

**EXAM 1 Fall 2009**  
**BCHS3304, SECTION # 21734,**  
**GENERAL BIOCHEMISTRY I**

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- **This is a Scantron exam. All answers should be transferred to the Scantron sheet using a #2 pencil.**
- **Write and “bubble in” your name and your PeopleSoft Student Identification Number** in the appropriate area on the front of the Scantron sheet. (See Dr. Legge if you require your student ID#. *If your name and ID# are not clearly legible on the Scantron sheet, you may be awarded 0 points for this exam.*)
- **Write the date of the exam (092409) in the box marked SPECIAL CODES** on the front side of the Scantron sheet and bubble in the appropriate circles.
- **Turn in the Scantron sheet to the instructor before leaving.** If the scantron is not received before you leave the classroom, you will receive 0 points for this Exam.
- **Note:** There are **60 questions on 14 double sided pages to this exam.** Count the pages prior to beginning exam. Each question is of equal worth, with percentage score multiplied to make 200 points for this exam. At the back of the exam, there are two pages of scratch paper. You may remove the back page for scratch paper, but you must return it with the exam.

I. True or False?

For the following statements, select “A” if the is *True* or “B” if it is *False*.

“A” “B”

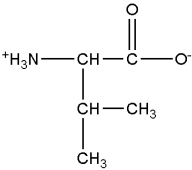
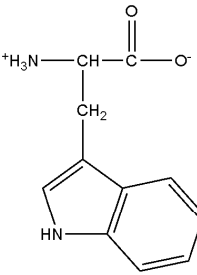
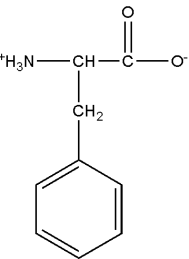
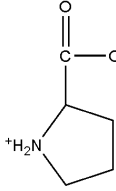
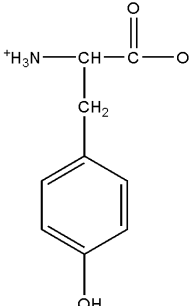
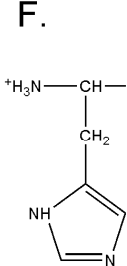
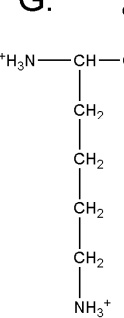
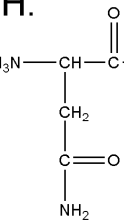
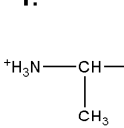
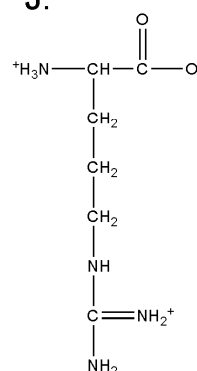
- |   |   |     |  |
|---|---|-----|--|
| T | F | 1.  | The pH at which a molecule carries no net charge in solution is known as its isoelectric point $pK$ .  |
| T | F | 2.  | Eukaryote and prokaryote cells may be distinguished from each other because the prokaryotes contain a nucleus.   |
| T | F | 3.  | Water contains one lone pair of electrons.   |
| T | F | 4.  | A micelle is comprised of molecules that are only hydrophilic.   |
| T | F | 5.  | A high $pK$ indicates a strongly acidic group.   |
| T | F | 6.  | Condensation reactions are not freely reversible in biological systems.  |
| T | F | 7.  | In a Fischer projection, all bonds in the vertical direction project behind the plane of the paper, while the horizontal bonds come out from the plane of the paper. |
| T | F | 8.  | A decrease in the number of particles (molecules) following a chemical reaction results in an increase in entropy.   |
| T | F | 9.  | All processes at equilibrium have a $\Delta H = 0$ .   |
| T | F | 10. | The midpoint of a weak acid titration is where the $pH = pI$ .   |
| T | F | 11. | Proline is an imino acid.  |
| T | F | 12. | The optimal range of a buffer is usually defined by $\pm 1$ pH unit.   |
| T | F | 13. | Natural proteins are comprised of L-Amino Acids.   |
| T | F | 14. | A negative $\Delta S$ corresponds to a favorable change in entropy   |
| T | F | 15. | Living organisms operate within the physical laws that apply to physics and chemistry.   |

**II. Matching**

A. Match the following amino acid with its correct single letter code by selecting “A-J” on your scantron sheet.

- |       |     |            |    |     |
|-------|-----|------------|----|-----|
| _____ | 16. | Asparagine | A. | “C” |
| _____ | 17. | Threonine  | B. | “G” |
| _____ | 18. | Glutamine  | C. | “K” |
| _____ | 19. | Cysteine   | D. | “L” |
| _____ | 20. | Lysine     | E. | “N” |
| _____ | 21. | Leucine    | F. | “Q” |
|       |     |            | G. | “R” |
|       |     |            | H. | “T” |
|       |     |            | I. | “W” |
|       |     |            | J. | “Y” |

B. Match the following amino acid three letter codes with the correct chemical structure by selecting “A-J” on your scantron sheet.

