CHM 333
HOMEWORK #1
DUE WEDNESDAY SEPTEMBER 16, 2009 (NO LATER THAN 5PM)
25 30 POINTS

ATTACH SEPARATE SHEETS FOR THE ANSWERS TO QUESTIONS 1-6
AND SHOW ALL OF YOUR WORK

1. a. Draw the fully protonated form of the peptide CGYLKE. 2 pts
   b. What is the overall charge of this peptide at pH 7.0? 1 pt
   c. Calculate the pK of this peptide? 2 pts
   5 (8 points)

2. Re-write the following peptides using the three letter amino acid codes.
   (4 points)
   a. WRATIGEH 2 pts
   b. KVQLDCMY 2 pts

3. a. Draw the different equilibrium equations of the ionization stages of the
         amino acid glutamate. Begin with the fully protonated form. 4 pts
   b. Calculate the pK. 1 pts
   c. Sketch a complete titration curve for glutamate. 3 pts
   (8 points)

4. (7 points) How many grams of sodium succinate (MW = 140 g/mol) and
disodium succinate (MW = 162 g/mol) must be added to 1 L of water to
produce a solution with pH = 6.0 and a total solute concentration of 50 mM?
The pKa is 5.64.

\[
\text{Na}^+ \text{O} \begin{array}{c} \text{H} \\ \text{H} \end{array} \text{OH} \quad \text{pK}_a = 5.64 \quad \text{H}^+ + \text{Na}^+ \text{O} \begin{array}{c} \text{H} \\ \text{H} \end{array} \text{O} \text{Na}^+
\]

\begin{align*}
\text{monosodium succinate} & \quad \text{disodium succinate} \\
3p^+ - HH & \quad \text{equation and ratio} \\
1p^+ - g & \quad \text{HA} \\
1p^+ - g & \quad \text{A}^-
\end{align*}
Homework #1

1. a. Try - Arg - Ala - Thr - Ile - Gly - Glu - His
   b. Lys - Val - Gln - Leu - Asp - Cys - Met - Tyr

2. \[ \text{Net charge} = +1 \quad \text{net charge} = 0 \quad \text{net charge} = -1 \]
\[
\text{net change} = -2
\]

\[
b. \quad pI = \frac{pK_{1} + pK_{2}}{2} = \frac{2.2 + 4.3}{2} = \boxed{3.25}
\]
4. \[ \text{pH} = \text{pK}_a + \log \frac{[A^-]}{[HA]} \]

\[ 6.0 = 5.64 + \log \frac{[A^-]}{[HA]} \]

\[ -5.64 - 5.64 \]

\[ 0.36 = \log \frac{[A^-]}{[HA]} \]

\[ 10^{0.36} = 10^{(\log \frac{[A^-]}{[HA]})} = 2.29 \]

\[ \frac{2.29}{1} = \frac{[A^-]}{[HA]} = 3.29 \text{ parts} \]

1 part = 15.2 mM

2.29 parts = 34.8 mM

\[ 14 \times \frac{34.8 \text{ m moles}}{14} = 34.8 \text{ m moles} \]

\[ 1L \times \frac{15.2 \text{ m moles}}{1L} = 15.2 \text{ m moles} \]

\[ 34.8 \text{ m moles} \times \frac{1 \text{ mole}}{1000 \text{ m moles}} = 0.0348 \text{ moles} \]

\[ 15.2 \text{ m moles} \times \frac{1 \text{ mole}}{1000 \text{ m moles}} = 0.0152 \text{ moles} \]

\[ 0.0348 \text{ moles} \times \frac{162.9 \text{ g}}{\text{mol}} = 5.64 \text{ g sodium succinate} \]

\[ 0.0152 \text{ moles} \times \frac{140 \text{ g}}{\text{mol}} = 2.13 \text{ g sodium succinate} \]
5. Complete the following crossword puzzle: (3 pts)

Down:
2. An amino acid has a pH of zero at its __________ point
5. This biological energy source is produced in the mitochondria
6. This is the number of naturally occurring amino acids

Across:
1. This amino acid's side chain is joined to both its α-carbon and its amino group
3. At physiological pH, amino acids exist with a + and − charge, which is called this
4. Stereoisomers that are non-superimposable mirror images of each other
7. The covalent bond between 2 amino acids