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Assessment

Chapter Test A

Chapter: Acid-Base Titration and pH

In the space provided, write the letter of the term or phrase that best completes each statement or best answers each question.

_____ **1.** What are the highest concentrations of H_3O^+ ions and OH^- ions that can coexist in an aqueous solution?
a. 1.0×10^{-14} M each
b. 1.0×10^{0} M and 1.0×10^{-14} M, respectively
c. 1.0×10^{-14} M and 1.0×10^{0} M, respectively
d. 1.0×10^{-7} M each

_____ **2.** Which of the following is *not* true regarding the self-ionization of water?
a. It involves the formation of hydronium and hydroxide ions.
b. It is in equilibrium.
c. It shows that water is a strong electrolyte.
d. It involves two water molecules forming two ions.

_____ **3.** A solution that has a $[H_3O^+]$ equal to 1×10^{-4} M
a. is neutral.
b. is acidic.
c. is basic.
d. could be neutral, basic, or acidic.

_____ **4.** The $[OH^-]$ of an aqueous solution is 6.4×10^{-5} M. What is the $[H_3O^+]$?
a. 1.6×10^{-9} M
b. 3.6×10^{-9} M
c. 1.6×10^{-10} M
d. 3.6×10^{-10} M

_____ **5.** What is the $[OH^-]$ in a 0.1 M HCl solution?
a. 1×10^{-1} M
b. 1×10^{-7} M
c. 1×10^{-13} M
d. 1×10^{-14} M

_____ **6.** What is the $[H_3O^+]$ in a 0.0040 M solution of NaOH?
a. 2.5×10^{-11} M
b. 4.0×10^{-11} M
c. 2.5×10^{-12} M
d. 4.0×10^{-12} M

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_____ **7.** A solution that has a pH of 4.0
- **a.** is neutral.
- **b.** is acidic.
- **c.** is basic.
- **d.** could be neutral, basic, or acidic.

_____ **8.** What is the pH of a 0.0001 M HCl solution?
- **a.** 1
- **b.** 4
- **c.** 7
- **d.** 11

_____ **9.** What is the concentration of hydroxide ions in a solution that has a pH of 6.0?
- **a.** 1×10^{6} M
- **b.** 1×10^{-6} M
- **c.** 1×10^{1} M
- **d.** 1×10^{-8} M

_____ **10.** What is the concentration of hydroxide ions in a solution that has a pOH of 8.0?
- **a.** 1×10^{8} M
- **b.** 1×10^{-8} M
- **c.** 1×10^{6} M
- **d.** 1×10^{-6} M

_____ **11.** How many moles of NaOH must be dissolved in 1.00 L of water to make NaOH(aq) with a pH of 12.2?
- **a.** 6.31×10^{-13} mol
- **b.** 1.22×10^{-4} mol
- **c.** 1.58×10^{-2} mol
- **d.** 6.31×10^{1} mol

_____ **12.** How would you classify nitric acid (HNO_3) in the reaction represented by the equation below?

$$HNO_3(l) + H_2O(l) \rightarrow H_3O^+(aq) + NO_3^-(aq)$$

- **a.** weak acid
- **b.** strong acid
- **c.** weak base
- **d.** strong base

_____ **13.** A strip of pH paper
- **a.** gives a quick approximation of pH.
- **b.** is a precise measure of pH.
- **c.** shows very little color change over a wide pH range.
- **d.** must be calibrated with a pH meter before it is used.

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_____**14.** A pH meter measures the pH of a solution by measuring the
- **a.** amount of charge on the hydronium ion.
- **b.** color of the solution.
- **c.** concentration of the solution.
- **d.** voltage difference between two electrodes in the meter's probe.

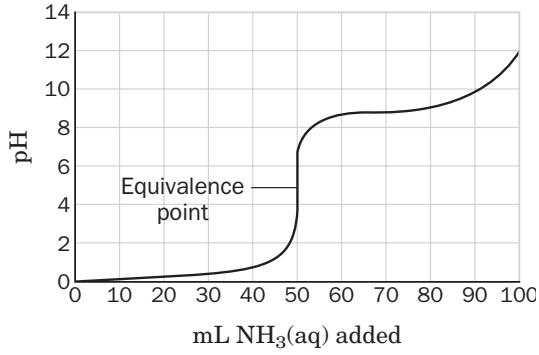
_____**15.** When you conduct an acid-base titration,
- **a.** the pH of the solution must go up.
- **b.** the pH of the solution must go down.
- **c.** the pH of the solution must be 7.0 at the end point.
- **d.** the equivalence point must be reached.

_____**16.** At the end point of a titration using an acid-base indicator,
- **a.** the color of the acid-base indicator should stay the same.
- **b.** the pH of the solution should change abruptly.
- **c.** the color of the acid-base indicator should change.
- **d.** Both (b) and (c)

_____**17.** A standard solution
- **a.** contains a precisely measured amount of solute.
- **b.** must be compared with a solution of primary standard before use.
- **c.** is the known solution used in a titration.
- **d.** All of the above

Use the figure below to answer questions 18–20.

pH vs. mL NH_3(aq) added during a titration



_____**18.** The figure above shows an example of the titration of
- **a.** a strong acid with a weak base.
- **b.** a strong acid with a strong base.
- **c.** a weak acid with a weak base.
- **d.** a weak acid with a strong base.

