was carried out with the substrate concentration initially a thousand times greater than the K_m for that substrate. After 8 minutes, 2% of the substrate had been converted to product, and the amount of product formed in the reaction mixture was 24 μmol. If, in a separate experiment, one third (1/3) as much enzyme and twice as much substrate had been combined, how long would it take for the same amount (24 μmol) of product to be formed? (Show your reasoning.)

8. (12 points) What type of inhibition is shown in the following graph?

A.) Give this graph a title.

B.) Label the line that has the highest concentration of inhibitor.

C.) What is Vmax for the uninhibited enzyme?



D.) What is the effect of the inhibitor on Km?

E.) What does the inhibitor bind to for this type of inhibition? E? ES? Either E or ES?

9. (2 points) Which of the following is true about zymogens?
   A.) Proproteins are one type of zymogen.
   B.) Zymogens are inactivated by inhibitor proteins.
   C.) Zymogens are enzymatically inactive.
   D.) Zymogens cleave proteases.
   E.) Chymotrypsin is regulated by binding to a zymogen

10. (10 points) Blood glucose levels in mammals are maintained within a tight concentration range. Discuss why ultra low glucose levels are a problem, why high levels of glucose are a problem and describe two ways that blood glucose levels are measured.

11. (18 points) Chymotrypsin (Mr 21,600) degrades peptides by cleaving the amide bond on the carboxyl side of aromatic amino acids. The following amino acids play important roles in the mechanism of catalysis: G_{193}, S_{195}, H_{57}, A_{102}. Under saturation conditions, the substrate glycyltyrosinylglycine, is cleaved at a rate of 4.1 moles/min, kcat is 100 sec^{-1}, and Km is 90 mM. The rate of the uncatalyzed reaction is 65 nmoles/min. The temperature is 37°C.

a. What is the catalytic triad and what does it do?

b. What amino acid is involved in covalent catalysis?

c. What amino acid is involved in general acid and general base catalysis?

d. What is role of the hydrophobic pocket?

e. What is the role of the oxyanion hole? What amino acids form the oxyanion hole?

f. What is the difference in activation energy for the catalyzed vs uncatalyzed reaction. (Show all of your work.)

12. (20 points) Choose two of the enzyme mechanisms presented in class, giver the reactants and products for the reaction that the enzyme catalyzyes. For each enzyme, describe the function of the amino acids at the active site, the role of metal ions and/or the role of any cofactors.

Name of first enzyme you selected_____

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Reactants Products

Description of how amino acids, cofactors and/or metal ions are involved in the mechanism:

Name of second enzyme you selected_____

→

Reactants Products

Description of how amino acids, cofactors and/or metal ions are involved in the mechanism: