

## Acids and Bases

- \_\_\_ 1. The pH of a solution is 2 at 25 °C. What is the pOH of this solution? (1) 0; (2) 2; (3) 12; (4) 14.
- \_\_\_ 2. In a solution with a pH of 3 the color of (1) litmus is red; (2) litmus is blue; (3) phenolphthalein is red; (4) phenolphthalein is blue.
- \_\_\_ 3. What is the total number of moles of  $H^{1+}$  ions that will neutralize 2.0 moles of  $OH^{1-}$  ions? (1) 1.0; (2) 2.0; (3) 17; (4) 34.
- \_\_\_ 4. Which salt hydrolyzes in water to form a solution that is acidic? (1) KCl; (2)  $NH_4Cl$ ; (3) NaCl; (4) LiCl.
- \_\_\_ 5. Which particle is amphiprotic? (1)  $HNO_3$ ; (2)  $NO_3^{1-}$ ; (3)  $NH_3$ ; (4)  $NH_4^{1+}$ .
- \_\_\_ 6. As 50. milliliters of 0.1 M HCl is added to 100 milliliters of 0.1 M NaOH the pH of the NaOH solution (1) decreases; (2) increases; (3) remains the same.
- \_\_\_ 7. Which compound is an electrolyte? (1)  $C_6H_{12}O_6$ ; (2)  $C_{12}H_{22}O_{11}$ ; (3)  $C_2H_5OH$ ; (4)  $CH_3COOH$ .
- \_\_\_ 8. The hydroxide ion concentration is greater than the hydronium ion concentration in a 0.1 M solution of (1) NaOH; (2)  $CH_3OH$ ; (3)  $HNO_3$ ; (4)  $H_2SO_4$ .
- \_\_\_ 9. What is the pH of a solution whose hydronium ion concentration is 0.0001 moles per liter? (1) 1; (2) 10; (3) 14; (4) 4.
- \_\_\_ 10. The conjugate base of the bisulfite ion is the (1) sulfide ion; (2) sulfite ion; (3) bisulfate ion; (4) sulfate ion.
- \_\_\_ 11. A weak acid (HX) has an equilibrium constant of  $1.0 \times 10^{-8}$ . What is the pH of a 1.0 M solution of this acid? (1) 1; (2) 7; (3) 8; (4) 4.
- \_\_\_ 12. If 6 milliliters of 1M HCl is exactly neutralized by 3 milliliters of KOH then the molarity of the KOH is (1) 1M; (2) 2M; (3) 3M; (4) 9M.
- \_\_\_ 13. The pH of 0.001M HCl is (1) 1; (2) 2; (3) 3; (4) 4.
- \_\_\_ 14.  $NH_3 + H_2O = NH_4^{1+} + OH^{1-}$  Given the above reaction the two Bronsted acids are (1)  $NH_3$  and  $H_2O$ ; (2)  $NH_3$  and  $OH^{1-}$ ; (3)  $NH_4^{1+}$  and  $H_2O$ ; (4)  $NH_4^{1+}$  and  $OH^{1-}$ .
- \_\_\_ 15. An organic compound whose water solution turns litmus red is (1)  $CH_3OH$ ; (2)  $C_6H_{12}$ ; (3)  $CH_3COOH$ ; (4)  $C_6H_{12}O_6$ .
- \_\_\_ 16. Which could act as either a Bronsted acid or a Bronsted base? (1) chloride ion; (2) sulfide ion; (3) bisulfide ion; (4) carbonate ion.
- \_\_\_ 17. Which solution will be exactly neutralized by 1.0 liter of 1.0M NaOH? (1) 1.0 liter of 0.50M HCl; (2) 1.0 liter of 2.0M HCl; (3) 0.50 liter of 0.50M HCl; (4) 0.50 liter of 2.0M HCl.
- \_\_\_ 18. Which pH indicates the highest concentration of hydronium ions? (1) 1; (2) 7;

- (3) 10; (4) 14.
- \_\_\_ 19. Which 0.1M aqueous solution is the poorest conductor of electricity? (1)  $C_2H_5OH$ ; (2) HCl; (3)  $H_2SO_4$ ; (4)  $NH_3$ .
