BL/CH401 -- EXAM 2 Scoop

Biochemistry I -- EXAM II Oct. 21, 1992

1. 50 Pts. Using the data shown below --

1) Draw "vo vs. [S]" and "1/vo vs 1/[S]" plots

2) Determine the Km and Vmax from the double reciprocal plot

3) Decide what type of inhibitors "x" and "z" are

4) Calculate the Ki for "x" and "z"

Competitive Inhibitor : Km' = Km (1 + [I]/Ki)

Noncompetitive Inhibitor: Vmax' = Vmax / (1 + [I]/Ki)

[S], μM	v_0 (μmol/min)		
	No Inhibitor	Inhibitor x = 3 μM	Inhibitor z = 1 mM
1	1.9	0.75	0.75
2	3.0	1.2	1.4
5	4.7	1.9	2.7
10	5.8	2.3	3.9
25	6.7	2.7	5.5

Figure 1. Data for kinetics problem

2. 40 Pts. Briefly describe each of the four levels of protein structure and illustrate the type of bonding or other stabilizing force involved in each type.

For your illustrations provide a drawing representing the chemical bonding involved with enough detail to show me that you know what you are describing.

BE SURE TO PUT DOWN ENOUGH INFORMATION TO GET FULL CREDIT!!!

3. 10 Pts. In discussing the relationship between a protein's structure and its function, I identified 3 types of situations that we now know. BASED ON THE INFORMATION I PROVIDED IN CLASS VERY BRIEFLY ANSWER THE FOLLOWING:

1) List these three types of proteins

2) Provide the features of each type

3) What were the 3 example proteins or types of 3-D shape

Answer to 1992 Kinetics Problem

Vmax = 7.7 micromol/min

Km = 3 microM

Inhibitor Z - Competitive

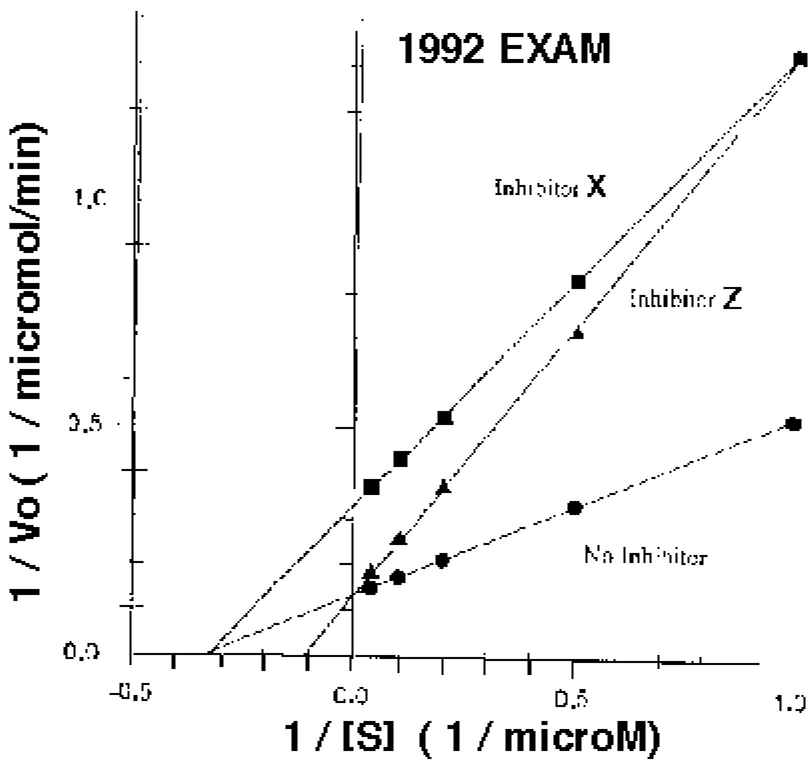
Km' = 9 microM

For Z, Ki = 0.5 mM at I = 1 mM

Inhibitor X - Non-Competitive

Vmax' = 2.9 micromol/min

For X, Ki = 1.8 microM at I = 3 microM



Graphic for Double Reciprocal Plot

1993 Exam II October 22, 1993

1. Kinetics Problem --- 50 Pts

A. Make Plots of i) vo vs. [S] and ii) 1/vo vs. 1/[S]

B. Determine the Km, Vmax and Ki values for inhibitors A and B (give proper Units)

Km' = Km (1 + [I]/Ki)

