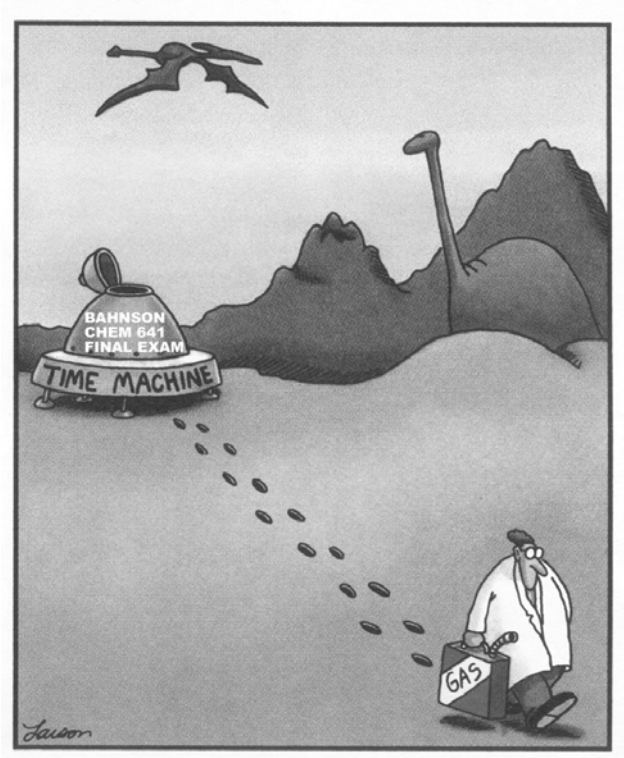
*Name:*_____ *CHEM 641 BAHNSON SECTION*

CHEM 641 Biochemistry Final

Friday, December 10, 2004

Please put your name on the front, initial each subsequent page, and check to make sure that your exam copy contains all 6 pages. If you have any questions, raise your hand and I will come to you.



Gas constant, R = 8.315 J mol^{-1} K^{-1}
Faraday's, $\mathcal{F}$ = 96,485 J V^{-1} mol^{-1}
ºC + 273.15 = ºK
1 cal = 4.184 Joule

Redox

$\Delta\mathscr{E}^{o\prime} = -\Delta G^{o\prime} / n\mathcal{F}$

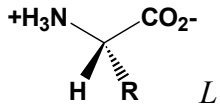
Van der Waals

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

Ionic interaction

$F = e_1e_2/Dr^2$

amino acid	pKa
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



L amino acid

BAHNSON SECTION

50/150 pts

Question	Points	Score
I	10	
II	15	
III	10	
IV	10	
V	5	
TOTAL	50	

I. **- [10 pts] Short answer** – 5 questions

1. Weak force interaction that is the main energetic driving force for formation of a lipid bilayer. _____

2. Draw how two peptide planes align in an α-helix.

3. Draw a cartoon of a clathrate structure and label appropriately.

4. Technique that is used most often to solve the 3-D structure of proteins. _____

5. A bio-analytical technique that separates based on a protein's molecular weight. _____

II. Peptides

a. [7 pts] Draw the structure of the tetra-peptide Asn-Trp-Pro-Cys as it would appear at pH 7.0 including the full structures of the side-chains. Also show proper stereochemistry around any chiral atoms of the *L*-amino acids.

b. [3 pts] Estimate the net charge on the molecule at pH 4, 7 and 11.0.

pH 4 _____

pH 7 _____

pH 11 _____

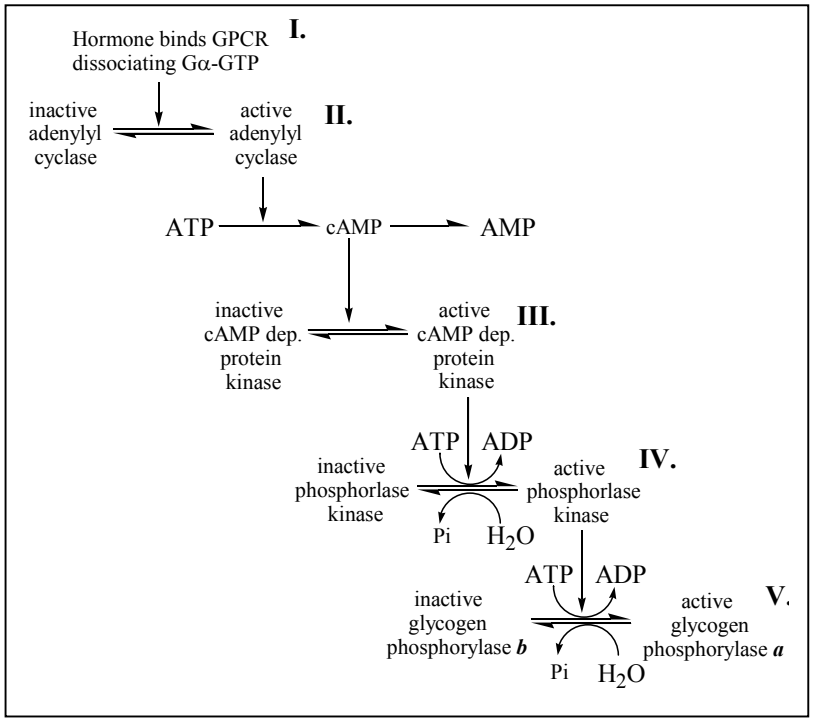
c. [5 pts] Suppose this peptide is biologically active only when proline's peptide bond is a cis-peptide bond. Furthermore, suppose this biologically active peptide is a pharmaceutical target (in other words a money making drug). In addition to standard peptide synthesis, which can be done with a peptide synthesizer, what would be needed in production in order to make the biologically active form?

III. Biological Thermodynamics

a. [5 pts] Is the free energy of hydrolysis of ATP affected by the presence of divalent cations, such as Mg^{2+} and Ca^{2+}? Explain your answer by drawing relevant chemical structures of any significant interactions.

b. [5 pts] With an excess of Mg^{2+} present, the hydrolysis of ATP has a $\Delta G^{o'} = -30.5$ KJ/mol. Under conditions with an excess of Mg^{2+}, 37.0 ºC, pH 7.0, [ATP] = 10 mM, [Pi] = 10 mM, and [ADP] = 1 mM, calculate the K_{eq} of the hydrolysis reaction. You should setup the calculation, showing units. A final numerical answer is not needed here for full credit since no calculators are allowed.

IV. Glycogen Phosphorylase



a. **[5 pts]** For each activated species above (labeled I-V in diagram), describe how the signal is turned off. Write your brief answer to the right of each step above.

b. **[5 pts]** The substrate ATP is involved in both steps IV. and V. above. Briefly describe how ATP is involved in the reaction catalyzed by glycogen phosphorylase.

V. Enzyme Catalysis [5 pts] List and briefly describe 5 different features of the design of enzymes that enable them to catalyze their reactions. Please refer to a particular enzyme for each of the 5 ways you pick. However, they do not all need to be from the same enzyme.