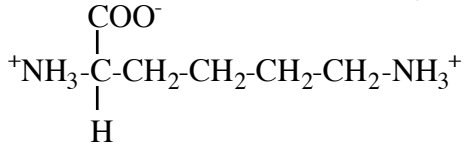
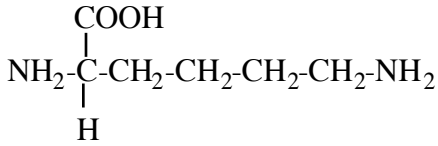
THIRD PROBLEM SET

1. We generally write the structure of the amino acid **lysine** as found in a cell as:



In text books, it is often written as:



a. Circle the groups in the above **two** structures that are likely to act as acids. Explain your reasoning.

b. Put a triangle around the groups in the above **two** structures that are likely to act as bases. Explain your reasoning.

c. Draw the structure of this amino acid as it would appear at very high pH, at very low pH. Explain your reasoning.

d. Why does chymotrypsin become inactive at high pH.

2. Circle ALL the correct answers in each of parts a, b and c.

After the reaction A $\rightleftharpoons$ B has reached equilibrium:

a. the rate at which A is converted to B is constant, increasing, decreasing, zero.

b. the concentration of A is constant, increasing, decreasing, zero, dependent on the ΔG of the reaction.

c. the rate at which A is converted to B is greater than, less than, equal to the rate at which B is converted to A.

3. Hemoglobin carrying oxygen circulates in the blood. When it gets to the leg, where oxygen is required for function, it releases the oxygen. When it gets to the lungs it binds to the oxygen that has been breathed in. How does it "know" it should bind oxygen in the lungs and release oxygen in the leg? (Assume that you are talking about a hemoglobin molecule that simply binds to or releases oxygen without any additional complicating effects.)

4. Why, at pH 8, does the isoleucine 16 in chymotrypsin have its proton (H^+) attached while the histidine 57 does not? Explain fully in a way that your Sanskrit-major roommate could understand. (HINT: you need not know what isoleucine 16 or histidine 57 do in order to answer this question.)

5. It has been shown that protons can bind to the amino acids at the end of the chains of both the α and β subunits of hemoglobin.

a. Active muscles have a pH of 7.2 compared to the normal pH of 7.4. This is attributed to the production of large amounts of lactic acid (lactate) in muscle during exercise. Why is the pH of the muscles decreased by the increase in the level of lactic acid (CH_3-CHOH-COOH)?

b. Would you expect to find more H^+ bound to the terminal amino acids of hemoglobin in the lungs or in the muscles. Explain.

c. Binding of protons to hemoglobin causes a change in the shape of the molecule to a form that has a different affinity for oxygen compared to the form not bound to protons. Assuming the physiology has been tuned in evolution to be advantageous to the organism, propose whether hemoglobin with the extra protons has a higher or lower affinity for oxygen. Explain.