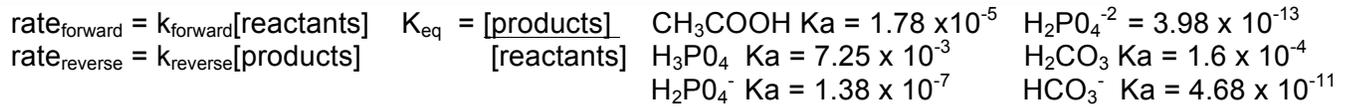


$$V_0 = \frac{V_{max} \times [S]}{K_m + [S]} \quad k_{cat} = \frac{kT}{h} \times e^{\frac{-G^\ddagger}{RT}} \quad V_{max} = k_{cat} \times E_t \quad \Delta G^\ddagger = -RT \ln K'_{eq}$$



For the reaction of water with carbon dioxide: $K_{eq} = 1.69 \times 10^{-3}$
 Remember: at constant enzyme concentration under saturation conditions, $k_{cat} \propto V_{max}$
 $R = 8.315 \text{ J/mole} \cdot \text{K}$ $k = 1.381 \times 10^{-23} \text{ J/K}$ $h = 6.636 \times 10^{-34} \text{ J} \cdot \text{sec}$.

1. (8 points) Use the following monomers:

- | | | |
|----------------------|----------------------|-----------------------|
| β -D-glucose | β -D-mannose | β -D-fructose |
| β -L-glucose | α -L-fructose | α -D-galactose |
| α -D-fructose | β -L-fructose | α -D-mannose |

Using only the monomers listed above give examples of the following:
 (there may be more than one pair that fits each description, but give only one pair.)

- A.) two monomers that are epimers: _____ and _____
- B.) two monomers that are **only** diastereomers: _____ and _____
- C.) two monomers that are anomers: _____ and _____
- D.) two monomers that are enantiomers: _____ and _____

2. (8 points) Fill in the following table for disaccharides:

Name of disaccharide	monomers	linkage	Where is this disaccharide found and/or what is its function?
Lactose			
Trehalose			
Sucrose			
Maltose			

3. (4 points) Which of the above disaccharides (in question 2) is(are) (a)non reducing sugar(s)?
 What makes a sugar "non reducing"?

4. (6 points) Draw the three possible structures for D-galactose. Label them as D-galactose, α -D-galactose, and β -D-galactose. Draw an arrow to the anomeric carbon(s).
5. (8 points) Give the best answer for the following questions:
- A) Give an example of a heteropolymer of glucose derivatives with a $\beta(1\rightarrow4)$ linkage, that provides structural support in cartilage.
- B) Proteins that “read the sugar code” bind to specific oligosaccharides, what are these proteins called?
- C) A newer test that measures a patient’s regulation of blood glucose detects a protein that reacts with glucose. What is the name of this glucose-protein adduct?
- D) What heteropolymer of glucose derivatives has an $\alpha(1\rightarrow4)$ linkage, is the mostly highly negatively charged biomolecule and provides a binding site for antithrombin and thrombin?
6. (6 points) Briefly describe the following:
- A) Amylose
- B) Amylopectin
- C) Glycogen

7. (3 points) Why do plants and animals store “quick” energy as high molecular weight branched polymers.
- I. To maximize the number of free reducing ends
 - II. To decrease entropy
 - III. To increase osmotic pressure
 - IV. To increase the rate of the hydrolysis reaction by increasing the substrate concentration

A) I and III B) II and IV C) I, II and III D) IV only E) none of these choices

8. (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

9. (5 points) An enzyme-catalyzed reaction was carried out with the substrate concentration initially 1000 times greater than the K_m for that substrate. After 4 minutes, 1% of the substrate had been converted to product, and the amount of product formed in the reaction mixture was 8 μmol . If, in a separate experiment, twice as much enzyme and half as much substrate had been combined, how long would it take for the same amount (8 μmol) of product to be formed? (Describe your reasoning.)

10. (8 points) Give the type of regulation(s) that is(are) used to control the activity of the following enzymes. Enzymes may have more than one type of regulation and each regulation type may be used more than once.

Regulation types

Allosteric

Proteolytic cleavage

Substrate concentration

Covalent modification

Protein-protein binding

Enzymes

Phosphorylase kinase

Adenylyl cyclase

Elastase

Hexokinase

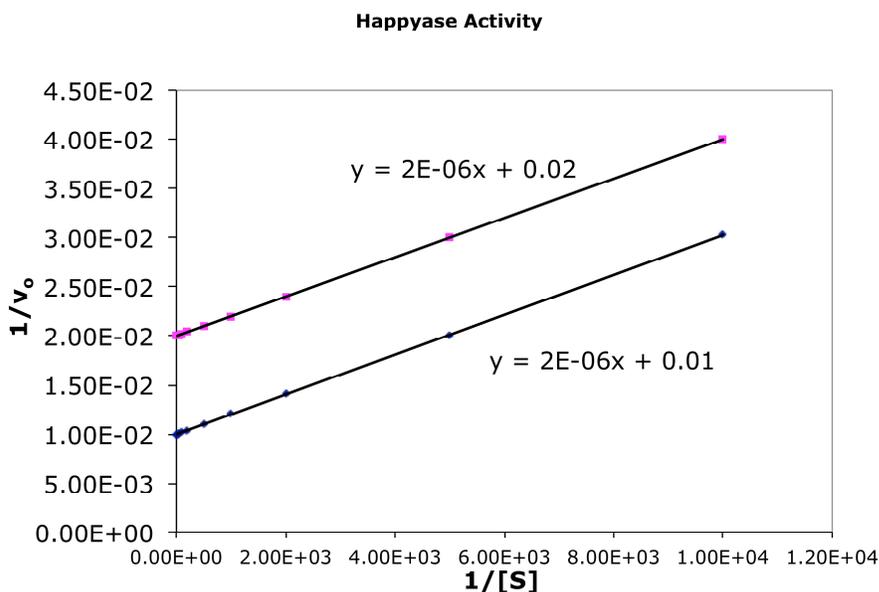
Chymotrypsin

Glycogen phosphorylase

cAMP dependent protein kinase

12. (12 points) Using complete sentences and structures, describe the enzyme mechanism that your group presented during the parade of mechanisms. Be sure to include the types of catalysis that are involved. Be specific and give details.

13. (8 points) Happyase is a naturally occurring enzyme that reacts with sugar to form 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 data is shown in the following graph. (You need to determine which line is for the experiment with Nosleepite.) The velocity of the reaction is measured in mmol/sec, the concentrations of the substrate (Sugar) were mM.



- a. Complete the following table

Experiment	K _m	V _{max}
Happyase		
Nosleepite + Happyase		

- b. What type of inhibition is this?
- c. Does Nosleepite bind to Happyase or to Happyase-Sugar or to both Happyase and to Happyase-Sugar?