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Assessment
Chapter Test B

## Chapter: Acids and Bases

PART I In the space provided, write the letter of the term or phrase that best completes each statement or best answers each question.
$\qquad$ 1. Which of the following is an oxyacid?
a. HCl
b. $\mathrm{H}_{2} \mathrm{O}$
c. $\mathrm{H}_{2} \mathrm{~S}$
d. $\mathrm{H}_{2} \mathrm{SO}_{4}$
$\qquad$ 2. Which acid is produced in the stomach?
a. $\mathrm{HNO}_{3}$
b. $\mathrm{CH}_{3} \mathrm{COOH}$
c. $\mathrm{H}_{2} \mathrm{SO}_{4}$
d. HCl
$\qquad$ 3. Which of the following is a strong base?
a. $\mathrm{NH}_{3}$
c. NaOH
b. aniline
d. acetate ion
$\qquad$ 4. In the reaction represented by the equation $\mathrm{HF}(a q)+\mathrm{H}_{2} \mathrm{O}(l) \leftrightarrows$ $\mathrm{H}_{3} \mathrm{O}^{+}(a q)+\mathrm{F}^{-}(a q)$, a conjugate acid-base pair is
a. $\mathrm{F}^{-}$and $\mathrm{H}_{2} \mathrm{O}$.
b. $\mathrm{H}_{3} \mathrm{O}^{+}$and HF.
c. HF and $\mathrm{F}^{-}$.
d. HF and $\mathrm{H}_{2} \mathrm{O}$.
$\qquad$ 5. If $\mathrm{H}_{2} \mathrm{O}$ in the reaction represented by the equation $\mathrm{H}_{2} \mathrm{O}+\mathrm{C}_{2} \mathrm{H}_{3} \mathrm{COOH} \leftrightarrows$ $\mathrm{H}_{3} \mathrm{O}^{+}+\mathrm{C}_{2} \mathrm{H}_{3} \mathrm{COO}^{-}$is considered to be a weaker base, then $\mathrm{H}_{3} \mathrm{O}^{+}$is a
a. stronger acid.
c. weaker acid.
b. stronger base.
d. weaker base.
$\qquad$ 6. Proton-transfer reactions favor production of the
a. stronger acid and stronger base.
b. weaker acid and weaker base.
c. stronger acid and weaker base.
d. weaker acid and stronger base.
7. Aqueous solutions of most bases contain
a. hydroxide ions and cations.
c. hydrogen ions and anions.
b. hydroxide ions and anions.
d. hydrogen ions and cations.
8. Acid strength increases with
a. increasing polarity and increasing bond strength.
b. increasing polarity and decreasing bond strength.
c. decreasing polarity and increasing bond strength.
d. decreasing polarity and decreasing bond strength.
$\qquad$
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$\qquad$

## PART II Write the correct term (or terms) in the space provided.

9. A substance that ionizes almost completely in aqueous solutions, producing
$\mathrm{H}_{3} \mathrm{O}^{+}$ions, is $\mathrm{a}(\mathrm{n})$ $\qquad$ acid.
10. An acid that contains hydrogen and only one other element is called $a(n)$
$\qquad$ acid.
11. The species that forms when an acid has given up a proton is called the acid's $\qquad$ _.
12. An acid that can donate two protons per molecule is called $a(n)$
$\qquad$ acid.
13. Bases are said to be neutralized when they react with
$\qquad$ to yield
$\qquad$ and $\mathrm{a}(\mathrm{n})$
$\qquad$
14. Any species that can react as either an acid or a base is described as
$\qquad$ .
15. Barium carbonate will react with hydrochloric acid to produce
$\qquad$
$\qquad$ and $\qquad$ .

## PART III

Write the name of each of the following acids in the space provided.
16. $\qquad$ $\mathrm{HNO}_{2}$
17. $\qquad$ HCl
18. $\qquad$ $\mathrm{H}_{2} \mathrm{CO}_{3}$
19. $\qquad$ $\mathrm{H}_{2} \mathrm{SO}_{4}$
20. HI
21. HBrO
$\qquad$ Class $\qquad$ Date $\qquad$
Chapter Test B, continued

Write the formula for each of the following acids in the space provided.
22. $\qquad$ hydrosulfuric acid
23. $\qquad$ nitric acid
24. $\qquad$ phosphorous acid
25. $\qquad$ perchloric acid

Refer to the equation below to answer questions $\mathbf{2 6}$ and 27.

$$
\mathrm{HCl}(g)+\mathrm{NH}_{3}(l) \leftrightarrows \mathrm{NH}_{4}^{+}(a q)+\mathrm{Cl}^{-}(a q)
$$

26. List the conjugate acid-base pairs.
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$\qquad$
27. Identify each reactant and product as acidic or basic.
$\qquad$
$\qquad$

Refer to the equation below to answer questions 28 and 29.

$$
\mathrm{H}_{2} \mathrm{O}(l)+\mathrm{NH}_{3}(g) \leftrightarrows \mathrm{NH}_{4}^{+}(a q)+\mathrm{OH}^{-}(a q)
$$

