Name _____

I.D. _____

Score _____

Exam 1, BICH 440, Section 500, Monday, September 25, 2000

Write your name on each page. Write concise answers to demonstrate effectively your mastery of the subject. Show your work in order to receive maximum credit where applicable.

gas constant R 8.315 J/mol-K

1. (15 pts) (a) Draw the structure of the tripeptide: glutamic acid – proline – lysine as it would exist at pH 7. You do not need to depict the proper stereochemistry.

(b) What is the approximate net charge on this tripeptide at pH 5? and at pH 12? Also, estimate the isoelectric point for this tripeptide. For this calculation use the following pKa values: carboxyl on alpha carbon: 2; amino on alpha carbon: 9.5; R-group of glu: 4.3; R-group of lys: 10.5.

Name _____

2. (15 pts) Consider the following coupled phosphoryl transfer reaction that is part of glycolysis:

phosphoenolpyruvate + ADP $\leftrightarrow$ pyruvate + ATP $\quad \Delta G^{\circ\prime} = -31.7$ kJ/mole

(a) Given that the standard free energy change for the hydrolysis of ATP is –30.5 kJ/mole, calculate the equilibrium constant at 25°C for the hydrolysis of phosphoenolpyruvate (PEP) (the reaction of PEP + H_2O $\leftrightarrow$ pyruvate + P_i).

(b) Which molecule has the higher phosphate group transfer potential, PEP or ATP? Why?

(c) Given the following (completely hypothetical) concentrations: [PEP] = 0.1 mM, [pyruvate] = 10 mM, [ATP] = 10 mM, [ADP] = 0.1 mM. Determine whether ATP will be synthesized or consumed (reaction goes to right, or left, respectively) at 25°C. Show your reasoning.

Name _____

3. (10 pts) Consider the peptides labeled A through E, below. Choose one peptide that best answers each question. A given peptide can be used as the answer to more than one question.

   A. glycine – methionine - proline
   B. cysteine – tryptophan – tyrosine
   C. lysine – arginine - valine
   D. aspartic acid – leucine - lysine
   E. glutamic acid – alanine - histidine

   _____ reacts with N-ethylmaleimide.

   _____ would elute last from a DEAE column at pH 7.

   _____ contains a guanidino group.

   _____ This sequence is least likely to part of an alpha helix in a protein.

   _____ has the greatest absorbance at 280 nm.

4. (6 pts) Discuss three complications that arise when using hydrolysis in 6 N HCl to obtain the amino acid composition of a purified protein. Specifically name amino acids whose determinations are compromised.

Name _____

5. (15 pts) Starting with 1 liter of a 0.3 M imidazole buffer, pH 7.3, what pH would result after the addition of 100 mL 1 M HCl? The pKa for imidazole is 7.0.

Name _____

6. (15 pts) Use the following data to deduce the sequence of a peptide.

i) The amino acid composition of the starting peptide contains one equivalent each of: ala, arg, cys, his, lys, met, tyr
ii) The starting peptide gave no product upon reaction with Edman reagent.
iii) The starting peptide was not digested by carboxypeptidase.
iv) Treatment of the starting peptide with cyanogen bromide resulted in a 7-mer peptide (peptide II). One round of Edman sequencing of peptide II gave PTH-his.
v) Treatment of the starting peptide with trypsin resulted in a tetramer (peptide III) and a trimer (peptide IV). One round of Edman sequencing of each tryptic peptide resulted in PTH-ala from peptide III, and PTH-tyr from peptide IV.
vi) Treatment of peptide II resulted in a two dipeptides (peptide V, peptide VI) and a trimer (peptide VII).
vii) Treatment of peptide III with cyanogen bromide resulted in production of two dipeptides.
viii) In addition, treatment of peptide III with carboxypeptidase resulted in the early release of lys.
ix) Peptides IV and VII react with iodoacetic acid.

Draw the primary structure of the starting peptide, AND explain your reasoning.

Name _____

7. (24 pts) Short-answer questions

A. Two electrophoretic techniques combined to produce 2D protein gels:

_____ , _____

B. (3 pts) Draw the structure of the deprotonated sidechain (R-group) of tyrosine:

C. ratio of proton concentrations between solutions of pH 3 and pH 5:

D. approximate number of amino acids in a protein of molecular weight 110,000:

E. Is the force of electrostatic interaction between two charged groups increased or decreased when transferred to a solution of lower dielectric constant? Why?

F. Two amino acids that are especially adaptable to beta-turn structures in proteins:

_____ , _____

G. Are proteins relatively more soluble or less soluble when the pH of their solution equals the isoelectric pH? Why?

H. Name the three aromatic amino acids:

_____ , _____ , _____

I. What famous chemist proposed the alpha helical structure of polypeptide chains?

J. Another name, or the structure, of Edman's reagent:

K. Name of chromatography technique used to separate proteins primarily according their sizes.