- \_\_\_ 20. Which of the following 0.1 M solutions is the best conductor of electricity? (1)  $HNO_3$ ; (2)  $HNO_2$ ; (3)  $NH_3$ ; (4)  $CH_3COOH$ .
- \_\_\_ 21. Which of the following is the weakest Bronsted acid? (1) HBr; (2) HI; (3) HCl; (4) HF.
- \_\_\_ 22. When  $K_2CO_3$  dissolves in water the resulting solution turn litmus paper (1) red and is acidic; (2) blue and is acidic; (3) red and is basic; (4) blue and is basic.
- \_\_\_ 23. A 30 milliliter sample of HCl is completely neutralized by 10. milliliters of a 1.5 M NaOH solution. What is the molarity of the HCl solution? (1) 0.25; (2) 0.50; (3) 1.5; (4) 4.5.
- \_\_\_ 24. Which could be the pH of a solution whose hydronium ion concentration is less than the hydroxide ion concentration? (1) 9; (2) 2; (3) 3; (4) 4.
- \_\_\_ 25. A solution of which metallic ion would have an acid pH? (1) sodium; (2) aluminum; (3) potassium; (4) lithium.
- \_\_\_ 26. Which compound is the weakest electrolyte? (1) HCl; (2)  $HNO_3$ ; (3)  $H_2S$ ; (4)  $H_2SO_4$ .
- \_\_\_ 27. Which hydrogen ion concentration indicates the most acidic solution? (1)  $1 \times 10^{-11}M$ ; (2)  $1 \times 10^{-9}M$ ; (3)  $1 \times 10^{-7}M$ ; (4)  $1 \times 10^{-5}M$ .
- \_\_\_ 28. Which compound is correctly classified as a salt? (1)  $KNO_3$ ; (2)  $HNO_3$ ; (3)  $CH_3COOH$ ; (4)  $C_2H_5OH$ .
- \_\_\_ 29. How many milliliters of 2.0 M NaOH are needed to exactly neutralize 50 mL of 2.0 M HCl? (1) 25; (2) 50; (3) 100; (4) 200.
- \_\_\_ 30. In the reaction  $H_2O + H_2O \rightleftharpoons H_3O^{1+} + OH^{1-}$  water is acting as (1) a Bronsted acid only; (2) a Bronsted base only; (3) neither a Bronsted acid nor base; (4) both a Bronsted acid and base.
- \_\_\_ 31. Which of the following combinations when dissolved in water would produce an acidic buffer? (1) KCl and NaCl; (2) NaOH and HOH; (3) NaCl and HCl; (4)  $CH_3COOH$  and  $NaCH_3COO$ .
- \_\_\_ 32. When titrating a strong acid and a weak base the stoichiometric point may have a pH of (1) 0; (2) 7; (3) 5; (4) 9.
- \_\_\_ 33. Which 0.1 molar aqueous solution contains the highest concentration of  $OH^{1-}$  ions? (1)  $CH_3OH$ ; (2) NaOH; (3)  $C_2H_5OH$ ; (4)  $NH_3$ .
- \_\_\_ 34. Red litmus will turn blue when placed in an aqueous solution of (1) HCl; (2)  $CH_3COOH$ ; (3) KOH; (4)  $CH_3OH$ .
- \_\_\_ 35. Which ion is amphiprotic? (1)  $Cl^{1-}$ ; (2)  $HSO_4^{1-}$ ; (3)  $O^{2-}$ ; (4)  $NH_4^{1+}$ .

- \_\_\_ 36. A solution at 25 degrees Celsius with a pH of 7 contains (1) more hydronium ions than hydroxide ions; (2) fewer hydronium ions than hydroxide ions; (3) an equal number of hydronium ions and hydroxide ions; (4) no hydronium ions or hydroxide ions.
- \_\_\_ 37. Which acid is almost completely ionized in a dilute solution at 25 °C? (1) CH<sub>3</sub>COOH; (2) H<sub>2</sub>S; (3) H<sub>3</sub>PO<sub>4</sub>; (4) HNO<sub>3</sub>.
- \_\_\_ 38. A solution of potassium carbonate would have a pH closest to (1) 1; (2) 5; (3) 3; (4) 8.
