Name _____ AP Chem ___/___/___

Chapter 14 HW - #3 (Due 11/21/2019)

Complete both free response questions. Show all work. Box and clearly label all final answers

1. In water, hydrazoic acid, HN_3, is a weak acid that has an equilibrium constant, K_a, equal to 2.8×10^{-5} at 25°C. A 0.800-liter sample of a 0.040-molar solution of the acid is prepared.

(a) Write the expression for the equilibrium constant, K_a, for hydrazoic acid.

(b) Calculate the pH of this solution at 25°C.

(c) Calculate the percent ionization of the solution.

(d) To 0.150 liter of this solution, 0.80 gram of sodium azide, NaN_3, is added. The salt dissolves completely. Calculate the pH of the resulting solution at 25°C if the volume of the solution remains unchanged.

2. $NH_3(aq) + H_2O(l) \leftarrow \rightarrow NH_4^+(aq) + OH^-(aq)$

In aqueous solution, ammonia reacts as represented above. In 0.0480 *M* $NH_3(aq)$ at 25°C, the hydroxide ion concentration, $[OH^-]$, is 7.30×10^{-5} *M*. In answering the following, assume that temperature is constant at 25°C and that volumes are additive.

(a) Write the equilibrium-constant expression for the reaction represented above.

(b) Determine the pH of 0.0480 *M* $NH_3(aq)$.

(c) Determine the value of the base ionization constant, K_b, for $NH_3(aq)$.

(d) Determine the percent ionization of NH_3 in 0.0480 *M* $NH_3(aq)$.

3. A pure 16.85 g sample of the weak base ethylamine, $C_2H_5NH_2$, is dissolved in enough distilled water to make 500. mL of solution.

(a) Calculate the molar concentration of the $C_2H_5NH_2$ in the solution.

The aqueous ethylamine reacts with water according to the equation below.

$$C_2H_5NH_2(aq) + H_2O(l) \leftrightarrows C_2H_5NH_3^+(aq) + OH^-(aq)$$

(b) Write the equilibrium-constant expression for the reaction between $C_2H_5NH_2(aq)$ and water.

(c) Of $C_2H_5NH_2(aq)$ and $C_2H_5NH_3^+(aq)$, which is present in the solution at the higher concentration at equilibrium? Justify your answer.

(d) A different solution is made by mixing 500. mL of 0.500 *M* $C_2H_5NH_2$ with 500. mL of 0.200 *M* HCl. Assume that volumes are additive. The pH of the resulting solution is found to be 10.93.

(i) Calculate the concentration of $OH^-(aq)$ in the solution.

(ii) Write the net-ionic equation that represents the reaction that occurs when the $C_2H_5NH_2$ solution is mixed with the HCl solution.

(iii) Calculate the molar concentration of the $C_2H_5NH_3^+(aq)$ that is formed in the reaction.

(iv) Calculate the value of K_b for $C_2H_5NH_2$.

4. $HC_3H_5O_2(aq) \leftarrow \rightarrow C_3H_5O_2^-(aq) + H^+(aq)$ $K_a = 1.34 \times 10^{-5}$

Propanoic acid, $HC_3H_5O_2$, ionizes in water according to the equation above.

(a) Write the equilibrium-constant expression for the reaction.

(b) Calculate the pH of a 0.365 *M* solution of propanoic acid.

(c) A 0.496 g sample of sodium propanoate, $NaC_3H_5O_2$, is added to a 50.0 mL sample of a 0.365 *M* solution of propanoic acid. Assuming that no change in the volume of the solution occurs, calculate each of the following.

(i) The concentration of the propanoate ion, $C_3H_5O_2^-(aq)$, in the solution

(ii) The concentration of the $H^+(aq)$ ion in the solution

The methanoate ion, $HCO_2^-(aq)$, reacts with water to form methanoic acid and hydroxide ion, as shown in the following equation.

$$HCO_2^-(aq) + H_2O(l) \rightleftharpoons HCO_2H(aq) + OH^-(aq)$$

(d) Given that $[OH^-]$ is 4.18×10^{-6} *M* in a 0.309 *M* solution of sodium methanoate, calculate each of the following.

(i) The value of K_b for the methanoate ion, $HCO_2^-(aq)$

(ii) The value of K_a for methanoic acid, HCO_2H

(e) Which acid is stronger, propanoic acid or methanoic acid? Justify your answer.