Recitation 1 - pH and pKa

Name: ____________________

Learning Outcome: Students will be able to calculate buffer conditions under multiple scenarios using the Henderson-Hasselbach equation.

You have been given an envelope of ions and molecules. Use these molecules to make a representative solution on your table. Start by having 4 molecules of water.

1. Show neutral water. What is the pH of this solution? What is the concentration of hydronium ions in neutral water?

2. Show the auto ionization of one molecule of your water. Does the pH go up or down?

3. Show the removal of a proton from the solution. Does the pH go up or down?

4. Show the addition of two protons to the solution. Does the pH go up or down?

5. Go back to neutral water. Now show the addition of KOH. Does the pH go up or down?

6. Now show the addition of HCl. Does the pH go up or down?

7. If you added equal amounts of KOH and HCl to neutral water, what would the pH be?
8. If you had a solution of 0.6M KOH and 0.5M HCl...
   a. Would the pH be neutral, slightly basic, very basic, slightly acidic, or very acidic?

   b. How would you represent this as an equation?

   \[ \text{pH} = \]

9. Buffer X has a pKa of 7.5. A solution starts with 100mM of buffer X in protonated form, and 50mM buffer X in the deprotonated form.
   a. Write an equation representing the pH of this solution.

   b. KOH was added to a final concentration of 25mM. Write an equation representing the pH of the solution after the addition of KOH.
Recitation 1 Challenge Question
Group members:

10. You have two representative molecules of buffer X.
   a. Write a Henderson-Hasselbalch equation representing the buffer solution at pH 7.5.

   b. Draw the protonation state of these two “representative” molecules at pH 7.5.

   c. If two molecules of buffer X were pulled out of solution at pH 5.5, what protonation state would they most likely be in?

   d. What percentage of the buffer molecules are deprotonated in solution at pH 5.5?