

Name \_\_\_\_\_

AP Chem

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

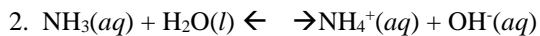
**Complete both free response questions. Show all work. Box and clearly label all final answers**

1. In water, hydrazoic acid,  $\text{HN}_3$ , is a weak acid that has an equilibrium constant,  $K_a$ , equal to  $2.8 \times 10^{-5}$  at  $25^\circ\text{C}$ . 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  $25^\circ\text{C}$ .
- (c) Calculate the percent ionization of the solution.
- (d) To 0.150 liter of this solution, 0.80 gram of sodium azide,  $\text{NaN}_3$ , is added. The salt dissolves completely. Calculate the pH of the resulting solution at  $25^\circ\text{C}$  if the volume of the solution remains unchanged.

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In aqueous solution, ammonia reacts as represented above. In  $0.0480 \text{ M NH}_3(\text{aq})$  at  $25^\circ\text{C}$ , the hydroxide ion concentration,  $[\text{OH}^-]$ , is  $7.30 \times 10^{-5} \text{ M}$ . In answering the following, assume that temperature is constant at  $25^\circ\text{C}$  and that volumes are additive.

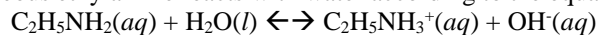
- (a) Write the equilibrium-constant expression for the reaction represented above.
- (b) Determine the pH of  $0.0480 \text{ M NH}_3(\text{aq})$ .
- (c) Determine the value of the base ionization constant,  $K_b$ , for  $\text{NH}_3(\text{aq})$ .
- (d) Determine the percent ionization of  $\text{NH}_3$  in  $0.0480 \text{ M NH}_3(\text{aq})$ .

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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.



(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.

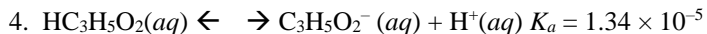
(i) Calculate the concentration of  $OH^-(aq)$  in the solution.

(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  $C_2H_5NH_2$ .

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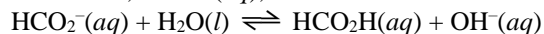
Propanoic acid,  $\text{HC}_3\text{H}_5\text{O}_2$ , ionizes in water according to the equation above.

- (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,  $\text{NaC}_3\text{H}_5\text{O}_2$ , 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,  $\text{C}_3\text{H}_5\text{O}_2^-(aq)$ , in the solution  
(ii) The concentration of the  $\text{H}^+(aq)$  ion in the solution

The methanoate ion,  $\text{HCO}_2^-(aq)$ , reacts with water to form methanoic acid and hydroxide ion, as shown in the following equation.



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

- (i) The value of  $K_b$  for the methanoate ion,  $\text{HCO}_2^-(aq)$   
(ii) The value of  $K_a$  for methanoic acid,  $\text{HCO}_2\text{H}$

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

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