

Exercise 14.5

Ionization of Weak Acids

Name: _____

Date: _____ Per: _____

DIRECTIONS: Complete the following in the space provided.

1. Write the dissociation reaction and the corresponding equilibrium expression for each of the following acids in water.

a. H_3PO_4 _____

b. HPO_4^{2-} _____

c. HNO_2 _____

2. Write balanced equations that describe the following reactions.

a. The dissociation of perchloric acid in water. _____

b. The reaction between acetic acid and sodium hydroxide. _____

c. The dissociation of ammonium ion in water. _____

3. Values of K_w as a function of temperature are as follows:

Temperature ($^{\circ}\text{C}$)	K_w
0	1.14×10^{-15}
25	1.00×10^{-14}
35	2.09×10^{-14}
40	2.92×10^{-14}
50	5.47×10^{-14}

a. Is the autoionization of water exothermic or endothermic? (*circle*)

b. What is the pH of pure water at 50°C ?

c. What is the pH of pure water at 0°C ?

d. How does the pH of water vary with temperature? _____

4. What major species are present in 0.250 M solutions of each of the following acids? Calculate the pH of each solution.

a. HBr _____

b. HCl _____

c. HClO _____

d. HNO_2 _____

5. Calculate the pH of each of the following solutions of a strong acid in water.

a. 0.1 M HCl _____

c. 0.1 M HNO_3 _____

b. $3.0 \times 10^{-5}\text{ M HCl}$ _____

d. $2.0 \times 10^{-2}\text{ M HNO}_3$ _____

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6. A solution is prepared by mixing 90.0 mL of 5.00 *M* HCl and 30.0 mL of 8.00 *M* HNO₃. Water is then added until the final volume is 1.00 L. Calculate [H₃O⁺], [OH⁻], and the pH for this solution.
7. What major species are present in a 0.250 *M* solution of each of the following acids? Calculate the pH of each solution.
- a. HC₂H₃O₂ ($K_a = 1.76 \times 10^{-5}$)
- b. NH₄Cl ($K_a = 5.6 \times 10^{-10}$)
- c. HCN ($K_a = 6.17 \times 10^{-10}$)
8. Calculate [H₃O⁺] and the pH for 0.10 *M* and 0.40 *M* solutions of acetic acid ($K_a = 1.76 \times 10^{-5}$)
9. For propanoic acid (HC₃H₅O₂, $K_a = 1.3 \times 10^{-5}$), determine the concentration of all species present, the pH and the percent dissociation of a 0.100 *M* solution.

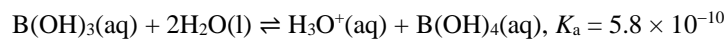
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10. Boric acid is commonly used in eyewash solutions in chemistry laboratories to neutralize bases splashed in the eye. It acts as monoprotic acid, but the dissociation reaction is slightly different from that of other acids:



Calculate the pH of a 0.50 M solution of boric acid.

11. A 0.15 M solution of a weak acid is 3.0% dissociated. Calculate K_a .

12. Calculate the percent dissociation of the acid in each of the following solutions. $K_a = 1.8 \times 10^{-5}$
- a. 0.50 M acetic acid

b. 0.0050 M acetic acid