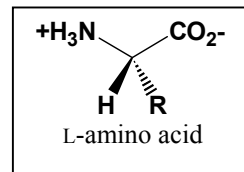
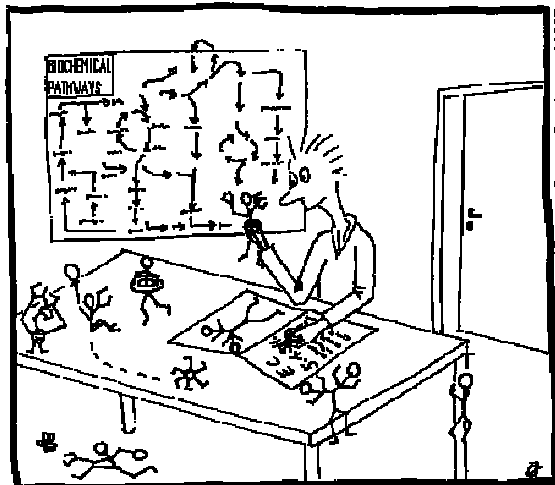


CHEM 641 Biochemistry First Exam**Saturday, October 2, 2004, 8-10am or noon – 2pm, 101 BRL****Instructor: Bahnson**

Please put your name on the front, initial each page, and check to make sure that your exam copy contains all 9 pages. During the exam, take care not to expose your answers to the scrutiny of your neighbors. If you have any questions, raise your hand and I will come to you.

The ENZYME data bankBreakdown of Exam

Part I	10 Short Answer	10 pts
Part II	5 multiple choice	15 pts
Part III	2 sections	25 pts
Part IV	3 questions	50 pts
Total		100 pts

Here are some useful constants and equations:

Gas constant - $R = 8.315 \text{ J mol}^{-1} \text{ K}^{-1}$
 or $R = 1.987 \text{ cal mol}^{-1} \text{ K}^{-1}$

Faraday's constant $\mathcal{F} = 96,485 \text{ J V}^{-1} \text{ mol}^{-1}$

$^{\circ}\text{C} + 273.15 = ^{\circ}\text{K}$

1 cal = 4.184 Joule

1 mM = 10^{-3} M, 1 Å = 10^{-10} m

Redox $\Delta \mathcal{E}^{\circ} = -\Delta G^{\circ} / n \mathcal{F}$

Van der Waals $E = B/r^{12} - A/r^6$

Ionic interaction $F = e_1 e_2 / D r^2$

<u>amino acid</u>	<u>pKa</u>
Asp	3.9
Glu	4.3
His	6.0
Cys	8.3
Tyr	10.1
Lys	10.5
Arg	12.5
Ser	13.0
Thr	13.0
N-term. amino group	9.5
C-term. carboxy group	2.0

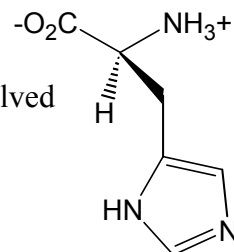
PART I. Short Answer (10 pts)

1. We need to know the wavelength, amplitude and _____ of each reflection to solve a crystal structure.
2. Example of heterogeneity in a protein. _____
3. Protein technique used to determine a protein's P_i value. _____
4. True or False: The hydrophobic effect is enthalpy driven. _____
5. Between NADH and NAD⁺, which is considered the high energy state? _____
6. The disulfide formed by two cysteines is the oxidized or reduced form. _____
7. Amino acid with a high propensity at the N-terminus of an α -helix. _____
8. The presence of Mg²⁺ will _____ the value of ΔG° for the hydrolysis of ATP? _____
9. The term for a molecule with both a polar and non-polar end. _____
10. An enzyme does not change the _____ of a reaction. _____

PART II. Select the one best answer and place answer in box (15 pts)

1. Which statement is **not true** about the molecule shown to the right.

- A. This is the naturally occurring form
- B. The protonation state shown of the side-chain could be involved in an enzyme's active site as a general acid catalyst
- C. The molecule is drawn correctly
- D. This is a zwitterionic molecule
- E. This form can exist in an enzyme's active site at pH 7.0

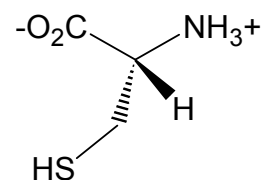


2. Where would you expect to find this amino acid sequence in a protein?
Gly-Ala-Asn-Phe-Glu-Val-Arg-Ile-Ser-Pro

- A. amphipathic α -helix
- B. antiparallel β -sheet
- C. parallel β -sheet
- D. a coil connecting elements of 2° structure
- E. all of the above

3. Which statement is **not true** about the molecule shown.

- A. It has a *S*-chiral center
- B. It is frequently found in proteins
- C. The side-chain is in a reduced form
- D. This is the molecule's protonation state at pH 7.0
- E. The molecule, as drawn, is isoelectric

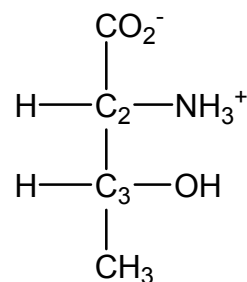


4. Select the amino acid sequence below that is most likely to be in an amphipathic α -helix on the surface of a water soluble protein.

