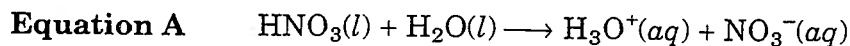


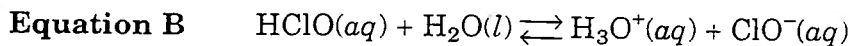
CHAPTER 15
Acids and Bases**15-1 What are acids and bases?** page 542**CONCEPT REVIEW****Acids**

Complete each statement by underlining the correct word, phrase, or formula in brackets.

1. Successive transfers of [protons, electrons] from [water, hydronium] ions to [water, hydronium] molecules allow the hydronium ion to move through a solution much [slower, faster] than an ion can move without these transfers.
2. **Equation A** represents a [strong, weak] acid that ionizes [completely, incompletely] in aqueous solution to form [molecules, ions], one of which is the [hydrogen, hydronium] ion.



3. **Equation B** is an example of a [strong, weak] acid. A [small, large] fraction of its molecules ionize when it is dissolved in water.



4. In **Equation B**, hypochlorite ions are reacting with [hydrogen, hydronium] ions to form HClO at [a different, the same] rate than HClO molecules reacting with [ClO⁻, H₂O] to form ions.

Mark each statement *T* if it is true and *F* if it is false.

5. ____ Hydrochloric acid readily reacts with zinc to produce hydrogen gas.
6. ____ Organic acids have the characteristic carboxyl group —HOOC.
7. ____ When a carboxylic acid ionizes, the oxygen atoms of the anion share the negative charge equally.

Bases

Complete each statement by underlining the correct word, phrase, or formula in brackets.

8. A base is a substance that, when dissolved in water, [decreases, increases] the hydroxide [OH⁻, H⁺] ion concentration.

CHAPTER 15 continued

PRACTICE PROBLEMS

Solve the following problems, and write your answer in the space provided.

20. Determine the $[\text{OH}^-]$ of a solution that contains 1×10^{-5} mol of H_3O^+ per liter. (Hint: See Sample Problem 15A.)

Answer _____

21. Find the $[\text{OH}^-]$ of a 0.00010 M HCl solution. HCl is 100% dissociated. (Hint: See Sample Problem 15A.)

Answer _____

22. Determine the $[\text{OH}^-]$ and $[\text{H}_3\text{O}^+]$ of a solution containing 0.001 M KOH. Assume 100% dissociation of KOH. (Hint: See Sample Problem 15A.)

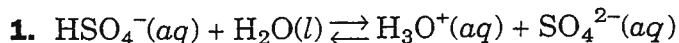
Answer _____

15-2 Can the strengths of acids and bases be quantified?

page 550

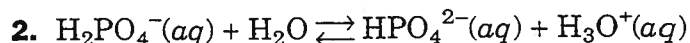
CONCEPT REVIEW**Brønsted-Lowry classification**

In the following equations, identify which reactant is the Brønsted-Lowry acid and which reactant is the Brønsted-Lowry base.



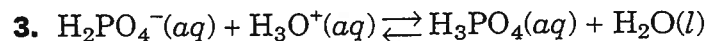
a. Brønsted-Lowry acid _____

b. Brønsted-Lowry base _____



a. Brønsted-Lowry acid _____

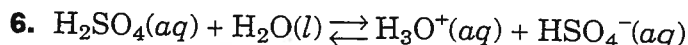
b. Brønsted-Lowry base _____



a. Brønsted-Lowry acid _____

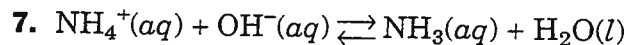
b. Brønsted-Lowry base _____

In the following equations, identify the conjugate acid and conjugate base in the products formed.



a. conjugate acid _____

b. conjugate base _____



a. conjugate acid _____

b. conjugate base _____

CHAPTER 15 continued**PRACTICE PROBLEMS**

Solve the following problems, and write your answer in the space provided.

- 10.** What is the pH of a 0.10 M solution of HCl, a strong acid? (Hint: See Sample Problem 15C.)

Answer _____

- 11.** Calculate the pH of a solution whose $[\text{H}_3\text{O}^+]$ is 0.000028 M. (Hint: See Sample Problem 15C.)

Answer _____

- 12.** Calculate the $[\text{H}_3\text{O}^+]$ of sea water with a pH of 8.3. (Hint: See Sample Problem 15C.)

Answer _____

13. Determine the $[\text{OH}^-]$ of the sea water in Problem 12. (Hint: See Sample Problem 15D.)

Answer _____

14. The $[\text{OH}^-]$ in a solution is 5×10^{-5} M. What is the $[\text{H}_3\text{O}^+]$ and pH of this solution? (Hint: See Sample Problem 15D.)

