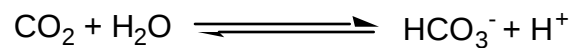


Biochemistry 5700
Fall, 2005
Exam 2
October 24, 2005

INSTRUCTIONS:

Do not begin until 10:30 AM. The exam must be turned in by 11:20 AM. This exam should have 11 questions and 9 pages. Answer **all** questions completely, concisely, and legibly in the spaces provided. Good Luck!!

(1) (6 points) Carbonic anhydrase, a zinc-metalloprotein, catalyzes the reversible hydration of CO₂ to bicarbonate:

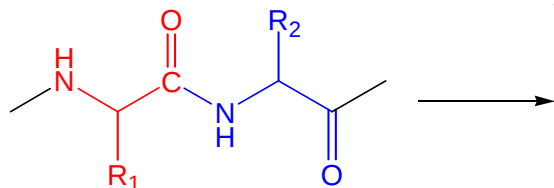


Draw the reaction mechanism for carbonic anhydrase. Clearly show how Zn²⁺ facilitates catalysis.

(2) (3 points). For metal ion catalysis in general , what is the difference between charge shielding and charge stabilization?

(3) (3 points) Briefly describe what a Schiff base adduct is and how it functions to accelerate a reaction.

(4) (a) (8 points) Draw a complete reaction mechanism for chymotrypsin starting with the substrate shown below. Add all necessary electron pushing arrows and general acids/bases (you may abbreviate bases as “B” and acids as “HA”) required to complete the mechanism.



(b) (6 points) Briefly describe the functions of the following features of chymotrypsin in accelerating the rate of the reaction. Feel free to use diagram(s) in answering the questions