- A. Pro-Ser-Glu-His-Asp-Gly-Thr-Tyr-Gln-Ser-Gly-Lys-Arg-Thr-Cys
- B. Glu-Val-Ser-Ala-His-Leu-Asn-Met-Arg-Phe-Lys-Ile-Ser-Ala-His
- C. Asp-Gly-Ser-Lys-Arg-His-Asn-Tyr-Val-Ile-Phe-Trp-Met-Ala-Val
- D. Pro-Asp-Ala-Phe-Cys-Thr-Trp-Val-Ser-Gly-Ile-Thr-Arg-Met-Leu
- E. All of the above would be equally likely

5. Assign the (*R,S*) stereochemistry of the molecule shown below as a Fischer projection.

- A. (*2S*, *3S*)
- B. (*2S*, *3R*)
- C. (*2R*, *3S*)
- D. (*2R*, *3R*)



PART III. Amino Acids

1. Write the **Single Letter Code** of the following 9 amino acids (**9 pts**)

Asparagine _____	Tyrosine _____	Tryptophan _____
Phenylalanine _____	Glutamine _____	Aspartic Acid _____
Proline _____	Lysine _____	Arginine _____

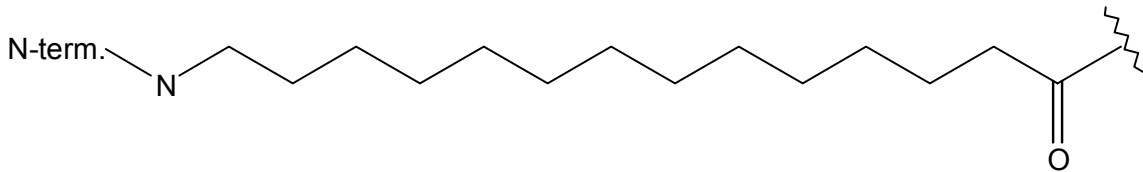
Name _____

2. Structures (16 pts) Draw the entire structures in each box of the following 8 naturally occurring amino acids at pH 7. Be sure to show the proper stereochemistry and any resonance forms.

Arginine	Tryptophan
Isoleucine	Glutamic acid
Cysteine	Lysine
Methionine	Alanine

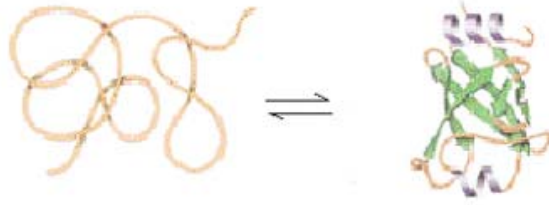
Name _____

2. Given the sequence Val-Thr-Phe-Ser-Leu taken from the middle of a protein sequence
- (5 pts)** Draw this stretch of protein structure onto the extended chain shown below, including the complete side chains, backbone atoms and proper stereochemistry.
 - (5 pts)** Think of this stretch of amino acids as part of an antiparallel β -sheet by drawing a second β -strand (below the one already drawn in part a.) with any relevant hydrogen bonding shown.
 - (5 pts)** Design a protein sequence for your second β -strand from part b. that would make this an amphipathic β -sheet. Label the side chains of this 2nd β -strand in drawing below, 3-letter code okay here.
 - (5 pts)** In the drawing sketch out one of the peptide planes, identify a peptide bond, and label the torsion angles Phi and Psi in one location of the protein structure.



3. Protein Folding

- a. (10 pts) Consider the folding of a cytosolic water soluble protein. As we have discussed in class, proteins are highly ordered structures. Succinctly, rationalize why the formation of a native protein fold does not defy the 2nd Law of Thermodynamics.



- b. (5 pts) Describe the energetic role that both the hydrophobic effect and hydrogen bonding (in 2° structures) have in protein folding.

Name _____

extra room:

Question	Available Points	Your Score
I. Short answer	10	
II. Multiple choice	15	
III. Amino Acids	25	
IV. Problems 1.	15	
2.	20	
3.	15	
Total points	100	