Experiment 9 Post-lab Help Sheet

This post-lab will be graded with no partial credit. Correct answers are worth 2 points, and any wrong answers will get 0 points. Correct answers with the wrong number of significant digits will lose ½ point.

1. A 0.360 M solution of hydrocyanic acid, HCN, has a pH of 4.83. Calculate the ionization constant for hydrocyanic acid. Show your work.

Start with the equilibrium expression, and assume that $[H^+] << [HCN]$. You should know (or be able to figure out) $[H^+]$, [HCN], and $[CN^-]$, and can calculate K_a from there. It will be a very small number.

2. How much water needs to be added to 50.0 ml of 0.360 M hydrocyanic acid to make a solution of pH = 5.10? Show your work.

Calculate [HCN] at pH 5.10 using the K_a you got in problem 1, then use $M_1V_1 = M_2V_2$ to find the final volume after the dilution. Remember that the question is asking for how much water has to be added to reach the final volume.

3. Calculate the mass of benzoic acid, C_6H_5COOH, that needs to be used to make 500.0 ml of solution of pH = 2.95. For benzoic acid, $K_a = 6.46\times10^{-5}$. Show your work.

Calculate the concentration of benzoic acid at pH 2.95, then multiply by volume (in liters), and convert moles to grams to get your final answer.

4. 50.0 ml of a 0.850 M sodium propionate, CH_3CH_2COONa, was added to 200.0 ml of a 0.300 M propionic acid, CH_3CH_2COOH. Calculate the pH of the resulting solution. For propionic acid, $K_a = 1.34\times10^{-5}$. Show your work.

Calculate moles of propionic acid and divide by the total volume to get concentration. Do the same for sodium propionate. Now you know three of the four variables in the equilibrium expression, so solve for $[H^+]$ and calculate pH.

5. A buffer solution is prepared by mixing 650.0 ml of 0.540 M formic acid, HCOOH, and 250.0 ml of 1.35 M sodium formate, HCOONa. How much will the solution pH change when 50.0 ml of 3.50 M sodium hydroxide is added to the buffer? For HCOOH,
$K_a = 1.8\times10^{-4}$. Show your work.

Calculate the initial pH of the buffer exactly like you did in the last problem, but with formic acid and sodium formate. It will be a number less than 4.0.

When you add NaOH, however many moles of base you add will convert that many moles of formic acid to sodium formate. Calculate the new number of moles of formic acid and sodium formate and divide by the new total volume. Then you'll have three of the four variables in the equilibrium expression and can solve for $[H^+]$ and then calculate pH. It will be a number greater than 4.0.

Then subtract your initial pH from the final pH to get the change.