(i) oxyanion hole

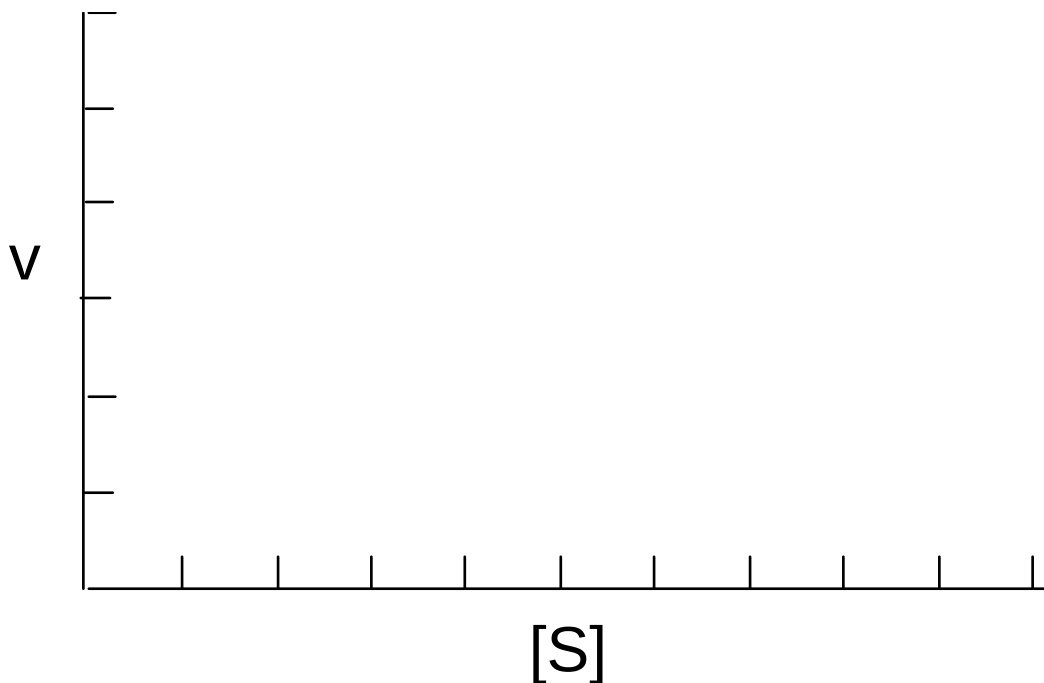
(ii) catalytic triad

(iii) hydrophobic pocket

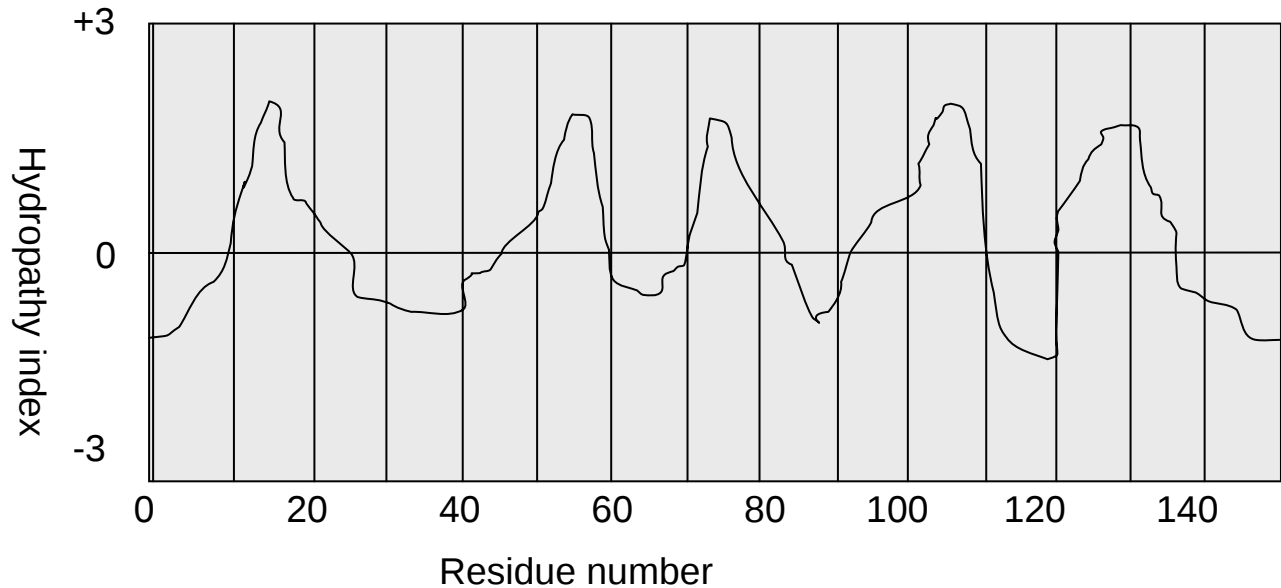
(5) Many allosteric enzymes have a C_nR_n quaternary structure (C stands for catalytic subunit, R for regulatory, where heterotropic modulators bind to the “R” subunits). Suppose you have such an allosteric enzyme with subunit composition C_6R_6 for which molecule “X” is a positive heterotropic modulator and molecule “Y” is a negative heterotropic modulator. Both modulators perturb $K_{1/2}$ but not $V_{\max}$.

(a) (6 points) Draw and label the kinetic plots that would be observed for the enzyme in the absence of modulator, in the presence of “X”, and in the presence of “Y”. Label the positions of $V_{\max}$ and $K_{1/2}$ for each line.

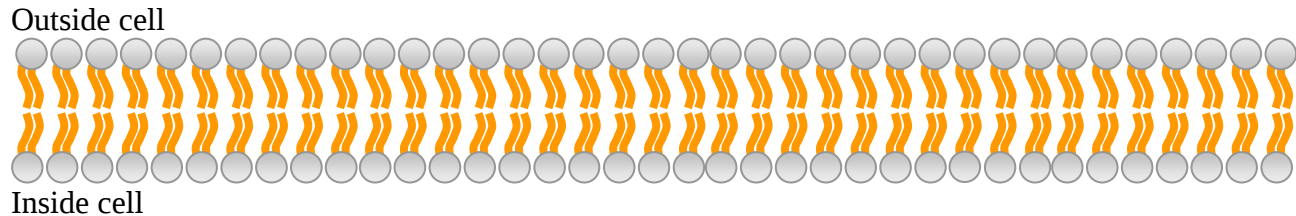
(b) (2 points) Assume that you are able to dissociate your enzyme into individual subunits, and that monomeric “C” subunits alone are catalytically active. On the plot, sketch what you would expect the v vs. S plot to look like for individual “C” subunits. Would you expect “X” or “Y” to affect the activity of isolated “C” subunits? Why or why not?



