Unit XII Answers

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1. Acids are sour, react with metals to produce hydrogen gas and salt, neutralize bases to form salt and water, good conductors of electricity, turn litmus red, turn phenolphthalein colorless.

2. A base is something that produces hydroxide ions in water solution.

6. A conjugate acid-base pair is a pair of species (compounds or ions) with an acid (proton donor) one side of the equation and the remaining part (the part left after the proton has been donated) on the other side of the equation.

10. acid H_3PO_4; base HPO_4^{2-}

13. Acid H_2SO_4 and base HSO_4^-; Acid HSO_3^- and base SO_3^{2-}

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1. $K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ They are inversely related to each other.

2. pH measures the acidity of the solution. $pH = - \log [H^+]$

3. A neutral solution has equal amounts of hydrogen ion (hydronium ion) and hydroxide ion.

4. $K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$; $pH = - \log [H^+]$; $pOH = -\log [OH^-]$; $pH + pOH = 14$

5. Acidic solutions have a pH of less than 7, basic solutions have a pH of more than 7.

7. $[OH^-] = 3.16 \times 10^{-12}$ M; pH=12.95

8. $[H_3O^+] = 1.3 \times 10^{-3}$ M; $[OH^-] = 7.7 \times 10^{-12}$ M

9. $[H_3O^+] = 1.1 \times 10^{-3}$ M; $[OH^-] = 0.088$ M; pH = 12.95

10. $[H_3O^+] = 3.1 \times 10^{-4}$ M; pH = 3.51

11. .0100 moles

12. 32 L

14. The pH is negative whenever the hydronium ion concentration is greater than 1.0 M.

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8. 0.177 M 9. 13.5 mL 10. 0.0791 M 11. 0.18 M 12. 58 mL

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2. $K_a = \dfrac{[H_3O^+][HSO_3^-]}{[H_2SO_3]}$

3. $HSO_3^-{}_{(aq)} + HOH_{(l)} \rightleftharpoons SO_3^{2-}{}_{(aq)} + H_3O^+{}_{(aq)}$

4. A buffer is a solution that contains a solution of a weak acid or base (and it's conjugate base or conjugate acid) and often a salt of that acid (or base) that resists changes in pH by following LeChatelier's Principle.

6. The reverse reaction is favored because hydronium ion is a much stronger acid than carbonic acid.

7. $K_a = 3.97 \times 10^{-8}$ 8. $K_a = 7.94 \times 10^{-11}$ 9. $K_a = 6.8 \times 10^{-4}$

10. The concentrations of ammonium ion and hydroxide ion will be almost equal so $K_a = 3.74 \times 10^{-20}$.

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21. $\underset{\text{acid}}{HCN_{(aq)}} + \underset{\text{base}}{HOH_{(l)}} \rightleftharpoons \underset{\text{acid}}{H_3O^+_{(aq)}} + \underset{\text{base}}{CN^-_{(aq)}}$

22. $HCO_3^-{}_{(aq)} + HOH_{(l)} \rightleftharpoons H_3O^+{}_{(aq)} + CO_3^{2-}{}_{(aq)}$ $HCO_3^-{}_{(aq)} + HCl_{(aq)} \rightleftharpoons H_2CO_3{}_{(aq)} + Cl^-{}_{(aq)}$

23. They are the same – two names for the same thing.

24. $2HOH_{(l)} \rightleftharpoons H_3O^+{}_{(aq)} + OH^-{}_{(aq)}$

25. pH = 11 is basic, pH = 3 is acidic, pH = 7 is neutral.

26. 1000, 100, 10, 3.16

27. On non graphing calculators – enter the number, push the *log* button, push the *change sign* button. On graphing calculators – push the *negative* button, push the *log* button, enter the number, press the *enter* button.

28. Measure pH with indicators – inexpensive and convenient but give poor resolution. Measure pH with electronic meters- very precise but expensive and more complicated to use.

29. The reaction of hydrogen (hydronium) ion and hydroxide ion to produce water.

30. Yours.

31. A titration curve is a graph that shows pH on the y-axis and the volume of either acid or base being added on the x-axis.

32. Choose an indicator that changes color in the pH range at the equivalence point.

33. Greater than 7

34. Methyl orange or thymol blue.

35. $HNO_2{}_{(aq)} + NH_3{}_{(aq)} \rightleftharpoons NO_2{}_{(aq)} + NH_4^+{}_{(aq)}$

36. A conjugate acid-base pair have an inverse relationship of strength. (If one is strong the other is weak).

37. $K_a = \dfrac{[H_3O^+][C_2H_5COO^-]}{[C_2H_5COOH]}$

38. c, a, d, b

39. A buffer is a solution that contains a solution of a weak acid or base (and it's conjugate base or conjugate acid) and often a salt of that acid (or base) that resists changes in pH by following LeChatelier's Principle.