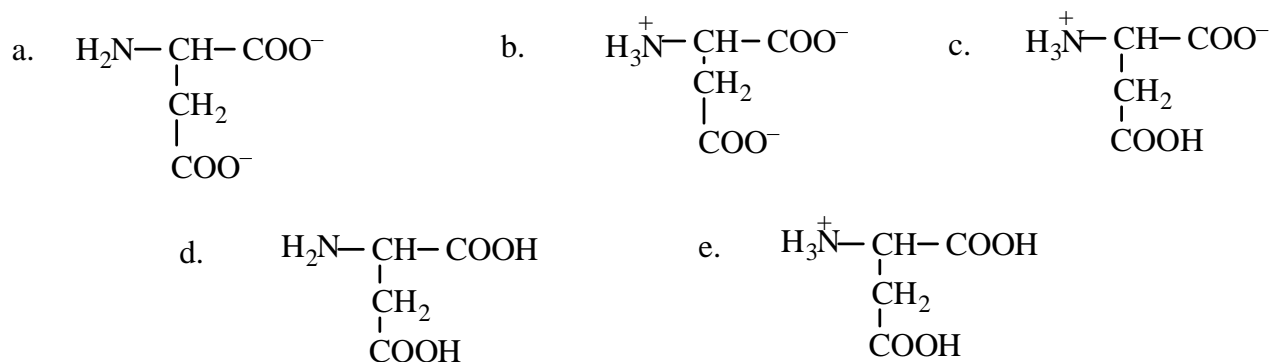
_____	22.	Ala	<b>A.</b>	<b>B.</b>	<b>C.</b>	<b>D.</b>	<b>E.</b>
_____	23.	His					
_____	24.	Tyr					
_____	25.	Trp					
_____	26.	Pro					
_____	27.	Phe					
_____	28.	Arg	<b>F.</b>	<b>G.</b>	<b>H.</b>	<b>I.</b>	<b>J.</b>
							

C. Match the following thermodynamic conditions with the appropriate sign of  $\Delta G$  by selecting "A-E" on your scantron sheet. *Note: "A-E" may be used more than once.*

- |           |                                   |    |  |
|-----------|-----------------------------------|----|--|
| _____ 29. | $\Delta H > 0$ and $\Delta S > 0$ | A. | $\Delta G = 0$                                 |
| _____ 30. | $\Delta H < 0$ and $\Delta S > 0$ | B. | sign of $\Delta G$ is dependent on pressure    |
| _____ 31. | $\Delta H = 0$ and $\Delta S > 0$ | C. | $\Delta G > 0$                                 |
| _____ 32. | $\Delta H > 0$ and $\Delta S = 0$ | D. | sign of $\Delta G$ is dependent on temperature |
| _____ 33. | $\Delta H > 0$ and $\Delta S < 0$ | E. | $\Delta G < 0$                                 |

### III. Multiple Choice

34. Which ionic form of the amino acid below would predominate at pH 7.0?



35. Dipole moments

- A. exist when charges are separated.
- B. are found in polar covalent bonds.
- C. are vectors that can be added to give a net dipole moment for a molecule.
- D. are not characterized by A., B., or C.
- E. are characterized by A., B., and C.

36. Water does not dissolve non-polar compounds because
- A. the  $\Delta H$  of interaction of non-polar groups with other non-polar groups is much stronger than the interaction of  $H_2O$  with non-polar groups.
  - B. the entropy change caused by ordering  $H_2O$  around non-polar groups is unfavorable and not compensated by a favorable  $\Delta H$ .
  - C. the dielectric constant of  $H_2O$  is much greater than that of the non-polar compound.
  - D. the thermodynamics favors increasing the surface-to-volume ratio of the regions where  $H_2O$  is interacting with non-polar groups.
  - E.  $H_2O$  and hydrophobic groups have a repulsive ( $> 0$ ) energy of interaction at all separation distances.
37. When 1 mole of crystalline sucrose is placed in 1 L pure water, the reaction vessel gets cool to the touch, and it takes many minutes for all of the sucrose to dissolve at room temperature. Given what you know of thermodynamics, what are the signs of the values of the change in enthalpy and entropy of the system?
- F.  $\Delta H +; \Delta S -$
  - G.  $\Delta H -; \Delta S +$
  - H.  $\Delta H +; \Delta S +$
  - I.  $\Delta H -; \Delta S -$
  - J. enthalpy and entropy values do not change
38. If the free energy change ( $\Delta G$ ) for a reaction is zero, which of the following is true?
- A. The equilibrium constant is zero.
  - B. The entropy change ( $\Delta S$ ) for the reaction is zero.
  - C. The enthalpy change ( $\Delta H$ ) for the reaction is zero.
  - D. The reaction is at equilibrium.
  - E. None of the above.

