

NAME _____

MMBB 380 - Fall 2005
EXAM 1 - Part I

You may use a calculator for this portion of the test. Show all your work. Good Luck.

(12,000 pts)

- 1) You have developed a new series of monoprotic buffers (HA) and you are characterizing their pK_a values. You make 125 mM solutions of each and carefully measure the pH of the first buffer as 3.08.**
 - a. Determine the pK_a of this buffer.**

(9,000 pts)

2) In a 200 mM solution of free glutamic acid ($pK_{a1} = 2.19$; $pK_{a2} = 4.25$; $pK_{a3} = 9.67$), the pH is adjusted to exactly 4.25. The concentration of the completely unprotonated form (A^{-2}) of this amino acid is closest to:

- A. 0 mM
- B. 50 mM
- C. 100 mM
- D. 150 mM
- E. 200 mM

Could glutamic acid be used to effectively buffer a solution at pH 7.0? Briefly justify your answer.

(7,000 pts)

3) A monoprotic buffer, X, has a pK_a of 8.25. A 25.0 mM solution of buffer X has been prepared and the pH has been adjusted to 8.00. Determine the concentration of the protonated form ($[HX^{+1}]$) of X in this solution.

NAME _____

**MMBB 380 - Fall 2005
EXAM I - PART II**

**You may not use a calculator for this portion of the exam; please put your calculator away.
Please read and answer each question carefully. Good Luck!**

(5,000 pts)

1) In a typical eukaryotic cell, protein synthesis occurs primarily at/in the:

- A. smooth endoplasmic reticulum
- B. nucleolus
- C. Golgi apparatus
- D. mitochondria
- E. rough endoplasmic reticulum

(5,000 pts)

2) In a typical eukaryotic cell, phospholipid synthesis occurs primarily at/in the:

- A. smooth endoplasmic reticulum
- B. nucleolus
- C. Golgi apparatus
- D. mitochondria
- E. rough endoplasmic reticulum

(5,000 pts)

3) Which one of the following has eukaryotic cellular components arranged in order of *increasing size*?

- A. amino acid, nucleic acid, mitochondrion, ribosome
- B. acetate, protein, ribosome, mitochondrion
- C. acetate, ribosome, protein, chromatin
- D. protein, amino acid, mitochondrion, mitotic spindle
- E. lipid, ribosome, mitochondrion, protein

(5,000 pts)

4) The bonding geometry of the carbonyl carbon in a ketone is best described as:

- A. linear
- B. tetrahedral
- C. trigonal planar
- D. bipyramidal

(6,000 pts)

5) For the following biopolymers, provide the appropriate building block (monomer).

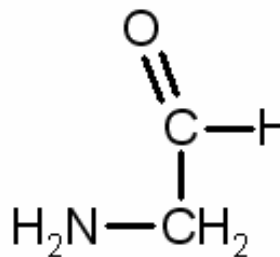
a. Carbohydrates _____

b. RNA _____

(5,000 pts)

6) What functional groups are present on this molecule?

- A. amide and ketone
- B. amide and aldehyde
- C. amine and ketone
- D. amine and aldehyde



(6,000 pts)

7) The following peptide is dissolved in a water solution that is maintained at pH 6.8. Predict the net charge of the molecule.

PRAFKND

- A. -2
- B. -1
- C. 0
- D. +1
- E. +2

(6,000 pts)

8) Which of the following atoms is *least* likely to participate directly in hydrogen bonding?

- A. hydrogen
- B. carbon
- C. oxygen
- D. nitrogen

(5,000 pts)

9) Which of the following bonds or interactions is usually stronger than the typical ionic bond?

- A. hydrogen bond
- B. covalent bond
- C. van der Waals attractions
- D. hydrophobic interaction
- E. none of the above

(5,000 pts)

10) Which of the following is considered to be a weak acid?

- A. HCl
- B. NaOH
- C. CH₃COOH
- D. NH₃
- E. none of the above acts as a weak acid

(12,000 pts)

11) Please answer the following questions regarding these three buffers.

	<u>pK_a</u>
Buffer 1:	6.25
Buffer 2:	7.25
Buffer 3:	9.25

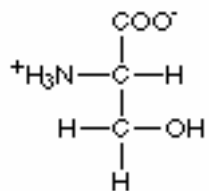
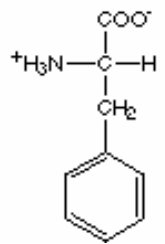
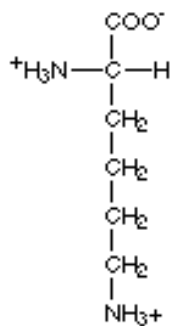
- a. Which would be best for maintaining pH in a solution with pH 8.1? _____
- b. If all three buffers were in a solution at pH 8.1, which of the buffers, if any, would be mostly in the protonated (HA) form? _____
- c. Which of the three is the weakest acid (i.e. has the most affinity for the proton)?

