

NAME _____ **KEY**

**MMBB 300 - Fall 2007
EXAM I**

**You may not use a calculator for this exam. Please read and answer each question carefully.
Good Luck!**

(7,000 pts)

- 1) In a typical prokaryotic cell, an invagination of the plasma membrane that serves as a site for complex enzymatic pathways is known as:
- A. the Golgi apparatus -6 k pts
 - B. the peroxisome
 - C. the mesosome
 - D. the nucleoid -6 k pts
 - E. the rough endoplasmic reticulum -5 k pts

(7,000 pts)

- 2) Which of the following eukaryotic organelles consumes CO₂ and generates O₂?
- A. nucleus
 - B. nucleolus
 - C. mitochondrion -5 k pts
 - D. chloroplast
 - E. peroxisome -5 k pts

(7,000 pts)

- 3) Which one of the following lists eukaryotic cellular components arranged in order of *decreasing* size?
- A. ribosome, ethanol, H₂O, mitochondrion
 - B. nucleus, nucleolus, ribosome, nucleotide
 - C. nucleotide, peroxisome, protein, ribosome
 - D. lipid, protein, ribosome, flagellum -5 k pts (increasing size)

(7,000 pts)

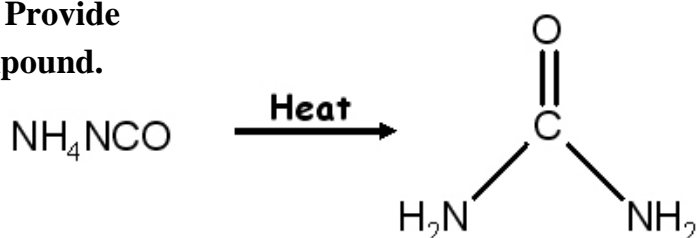
- 4) The bonding geometry of the carbonyl carbon atom in glycine is best described as:
- A. linear
 - B. tetrahedral -5 k pts
 - C. trigonal planar
 - D. trigonal pyramidal -5 k pts

Drawing the correct structure but choosing the wrong answer – 3.5 k pt

(7,000 pts)

- 5) In 1928, Freidreich Wöhler heated ammonium cyanate and generated which organic compound? Provide the name *or* draw the structure of the compound.

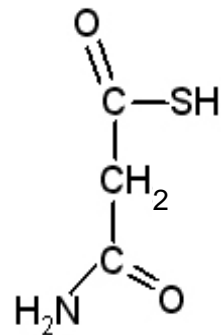
Urea



(7,000 pts)

6) Circle all of the functional groups found in this molecule.

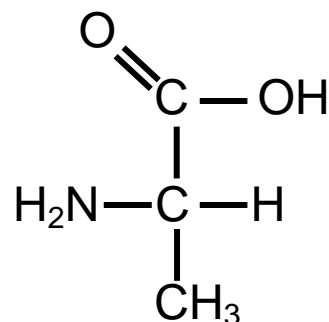
- A. carboxylic acid
- B. ketone
- C. amide
- D. thioester
- E. imidazole



(7,000 pts)

7) The molecule shown is dissolved in a water solution that is maintained at pH 7.0. Predict the net charge of the molecule.

- A. -2
- B. -1 **-4.5 k pts**
- C. 0
- D. +1 **-4.5 k pts**
- E. +2



(7,000 pts)

8) In a soap bubble, the hydrocarbon chain of a single soap molecule is mostly likely to be found:

- A. sticking out of the H₂O
- B. hydrogen bonded to H₂O
- C. bonded to other hydrocarbon chains **-5 k pts**
- D. covalently bonded to sodium

(7,000 pts)

9) When two electronegative atoms share a single hydrogen atom, the bonding is known as:

- A. ionic bonding
- B. van der Waals attraction **-5 k pts**
- C. hydrophobic bonding
- D. none of the above

It is hydrogen bonding

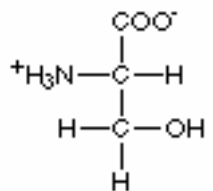
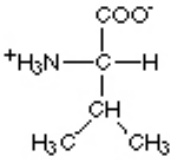
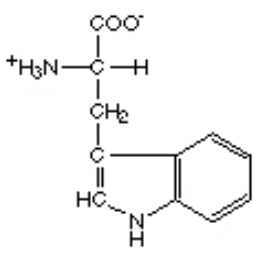
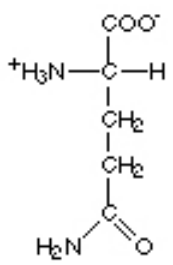
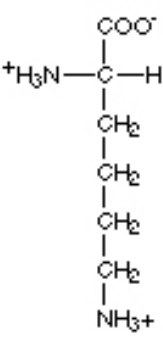
(7,000 pts)

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

The isoelectric point is the pH at which the net charge of the molecule is zero.

(40,000 pts)

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

<u>Aqueous Structure at pH 7.0</u>	<u>Full Name</u>	<u>3 Letter Code</u>	<u>1 Letter Code</u>	<u>Indicate hydrophobic or hydrophilic R group</u>
a. 	Serine	Ser	S	hydrophilic
(struct = 4 k pts)	(full name = 4 k pts)	(2 k pts)	(2 k pts)	(2 k pts)
b. 	Valine	<u>Val</u>	<u>V</u>	<u>hydrophobic</u>
c. 	Tryptophan	<u>Trp</u>	<u>W</u>	<u>hydrophobic</u>
d. 	<u>Glutamine</u>	<u>Gln</u>	<u>Q</u>	<u>hydrophilic</u>
e. 	<u>Lysine</u>	<u>Lys</u>	<u>K</u>	<u>hydrophilic</u>

(8,000 pts)

12) The following peptide, VANDALSPLAYHERE, was treated separately with each of the following four reagents. Circle all that would result in one or more cleavages.