- \_\_\_ 39. How many liters of 2.5 M HCl are required to exactly neutralize 1.5 liters of 5.0 M NaOH? (1) 1.0; (2) 2.0; (3) 3.0; (4) 4.0.
- \_\_\_ 40. What are the Bronsted-Lowry bases in the following reaction:  
 $\text{H}_2\text{S} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^{1+} + \text{HS}^{1-}$ ? (1) H<sub>2</sub>S and H<sub>2</sub>O; (2) H<sub>2</sub>S and H<sub>3</sub>O<sup>1+</sup>; (3) HS<sup>1-</sup> and H<sub>2</sub>O; (4) HS<sup>1-</sup> and H<sub>3</sub>O<sup>1+</sup>.
- \_\_\_ 41. When additional solid NaCl dissolves in a solution of NaCl in water the pH of the solution (1) decreases; (2) increases; (3) remains the same.
- \_\_\_ 42. When hydrochloric acid is neutralized by sodium hydroxide then the salt formed is sodium (1) hydrochlorate; (2) chlorate; (3) chloride; (4) perchloride.
- \_\_\_ 43. The ionization constant of  $1.8 \times 10^{-5}$  is for a weak acid. A reasonable pH for a 0.1 M solution of this acid would be (1) 1; (2) 9; (3) 3; (4) 14.
- \_\_\_ 44. A 1 molal solution of magnesium chloride has a higher boiling point than a 1 molal solution of solution of (1) FeCl<sub>3</sub>; (2) CaCl<sub>2</sub>; (3) BaCl<sub>2</sub>; (4) NaCl.
- \_\_\_ 45. A water solution of which gas contains more hydroxide ions than hydronium ions? (1) HCl; (2) NH<sub>3</sub>; (3) CO<sub>2</sub>; (4) SO<sub>2</sub>.
- \_\_\_ 46. The following are hydrogen ion concentrations. Which hydrogen ion concentration indicates the strongest acid? (1)  $1.0 \times 10^{-4}$ ; (2)  $2.0 \times 10^{-5}$ ; (3)  $3.0 \times 10^{-6}$ ; (4)  $4.0 \times 10^{-7}$ .
- \_\_\_ 47. How many milliliters of 0.200 molar NaOH are needed to neutralize 100 milliliters of 0.100 molar HCl? (1) 40.0; (2) 50.0; (3) 100.; (4) 200.
- \_\_\_ 48. Given the following reaction:  $\text{H}_2\text{SO}_4 + \text{H}_2\text{O} \rightleftharpoons \text{HSO}_4^{1-} + \text{H}_3\text{O}^{1+}$ . The two Bronsted-Lowry acids are (1) H<sub>2</sub>SO<sub>4</sub> and H<sub>2</sub>O; (2) H<sub>2</sub>SO<sub>4</sub> and H<sub>3</sub>O<sup>1+</sup>; (3) H<sub>2</sub>O and H<sub>3</sub>O<sup>1+</sup>; (4) HSO<sub>4</sub><sup>1-</sup> and H<sub>3</sub>O<sup>1+</sup>.
- \_\_\_ 49. Neutralization of 15 milliliters of a 1.0-molar solution of KOH requires 5 milliliters of hydrochloric acid. What is the molarity of the HCl solution? (1) 1.0; (2) 2.0; (3) 3.0; (4) 6.0.
- \_\_\_ 50. Which solution is the best conductor of electricity? (1) 1.0 M boric acid; (2) 1.0 M carbonic acid; (3) 1.0 M acetic acid; (4) 1.0 M hydrochloric acid.
- \_\_\_ 51. If the [H<sup>1+</sup>] of a solution is  $1 \times 10^{-2}$  M the pH of the solution will be (1) 1; (2) 2; (3) 11; (4) 12.

- \_\_\_ 52. A salt whose water solution has a pH closest to 7 is (1)  $\text{NaC}_2\text{H}_3\text{O}_2$ ; (2)  $\text{NaCl}$ ; (3)  $\text{Na}_3\text{PO}_4$ ; (4)  $\text{Na}_2\text{CO}_3$ .