Vmax' = Vmax/(1 + [I]/Ki)

[S] mM	v_o (µmol/min) No Inhibitor	I = A = 3 mM	I = B = 10 µM
0.0	0.0	0.0	0.0
1.0	4.4	2.0	1.0
3.0	9.4	5.1	2.2
5.0	12.2	7.3	2.8
7.0	14.0	9.1	3.2
10.0	15.7	11.0	3.6

Figure 1. Data for Kinetics Problem.

2. Protein Structure ---- 40 Pts.

Briefly describe and illustrate with a small graphic:

A. The four levels of Protein Structure

B. The types of bonding that stabilize these parts of a protein

3. Thought Question ---- 10 Pts.

Explain briefly how a single amino acid change in the sequence of a protein can cause a disease. For example, sickle cell anemia.

EXAM II 1995

1. Kinetics Problem - 50 Points.

A. Make Plots of i) Vo vs. [S] and ii) 1/Vo vs. 1/[S] -- Using graph paper provided.

B. Determine the Km, Vmax, type of inhibitors for A and B, and Ki values for inhibitors A and B (give proper Units).

Km' = Km (1 + [I]/Ki)

Vmax' = Vmax/(1 + [I]/Ki)

[S]	Vo (μmol/min)		
mM	No Inhibitor	I = A = 10 μM	I = B = 300 μM
0.00	0.0	0.0	0.0
0.05	15.0	5.0	8.3
0.10	25.0	8.3	15.0
0.20	37.5	12.5	25.0
1.00	62.5	20.8	53.6
5.00	72.1	24.0	69.4

2. Protein Structure - 40 Points.

Fully describe with words and illustrate with a small graphic:

A. The four levels of Protein Structure

B. The types of bonding that stabilize these parts of a protein

3. Thought Problem - 10 Points.

Explain briefly why giving ethanol to a person who has been poisoned with methanol will be beneficial and perhaps prevent the damage normally caused by methanol (ie. blindness). Your explanation/answer must be in biochemical terms to get the credit.

(Hint: think about the chemical structures of the two alcohols).

ANSWERS 1995 EXAM II

1. Kinetics Problem - 50 Points.

Km = 0.2 mM

Vmax = 75 micromol/min

Inhibitor A = Non-Competitive

Km' = 0.2 mM

Vmax' = 25 micromol/min

At [I] = [A] = 10 microM, Ki = 5 microM.

Inhibitor B = Competitive

Km' = 0.4 mM

Vmax' = 75 micromol/min

At [I] = [B] = 300 microM, Ki = 300 microM.

2. Protein Structure - 40 Points.

See lecture notes for Lectures 8 and 9.

3. Thought Problem - 10 Points.

Methanol and ethanol are both substrates for alcohol dehydrogenase. So, when ethanol is given to a person with methanol poisoning, ethanol will act as a competitive inhibitor and thereby prevent (at least dramatically slow) the catalytic conversion of methanol to formaldehyde, which presumably causes the damage in methanol poisoning.