IV. **Calculations** - Complete the following questions (#39-#41) based on the following information.

- 1X TAE contains 40mM Tris, 40mM Acetic Acid and 10mM EDTA.
- The molecular weight of Tris is 121.4 g/mole and
- The molecular weight of EDTA is 292.2 g/mole.
- Acetic Acid is obtained as a concentrated solution that is 17.4 M.
- You need to prepare 200ml 10X TAE stock solution.

39. How much Tris would you mix into water to prepare the stock solution?

- |                |               |
|----------------|---------------|
| A. 9.7 mg Tris | D. 9.7 g Tris |
| B. 0.5 mg Tris | E. 0.5 g Tris |
| C. 9.7         |               |

40. How much EDTA would you mix with the Tris you added above in #41 to prepare the stock solution?

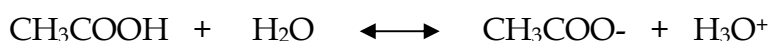
- |                |                |
|----------------|----------------|
| A. 2.4 g EDTA  | D. 0.3 g EDTA  |
| B. 5.8 g EDTA  | E. 0.3 mg EDTA |
| C. 5.8 mg EDTA |                |

41. How much Acetic Acid would you mix with the Tris and EDTA you added in #39 & #40?

- |                       |                       |
|-----------------------|-----------------------|
| A. 70 mg Acetic Acid  | D. 0.2 ml Acetic Acid |
| B. 1.4 g Acetic Acid  | E. 4.6 mg Acetic Acid |
| C. 4.6 ml Acetic Acid |                       |

1. 42. What is the pH of the solution that has a 1:4 ratio of acetic acid and acetate ion (pK acetic acid 4.75)?
- A. 0.6  
 B. 5.4  
 C. 4.1  
 D. 0.3  
 E. 4.8

The following equation represents the dissociation of the weak acid, acetic acid when diluted in H<sub>2</sub>O.



43. In the equation above, which of the following molecules in this reaction is the conjugate acid?
- A. H<sub>3</sub>O<sup>+</sup>  
 B. CH<sub>3</sub>COO<sup>-</sup>  
 C. H<sub>2</sub>O  
 D. CH<sub>3</sub>COOH  
 E. none of these molecules
44. In the equation above, which of the following molecules represent the conjugate base?
- A. H<sub>3</sub>O<sup>+</sup>  
 B. CH<sub>3</sub>COO<sup>-</sup>  
 C. H<sub>2</sub>O  
 D. CH<sub>3</sub>COOH  
 E. none of these molecules
45. Calculate the  $\Delta G^{\circ}$  for the dissociation of acetic acid at equilibrium. The universal gas constant  $R = 8.3 \times 10^{-3} \text{ kJ/K}\cdot\text{mol}$ . The equilibrium constant for acetic acid dissociation ( $K'_{\text{eq}}$ ) is  $1.74 \times 10^{-5}$ .
- A. 27.1 kJ/mol  
 B. 11.8 kJ/mol  
 C. -0.98 kJ/mol  
 D. 0.98 kJ/mol  
 E. -11.8 kJ/mol

46. Trypsin digestion of a peptide yields the fragments (H, MNK, IMR, and LMR). CNBr treatment yields (RH, RM, NKIM, and LM). What is the sequence of the intact peptide?

