Exam 3 Fall 2010 Dr. Stone 12:00 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. (3 points) Which of following is an anomeric pair?

A) β–D-glucose and β–D-mannose
B) α-D-fructose and β-D-fructose
C) β–D-glucose and β–L-glucose
D) α–D-galactose and α–L-fructose
E) α-D-fructose and β-L-fructose

2. (6 points) Draw the three possible structures for D-mannose. Label them as D-mannose, α-D- mannose, and β-D-mannose.

3. (10 points) Put the letter of **one** of the following choices by the descriptions below. Answers could be used more than once, some may not get used.

a. Chitin b. Sucrose c. Cellobiose d. Chondroitin e. Lectin f. Cellulose g. Lactose
h. Hemoglobin glycation product i. trehalose j. Advanced glycation end products k. Maltose

_____Disaccharide of galactose and glucose monomers with β(1→4) linkages
_____ Circulating form of energy in insects.
_____Circulating form of energy in plants
_____Heteropolymer of glucose with a β(1→4) linkage, provides support in cartilage
_____A disaccharide of glucose monomers that will not give a positive Benedict's test
_____ Proteins that bind to specific oligosaccharides
_____Used to determine circulating blood glucose levels over a period of weeks
_____Disaccharide of glucose with α(1 → 4) linkages
_____Results from the reaction of reducing sugars with hemoglobin
_____Polymer of N-acetylglucosamine

4. (3 points) Which of the following statements about starch and glycogen is *true*?

A) Amylose is branched; amylopectin and glycogen contain many $\alpha(1 \rightarrow 6)$ branches.
B) Both are heteropolymers of glucose.
C) Both serve primarily as structural elements in cell walls.
D) Both starch and glycogen are water soluble.
E) Glycogen has fewer branches than starch.

5. (5 points) Describe three reasons why plants and animals store sugar energy as high molecular weight polymers. Write in complete sentences.

6. (3 points) A good transition-state analog:
A) binds covalently to the enzyme.
B) binds to the enzyme more tightly than the substrate.
C) binds very weakly to the enzyme.
D) is too unstable to isolate.
E) must be almost identical to the substrate

7. (5 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-fourth (1/4) 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. (20 points) Chymotrypsin (Mr 21,600) degrades peptides by cleaving the amide bond on the carboxyl side of aromatic amino acids. 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. The following amino acids play important roles in the mechanism of catalysis. Using complete sentences, describe in detail what each of these amino acids does during the cleavage of the peptide bond. G^{193}, S^{195}, H^{57}, A^{102}

b. What is role of the hydrophobic pocket?

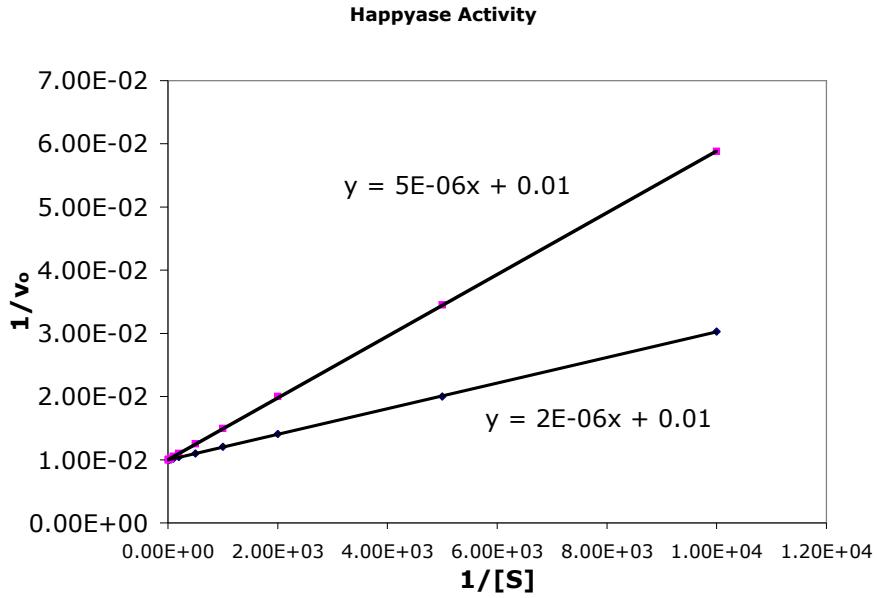
c. What is the difference in activation energy for the catalyzed vs uncatalyzed reaction. (Show all of your work.)

9. (20 points) Using complete sentences and structures, describe the types of catalysis that are involved in the enzyme mechanism that your group presented during the parade of mechanisms. Be specific and give details.

10. (5 points) Explain, in detail, a specific example of how an enzyme can be regulated by covalent modification.

11. (5 points) Using complete sentences describe how a biochemist might discover that a certain enzyme is allosterically regulated.

12. (15 points) Happyase is a naturally occurring enzyme that cleaves sugar into molecules that act like the active ingredient in chocolate. With Happyase, all is grand. However, Happyase is inhibited by a compound called Nosleepite. An experiment was done to measure the effect of Nosleepite on Happyase and the date is shown in the following graph. (You need to determine which line is for the experiment with Nosleepite.)



a. What is the Vmax for the uninhibited enzyme? Show your work.

b. What is the Km for the inhibited enzyme? Show your work.

c. What type of inhibition is this? How are you able to determine this?