1. Circle the strongest acid:
   a. NH$_3$ or NH$_4^+$
   b. H$_2$O or NH$_3$
   c. HCl or HBr
   d. CH$_3$CH$_2$OCH$_2$CH$_2$OH or CH$_3$OCH$_2$CH$_2$OH
   e. CH$_3$COOH or CH$_3$CH$_2$OH
   f. CH$_3$CH$_3$ or CH$_2$=CH$_2$

2. Circle the strongest base:
   a. CH$_3$S$^-$ or CH$_3$O$^-$
   b. PH$_3$ or H$_2$S
   c. CF$_3$COO$^-$ or CH$_3$COO$^-$

3. Identify the acids and bases in the following reaction

   \[
   \text{HCOOH} + \text{CH$_3$NH}_3^+ \rightleftharpoons \text{HCOO}^+\text{H} + \text{CH$_3$NH}_2
   \]

   a. Draw a curved arrow mechanism to show the electron flow in the reaction

   b. Use pKa values to state whether the reactants or products are favored at equilibrium
4. The pKa of carbonic acid (H$_2$CO$_3$) is 6.4.
   a. Which species, the acid or its conjugate base, is more prevalent at a physiological pH of 7.4?

   b. What is the ratio of acid to conjugate base at pH = 7.4?

   c. At what pH is more than 99% of carbonic acid in its neutral form?

5. Lysine, an amino acid, has the following structure:

   a. Why is the pKa of the carboxylic acid in lysine lower than acetic acid (pKa = 4.75)?

   b. Draw the structures of lysine at the pH values of 0, 7, and 12.