

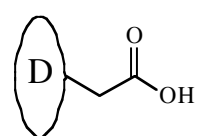
## Problem Set #8 – Chemistry 102 – Spring 2008

Due Wednesday, April 16<sup>th</sup> at the beginning of class

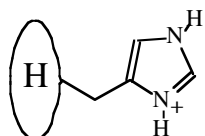
From Whitten: Ch. 19 #'s **15, 35, 51ac&e** and Ch. 20; #'s **15, 29**

- An imidazolium ( $\text{HIm}^+$ ) buffer starts with 0.10 M of both conjugate acid and base (Im).
  - Calculate the change in pH if HCl is added to the buffer to a final concentration of 0.01 M. (The  $\text{pK}_a$  of  $\text{HIm}^+$  is 6.8).
  - Repeat the calculation assuming that you start with 0.18 M  $\text{HIm}^+$  and 0.02 M Im. What is the initial pH and what would be the final pH?
- Describe how to prepare 1.00 L of a 0.100 M ammonium buffer, pH 10.0 starting with a 5.0 M solution of  $\text{NH}_3$  in water and a 2.0 M solution of HCl. Specifically identify what volume of each solution you will need to add to create 1.00 L of a buffer of the appropriate pH.

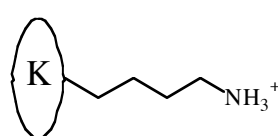
- Consider three proteins D, H and K. Each of them uses a different amino acid side chain as a proton donor (D = aspartic acid, H = histidine, K = lysine):



$\text{pK}_a = 4.7$



$\text{pK}_a = 6.8$



$\text{pK}_a = 10.2$

- Rank these three amino acid side chains in order of increasing acid strength.
  - Use the Henderson-Hasselbalch equation to calculate the ratio of conjugate base to conjugate acid for each amino acid sidechain at pH = 7.0.
  - In biochemistry, it is commonly accepted that histidine (H) is the best amino acid side chain for a protein to use if a proton donor is required for its function. Based on your results in "a" & "b", explain why that is the case.
- Use equilibrium tables (ICE boxes) to answer the following:
    - What is the solubility of  $\text{Zn}(\text{OH})_2$ , which has a  $\text{K}_{\text{sp}}$  of  $4.5 \times 10^{-17}$ ?
    - Calculate the pH of a saturated solution of  $\text{Zn}(\text{OH})_2$ .
    - What would the saturating concentration of  $\text{Zn}^{2+}$  be in a buffer at pH 7.0?
  - NOTE: The original question #5 is not required for this week's problem set.