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Score _____

Exam 1, BICH 440 Honors, Friday, October 3, 2003

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) (A) (12 pts) Draw the structure of the tripeptide, phosphothreonine-histidine-arginine methyl ester at pH8. (Some notes about the above nomenclature: the threonine sidechain is modified with a phosphoryl group; the carboxyl terminus of the peptide is modified to a methyl ester.) You do NOT need to depict the proper stereochemistry.

(B) (8 pts) Calculate the net charge on this peptide at pH4 AND pH10. Show your work. Assume the pKa's of the phosphoryl group are 2.2 and 7.2. For the other ionizable groups, use the pKa's listed on the table attached to this exam.

(C) (4 pts) Estimate the isoelectric point for this peptide.

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2) (10 pts) 100 mL of 0.2M NaH_2X is mixed with 100 mL of 0.5M Na_2HX , and the pH of the resulting solution is measured to be 5.2. Calculate the equilibrium constant for the dissociation of a proton from H_2X .

3) (8 pts) In one sentence describe the major accomplishment of each of the following biochemists that has been covered so far in this course.

(A) Frederick Sanger

(B) John Kendrew

(C) Linus Pauling

(D) G. N. Ramachandran

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- 4) (15 pts) Determine the sequence of an unknown peptide given the following information. Use the table of information attached to this exam. Note that the problem can be solved without using the data on masses, but you might want to verify your solution with this information. To receive full credit, you must explain briefly HOW you used the relevant pieces of information.

The mass of the peptide is 763 Da.

The absorbance at 280 nm of a 0.1mM solution of the peptide is 0.5 (1cm pathlength cuvette).

There is no reaction with phenylisothiocyanate to give a PTH-amino acid product.

The peptide reacts with dansyl chloride at a ratio of one mole dansyl chloride per mole of peptide (dansyl chloride reacts with free amino groups).

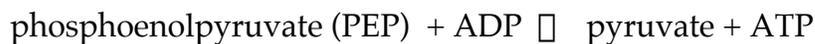
Cleavage of the peptide with trypsin resulted in two products of masses 566 Da and 215 Da. The 215 Da product was identified to be arginine that is acetylated on its amino group.

Cleavage with cyanogen bromide resulted in two fragments with masses of 449 Da and 332 Da. The larger fragment reacted with N-ethylmaleimide. The smaller fragment absorbed UV light at 280 nm.

- 5) (8 pts) Sketch the pattern of spots obtained when the following proteins are separated by electrophoresis on a single 2D gel (first dimension: isoelectric focusing under nondenaturing conditions; second dimension: SDS polyacrylamide gel). Be sure to label the gel dimensions, noting the directions of electrophoresis and identify each spot.

protein	pI	size
A	4.5	two subunits: 20,000 and 30,000
B	7.5	one subunit of 30,000
C	9.0	two subunits: 30,000 and 40,000
D	4.5	one subunit of 40,000

- 6) (15 pts) (Note that there are two parts to this question – Part A is on this page; part B is on the next page.) Consider the following reaction from glycolysis:



- (A) Given that $\Delta G^\circ = -62.2 \text{ kJ/mole}$ for hydrolysis of PEP and $\Delta G^\circ = -30.5 \text{ kJ/mole}$ for hydrolysis of ATP, what is the equilibrium constant for the combined reaction (above)? Temp = 37°C

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(B) If $\Delta G = -23.0$ kJ/mole for this reaction in the cell, and the ratio of $[ATP]/[ADP] = 10$, what is the ratio of $[PEP]/[pyruvate]$ under these conditions? Temp=37°C

(20 pts) Short(er) answer:

7) (5 pts) What two amino acids are predominant in the primary structure of collagen?

Draw the structure of a modified form of one of these amino acids that results in a higher capacity for hydrogen bonding in the overall structure of collagen.

8) (5 pts) Draw the polypeptide backbone (i.e., no specific R-groups) for three residues, each, of two chains involved in an antiparallel beta sheet. With a dotted line, delineate one location of a hydrogen bond that stabilizes the beta sheet.

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9) (3 pts) Approximately how many amino acids are contained in an alpha helix that is 11 Angstroms in length?

10) (4 pts) Explain briefly WHY the specific activity of a protein increases as it is purified.

11) (3 pts) What is the purpose of adding high concentrations of beta-mercaptoethanol or dithiothreitol to a protein sample?