- \_\_\_ 53. Which 0.1 M solution would have the smallest pH value? (1)  $\text{HCl}$ ; (2)  $\text{H}_2\text{O}$ ; (3)  $\text{KOH}$ ; (4)  $\text{NaCl}$ .
- \_\_\_ 54. During acid-base neutralization how many moles of hydroxide ions will react with one mole of hydrogen ions? (1) 1.0 mole; (2) 0.5 mole; (3) 17.007 moles; (4) 22.4 moles.
- \_\_\_ 55. A water solution of  $\text{KCl}$  would have a pH closest to (1) 5; (2) 7; (3) 3; (4) 9.
- \_\_\_ 56. If 50 ml. of a 0.20 M solution of  $\text{NaOH}$  are required to titrate 10 ml. of an acid solution then what is the concentration of the acid solution? (1) 1.0 M; (2) 2.5 M; (3) 0.10 M; (4) 0.50 M.
- \_\_\_ 57. What is the pH of a solution that has a hydronium concentration of 0.001 mole per liter? (1) 1; (2) 2; (3) 3; (4) 11.
- \_\_\_ 58. In a solution litmus is blue. The pH of the solution could be (1) 10; (2) 2; (3) 3; (4) 4.
- \_\_\_ 59. If 50 milliliters of a 1.0 M  $\text{NaOH}$  solution is needed to exactly neutralize 10 milliliters of an  $\text{HCl}$  solution then the molarity of the  $\text{HCl}$  solution is (1) 1.0 M; (2) 0.20 M; (3) 5.0 M; (4) 10. M.
- \_\_\_ 60. What is the equilibrium constant of water at 25 degrees Celcius? (1)  $1.0 \times 10^{-14}$ ; (2)  $1.0 \times 10^{-7}$ ; (3)  $1.0 \times 10^{14}$ ; (4)  $1.0 \times 10^7$ .
- \_\_\_ 61. What is the pH of a 0.001 M solution of  $\text{HCl}$ ? (1) 1; (2) 7; (3) 3; (4) 11.
- \_\_\_ 62. Which of the following acids has the weakest conjugate base? (1)  $\text{HCl}$ ; (2)  $\text{H}_3\text{PO}_4$ ; (3)  $\text{HF}$ ; (4)  $\text{H}_2\text{S}$ .
- \_\_\_ 63. Phenolphthalein has a pink color in a solution which has a pH of (1) 1; (2) 5; (3) 7; (4) 11.
- \_\_\_ 64. A Lewis base is a(n) (1) electron pair donor; (2) electron pair acceptor; (3) proton donor; (4) proton acceptor..
- \_\_\_ 65. How many milliliters of 0.4 M  $\text{HCl}$  are required to completely neutralize 200 milliliters of 0.16 M potassium hydroxide? (1) 500; (2) 200; (3) 80; (4) 30.
- \_\_\_ 66. Which compound in a water solution would turn red litmus paper blue? (1)  $\text{HNO}_3$ ; (2)  $\text{C}_2\text{H}_5\text{OH}$ ; (3)  $\text{HC}_2\text{H}_3\text{O}_2$ ; (4)  $\text{NaOH}$ .
- \_\_\_ 67. The pH of a solution is 1. The hydrogen ion concentration of this solution in moles per liter is\* (1) 1; (2) 10; (3) 0.01; (4) 0.1.
- \_\_\_ 68. As the concentration of a  $\text{KOH}$  solution increases the number of moles of  $\text{HCl}$  needed to neutralize the  $\text{KOH}$  solution (1) decreases; (2) increases; (3) remains the same.

- \_\_\_ 69. The pH of a 0.001 M HCl solution is closest to (1) 1; (2) 7; (3) 3; (4) 10.
- \_\_\_ 70. One liter of 1 M NaOH will completely neutralize one liter of (1) 1 M H<sub>2</sub>SO<sub>4</sub>; (2) 2 M H<sub>2</sub>SO<sub>4</sub>; (3) 0.5 M H<sub>2</sub>SO<sub>4</sub>; (4) 1.5 M H<sub>2</sub>SO<sub>4</sub>.
