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

   A) Write a balanced chemical equilibrium equation for this system/reaction.

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

   C) At equilibrium, determine the value of $[H^+]$ (or $[H_3O^+]$).

   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 $1.5 \times 10^{-7}$ M solution of $Ba(OH)_2$? 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.

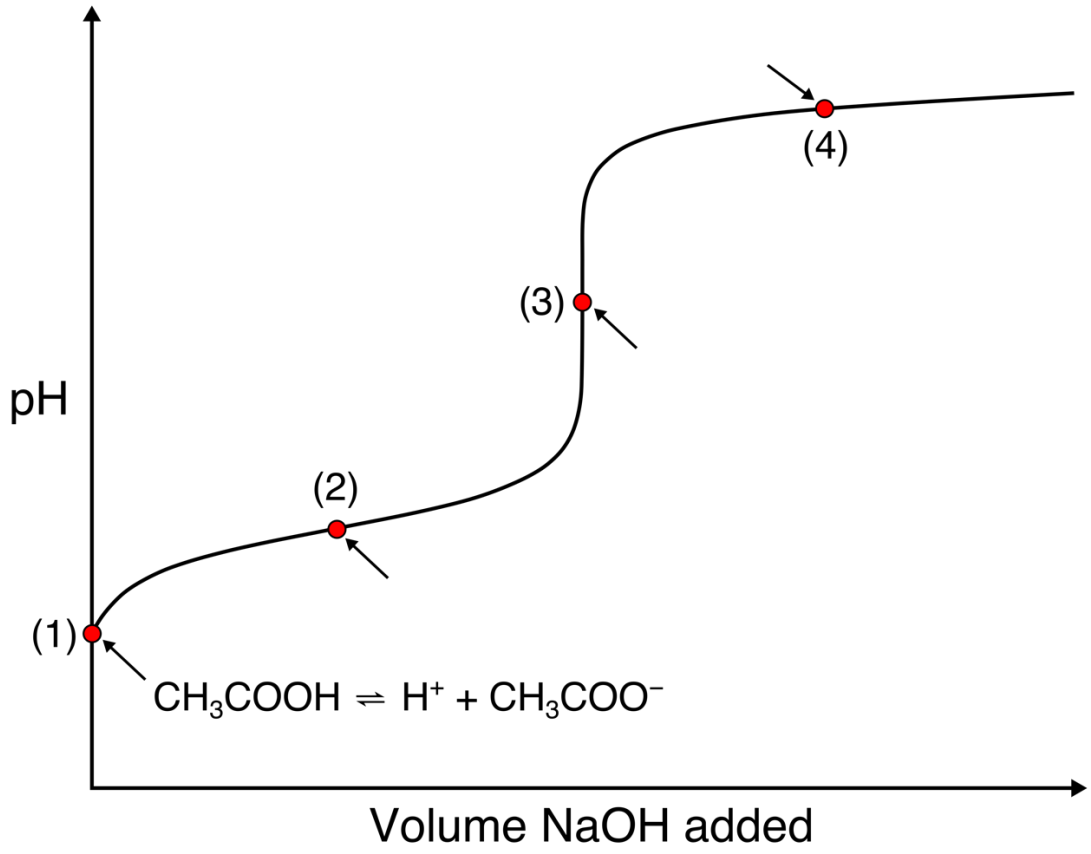
   B) Calculate the pH after 1.00 mL of 11.6 M HCl is added to the buffer solution.

   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, write the chemical species you would expect to find in solution.

   *I did point (1) for you in the form of an equilibrium expression.*




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

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

D) How much NaOH is required to get to point (2) if the pH = p$K_a$?

E) Do you expect the pH at the equivalence point 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?