1. A 0.050 M solution of weak acid, HA, has a pH = 2.23 at 25 °C.

   A) Write the chemical equilibrium of the weak acid in water.

   B) Write an expression for K_a (the weak acid dissociation equilibrium constant).

   C) Determine the value of $[H^+]$ (or $[H_3O^+]$) at equilibrium.

   D) What is the percent ionization of this acid?

   E) What is the value of K_a for this acid?

   F) Without any calculations: If we increase the volume by 10×, do you expect the percent ionization to increase, decrease, or stay the same? What about the pH? Why?

   Hint: What is Q immediately after adding more water?

2. What is the pH of a 0.200 M solution of $C_6H_5NH_2$ if its pK_b = 9.40?

3. What is the pH of a 1.5×10^{-7} M solution of $Ba(OH)_2$?

   Hint: Before you start this problem, do you expect the pH to be <7, ~7, or >7?

4. Rank the following in order of increasing acid strength.

   H_2SeO_4 H_2SO_4 H_2SeO_3 H_2SO_3

   Hint: Draw a Lewis structure for the conjugate-base of H_2SO_4.

5. You make a 1.00 L solution that is 0.120 M HNO_2 and 0.150 M $NaNO_2$, K_a of $HNO_2 = 4.0 \times 10^{-4}$.

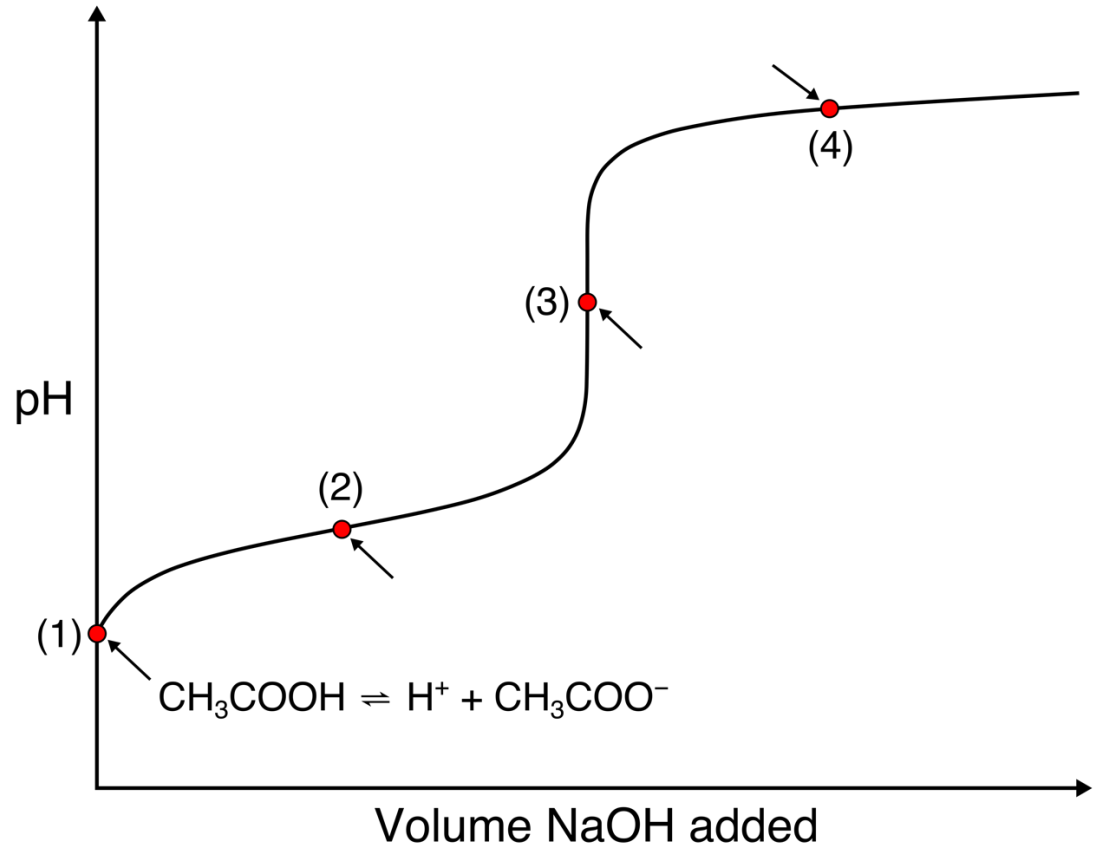
   A) Calculate the pH of this buffer solution.

   B) Calculate the pH after 1.00 mL of 11.6 M HCl is added to the buffer solution.

   C) Calculate the pH after 1.00 mL of 11.6 M NaOH is added to the buffer solution.

6. You are titrating 2.0 mL of 1.0 M acetic acid (CH_3COOH, $K_a = 1.76 \times 10^{-5}$) with 1.0 M NaOH.

   A) Below is a sketch of the titration curve. At each labelled point, what is the dominant species in solution?



   B) Calculate the pH before any NaOH is added, point (1).

   C) Calculate the pH after 0.5 mL of 1.0 M NaOH is added.

D) How much (in moles) NaOH is required to get to point (2) where the pH = pK_a?

E) Do you expect the pH at the equivalence point (point 3) to be <7, =7, or >7?

F) Calculate the pH at the equivalence point, point (3).

G) Calculate the pH after 3.0 mL of NaOH is added, point (4).

H) Go back to the diagram above. Circle the region in which you would find a buffer solution. What do you notice about the pH in this range? Does the pH-dependence make sense?