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_____**19.** In the figure on the previous page, the pH at the equivalence point
- **a.** is equal to 7.0.
- **b.** is greater than 7.0.
- **c.** is less than 7.0.
- **d.** cannot be determined from the data given.

_____**20.** In the figure on the previous page, the volume of titration standard necessary to reach the equivalence point is
- **a.** 0 mL.
- **b.** 40 mL.
- **c.** 50 mL.
- **d.** 90 mL.

_____**21.**

Indicator	pH range
methyl orange	3.1 – 4.4
methyl red	4.4 – 6.2
bromthymol blue	6.2 – 7.6
phenolphthalein	8.0 – 10.0

According to the table above, which pH indicator would be the best choice when titrating acetic acid, CH_3COOH, with sodium hydroxide, NaOH?
- **a.** methyl orange
- **b.** methyl red
- **c.** bromthymol blue
- **d.** phenolphthalein

_____**22.** In the titration of a solution of $Sr(OH)_2$ with HCl, the mole ratio of hydroxide ions to hydronium ions
- **a.** is 1:1.
- **b.** is 2:1.
- **c.** is 1:2.
- **d.** cannot be determined from the data given.

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_____**23.** What is the molarity of an HCl solution if 50.0 mL is neutralized in a titration by 40. mL of 0.4000 M NaOH?

a. 0.20 M
b. 0.28 M
c. 0.32 M
d. 0.50 M

_____**24.** If 72.1 mL of 0.543 M H_2SO_4 completely titrates 39.0 mL of KOH solution, what is the molarity of the KOH solution?

a. 0.317 M
b. 0.502 M
c. 1.00 M
d. 2.01 M

_____**25.** What is the molarity of a $Ba(OH)_2$ solution if 93.9 mL is completely titrated by 15.3 mL of 0.247 M H_2SO_4?

a. 0.0101 M
b. 0.0805 M
c. .0201 M
d. .0402 M

water to produce a sulfuric acid solution that falls to the ground as rain or snow. $SO_3(g) + H_2O(l) \rightarrow H_2SO_4(aq)$

37. Have a sour taste; change the color of acid-base indicators; some react with active metals to release hydrogen gas; react with bases to produce salts and water; conduct electric current

38. $H_3PO_4(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + H_2PO_4^-(aq)$
$H_2PO_4^-(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + HPO_4^{2-}(aq)$
$HPO_4^{2-}(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + PO_4^{3-}(aq)$

15 *Acid-Base Titration and pH,* *pp. 134–143*

TEST A

1. d **2.** c
3. b **4.** c
5. c **6.** c
7. b **8.** b
9. d **10.** b
11. c **12.** b
13. a **14.** d
15. d **16.** d
17. d **18.** a
19. c **20.** c
21. d **22.** b
23. c **24.** d
25. d

TEST B

1. d **2.** b
3. d **4.** c
5. a **6.** b
7. a **8.** d
9. self-ionization
10. basic
11. transition interval
12. pH
13. 10^{-14}
14. 14
15. decreases
16. end point
17. higher
18. lower
19. primary standard
20. higher
21. acidic
22. acidic
23. acidic
24. basic
25. basic
26. A pH meter measures the pH of a solution by measuring the voltage between the two electrodes that are placed in the solution. This works because the voltage is proportional to the hydronium ion concentration.
27. The pH changes slowly at first, then rapidly through the equivalence point, then slowly again.
28. $HIn + H_2O \rightleftarrows H_3O^+ + In^-$ or $HIn \rightleftarrows H^+ + In^-$
In acidic solutions, the H_3O^+ ions in solution drive the equation toward the nonionized form. HIn is present in largely nonionized form in acidic solutions, and In^- ions are present in largely ionized form in basic solutions. HIn is a different color than the In^- ion.
29. acidic
30. neutral
31. basic
32. basic
33. basic
34. $[H_3O^+] = 1 \times 10^{-4}$ M; $[OH^-] = 1 \times 10^{-10}$ M
35. $[H_3O^+] = 1.0 \times 10^{-10}$ M; $[OH^-] = 1.0 \times 10^{-4}$ M
36. $[H_3O^+] = 5.0 \times 10^{-11}$ M; $[OH^-] = 2.0 \times 10^{-4}$ M
37. $[H_3O^+] = 1 \times 10^{-4}$ M; $[OH^-] = 1 \times 10^{-10}$ M
38. $[H_3O^+] = 5 \times 10^{-3}$ M; $[OH^-] = 2 \times 10^{-12}$ M
39. 1×10^{-5} M
40. 4.0
41. 2.5×10^{-2} M
42. 0.232 M
43. 2.01 M
44. 0.0175 M

16 *Reaction Energy,* *pp. 144–153*

TEST A

1. d **2.** a
3. c **4.** a
5. b **6.** c
7. a **8.** a