- \_\_\_ 71. Which 0.1 M acid solution contains the highest concentration of H<sub>3</sub>O<sup>1+</sup> ions? (1) H<sub>2</sub>S; (2) H<sub>3</sub>PO<sub>4</sub>; (3) HNO<sub>2</sub>; (4) HF.
- \_\_\_ 72. How much water is formed when 1.0 mole of HCl reacts completely with 1.0 mole of NaOH? (1) 1.0 mole; (2) 2.0 moles; (3) 0.50 mole; (4) 0.25 mole.
- \_\_\_ 73. Which substance is amphiprotic? (1) HI; (2) NH<sub>4</sub><sup>1+</sup>; (3) HNO<sub>3</sub>; (4) HS<sup>1-</sup>.
- \_\_\_ 74. Which relationship between the concentrations always exists in an aqueous solution that is basic? (1) [H<sup>1+</sup>] equals zero.; (2) [H<sup>1+</sup>] equals [OH<sup>1-</sup>].; (3) [H<sup>1+</sup>] is less than [OH<sup>1-</sup>].; (4) [H<sup>1+</sup>] is greater than [OH<sup>1-</sup>].
- \_\_\_ 75. Which compound is an electrolyte? (1) C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>; (2) C<sub>12</sub>H<sub>22</sub>O<sub>11</sub>; (3) CH<sub>3</sub>CH<sub>2</sub>OH; (4) CH<sub>3</sub>COOH.
- \_\_\_ 76. As a solution of NaOH is added to a solution of HCl at constant temperature the product of [H<sub>3</sub>O<sup>+</sup>]\*[OH<sup>-</sup>] (1) decreases; (2) increases; (3) remains the same.
- \_\_\_ 77. What volume of a 0.200 M NaOH solution is needed to exactly neutralize 40.0 milliliters of a 0.100 M HCl solution? (1) 10.0 mL; (2) 20.0 mL; (3) 40.0 mL; (4) 80.0 mL.
- \_\_\_ 78. In the reaction NH<sub>3(g)</sub> + H<sub>2</sub>O<sub>(l)</sub> <=====> NH<sub>4</sub><sup>1+</sup><sub>(aq)</sub> + OH<sup>1-</sup><sub>(aq)</sub> which pair are Bronsted bases? (1) NH<sub>3</sub> and H<sub>2</sub>O; (2) NH<sub>3</sub> and OH<sup>1-</sup>; (3) NH<sub>4</sub><sup>1+</sup> and H<sub>2</sub>O; (4) NH<sub>4</sub><sup>1+</sup> and OH<sup>1-</sup>.
- \_\_\_ 79. According to the Bronsted-Lowry theory an acid is any species that can (1) donate a proton; (2) accept a proton; (3) donate an electron; (4) accept an electron.
- \_\_\_ 80. Which is a net ionic equation for a neutralization reaction? (1) H<sup>1+</sup> + HCO<sub>3</sub><sup>1-</sup> ----> H<sub>2</sub>CO<sub>3</sub>; (2) NH<sub>4</sub><sup>1+</sup> + OH<sup>1-</sup> ----> NH<sub>4</sub>OH; (3) Ag<sup>1+</sup> + Cl<sup>1-</sup> ----> AgCl; (4) H<sup>1+</sup> + OH<sup>1-</sup> ----> H<sub>2</sub>O.
- \_\_\_ 81. When substance X is dissolved in water the only positive ions in the solution are hydrogen ions. Substance X could be (1) NaOH; (2) NaH; (3) H<sub>2</sub>S; (4) NH<sub>3</sub>.
- \_\_\_ 82. How many milliliters of 2.5 M HCl are required to exactly neutralize 15 milliliters of 5.0 M NaOH? (1) 10; (2) 20; (3) 30; (4) 40.
- \_\_\_ 83. Which solution can turn phenolphthalein pink? (1) CH<sub>3</sub>OH (aq); (2) CH<sub>3</sub>COOH (aq); (3) HCl (aq); (4) NaOH (aq).
- \_\_\_ 84. In the reaction HBr + H<sub>2</sub>O <=====> H<sub>3</sub>O<sup>1+</sup> + Br<sup>1-</sup> which is a conjugate acid-base pair? (1) HBr and Br<sup>1-</sup>; (2) HBr and H<sub>2</sub>O; (3) H<sub>3</sub>O<sup>1+</sup> and Br<sup>1-</sup>; (4) H<sub>3</sub>O and HBr.