BL/CH401 EXAM 2 October 28th 1996

1. 50 Pts. Enzyme Kinetics Problem

- Draw 2 plots: (1) Vo vs [S]; and (2) 1/Vo vs 1/[S], using the data given below - 25 Pts
- Determine Km and Vmax for uninhibited reaction (include units) - 10 Pts
- Determine what type of Inhibitor A and B are using the Km' and Vmax' for the inhibitors (show your reasoning by comparing Vmax and Vmax' and Km and Km') - 10 Pts
- Calculate the Ki for binding of Inhibitor A and B to the enzyme (include units) - 5 Pts

Use these equations for calculating the Ki

Competitive Inhibitor Km' = Km (1 + [I]/Ki)

Noncompetitive Inhibitor Vmax' = Vmax / (1 + [I]/Ki)

[S]	Vo (No I)	Vo (I = 1 mM A)	Vo (I = 2 mM B)
mM	µmol/min	µmol/min	µmol/min
0.0	0.0	0.0	0.0
1.0	30.0	15.0	15.0
2.0	45.0	22.5	25.7
5.0	64.3	32.1	45.0
10.0	75.0	37.5	60.0
50.0	86.5	43.3	81.8

2. 40 Pts. Protein Structure Problem (Use Words and Diagrams)

Describe the four levels of protein structure and the bonds that hold these structures together. **Be sure to illustrate each level of the structure of a protein with a drawing of the bonds or interactions involving the polypeptide backbone and/or the amino acid side chains.**

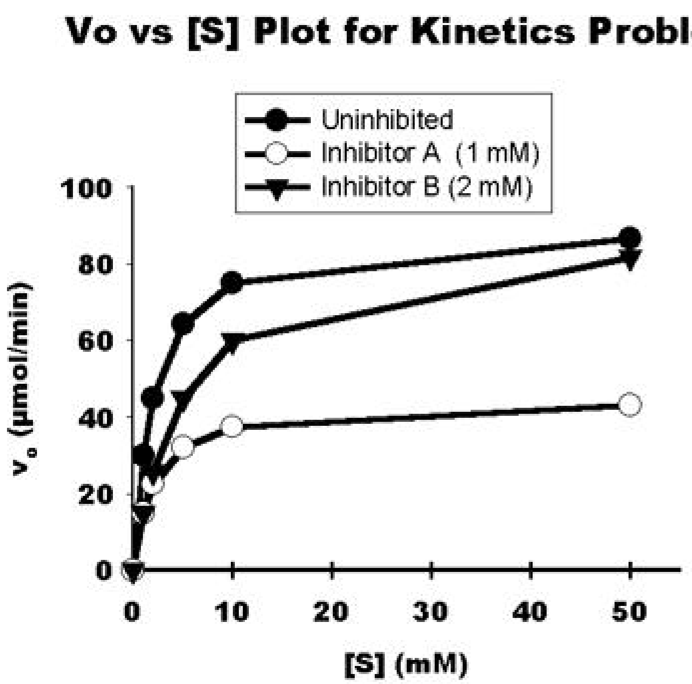
3. 10 Pts. Thought Question

Design an alpha-helix (list an Amino Acid Sequence with at least 12 amino acid residues) which has one side facing the aqueous environment surrounding a protein and one side facing the interior of the protein. ***Remember that alpha helixes have ~4 residues per turn, so that the 1st, 4th, 5th, 8th, 11th, and 12th amino acid side chains are on one side of the helix and 2nd, 3rd, 6th, 7th, 9th, and 10th on the other side.***

ANSWERS:

1. 50 Pts. Enzyme Kinetics Problem

Vo vs [S] Plot:



