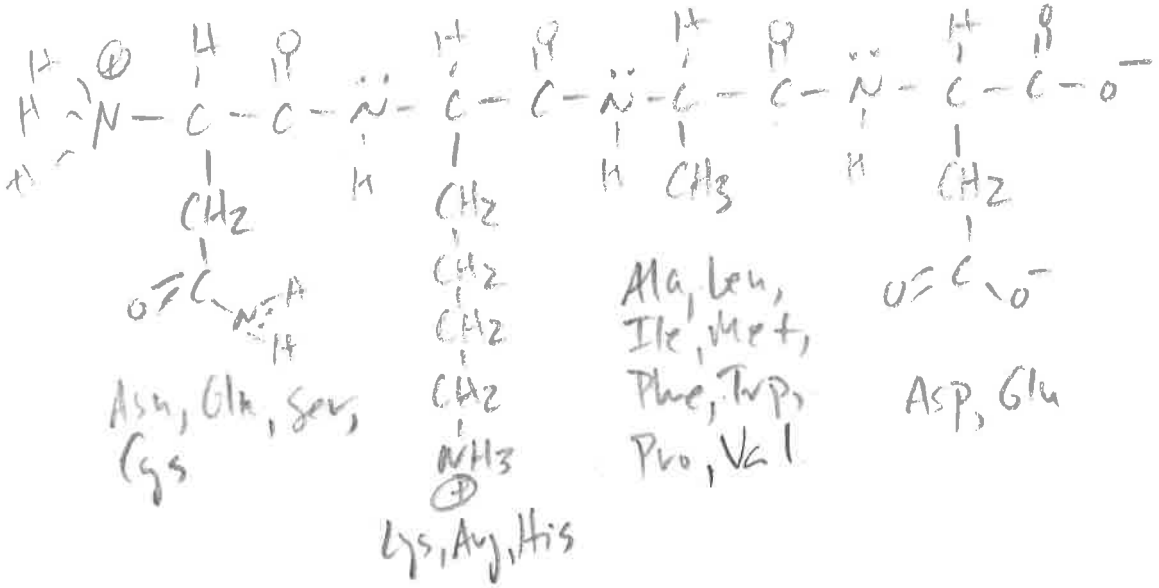
CHEM106 Section 001 Test #2 **Name:** Key
October 17, 2018

Answer all of the following questions in the space provided. Should you need more room, please do so on the accompanying blank paper. You must clearly indicate which problem you are continuing to answer on that sheet and draw lines to separate it from other answers. If I have to hunt for it, you may not get credit.

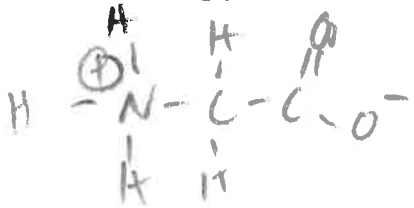
1) (24 points, as indicated) Answer the following questions about amino acids:
a) (12 points total, 3 points each) Draw a tetrapeptide at physiological pH consisting of (in order): an amino acid with a polar side chain, and amino acid with a basic side chain, an amino acid with a hydrophobic side chain and an amino acid with an acidic side chain.



b) (8 points total, 1 point for each force and 1 point for each example) What are the four intermolecular forces starting from highest energy to lowest energy and give an example of amino acids whose side chains would participate in each interaction.

(1) Ion-Dipole — Lys-Ser
(2) Dipole-Dipole — Ser-Ser
(3) Dipole-Induced Dipole — Ser-Leu
(4) London Dispersion Forces or Induced Dipole-Induced Dipole — Phe-Phe

c) (4 points) Draw the structure of glycine at it's isoelectric point.



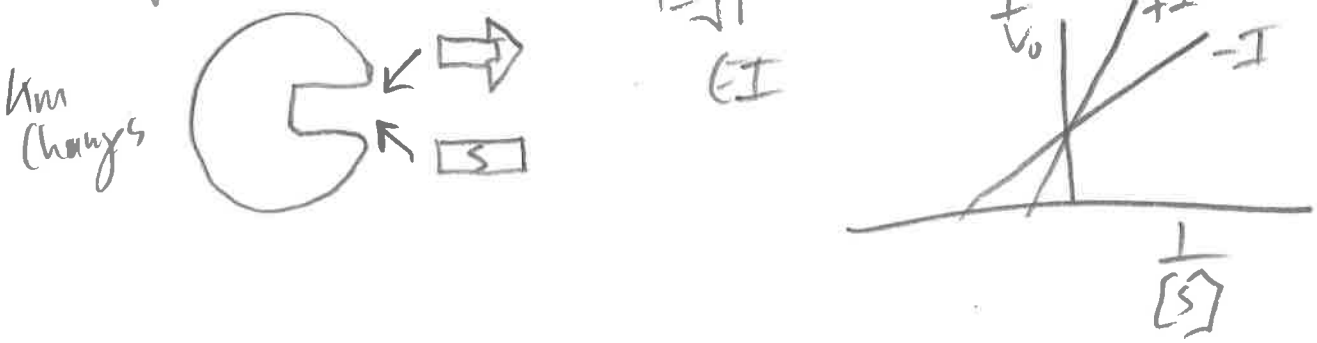
3) (12 points total, 2 points each) This question refers to the structures found in Figure 2 at the back of the exam.
For each of the compounds found in the figure, **circle the functional group** found in each molecule. **Write the name of the functional group underneath** each compound. You do not need to label or name alkyl groups, they all have at least one.