Answer _____

15. Determine the $[\text{H}_3\text{O}^+]$, $[\text{OH}^-]$, and pH of the strong acid 0.020 M HClO_4 . (Hint: See Sample Problem 15D.)

Answer _____

PRACTICE PROBLEMS**Titration calculations**

Solve the following problems, and write your answer in the space provided.

16. What is the molarity of an HCl solution if 30.0 mL of the solution is just neutralized by 48.0 mL of 0.100 M NaOH? (Hint: See Sample Problem 15E.)

Answer _____

17. How many milliliters of 0.500 M HNO_3 are required to neutralize 25.0 mL of a 0.200 M NaOH solution? (Hint: See Sample Problem 15E.)

Answer _____

18. A student titrates a 4.00 mL sample of Brand X vinegar with a 0.100 M NaOH solution. The average volume of base solution needed to reach the equivalence point is 13.6 mL.

- a. What is the molarity of acetic acid in the Brand X vinegar?
- b. By law, vinegar must contain at least 4% acetic acid, which corresponds to 0.67 M acetic acid. Does the concentration of acetic acid in Brand X vinegar meet the legal standard?

a. _____

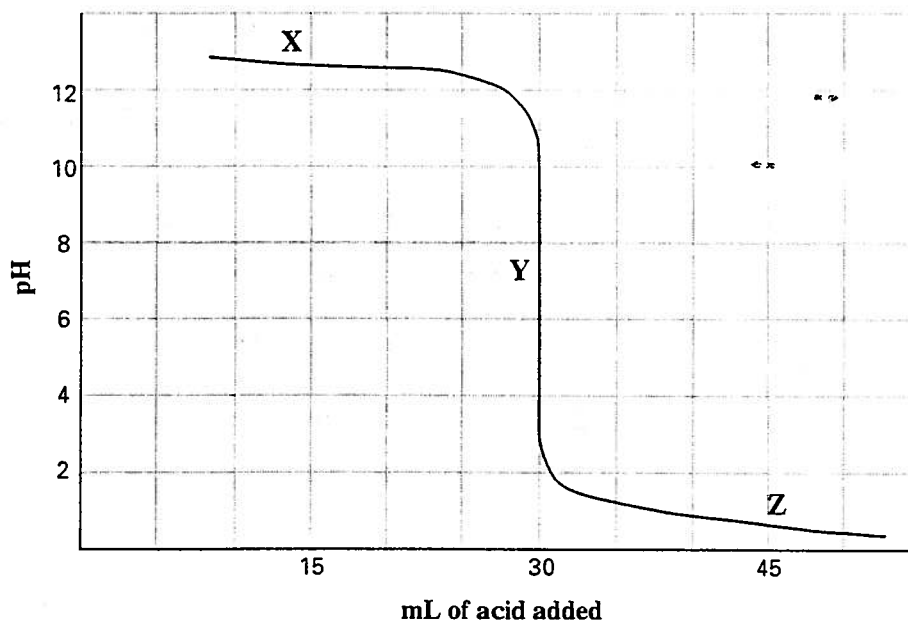
b. _____

CHAPTER 16 REVIEW*Acid-Base Titration and pH***MIXED REVIEW****SHORT ANSWER** Answer the following questions in the space provided.**1.** Calculate the following values: (A calculator should not be necessary.)_____ a. If the $[\text{H}_3\text{O}^+] = 1 \times 10^{-4} \text{ M}$ for a solution, calculate the pH._____ b. If the $\text{pH} = 13.0$ for a solution, calculate the $[\text{H}_3\text{O}^+]$._____ c. If the $[\text{OH}^-] = 1 \times 10^{-5} \text{ M}$ for a solution, calculate the $[\text{H}_3\text{O}^+]$._____ d. If the $\text{pH} = 4.72$ for a solution, calculate the pOH._____ e. If the $[\text{OH}^-] = 1.0 \text{ M}$ for a solution, calculate the pH.**2.** Calculate the following values:_____ a. If the $[\text{H}_3\text{O}^+] = 6.25 \times 10^{-9} \text{ M}$ for a solution, calculate the pH._____ b. If the $\text{pOH} = 2.34$ for a solution, calculate the $[\text{OH}^-]$.**PROBLEMS** Write the answer on the line to the left. Show all your work in the space provided.**3.** A 0.0012 M solution of H_2SO_4 is 100% ionized._____ a. What is the $[\text{H}_3\text{O}^+]$ of the H_2SO_4 solution?_____ b. What is the $[\text{OH}^-]$ of this solution?