(8,000 pts)

12) In 20 words or less, define the isoelectric point of a molecule.

(32,000 pts)

13) Fill out this table describing the following common amino acids; include structures.

<u>Aqueous Structure</u> <u>at pH 7.0</u>	<u>Full Name</u>	<u>3 Letter Code</u>	<u>1 Letter Code</u>	<u>Indicate hydrophobic</u> <u>or hydrophilic R group</u>
a. 	Serine	Ser	S	hydrophilic
b.	Alanine	_____	_____	_____
c.	Isoleucine	_____	_____	_____
d. 	_____	_____	_____	_____
e. 	_____	_____	_____	_____

(5,000 pts)

14) Brief elastase treatment of the peptide, TERMINALPEPTIDE, should generate the following peptide product(s).

- A. TERM + INALPEPTIDE
- B. TERMINAL + PEPTIDE
- C. TERMINA + LPEPTIDE
- D. TER + MINALPEPTIDE
- E. TERMINALPEPTIDE (no cleavage)

(8,000 pts)

15) Draw the chemical structure of the following functional groups. Indicate by a yes or no if one or more of the 20 common amino acids contains this functional group.

Occurs in 1 or more of the 20 aa

a. thioester group Yes No

b. imidazole group Yes No

(6,000 pts)

16) If a pentapeptide is made using a completely random choice of the common 20 amino acids, how many different peptide sequences are possible?

- A. 20
- B. between 20 and 100
- C. $20 + 20 + 20 + 20 + 20$
- D. $20 \times 20 \times 20 \times 20 \times 20$
- E. none of the above

(6,000 pts)

17) Provide the full name and draw the structure of the molecule, SDS.

(6,000 pts)

19. SDS treatment of a protein in the absence of additional reagents (besides H₂O) should result in:

- A. cleavage of disulfide bonds**
- B. unfolding of the protein**
- C. oxidation of the protein**
- D. all of the above**
- E. none of the above**

(6,000 pts)

20. As described in class, standard two dimensional gel electrophoresis of proteins consists of which two techniques? Provide the full name for each.

1st Dimension:

2nd Dimension:

(6,000 pts)

21) Prior to certain types of electrophoresis, a protein sample can be treated with 6 M urea.

The purpose of the urea is to:

- A. reduce disulfide bonds within the protein**
- B. coat the protein, 1 urea/2 amino acids**
- C. disrupt hydrophobic interactions**
- D. all of the above**

(10,000 pts)

22) Draw the dipeptide, Cys-Asn. Identify the peptide bond. Identify any additional atoms that lie in the same plane as the two atoms forming the peptide bond.

(6,000 pts)

23) Sequential Edman degradation is performed on the following tetrapeptide: MAGS

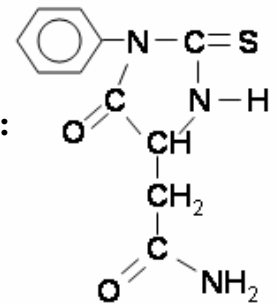
Following three cycles, which amino acid(s) has/have *not* been modified with PITC?

- A. Methionine
- B. Alanine
- C. Glycine
- D. Serine
- E. all of the above
- F. none of the above

(8,000 pts)

24) Identify the primary amino acid sequence of this heptapeptide. The following was observed.

- a. Amino acid analysis (hydrolyzes all peptide bonds) gave a relative ratio of one each of the following: Asp Val Gly Lys Met Trp Leu NH_4^+
- b. Trypsin treatment generated Leu and a hexapeptide.
- c. Edman degradation generated the PTH derivative shown to the right:
- d. Chymotrypsin treatment yielded two products, one tripeptide which showed strong absorbance at 280 nm and one tetrapeptide that contained an amino acid with a basic side chain.
- e. Brief elastase treatment generated a dipeptide and a pentapeptide; the pentapeptide contained no amino acids with acidic or basic side chains.
- f. CNBr treatment yielded a tripeptide and a tetrapeptide.



b	_____	_____	_____	_____	_____	_____	} optional worksheet
c	_____	_____	_____	_____	_____	_____	
d	_____	_____	_____	_____	_____	_____	
e	_____	_____	_____	_____	_____	_____	
f	_____	_____	_____	_____	_____	_____	
	_____	_____	_____	_____	_____	_____	

FINAL ANSWER

(8,000 pts)

Bonus Question: Illustrate the Merrifield Synthesis of Leu-Pro starting with prolyl acyl resin.

Page #	Points Possible	Points
Part I	28,000	
2	26,000	
3	22,000	
4	25,000	
5	32,000	
6	25,000	
7	28,000	
8	14,000	
Bonus	8,000	
Total	200,000	