See Figure 2

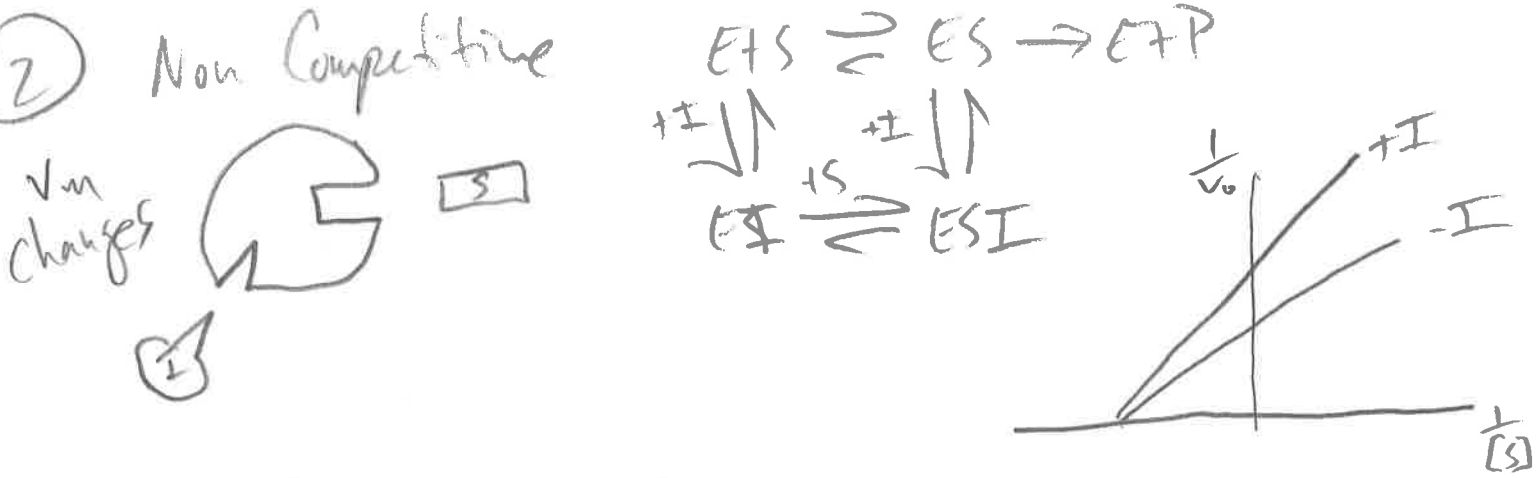
4) (15 points, 1 point each) Describe the changes to K_m and V_m for the three primary types of reversible, Michaelis-Menton inhibition. In order to properly answer the question, you need to show: **i)** a representative Lineweaver-Burk plot with labeled curves for the reaction in the presence and absence of inhibitor, **ii)** in which step(s) the inhibitor binds enzyme in the reaction equation, **iii)** what kinetic parameters change in each type of inhibition and **iv)** a cartoon showing where the inhibitor and substrate bind to the enzyme.

