

Name:

BIO 375: Biochemistry – Fall 2026
Homework 1 – pH and buffers (10 points)
(Due Thursday, 9/10/26, in class)

Useful information:

1. For the following weak acid: $\text{HA} \rightleftharpoons \text{H}^+ + \text{A}^-$
 $K_a = [\text{H}^+][\text{A}^-]/[\text{HA}]$
 $\text{p}K_a = -\log K_a$

(Strong acids and bases undergo complete dissociation: $\text{HA} \rightarrow \text{H}^+ + \text{A}^-$)

2. Henderson-Hasselbach equation: $\text{pH} = \text{p}K_a + \log ([\text{A}^-]/[\text{HA}])$
3. Normality = Molarity X n (where n = number of protons exchanged)
4. Concentration of buffer = [acid] + [conjugate base] = $[\text{HA}] + [\text{A}^-]$

Always look at “useful information” provided

Note – I will deduct points if you do not provide units in your answers.

Please SHOW all work/calculations that helped you arrive at your answers.

Name:

Questions:

1. a) What is the $[\text{OH}^-]$ of a 0.1 M HCl solution?
b) The K_b for ammonia (NH_3) is 1.8×10^{-5} mole/liter. What is its K_a value?
2. a) Which is stronger: a 0.05 M H_2SO_4 solution or a 0.1 M acetic acid solution? Calculate respective pHs to figure this out. (The first proton of H_2SO_4 dissociates completely, while the second has a pK_a of 1.9. The pK_a of acetic acid is 4.8.)
b) What volume of 0.1 N NaOH would be required to titrate 10 mL aliquots of each acid solution to their respective end points?
3. a) Calculate the molarity of glacial acetic acid? (Mol. Wt. = 60 g/mole; specific density = 1.049 g/mL)
b) Calculate the amount (in grams) of sodium acetate (Mol. Wt. = 82 g/mole) and the amount (in mL) of glacial acetic acid required to make 1 L of 0.1 M sodium acetate buffer at pH 4.5. The pK_a of acetic acid is 4.8.
4. If 10 mL of an acid at 0.09 M gave rise to a solution of pH 5.9 when mixed with 20 mL of 0.15 M potassium salt of itself, what is the pK_a of this acid?
5. If one mixes 100 mL of 0.1 M sodium acetate with 100 mL of 0.1 M acetic acid, the pH of the solution obtained is 4.8. What would be the new pH if 80 mL of 0.1 N NaOH were added to this solution? The pK_a of acetic acid = 4.8.
6. You need to make 500 mL of a 0.2 M phosphate buffer at pH 7.0. Given 1 M stock solutions of H_3PO_4 , NaH_2PO_4 , Na_2HPO_4 , and Na_3PO_4 , how might you go about doing this?
(pK_{a1} of phosphoric acid = 2.1; pK_{a2} = 7.2; and pK_{a3} = 12.3)