1/Vo vs 1/[S] Plot

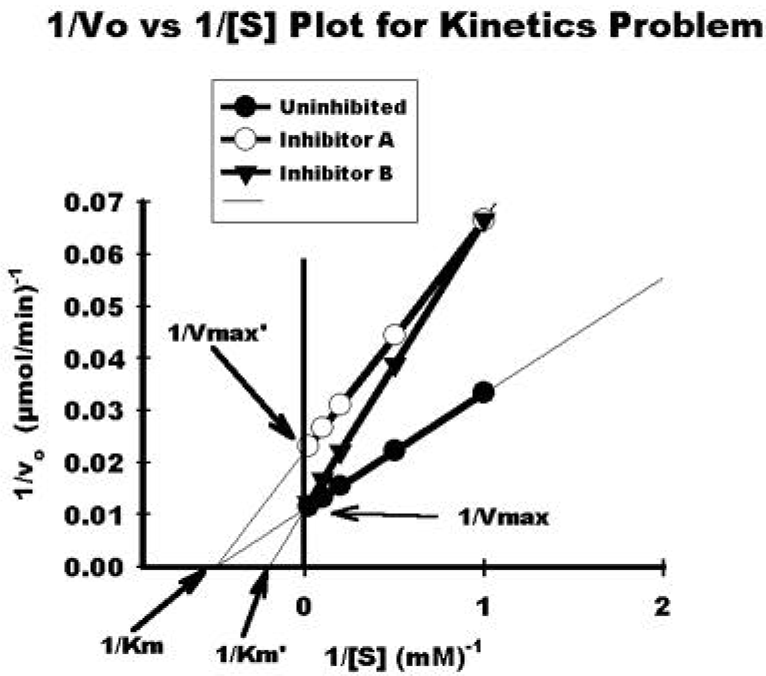


Table of Results:

Reaction	Km or Km'	Vmax or Vmax'	Type of Inhibitor	Ki
(Units)	mM	µmol/min		mM
No Inhibitor	Km = 2.0	Vmax = 90		
I = A (1 mM)	Km' = 2.0	Vmax' = 45	NonCompetitive	Ki for A = 1
I = B (2 mM)	Km' = 5.0	Vmax' = 90	Competitive	Ki for B = 1.3

2. 40 Pts. Protein Structure

See Lecture Notes for Lectures 8 and 9

3. 10 Pts. Thought Question

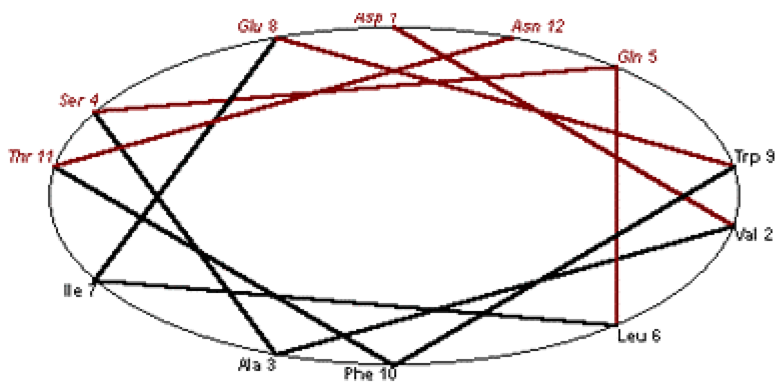
Basically the aqueous environment surrounding the protein will require the amino acid side chains facing it on the alpha helix to be hydrophilic amino acids (polar ones) while the side of the helix facing the interior of the protein will need to display hydrophobic side chains (non-polar ones).

The design of the alpha helix with one face hydrophilic and one face hydrophobic could be accomplished by placing hydrophilic amino acids on one side (ie. at positions 1, 4, 5, 8, 11 and 12 of the amino acid sequence) and hydrophobic amino acids on the other side (ie. at positions 2, 3, 6, 7, 9 and 10 of the amino acid sequence) or you could start with the hydrophobic side chains and follow with the hydrophilic on the other face of the helix. Either way is OK but my example below is done with hydrophilics first, then the hydrophobics:

1 || 2 || 3 || 4 || 5 || 6 || 7 || 8 || 9 || 10 || 11 || 12

Asp Val Ala Ser Gln Leu Ile Glu Trp Phe Thr Asn

Another way to illustrate this is with the Helix Wheel, which simulates the distribution of Amino Acid side chains in an alpha helix:



Basically a view looking down on helix from the central axis with side chains array around the helix.