_____ c. What is the pH of this solution?

CHAPTER 16 REVIEW*Acid-Base Titration and pH***SECTION 16-2****SHORT ANSWER** Answer the following questions in the space provided.**1.** Below is a pH curve from an acid-base titration. On it are labeled three points: X, Y, and Z.

- _____ a. Which point represents the equivalence point?
- _____ b. At which point is there excess acid in the system?
- _____ c. At which point is there excess base in the system?
- _____ d. If the base solution is 0.250 M, how many moles of OH^- are consumed at the end point of the titration?

Acid-Base Titration Curve**PROBLEMS** Write the answer on the line to the left. Show all your work in the space provided.**2.** A standardized solution of 0.065 M HCl is titrated with a saturated solution of calcium hydroxide to determine its molarity and its solubility. It takes 25.0 mL of base to neutralize 10.0 mL of the acid.

- a. Write the balanced molecular equation for this neutralization reaction.
- _____

SECTION 16-2 continued

_____ b. Determine the molarity of the $\text{Ca}(\text{OH})_2$ solution.

_____ c. Based on your answer to part b, calculate the solubility of the base in grams per liter of solution.

3. It is possible to carry out a titration without any indicator present. Instead, a pH probe is immersed in a beaker containing the solution of unknown molarity. The solution of known molarity is slowly added from a buret. Use the titration data below to answer the following questions:

Volume of $\text{KOH}(aq)$ in the beaker = 30.0 mL

Molarity of $\text{HCl}(aq)$ in the burette = 0.50 M

At the instant the pH falls from 10 to 4, 27.8 mL of acid have been added to the KOH in the beaker.

- _____ a. What is the mole ratio of chemical equivalents in this system?
- _____ b. Calculate the molarity of the KOH solution based on the above data.

CHAPTER 16 REVIEW

Acid-Base Titration and pH

SECTION 16-1

SHORT ANSWER Answer the following questions in the space provided.

1. Calculate the following values: (A calculator should not be necessary.)

- _____ a. If the $[\text{H}_3\text{O}^+] = 1 \times 10^{-6} \text{ M}$ for a solution, calculate the $[\text{OH}^-]$.
- _____ b. If the $[\text{H}_3\text{O}^+] = 1 \times 10^{-9} \text{ M}$ for a solution, calculate the $[\text{OH}^-]$.
- _____ c. If the $[\text{OH}^-] = 1 \times 10^{-12} \text{ M}$ for a solution, calculate the $[\text{H}_3\text{O}^+]$.
- _____ d. If the $[\text{OH}^-]$ in part c is reduced by half, to $0.5 \times 10^{-12} \text{ M}$, calculate the $[\text{H}_3\text{O}^+]$.
- _____ e. The $[\text{H}_3\text{O}^+]$ and $[\text{OH}^-]$ are _____ (directly, inversely, or not) proportional in any system involving water.

2. Calculate the following values: (A calculator should not be necessary.)

- _____ a. If the $\text{pH} = 2.0$ for a solution, calculate the pOH .
- _____ b. If the $\text{pOH} = 4.73$ for a solution, calculate the pH .
- _____ c. If the $[\text{H}_3\text{O}^+] = 1 \times 10^{-3} \text{ M}$ for a solution, calculate the pH .
- _____ d. If the $\text{pOH} = 5.0$ for a solution, calculate the $[\text{OH}^-]$.
- _____ e. If the $\text{pH} = 1.0$ for a solution, calculate the $[\text{OH}^-]$.

3. Calculate the following values:

- _____ a. If the $[\text{H}_3\text{O}^+] = 2.34 \times 10^{-5} \text{ M}$ for a solution, calculate the pH .
- _____ b. If the $\text{pOH} = 3.5$ for a solution, calculate the $[\text{OH}^-]$.
- _____ c. If the $[\text{H}_3\text{O}^+] = 4.6 \times 10^{-8} \text{ M}$ for a solution, calculate the $[\text{OH}^-]$.

PROBLEMS Write the answer on the line to the left. Show all your work in the space provided.

4. The $[\text{H}_3\text{O}^+] = 2.3 \times 10^{-3} \text{ M}$ for an aqueous solution.

- _____ a. Calculate $[\text{OH}^-]$ in this solution.

SECTION 16-1 continued

_____ b. Calculate the pH of this solution.

_____ c. Calculate the pOH of this solution.

d. Is the solution acidic, basic, or neutral? Explain your answer.

5. Consider a dilute solution of 0.025 M $\text{Ba}(\text{OH})_2$ to answer the following questions.

a. What is the $[\text{OH}^-]$ of this solution? Explain your answer.

_____ b. What is the pH of this solution?

6. Vinegar purchased in a store may contain 6 g of CH_3COOH per 100 mL of solution.

_____ a. What is the molarity of the solute?

