CHEM 1F92 Assignment 14. Buffers

Assignment 14, Version # 34

1. Write the equations for the reaction of the following Bronsted acids with water:
(a) $H_2PO_4^-$ (b) HOCN (c) $H_2C_2O_4$

2. Write equations for the reactions of the following Bronsted bases with water:
(a) CO_3^{2-} (b) N_2H_4 (c) OCN^-

3. Give the letters of the solutions below that represent buffers.
(a) a solution of sodium hydrogen carbonate and sodium chloride;
(b) a solution of acetic acid and sodium acetate;
(c) a solution of sodium hydrogen sulfate and sodium sulfate;
(d) a solution of aniline and anilinium nitrate.

4. A solution of 0.193 M KOH (34.8 mL) is mixed with 34.6 mL of 0.179 M HCl. Assuming that the final volume is the sum of the initial volumes, calculate:
(a) the molarity of the K^+ cation
(b) the molarity of the Cl^- anion
(c) the pH of the final solution
(d) the pOH of the final solution

5. Calculate the pH of the following buffer solutions:
(a) a solution made by dissolving 4.777 g KH_2PO_4 and 2.799 g K_2HPO_4 in water to give 450. mL of solution. Stepwise acid dissociation constants for phosphoric acid may be found in your textbook.
(b) a solution made by mixing 40.00 mL 0.25 M NH_3 with 10.00 mL 0.27 M NH_4Cl. The base dissociation constant K_b is 1.79×10^{-5} for NH_3. Assume that the final volume is the sum of the volunes of the two solutions that are mixed.

6. You have 15.00 mL of a 0.150 M aqueous solution of the weak base C_5H_5N ($K_b = 1.50 \times 10^{-9}$). This solution will be titrated with 0.150 M HCl.
(a) How many mL of acid must be added to reach the equivalence point?
(b) What is the pH of the solution before any acid is added?
(c) What is the pH of the solution after 5.00 mL of acid has been added?
(d) What is the pH of the solution at the equivalence point of the titration?
(e) What is the pH of the solution when 20.00 mL of acid has been added?

7. In each of the following questions, assume that there is no volume change when HCl is added to water in part (a) or the phosphate buffer in part (c).
(a) Calculate the pH when 0.021 moles of HCl are added to 1.000 liter of water.
(b) What is the difference between the pH of pure water (pH 7.00) and the pH of the solution after HCl was added?
(c) Calculate the pH when 0.021 moles of HCl are added to 1.000 liters of a buffer containing 0.128 M KH_2PO_4 and 0.122 M K_2HPO_4.
(d) The pH before the HCl was added is equal to 7.187. What is the difference between the pH before adding the HCl and after adding the HCl?