40. 6.13×10^{-7} M   41. 2.74×10^{-14} M   42. 1.7×10^{-3} mole   43. 5.35×10^{-12} M

44. $[OH^-] = 0.300$ M; $[H_3O^+] = 3.33 \times 0^{-14}$ M   45. 1.41×10^{-7} M   46. 1.52

47. 12.13   48. 0.82   49. 12.91   50. 0.54

51. a) 2.3   b) 1.3   c) 0.3   d) –0.7

52. 12.81   53. 13.48   54. 9.00   55. 0.17

56. 11.66   57. 5.72   58. 12.50

59. $[OH^-] = 3.2 \times 10^{-5}$ M; $[H_3O^+] = 3.2 \times 10^{-10}$ M   60. 2.0×10^{-5} M   61. 3×10^{-5} mole

62. $[H_3O^+] = 1 \times 10^{-4}$ M   63. $[OH^-] = 5.25 \times 10^{-6}$ M

64. $[OH^-] = 1 \times 10^{-9}$ M; $[H_3O^+] = 1 \times 10^{-5}$ M   65. $[OH^-] = 1.3 \times 10^{-4}$ M; $[H_3O^+] = 7.9 \times 10^{-11}$ M

66. $[H_3O^+] = 3.2 \times 10^{-6}$ M   67. $[OH^-] = 2.0 \times 10^{-10}$ M   68. $[H_3O^+] = 1.0 \times 10^{-10}$ M

69. $[H_3O^+] = 1.0 \times 10^{-3}$ M   70. $[H_3O^+] = 1.3 \times 10^{-2}$ M   71. $[H_3O^+] = 5.0 \times 10^{-14}$ M

72. Between 0.0 and 0.5 mL

73. To avoid going past the end point.

74. The initial and final buret readings.

75. 55.0 mL   76. 37.5 mL   77. 0.5260 M   78. 1.412 M

79. 0.798 M   80. 0.1130 M   81. 0.1544 M   82. 3.8 mL

83. $K_a = 1.8 \times 10^{-4}$ 84. $K_a = 6.7 \times 10^{-4}$ 85. $K_a = 1.6 \times 10^{-5}$ 86. 2.5×10^{-5}

87. $K_a = 2.5 \times 10^{-3}$ 88. $K_a = 6.3 \times 10^{-7}$ 89. $K_a = 1.3$

90.

ion	moles	molarity
Na^+	0.075	0.75
OH^-	0.050	0.50
Cl^-	0.025	0.25

91. $[OH^-] = 2.5 \times 10^{-14}$ M; $[H_3O^+] = 0.4$ M; pH = 0.398

92. $[OH^-] = 1.56 \times 10^{-2}$ M; $[H_3O^+] = 6.41 \times 10^{-13}$ M

93. $K_a = 1.7 \times 10^{-7}$

94. 0.12 M

95. $[H_3O^+] = 1.1 \times 10^{-3}$ M; $[C_6H_5COOH] = 0.020$ M; $[C_6H_5COO^-] = 1.2 \times 10^{-3}$ M

96. 1.75×10^{-5} M

97.

pH	$[H_3O^+]$ M	$[OH^-]$ M
14.25	5.6×10^{-15}	1.8
14.00	1.0×10^{-14}	1.0
13.75	1.8×10^{-14}	0.56
13.25	5.6×10^{-14}	0.18
13.00	1.0×10^{-13}	0.10
7.25	5.6×10^{-8}	1.8×10^{-7}
7.00	1.0×10^{-7}	1.0×10^{-7}
6.75	1.8×10^{-7}	5.6×10^{-8}
1.00	0.10	1.0×10^{-13}
0.75	0.18	5.6×10^{-14}
0.50	0.32	3.2×10^{-14}
0.25	0.56	1.8×10^{-14}
0.00	1.0	1.0×10^{-14}
-0.25	1.8	5.6×10^{-15}

98. $NH_4^+{}_{(aq)} + H_2O_{(l)} \rightleftharpoons NH_{3\,(aq)} + H_3O^+{}_{(aq)}$ $\qquad K_a = \dfrac{[H_3O^+][NH_3]}{[NH_4^+]}$

99. 1.24 g

100. pH = 7.20