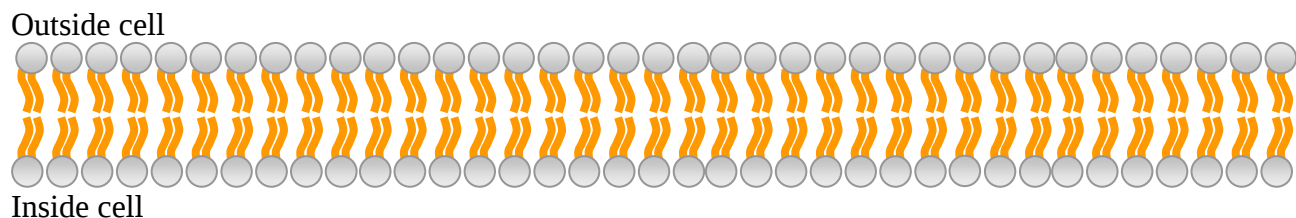
(6) Shown below is the hydropathy plot for a membrane protein. The N-terminus of the enzyme is known to be inside the cell.



(a) (5 pts) Diagram your protein on the lipid bilayer template provided below. Clearly indicate the N- and C-terminus of your protein on the diagram and clearly show each transmembrane spanning domain and the loops connecting them. With arrows, indicate portion(s) of your polypeptide that might be glycosylated.



(b) (8 pts) On the lipid bilayer template shown below, draw examples of (a) an asymmetrically oriented integral membrane protein, (b) a transmembrane protein, (c) a peripheral membrane protein and (d) a lipid-linked membrane protein.



(7) (15 points) In the spaces provided, draw the structures of the indicated molecules

(a) 1-stearoyl-2-oleoyl-3-phosphatidylcholine

(b) a guanine-cytosine base pair (bases only, no sugars; G on left, C on right)

(c) D-altrose and alpha-D-altropyranose (draw BOTH the linear and cyclic forms), given that D-altrose is a C-3 epimer of D-mannose, and D-Mannose is a C-2 epimer of D-glucose

(d) sphingosine

(e) glyceraldehyde AND dihydroxyacetone

(8) Definitions. 20 points.

Name the unbranched form of starch
When relatively high concentrations of fatty acids are placed in water they form structures known as _____.
How many stereoisomers are possible for the family of D-ketoses with seven carbon atoms?
What is the repeating sugar unit and linkage in chitin?
Which hexopyranose sugar contains all bulky groups in equatorial positions?
The compound resulting from the nucleophilic addition of an alcohol to an aldehyde is called what?
What type of bond joins two sugar units in a disaccharide?
What type of bond joins a nitrogenous base and sugar?
What type of membrane protein may be solubilized by high salt concentration or change in pH?
What is the repeating sugar unit and linkage in peptidoglycan?
Which nitrogenous base is present in DNA but not RNA?
What is the name of the family of derivatized polysaccharides that associate with proteins in the extracellular matrix of animal cell tissue
What specific two types of sugar linkages are found in glycogen?
Ring-cyclized sugars that contain a free hydroxyl group at the anomeric carbon are called _____ sugars
The inhibition of an enzyme by a downstream product of a metabolic pathway is called what?
What vitamin is associated with vision?
What vitamin is associated with regulating calcium uptake for bone formation?
The relations $A = T$ and $G = C$ are called what?
Name a general role for lipids other than serving as an energy reserve or structural component of membranes
What conformation does double stranded RNA form in solution?

(9) 10 points. Briefly define the following terms as they relate to DNA structure (feel free to use structures/drawings to assist in answering):

(a) major groove

(b) two periodicities

(c) base tilt

(d) anti parallel

(e) sugar pucker

(10) (4 points)

How do the following alterations to a lipid bilayer affect fluidity and the transition temperature and why?

(a) increase degree of fatty acid side chain unsaturation

(b) increase length of fatty acid side chains

(11) (4 points) Explain how cholesterol is capable of acting as a membrane plasticizer both in response to higher temperatures and lower temperatures.