For uncompetitive see attached sheet

(1) Competitive Inhibition



(2) Non Competitive



Problem 4, Part 3

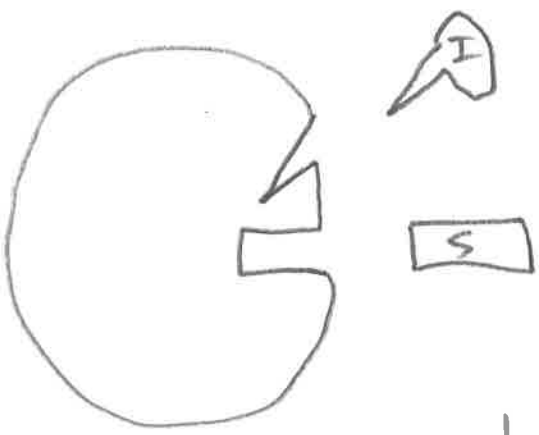
Uncompetitive Inhibition

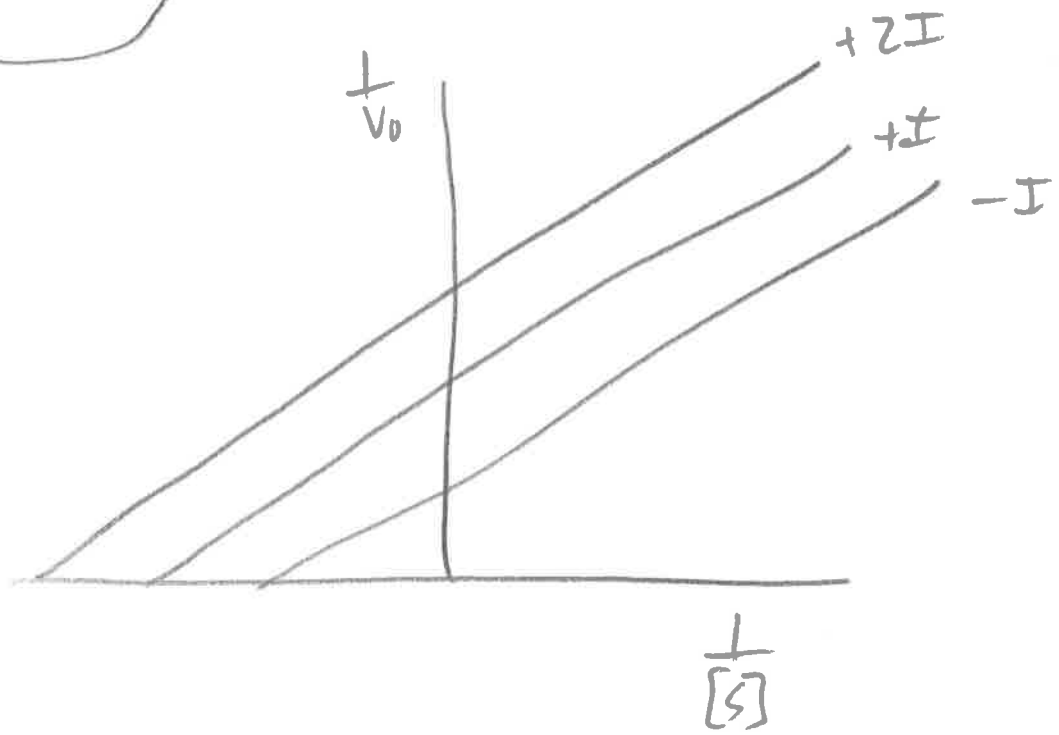
$E + S \rightleftharpoons ES \rightarrow E + P$

$+I \downarrow \uparrow$

ESI

K_M and V_{max} Both change by the same amount.





5) (20 points, 5 points each) This question refers to the idealized peptide found in Figure 1.

i) What is the primary structure of the peptide?

See Sheet

ii) This peptide is known to fold into an antiparallel beta-sheet. In order for it to do so, another secondary structural element must be present. Name this element and list the sequence of amino acids could compose it in the peptide.

A β-turn is needed. β-turns contain Proline and Glycine. Sequence is APGA

iii) Select one amino acid in the figure, draw boxes around the atoms that are the angles used in a Ramachandran plot and label each box with the appropriate angle name.

See sheet

iv) Could this peptide be a target for a protein kinase? Which residue would be affected if a kinase were to use the peptide as a substrate?

yes. The Serine @ Position 5 Could be a Kinase substrate

6) (8 points) What forces are important in maintaining the tertiary structure of a protein? Give examples of each. (In lecture we listed 4 such forces, and no they are not the same as the four IMFs we have discussed this semester).

1) London Dispersion forces.
Hydrophobic amino acids @ the core of the protein

2) Disulfide bonds
Between cysteines in the protein

3) Metal Ion Binding
A metal ion like Zn^{2+} could be bound

4) Hydrogen bonding
Between Carbonyl oxygens and amino protons or polar side chains.

7) (12 points, 4 points each) Describe, give the advantage(s) of and give an example of an enzyme that uses the following enzymatic control mechanisms:

i) Phosphorylation Attachment of a PO_4^{2-} to cSer, Thr or Tyr

Glycogen phosphorylase. Insulin receptor tyrosine kinase. The advantage is that the protein can be activated or deactivated as needed.

ii) Feedback Inhibition

The product of an enzyme far down or from a different pathway inhibits an initial enzyme in a different pathway. Example: Citrate inhibiting Phosphofructokinase. Advantage is that multiple pathways can communicate to maintain cellular equilibrium

iii) Production as a zymogen

An enzyme made in an initial, inactive form that is processed to an active form by enzymatic cleavage. Examples include chymotrypsin and insulin.

The advantage is that the enzyme can be made, but is only active when needed.