- \_\_\_ 85. What is the ionization constant for water at 25 °C? (1) 1.0 x 10<sup>-14</sup>; (2) 1.0 x 10<sup>-7</sup>; (3) 1.0 x 10<sup>7</sup>; (4) 1.0 x 10<sup>14</sup>.
- \_\_\_ 86. The pH of a 0.1 M CH<sub>3</sub>COOH solution is (1) less than 1; (2) greater than 1 but

less than 7; (3) equal to 7; (4) greater than 7 but less than 14.

- \_\_\_ 87. Which equation represents a neutralization reaction? (1)  $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2$ ; (2)  $2\text{HCl} + \text{Zn} \rightarrow \text{ZnCl}_2 + \text{H}_2$ ; (3)  $\text{H}_2\text{SO}_4 + \text{CaCO}_3 \rightarrow \text{CaSO}_4 + \text{H}_2\text{O} + \text{CO}_2$ ; (4)  $\text{HNO}_3 + \text{KOH} \rightarrow \text{KNO}_3 + \text{H}_2\text{O}$ .
- \_\_\_ 88. Which of the following is the strongest Bronsted-Lowry base? (1)  $\text{HS}_1^-$ ; (2)  $\text{S}^{2-}$ ; (3)  $\text{HSO}_4^{1-}$ ; (4)  $\text{NO}_3^{1-}$ .
- \_\_\_ 89. When the salt  $\text{NaHCO}_3$  is dissolved in water the solution becomes (1) basic due to the production of  $\text{H}_3\text{O}^{1+}$  ions; (2) acidic due to the production of  $\text{H}_3\text{O}^{1+}$  ions; (3) basic due to the production of  $\text{OH}^{1-}$  ions; (4) acidic due to the production of  $\text{OH}^{1-}$  ions.
- \_\_\_ 90. Which of the following is the strongest Bronsted acid? (1)  $\text{HNO}_2$ ; (2)  $\text{H}_2\text{S}$ ; (3)  $\text{CH}_3\text{COOH}$ ; (4)  $\text{H}_3\text{PO}_4$ .
- \_\_\_ 91. Pure water at 25 °C has a pH of (1)  $1 \times 10^{-7}$ ; (2)  $1 \times 10^{-14}$ ; (3) 7; (4) 14.
- \_\_\_ 92. Which metal will react spontaneously with  $\text{HCl}(\text{aq})$ ? (1) Au; (2) Ag; (3) Cu; (4) Mg.
- \_\_\_ 93. In the reaction  $\text{HCl} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^{1+} + \text{Cl}^{1-}$  a conjugate acid-base pair is (1)  $\text{HCl}$  and  $\text{H}_3\text{O}^{1+}$ ; (2)  $\text{HCl}$  and  $\text{H}_2\text{O}$ ; (3)  $\text{HCl}$  and  $\text{Cl}^{1-}$ ; (4)  $\text{H}_2\text{O}$  and  $\text{Cl}^{1-}$ .
- \_\_\_ 94. As the  $\text{H}_3\text{O}^{1+}$  ion concentration of a solution increases the pH of the solution (1) decreases; (2) increases; (3) remains the same.
- \_\_\_ 95. In the reaction  $\text{H}_2\text{O} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^{1+} + \text{OH}^{1-}$  the water is acting as (1) a proton acceptor only; (2) a proton donor only; (3) both a proton acceptor and donor; (4) neither a proton acceptor nor donor.
- \_\_\_ 96. Which solution will turn litmus from red to blue? (1)  $\text{H}_2\text{S}(\text{aq})$ ; (2)  $\text{NH}_3(\text{aq})$ ; (3)  $\text{SO}_2(\text{aq})$ ; (4)  $\text{CO}_2(\text{aq})$ .
