NAME _____

MMBB 380 - Fall 2002
EXAM I - PART I

You may use a calculator for this portion of the exam. Show your work.

(8 pts)

1) The pH of a 0.150 M solution of a pure weak acid (no other solutes) was measured at 4.25.

a. What is the pK_a of this acid?

b. Could this weak acid be used to buffer a solution at pH 4.40? Explain.

(6 pts)

2. Arginine can act as a triprotic acid with 3 pK_a values of 2.17, 9.04, and 12.48.

a. Draw the structure of the predominant form in an aqueous solution of pH 7.0.

b. What is the concentration of the structure from part (a) in a 0.80 M arginine solution after the pH is adjusted to 9.04.

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EXAM I - PART II

You may not use a calculator for this portion of the exam. Good Luck!

Page	Points Possible	Points
Part I	14	
3	11	
4	11	
5	9	
6	16	
7	10	
8	12	
9	13	
10	4	
Bonus	4	
Total	104	

(3 pts)

1) Following the molecular hierarchy of cells, number the following in the correct order from smallest (# 1) to largest (# 6).

_____ **cell**

_____ **macromolecules**

_____ **inorganic precursors**

_____ **organelles**

_____ **metabolites**

_____ **supramolecular complexes**

(2 pts)

2) For the following biopolymers, provide the appropriate building block.

a. Carbohydrates _____

b. Nucleic Acids _____

(3 pts)

3) What is the defining difference between prokaryotic organisms & eukaryotic organisms? Limit your answer to 30 words.

(3 pts)

4) Every organelle performs specific functions for the cell. Name the most appropriate organelle for each of the following functions.

_____ **sorting and packaging of proteins**

_____ **phosopholipid biosynthesis**

_____ **ATP generation**

(3 pts)

5) What is the maximum number of hydrogen bonds that each of the following molecules is capable of forming in an aqueous solution.

_____ **H_2O**

_____ **CH_3OH**

_____ **benzene (C_6H_6)**

(3 pts)

6) Which of the following order of bond strength (weakest to strongest) is correct.

a. ionic < van der Waals < covalent

b. ionic < hydrogen < covalent

c. van der Waals < ionic < hydrogen

d. van der Waals < hydrogen < covalent

e. none of the above

(2 pts)

7) Which of the following attributes would contribute the most to making a molecule hydrophobic?

a. polar

b. charged

c. nonpolar

(3 pts)

8) If the pK_a of a weak acid is 4.4 & the pH of a solution containing the acid is 4.5, is there more of the acid form or base form?

_____

(3 pts)

9) Which of the following best describes pK_a?

a. $-\log [H^+]$

b. the pH at which [HA] = [A]

c. $+\log K_a$

d. the pH at the equivalence point

(6 pts)

10) Draw 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. hydroxyl group _____

b. aldehyde group _____

c. guanido _____

(16 pts)

11) Fill out this table describing the following common amino acids.

Structure	Full Name	3 Letter Code	1 Letter Code	Side Chain Behaviour
a. **{Cysteine}**	**Cysteine**	**Cys**	**C**	**Sulfur-Containing**
b.	**Tryptophan**	_____	_____	_____
c.	_____	**Gln**	_____	_____
d. **{Serine}**	_____	_____	_____	_____
e. **{Leucine}**	_____	_____	_____	_____

(10 pts)

12) a. Draw the following dipeptide, AG. Use the trans-configuration shown in class.

b. On this diagram, use arrows to indicate only the peptide bonds.

c. Use this peptide to illustrate hydrolysis. For full credit, use the nucleophyllic acyl substitution mechanism.

(3 pts)

13) Indicate the net charge of the following peptide in an aqueous solution at pH 7.0

ACDEFGKLM

a. -3

b. -2

c. -1

d. 0

e. 1

f. 2

g. 3

(3 pts)

14) Using a line, show where the following treatments would cleave the following peptide:

a. CNBr Treatment **ACDEFGKLM**

b. Tryptic digestion **ACDEFGKLM**

c. Elastase digestion **ACDEFGKLM**

(3 pts)

15) Define the isoelectric point of a protein. Limit your answer to 20 words or less.

(3 pts)

16) *Briefly* describe the function/purpose of Edman degradation (structures are not necessary).

(6 pts)

17) Describe the *effect* of the following reagents on proteins (i.e. describe their function not their structure?). *Be brief*

a. ? **-ME, beta mercaptoethanol**

b. SDS, sodium dodecyl sulfate

c. urea

(4 pts)

18) Two dimensional gel electrophoresis uses what forms of electrophoresis? How does each separate proteins? *Use short answers*.

	Name	**Separates proteins based on:**
First:	_____	_____
Second:	_____	_____

(3 pts)

19) Cadaverine, shown here, is a volatile molecule with an unpleasant odor that occurs in dead animal tissue by a simple decarboxylation of a common amino acid. That amino acid is most likely to be:

a. Arginine

b. Glutamine

c. Valine $H_2N\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}NH_2$

d. Lysine

e. Putrescine

f. None of the above

(4 pts)

20. Describe the difference between MALDI-TOF mass spectrometry and tandem mass spectrometry, especially with regard to the study of proteins. For example, what can tandem mass spec do that MALDI-TOF can not.

(4 pt)

Bonus question:

Regarding Merrifield peptide synthesis:

a. Briefly explain the role of FMOC (or tBoC)

b. Briefly explain the role of DCC

c. If the peptide, ACDEFGH, were synthesized by this process, identify which amino acid (by full name) would be the last one added to complete the synthesis.