- |    |            |    |            |
|----|------------|----|------------|
| A. | NKIMRHLMRM | D. | LMRIMRMNKH |
| B. | LMRHNKIMRM | E. | NKIMLMRHRM |
| C. | LMRMNKIMRH |    |            |

47. A heptapeptide was subjected to the following treatments:

- Complete acid hydrolysis: (L, W, Y, K, R, M, D)
- Edman Degradation Yielded a PTH-labeled Y
- Trypsin Digestion Yielded: (K), (L, W, Y, R, M, D)
- Chymotrypsin Digestion Yielded: (Y), (W, D), and (R, L, K, M)
- Cyanogen Bromide Treatment Yielded: (K, L, R), and (D, W, M, Y)

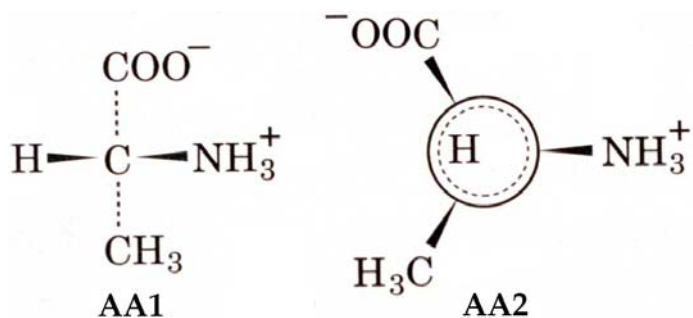
The primary sequence of this amino acid is:

- |    |   |
|----|---|
| A. | $\text{NH}_3^+$ -Leu-Trp-Tyr-Lys-Arg-Met-Asp- $\text{CO}_2^-$ |
| B. | $\text{NH}_3^+$ -Tyr-Asp-Trp-Met-Leu-Arg-Lys- $\text{CO}_2^-$ |
| C. | $\text{NH}_3^+$ -Tyr-Asp-Trp-Met-Arg-Leu-Lys- $\text{CO}_2^-$ |
| D. | $\text{NH}_3^+$ -Tyr-Asp-Trp-Met-Leu-Lys-Arg- $\text{CO}_2^-$ |
| E. | $\text{NH}_3^+$ -Tyr-Asp-Trp-Met-Leu-Arg-Lys- $\text{CO}_2^-$ |
| F. | $\text{NH}_3^+$ -Tyr-Trp-Asp-Met-Leu-Arg-Lys- $\text{CO}_2^-$ |
| G. | $\text{NH}_3^+$ -Tyr-Trp-Asp-Met-Leu-Lys-Arg- $\text{CO}_2^-$ |

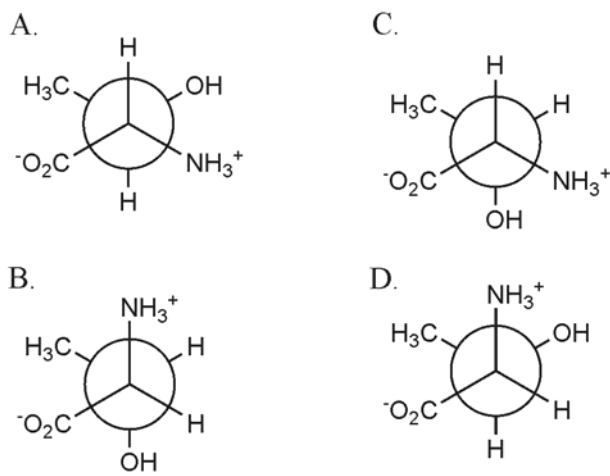


48. It would be possible for an ionic bond (salt bridge) to form between the following two amino acid *side chains*:
- A. isoleucine and leucine
  - B. histidine and glycine
  - C. methionine and cysteine
  - D. aspartic acid and arginine
  - E. alanine and phenylalanine
49. It would be possible for a hydrogen bond to form between the following two amino acid *side chains*:
- A. isoleucine and leucine
  - B. alanine and glycine
  - C. methionine and alanine
  - D. phenylalanine and glycine
  - E. glutamine and tyrosine
50. The pI of an amino acid may best be defined:
- A. as when the  $\text{pH} = (\text{pK}_1 + \text{pK}_2)/2$ .
  - B. as the pH at which the net charge of the amino acid is 0.
  - C. by Edman degradation analysis.
  - D. by analysis of its molecular mass.
  - E. as fully protonated.
51. The pI of the free amino acid Glycine is approximately:
- A. 0
  - B. 2
  - C. 9
  - D. 6
  - E. 10
52. The pH of a 10 mM solution of HCl is approximately:
- A. 0.5
  - B. 0.05
  - C. 2
  - D. 3
  - E. 10

53. Which of the following best describes the chirality of the two alanine amino acids (AA1 and AA2) below? (Note that C $\alpha$ -H $\alpha$  bond is going into the paper in AA2)



- A. AA1 and AA2 are enantiomers, with AA1 as an L isomer, and AA2 is 2R
- B. AA1 and AA2 are superimposable, with AA1 as an L isomer, and AA2 is 2R
- C. AA1 and AA2 are enantiomers, with AA1 as a D isomer, and AA2 is 2R
- D. AA1 and AA2 are superimposable, with AA1 as a D isomer, and AA2 is 2R
- E. AA1 and AA2 are enantiomers, with AA1 as an L isomer, and AA2 is 2S
- F. AA1 and AA2 are superimposable, with AA1 as an L isomer, and AA2 is 2S
- G. AA1 and AA2 are enantiomers, with AA1 as a D isomer, and AA2 is 2S
- H. AA1 and AA2 are superimposable, with AA1 as a D isomer, and AA2 is 2S
54. Which of the following Newman Projections show the amino acid threonine in the (2S,3R) configuration?



