1. A 50.00 mL sample of 0.100 M acetic acid ($K_a = 1.8 \times 10^{-5}$), is titrated with an 0.0500 M calcium hydroxide solution. Calculate the pH of the solution after the given amount of calcium hydroxide solution has been added.
   a. 0.00 mL
   b. 25.0 mL
   c. 50.0 mL
   d. 75.0 mL

2. Consider the titration of 60.0 mL of 0.100 M NH$_3$ ($K_b = 1.8 \times 10^{-5}$) with 0.150 M HCl. Calculate the pH after each of the following volumes of HCl have been added to the NH$_3$ solution.
   a. 0.00 mL
   b. 20.0 mL
c. 40.0 mL

d. 60.0 mL

3. A solution contains 1.35 g of acetic acid ($K_a = 1.8 \times 10^{-5}$) and 2.42 g of sodium acetate in 1.00L. What is the pH of this solution? How many mL of a 0.100 M nitric acid solution must be added to lower the pH by 0.50? How many mL of a 0.100 M calcium hydroxide must be added to raise the pH by 0.50?
4. How many milliliters of 0.0350 M sodium hydroxide NaOH are required to titrate the following solutions to the equivalence point?

   a. 40.0 mL of 0.0350 M nitric acid?

   b. 80.0 mL of a solution that contains 1.65 g of HCl per liter?

5. State whether each of the following gives an acidic or basic solution when put into water.

   \[
   \begin{align*}
   \text{CO}_2 & \quad \text{MgO} & \quad \text{Al}_2\text{O}_3 & \quad \text{P}_2\text{O}_5 \\
   \text{SO}_3 & \quad \text{BaO} & \quad \text{SiO}_2 & \quad \text{CaO}
   \end{align*}
   \]
6. A 0.1044 g sample of an unknown monoprotic acid required 22.10 mL of 0.0500 M NaOH to reach the end point.

   a. What is the molecular weight of the unknown acid?

   b. The pH of the solution after addition of 11.05 mL of the base is 4.89. What is the $K_a$ for the acid?

7. Tell what species are present at each of the points labeled on the titration curve for sodium hydroxide and acetic acid.
Chuck decided he should clean out his hood so he started a waste beaker. In this beaker Chuck combined 100.00 mL of 0.100 M hydrochloric acid, 100.00 mL of 0.100 M strontium hydroxide, 150.0 mL of 0.200 M of a weak acid, HA, \(K_a = 1.3 \times 10^{-5}\), and 150.0 mL of 0.200 M the weak acids conjugate base, NaA. Calculate the pH of this solution?
9. Given a 30.0 M solution of $\text{H}_3\text{AsO}_4$, calculate the concentration of $\text{AsO}_4^{3-}$ at equilibrium.

Ka$_1$ = $5.0 \times 10^{-3}$
Ka$_2$ = $6.0 \times 10^{-8}$
Ka$_3$ = $6.0 \times 10^{-10}$