- \_\_\_ 97. The pH of a solution is 8. At 1 atmosphere and 25 °C the product of the  $[\text{H}_3\text{O}^{1+}]$   $[\text{OH}^{1-}]$  is (1)  $1 \times 10^{-2}$ ; (2)  $1 \times 10^{-6}$ ; (3)  $1 \times 10^{-8}$ ; (4)  $1 \times 10^{-14}$ .
- \_\_\_ 98. Which is an amphiprotic ion? (1)  $\text{HSO}_4^{1-}$ ; (2)  $\text{NH}_4^{1+}$ ; (3)  $\text{NO}_3^{1-}$ ; (4)  $\text{Cl}^{1-}$ .
- \_\_\_ 99. If  $\text{HCl}$  and  $\text{H}_2\text{O}$  react together in an acid-base reaction to form their Bronsted-Lowry conjugates the products would be (1)  $\text{HCl}$  and  $\text{H}_3\text{O}^{1+}$ ; (2)  $\text{Cl}^{1-}$  and  $\text{OH}^{1-}$ ; (3)  $\text{Cl}_2$  and  $\text{H}_2$ ; (4)  $\text{Cl}^{1-}$  and  $\text{H}_3\text{O}^{1+}$ .
- \_\_\_ 100. What is the hydronium ion concentration of a solution at 25 °C whose hydrogen ion concentration is  $1 \times 10^{-8}$ ? (1)  $1 \times 10^{-6}$ ; (2)  $1 \times 10^{-7}$ ; (3)  $1 \times 10^{-8}$ ; (4)  $1 \times 10^{-14}$ .
- \_\_\_ 101. An 0.1 M acid solution at 25 °C would conduct electricity best if the acid had a  $K_a$  value of (1)  $1.0 \times 10^{-7}$ ; (2)  $1.8 \times 10^{-5}$ ; (3)  $6.7 \times 10^{-4}$ ; (4)  $1.7 \times 10^{-2}$ .
- \_\_\_ 102. If 50 mL of a 0.01 M  $\text{HCl}$  solution is required to neutralize exactly 25 milliliters of  $\text{NaOH}$  then what is the concentration of the base? (1) 0.01 M; (2) 0.02 M; (3) 0.005 M; (4) 0.04 M.
- \_\_\_ 103. When tested a solution turns red litmus to blue. This indicates that the solution

contains more (1)  $\text{H}^{1+}$  ions than  $\text{OH}^{1-}$  ions; (2)  $\text{H}_3\text{O}^{1+}$  ions than  $\text{OH}^{1-}$  ions; (3)  $\text{OH}^{1-}$  ions than  $\text{H}_3\text{O}^{1+}$  ions; (4)  $\text{H}^{1+}$  and  $\text{OH}^{1-}$  ions than  $\text{H}_2\text{O}$  molecules.

- \_\_\_ 104. What is the pH of an aqueous solution of  $\text{C}_6\text{H}_{12}\text{O}_6$ ? (1) 1; (2) 7; (3) 11; (4) 14.
- \_\_\_ 105. A sample of pure water contains (1) neither  $\text{OH}^{1-}$  ions nor  $\text{H}_3\text{O}^{1+}$  ions; (2) equal concentrations of  $\text{OH}^{1-}$  and  $\text{H}_3\text{O}^{1+}$  ions; (3) a larger concentration of  $\text{H}_3\text{O}^{1+}$  ions than  $\text{OH}^{1-}$  ions; (4) a smaller concentration of  $\text{H}_3\text{O}^{1+}$  ions than  $\text{OH}^{1-}$  ions.
- \_\_\_ 106. Which of the following acids ionizes to the least extent at 25 °C? (1) HF; (2)  $\text{HNO}_2$ ; (3)  $\text{H}_2\text{S}$ ; (4)  $\text{H}_2\text{O}$ .
- \_\_\_ 107. Which substance is amphiprotic? (1)  $\text{H}_2\text{SO}_4$ ; (2)  $\text{HNO}_3$ ; (3)  $\text{NH}_3$ ; (4)  $\text{HBr}$ .
- \_\_\_ 108. As 0.1 M  $\text{HCl}$  is added to 0.1 M  $\text{KOH}$  the pH of the basic solution (1) decreases and basicity decreases; (2) increases and basicity decreases; (3) decreases and basicity increases; (4) increases and basicity increases.