A. cyanogen bromide

B. chymotrypsin cleaves after Y

C. elastase cleaves after A, S

D. trypsin cleaves after R

(10,000 pts)

13) 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. guanido group $\begin{array}{c} \text{R}-\text{N}-\text{C}-\text{NH}_2 \\ | \quad || \\ \text{H} \quad \text{NH} \end{array} + \text{H}^+ \longrightarrow \begin{array}{c} \text{R}-\text{N}-\text{C}-\text{NH}_2 \\ | \quad || \\ \text{H} \quad \text{NH}_2^+ \end{array}$ X Yes _____ No

b. alcohol **R-CH₂-OH** X Yes _____ No

(7,000 pts)

14) Titin is the largest protein in your body. Edman degradation would allow you to:

A. compare the relative amounts of Ala and Gly **-5k pts**

B. estimate the mass of titin

C. calculate the isoelectric point of titin

D. identify the amino terminal amino acid

E. identify the carboxy terminal amino acid **-5 k pts**

(7,000 pts)

15) The primary function of acrylamide in protein electrophoresis is to:

A. oxidize protein disulfide bonds

B. reduce protein disulfide bonds

C. unfold or denature proteins

D. generate a consistent charge to mass ratio

E. form a polymeric gel

(7,000 pts)

16) Urea is often used in protein electrophoresis for the following reason:

- A. to oxidize protein disulfide bonds
- B. to reduce protein disulfide bonds
- C. **to unfold or denature proteins urea is a chaotrope that causes proteins to unfold**
- D. to generate a consistent charge to mass ratio
- E. to form a polymeric gel

(12,000 pts)

17) The most popular form of 2-D gel electrophoresis of proteins was described in class.

List the full name of each type of electrophoresis and explain how proteins are separated by each technique.

You needed to give more than a one or two word answer to the mode.

First Dimension: Isoelectric Focusing

Mode of protein separation:

The electrophoretic gel is poured with a pH gradient. The protein moves in the electric field until it reaches the pH that is equal to its pI or isoelectric point. At this pH, the net charge on the molecule is 0, no force is felt and no movement occurs.

Second Dimension: Sodium Dodecyl Sulfate Polyacrylamide Gel Electrophoresis

Mode of protein separation:

All protein is coated evenly with SDS. Each protein has the same charge to mass ratio. All proteins separate by size/mass.

(18,000 pts)

18) Draw the tripeptide, Ser-Ala-Val; use the trans configuration. Use arrows to identify all peptide bonds. Choose the 1st peptide bond and circle all atoms that lie in the same plane as that bond.

(7,000 pts)

19) Provide a brief definition of a weak base. Identify one weak base.

A weak base is only partially protonated or partially releases OH⁻ when dissolved in H₂O.

Examples: NH₃, H₂O

(7,000 pts)

20) The pK_a of a buffer is:

- A. log [H⁺]
- B. -log [H⁺] **-6 k pts**
- C. log [HA]
- D. -log [HA] **-5 k pts**
- E. other **-log K_a** _____ (if other, provide correct answer)
also accept pK_a = pH + log [HA]/[A⁻] or pK_a = -log [H⁺][A⁻]/[HA]

(7,000 pts)

21) Which of the following solutions would have the highest concentration of protons or hydronium ions ([H⁺] or [H₃O⁺])?

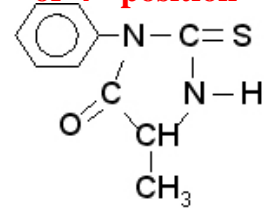
- A. pH 3.4 the lower the pH, the more acidic the solution; [H⁺] increases with lower pH**
- B. pH 4.8
- C. pH 7.0
- D. pH 7.2
- E. can not be determined with information given

pH = -log [H⁺] the more acidic, the higher [H⁺], the lower the pH

Bonus Question (8,000 pts)

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 Ser Arg Met Trp Ala (**no NH₄⁺, thus no Asn**)
- b. Trypsin treatment generated a tripeptide and a tetrapeptide. The tripeptide absorbed light strongly at 280 nm; the tetrapeptide did not. **Arg must be at 3rd or 4th position**
- c. N-terminal sequencing generated this PTH amino acid



PTH-Ala, thus Ala is the 1st aa (Edman Degradation)

- d. Chymotrypsin treatment yielded two products, one dipeptide which contained no acidic or basic amino acids and one pentapeptide that contained one basic amino acid.
- e. Exhaustive elastase treatment generated free alanine and a hexapeptide. **Ser is last**
- f. CNBr treatment yielded a dipeptide and a pentapeptide.

b	_____	_____	Arg	Arg	_____	_____	}	optional worksheet
c	Ala	_____	_____	_____	_____	_____		
d	_____	Trp	_____	Arg	Trp	_____		
e	Ala	_____	_____	_____	_____	Ser		
f.	_____	Met	Asp	_____	Met	Val		
	Ala	Met	Asp	Arg	Trp	Val		
	Ala	Trp	Arg	Asp	Met	Val	Ser	
	Ala	Trp	Arg	Val	Met	Asp	Ser	

There were three possible solutions for the sequence

Page #	Points Possible	Points
2	35,000	
3	35,000	
4	40,000	
5	32,000	
6	37,000	
7	21,000	
Bonus	8,000	
Total	200,000	