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CHAPTER 19 STUDY GUIDE FOR CONTENT MASTERY

Section 19.3 What is pH?

In your textbook, read about the ion product constant for water.

Answer the following questions.

1. Write the simplest form of the chemical equation for the self-ionization of water.
   $H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq)$
2. Write the equilibrium constant expression, K_{eq}, for this equation.
   $K_{eq} = [H^+][OH^-]/[H_2O]$
3. Write the expression for the equilibrium constant for water, K_w.
   $K_w = [H^+][OH^-]$
4. Why can the concentration of water be ignored in the equilibrium expression for water?
   The concentration of water molecules is essentially constant.
5. What is the numerical value of K_w at 298 K?
   1.0×10^{-14}
6. In solution, if the hydroxide ion concentration increases, what happens to the hydrogen ion concentration?
   It decreases.
7. If the concentration of hydroxide ions in solution is 1.0×10^{-6}, what is the hydrogen ion concentration?
   $[H^+] = K_w/[OH^-] = 1.0 \times 10^{-14}/1.0 \times 10^{-6} = 1.0 \times 10^{-8}$
8. Is the solution in question 7 acidic, basic, or neutral? Explain.
   It is basic because the $[OH^-]$ is greater than 1.0×10^{-7}.

In your textbook, read about pH and pOH.

In the space at the left, write *true* if the statement is true; if the statement is false, change the italicized word or number to make it true.

hydrogen — 9. The pH of a solution is the negative logarithm of its *hydroxide* ion concentration.

true — 10. Values for pH range from *0 to 14*.

acidic — 11. Stomach contents can have a pH of 2, which means that they are *basic*.

100 — 12. The hydrogen ion concentration in a solution with a pH of 3 is *two* times greater than the hydrogen ion concentration in a solution with a pH of 5.

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CHAPTER 19 STUDY GUIDE FOR CONTENT MASTERY

Section 19.3 *continued*

true — 13. The pH of a neutral solution at room temperature *equals* the pOH of the solution.

11 — 14. If the pH of a solution is 3, its pOH is *10*.

true — 15. The pH of a solution with a $[H^+]$ of 1×10^{-8} is *8*.

8 — 16. The pH of a solution with a $[OH^-]$ of 1×10^{-6} is *6*.

In your textbook, read about calculating the pH of acids and bases.

Solve each of the following problems. Show your work.

17. What is the pH of a $4.3 \times 10^{-2}M$ HCl solution? HCl is a strong acid.
    $[H^+] = 4.3 \times 10^{-2}M$; $pH = -\log(4.3 \times 10^{-2}) = 1.37$

18. Calculate the pH of a $5.2 \times 10^{-3}M$ H_2SO_4 solution? H_2SO_4 is a strong acid.
    $[H^+] = 2 \times 5.2 \times 10^{-3}M = 1.0 \times 10^{-2}M$; $pH = -\log(1.0 \times 10^{-2}) = 1.98$

19. What is the pH of a $2.5 \times 10^{-5}M$ NaOH solution? NaOH is a strong base.
    $[OH^-] = 2.5 \times 10^{-5}M$; $[H^+] = K_w/[OH^-] = 1.0 \times 10^{-14}/2.5 \times 10^{-5} = 4.0 \times 10^{-10}$
    $pH = -\log(4.0 \times 10^{-10}) = 9.40$

20. Calculate the pH of a $3.6 \times 10^{-6}M$ $Ca(OH)_2$ solution. $Ca(OH)_2$ is a strong base.
    $[OH^-] = 2 \times 3.6 \times 10^{-6}M = 7.2 \times 10^{-6}M$; $[H^+] = K_w/[OH^-] =$
    $1.0 \times 10^{-14}/7.2 \times 10^{-6} = 1.4 \times 10^{-9}$
    $pH = -\log(1.4 \times 10^{-9}) = 8.85$

In your textbook, read about measuring pH.

Complete the passage.

Indicator paper can be used to measure the **(21)** pH of a solution. Indicators are substances that are different **(22)** colors depending on the pH of the solution tested. Another way to measure the acidity of the solution is the **(23)** pH meter, which uses electrodes placed in solution to directly read the results.