8) **(14 points)** Answer the following questions about protein secondary structures.

a) **(4 points)** What amino acids are always found in beta-turn secondary structures?

Glycine, Proline

b) **(6 points)** Name two types of secondary structures found in proteins. What makes them different from each other? What hold each together?

α-Helix and β-sheet.
Both are held together with hydrogen bonds, but in an α-helix, the hydrogen bonds are between the carbonyl oxygen and an amino proton four residues away. In a β-sheet they are between residues that can be far away sequentially

c) **(4 points)** What is meant by amphipathic and how does the term apply to the two types of protein secondary structure?

Two natures / two sides / two bodies
Hydrophobic residues on one side of an α-helix or β-sheet and hydrophilic on the other.

Extra Credit: (5 points) If there is something that you studied that wasn't on this exam, go ahead and write: a question that could have been on this test and the answer to that question.

Figure 1:

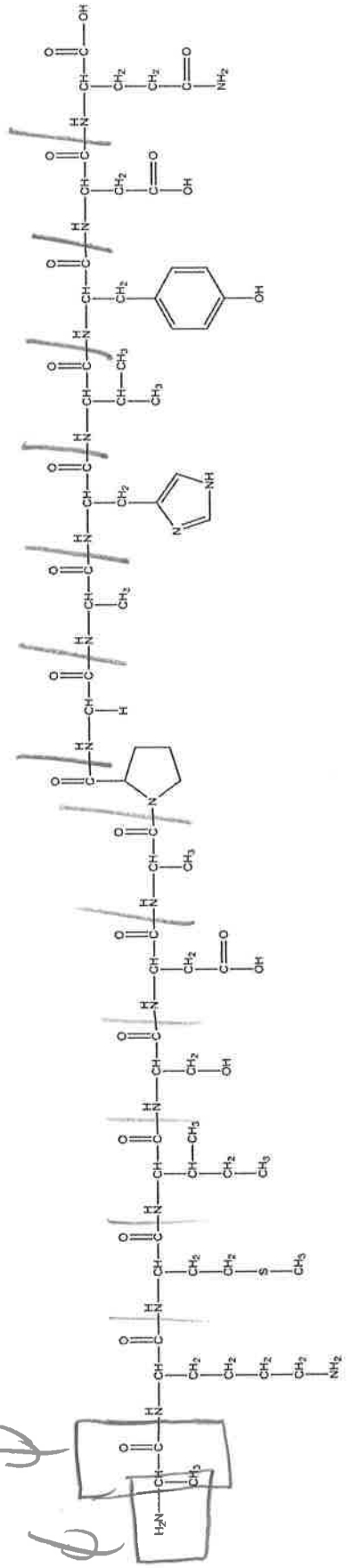
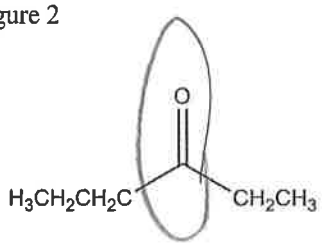


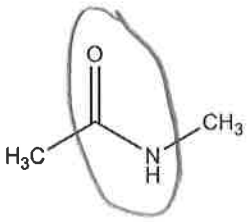
Figure 2

a)



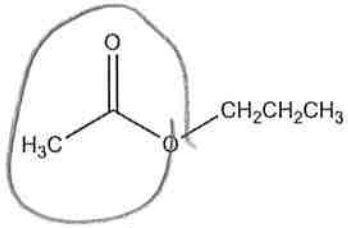
Ketone

b)



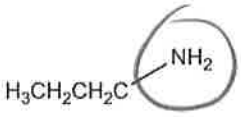
Amide

c)



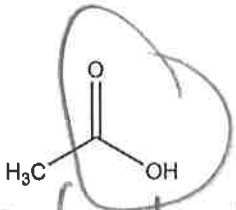
Ester

d)



Amino

e)



Carboxylic Acid

f)

Ether

Amino Acid pKa values

A.A.	Carboxylic acid	Amine	Side Chain
Ala	2.3	9.9	-
Cys	1.8	10.8	8.6
Asp	2.0	10.0	4.5
Glu	2.2	9.7	4.5
Phe	1.8	9.1	-
Gly	2.4	9.8	-
His	1.8	9.2	6.8
Ile	2.4	9.7	-
Lys	2.2	9.2	11.1
Leu	2.4	9.6	-
Met	2.3	9.2	-
Asn	2.0	8.8	-
Pro	2.0	10.6	-
Gln	2.2	9.1	-
Arg	1.8	9.0	12.5
Ser	2.1	9.2	-
Thr	2.6	10.4	-
Val	2.3	9.6	-
Trp	2.4	9.4	-
Tyr	2.2	9.1	9.8