

CHEMISTRY 326

NAME_____KEY_____

Summer 2005

EXAM 1

1. If two molecules had a tendency to associate with each other because groups on their surfaces could form hydrogen bonds, what would be the effect of putting these two molecules in water? Explain your answer. (10pts)

Discuss Coulomb's Law related to solubility and polarity in water

2. Match the amino acids in the left hand column with the appropriate term in the right hand column. There is only one correct answer for each amino acid. The terms in the right hand column can only be used once. (10pts)

___3___ a. Lys

1. Non-polar aliphatic

___4___ b. Glu

2. Non-polar aromatic

___1___ c. Ala

3. Basic

___5___ d. Cys

4. Acidic

___6___ e. Ser

5. Sulfur containing

6. Hydroxyl containing

3. You are instructed to prepare 100mL of a 0.02M sodium phosphate buffer at pH7.2 by mixing 50mL of 0.02M Na₂HPO₄ and 50mL of 0.02M NaH₂PO₄. The pK for the species present is 7.2. Explain why this will be an effective buffer at the desired pH and concentration. (10pts)

$$pH = pKa + \log([A]/[HA]) \text{ or } pKa - \log([HA]/[A]) \quad (2 \text{ points})$$

$$7.2 = 7.2 + \log[50\text{mL} \times 0.02\text{M}]/[50\text{mL} \times 0.02\text{M}] \quad (6 \text{ points})$$

$$7.2 = 7.2 + \log 1 \quad (4 \text{ points})$$

log of 1 = 0 therefore the pK equals the pH and so the system is at the midpoint of the buffer range which will be the effective buffer zone since it will buffer between +/- 1 pH of the pK of the weak acid.

4. Absorption of food in the stomach and digestive tract depends on the ability of the molecules to penetrate the cell membrane and pass into the blood. Because hydrophobic molecules are more likely to be absorbed than hydrophilic or charged molecules, the absorption of orally administered drugs depends on their pK values and the pH of the digestive organ. Aspirin has an acid proton that will dissociate and its pK value is 3.5. (R-COOH; pK = 3.5) Calculate the PERCENTAGE of aspirin available for absorption in the stomach (pH is 1) vs. the intestine (pH is 6.8). (10pts)

$$pH = pKa + \log([A]/[HA]) \text{ or } pKa - \log([HA]/[A]) \quad (2 \text{ points})$$

$$1 = 3.5 + \log([A]/[HA]) \quad \text{OR}$$

$$-2.5 = \log([A]/[HA])$$

$$6.8 = 3.5 + \log([A]/[HA])$$

$$3.3 = \log([A]/[HA])$$

0.003 = [A]/[HA] ~0.003%
Species deprotonated at
At pH1 (makes sense)

1955/1 = [A]/[HA] 99.9% species
deprotonated at pH6.8 (makes sense)

5. Answer True (T) or FALSE (F): (14pts)

 F 1. All amino acids found in proteins have L-configurations.

 T 2. The amide link that joins two amino acids is called a "peptide" bond.

 T 3. Two different dipeptides can be formed from the amino acids Gly & Phe.

 F 4. The molecule Ala-Phe-Tyr has 3 different amino acids therefore it can be classed as a dipeptide.

 T 5. A "zwitterion" is a dipolar ion form of an amino acid.

 T 6. The solubility of an amino acid decreases as the pH approaches the pI of the amino acid.

 T 7. Glutathione is a natural peptide that functions as an anti-oxidant.

6. Define the following terms: (6pts)

a. pI

Isoelectric point at which the net charge on the molecule is equal to zero.

b. Buffer range

+/- 1 pH unit of the pK of the weak acid or base

c. Reducing equivalents

2e⁻ and 2 H⁺

7. Differentiate between the following members of each pair: (5 pts)

a. cytoplasm vs cytosol

sol-gel system and the organelles vs just the sol-gel system

b. Orthophosphate vs pyrophosphate

single inorganic phosphate vs the phosphate diester; P_i vs PP_i

8. List five different molecular forces responsible for maintaining the 3-D spatial shape of proteins. Give a specific amino acid that would contribute to each of these forces, assuming the appropriate conditions. (10pts)

London

Phobic/ phobic

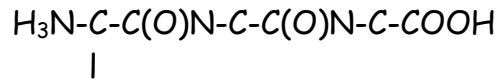
Covalent

H-bonding

Electrostatic

Examples vary depending on the R-group

9. Draw the peptide that is composed of glutamic acid, lysine and cysteine.
 The Lysine residue is the N-terminus and the cysteine residue is the C-terminus.
 Indicate the net charge on the peptide at pH6 show your work. (10pts)



net charge at pH6=0

10. A direct current was passed through a solution containing ala, lys, and asp at a pH of 6.0. Match the behavior with the correct amino acid at the pH condition stated. (5pts)

A. Migrated to the cathode (negative pole) _____ lys _____

B. Migrated to the anode (positive pole) _____ asp _____

C. Remained stationary _____ ala _____

11. The isoelectric point of fibroin is 2.2. Which of the following amino acids is likely to be present in large amounts? (5pt) _____ *A* _____

- a. aspartic acid
- b. lysine
- c. alanine
- d. None of the above

12. Arrange the following cellular components in order of increasing size.
 NO PARTIAL CREDIT. (5pts)

amino acid, ribosome, water molecule, protein, endoplasmic reticulum

water, amino acid, protein, ribosome, endoplasmic reticulum