- E. Threonine has only one chiral center and cannot be shown as a Newman Projection.

55. A 0.1 M solution of cacodylate buffer was found to be 20% dissociated at pH 5.57. What is the pK of cacodylate buffer?

A. 4.87

D. 6.97

B. 5.57

E. 5.92

C. 6.17

56. A reaction with  $\Delta H = 11 \text{ kJ/mol}$  and  $\Delta S = 40 \text{ J/K mol}$ , at  $27^\circ\text{C}$ , is

A. spontaneous.

D. impossible to determine reactivity.

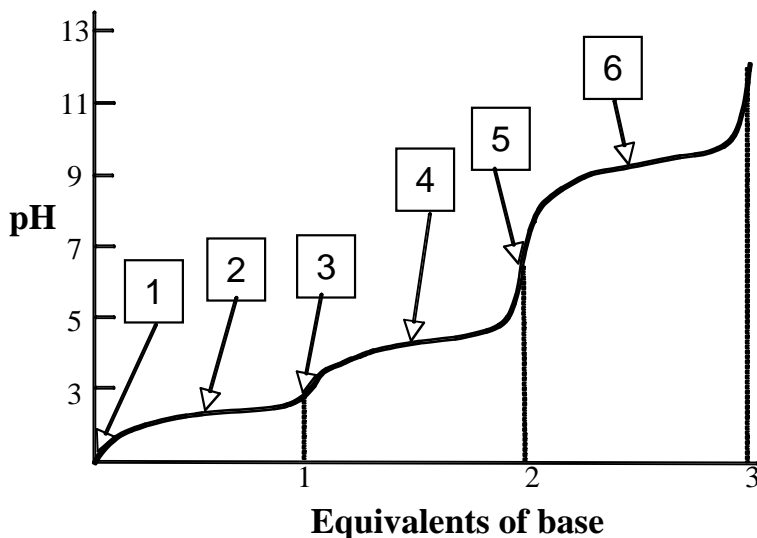
B. non-spontaneous.

E. none of the above.

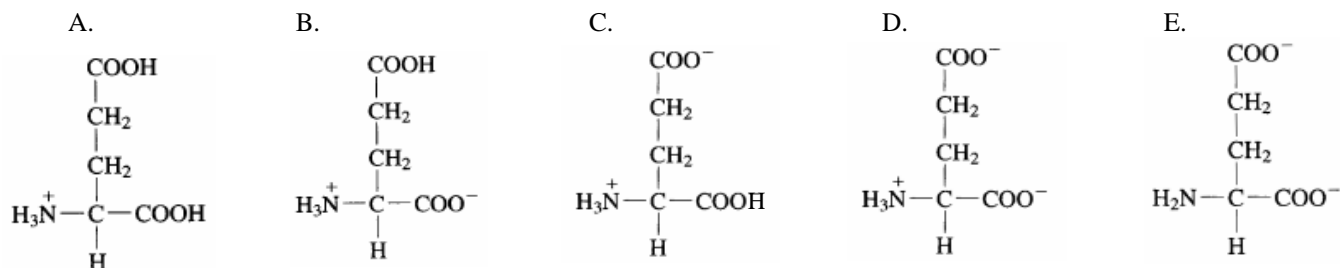
C. at equilibrium.

Shown below is a titration curve for glutamic acid. Examine the structures of the glutamic acid species (A – E) below. Choose the correct answer from A – E (questions #57-59).

Note: Answers may be used more than once.



57. What is the structure of the species that predominates at the labeled point “3”? \_\_\_\_\_
58. What is the structure of the species that predominates at the labeled point “5”? \_\_\_\_\_
59. What is the structure of the species that predominates at pH 11? \_\_\_\_\_



60. In the pH titration curve for glutamic acid shown above, the pI is at which point?

- |    |    |    |          |
|----|----|----|----------|
| A. | 1. | D. | 4        |
| B. | 2  | E. | <u>5</u> |
| C. | 3  | F. | <u>6</u> |

**Scratch Page 1**

**Scratch Page 2**