\[ \text{pH} = -\log[H_3O^+] \quad \text{pOH} = -\log[OH^-] \quad \text{pH} + \text{pOH} = 14 \quad \left[H_3O^+\right]\left[OH^-\right] = 1 \times 10^{-14} \text{M} \]

Chapter 16 Prep Test

Multiple Choice

Identify the choice that best completes the statement or answers the question.

1. A conjugate base is the species that
   a. remains after a base has given up a proton.
   b. is formed by the addition of a proton to a base.
   c. is formed by the addition of a proton to an acid.
   d. remains after an acid has given up a proton.

2. A substance that ionizes nearly completely in aqueous solutions and produces H⁺ is a
   a. weak base.
   b. strong base.
   c. weak acid.
   d. strong acid.

3. In the reaction \( H_3PO_4 + H_2O \rightleftharpoons H_3O^+ + H_2PO_4^- \), the molecule \( H_2O \) acts as a(n)
   a. acid.
   b. base.
   c. spectator species.
   d. salt.

4. The substances produced when KOH(aq) neutralizes HCl(aq) are
   a. HClO(aq) and KH(aq).
   b. KH₂O⁺(aq) and Cl⁻(aq).
   c. \( H_2O(l) \) and KCl(aq).
   d. \( H_3O^+(aq) \) and KCl(aq).

5. The pH of a solution is 12. What is its [OH⁻]?
   a. 1 \times 10^{-12} \text{M}
   b. 1 \times 10^{-7} \text{M}
   c. 0.01 \text{M}
   d. 12 \text{M}

6. A species that is formed when a base gains a proton is a
   a. conjugate base.
   b. conjugate acid.
   c. strong base.
   d. strong acid.

7. What is the pH of a 0.001 M KOH solution?
   a. 3.00
   b. 11.0
   c. 12.0
   d. 14.0

8. In the reaction \( HClO_3 + NH_3 \rightleftharpoons NH_4^+ + ClO_3^- \), the conjugate base of HClO₃ is
   a. \( ClO_3^- \).
   b. \( NH_3 \).
   c. \( NH_4^+ \).
   d. not shown.

9. Which expression represents the pH of a solution?
   a. \( \log[H^+] \)
   b. \( -\log[H^+] \)
   c. \( \log[OH^-] \)
   d. \( -\log[OH^-] \)

10. Acids make blue litmus paper turn
    a. red.
    b. yellow.
    c. blue.
    d. black.

11. Which of the following is a diprotic acid?
    a. \( H_2SO_4 \)
    b. \( CH_3COOH \)
    c. HCl
    d. \( H_3PO_4 \)

12. The pH scale in general use ranges from
    a. 0 to 1.
    b. –1 to 1.
    c. 0 to 7.
    d. 0 to 14.
\[
pH = -\log[H_3O^+] \\
pOH = -\log[OH^-] \\
pH + pOH = 14 \\
[H_3O^+][OH^-] = 1 \times 10^{-14} M
\]

13. In the equation \(\text{HCl}(g) + \text{H}_2\text{O}(l) \rightarrow \text{H}_3\text{O}^+(aq) + \text{Cl}^-(aq)\), which species is a Brønsted-Lowry acid?
   a. \(\text{HCl}\)  
   b. \(\text{Na}_2\text{O}\)  
   c. \(\text{Cl}^-\)  
   d. none of the above

14. A species that can react as either an acid or a base is a(n)
   a. Lewis acid.  
   b. amphoteric substance.  
   c. oxyacid.  
   d. organic substance.

15. All acid base reactions have two conjugate acid base pairs. What is one conjugate acid base pair in the above reaction?
   a. \(\text{H}_2\text{O}/\text{H}_3\text{O}^+\)  
   b. \(\text{H}_2\text{O}/\text{HCO}_3^-\)  
   c. \(\text{CO}_3^{2-}/\text{H}_3\text{O}^+\)  
   d. \(\text{H}_2\text{O}/\text{OH}^-\)  

16. If \([\text{H}^+]\) of a solution is greater than \([\text{OH}^-]\), the solution
   a. is always acidic.  
   b. is always basic.  
   c. is always neutral.  
   d. might be acidic, basic, or neutral.

17. Acids taste
   a. sweet.  
   b. sour.  
   c. bitter.  
   d. salty.

18. If \([\text{H}^+] = 1.00 \times 10^{-5} \text{ M}\), what is the pH of the solution?
   a. 2.00  
   b. 3.00  
   c. 5.00  
   d. 9.00

19. The traditional (1st) definition of acids is based on the observations of
   a. Brønsted and Lowry.  
   b. Lewis.  
   c. Arrhenius.  
   d. Faraday.

20. Acids react with
   a. bases to produce salts and water.  
   b. salts to produce bases and water.  
   c. water to produce bases and salts.  
   d. neither bases, salts, nor water.

21. Which of the following is NOT a strong acid?
   a. \(\text{HNO}_3\)  
   b. \(\text{CH}_3\text{COOH}\)  
   c. \(\text{H}_2\text{SO}_4\)  
   d. \(\text{HCl}\)

22. Bases feel
   a. rough.  
   b. moist.  
   c. slippery.  
   d. dry.

23. In the reaction \(\text{HClO}_3 + \text{NH}_3 \rightleftharpoons \text{NH}_4^+ + \text{ClO}_3^-\), the conjugate base of \(\text{NH}_3\) is
   a. \(\text{HClO}_3\).  
   b. \(\text{ClO}_3^-\).  
   c. \(\text{NH}_4^+\).  
   d. not shown.
24. In the reaction HSO₄⁻ + H₂O ⇌ H₃O⁺ + SO₄²⁻, the ion HSO₄⁻ acts as a(n)
   a. acid.  c. spectator species.
   b. base.  d. salt.

25. What is the [H⁺] from Solution D above?
   a. 2.1 x 10⁻⁴ M  c. 4.8 x 10⁻¹¹ M
   b. 3.1 x 10⁻⁶ M  d. 1.9 x 10⁻¹² M

26. What is the pH of a 1 x 10⁻⁵ M KOH solution?
   a. 3  c. 9
   b. 5  d. 11

27. What is the hydrogen ion concentration of a solution whose pH is 4.00?
   a. 1.0 x 10⁻¹⁰ M  c. 6.0 x 10⁻⁴ M
   b. 5.0 x 10⁻⁶ M  d. 1.0 x 10⁻⁴ M

28. Pure water can partially break down into charged particles in a process called
   a. hydration.  c. self-ionization.
   b. hydrolysis.  d. dissociation.

29. A Brønsted-Lowry acid is
   a. an electron-pair acceptor.  c. a proton acceptor.
   b. an electron-pair donor.  d. a proton donor.

30. In the reaction HF + H₂O ⇌ H₃O⁺ + F⁻, a conjugate acid-base pair is
   a. HF and H₂O.  c. H₃O⁺ and H₂O.
   b. F⁻ and H₃O⁺.  d. HF and H₃O⁺.

31. The pH of a basic solution is
   a. less than 0.  c. greater than 7.
   b. less than 7.  d. greater than 14.