28. List the conjugate acid-base pairs.
$\qquad$
$\qquad$
29. Identify each reactant and product as a proton donor or a proton acceptor.
$\qquad$
Chapter Test B, continued

## Refer to the following statement to answer questions 30-32:

Dilute $\mathrm{HCl}(a q)$ and $\mathrm{NaOH}(a q)$ are mixed in chemically equivalent quantities.
30. Write the chemical equation for the reaction.
31. Write the overall ionic equation for the reaction.
32. Write the net ionic equation.
$\qquad$

Use the following three acids to answer questions 33 and 34:
iodic acid hypoiodous acid periodic acid
33. Give the formulas for these three acids.
34. List the acids in order of increasing acid strength.
$\qquad$
Chapter Test B, continued
PART IV Write the answers to the following questions in the space provided.
35. Explain the difference between strong acids and weak acids.
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$\qquad$
$\qquad$
$\qquad$
36. Explain how the production of sulfur trioxide, $\mathrm{SO}_{3}$, in industrial processes can result in acid rain. Write an equation for the reaction.
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$\qquad$
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$\qquad$
$\qquad$
37. List five properties of aqueous acids.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
38. Write the balanced equations that describe the three-stage ionization of phosphoric acid in a dilute aqueous solution.
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$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
dissolves. The ions, already present, separate from one another. Ionization is the process of forming ions from the solute molecules by the action of the solvent. When a molecular compound dissolves and ionizes in a polar solvent, ions are formed.
21. In a strong electrolyte, all or almost all of the dissolved compound exists as ions in aqueous solution. In a weak electrolyte, little of the dissolved compound exists as ions in aqueous solution.
22. When a compound containing hydrogen dissolves in water to form a hydrogen ion, $\mathrm{H}^{+}$, the $\mathrm{H}^{+}$ion attracts other molecules or ions so strongly that it rarely exists alone. In water, the $\mathrm{H}^{+}$ion immediately bonds to a water molecule, forming a hydronium ion, $\mathrm{H}_{3} \mathrm{O}^{+}$.
23. Dissolved salt will lower the freezing point of water. Therefore, adding salt to icy roads will help melt the ice and prevent further freezing of any water on the road's surface. It will also prevent the refreezing of water as it melts.
24. none
25. $\mathrm{Ba}^{2+}(a q)+\mathrm{SO}_{4}^{2-}(a q) \rightarrow \mathrm{BaSO}_{4}(s)$
26. $\mathrm{Cd}^{2+}(a q)+\mathrm{S}^{2-}(a q) \rightarrow \operatorname{CdS}(s)$
27. none
28. none
29. $42 \mathrm{~g} / \mathrm{mol}$
30. $0.77^{\circ} \mathrm{C} / m$
31. $-0.261^{\circ} \mathrm{C}$
32. $-2.81^{\circ} \mathrm{C} / m$
33. 690 g
34. $0.73^{\circ} \mathrm{C}$

## 14 Acids and Bases,

pp. 125-133

## TEST A

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

## TEST B

1. d
2. d
3. c
4. c
5. a
6. b
7. a
8. b
9. strong
10. binary
11. conjugate base
12. diprotic
13. acids, water, salt
14. amphoteric
15. carbon dioxide, barium chloride, water
16. nitrous acid
17. hydrochloric acid
18. carbonic acid
19. sulfuric acid
20. hydriodic acid
21. hypobromous acid
22. $\mathrm{H}_{2} \mathrm{~S}$
23. $\mathrm{HNO}_{3}$
24. $\mathrm{H}_{3} \mathrm{PO}_{3}$
25. $\mathrm{HClO}_{4}$
26. HCl and $\mathrm{Cl}^{-}$ $\mathrm{NH}_{3}$ and $\mathrm{NH}_{4}^{+}$
27. acidic: HCl and $\mathrm{NH}_{4}^{+}$ basic: $\mathrm{NH}_{3}$ and $\mathrm{Cl}^{-}$
28. $\mathrm{H}_{2} \mathrm{O}$ and $\mathrm{OH}^{-}$ $\mathrm{NH}_{3}$ and $\mathrm{NH}_{4}^{+}$
29. proton donors: $\mathrm{H}_{2} \mathrm{O}$ and $\mathrm{NH}_{4}^{+}$ proton acceptors: $\mathrm{OH}^{-}$and $\mathrm{NH}_{3}$
30. $\mathrm{HCl}(a q)+\mathrm{NaOH}(a q) \rightarrow \mathrm{NaCl}(a q)+$ $\mathrm{H}_{2} \mathrm{O}(l)$
31. $\mathrm{H}_{3} \mathrm{O}^{+}(a q)+\mathrm{Cl}^{-}(a q)+\mathrm{Na}^{+}(a q)+$ $\mathrm{OH}^{-}(a q) \rightarrow \mathrm{Na}^{+}(a q)+\mathrm{Cl}^{-}(a q)+$ $2 \mathrm{H}_{2} \mathrm{O}(l)$
32. $\mathrm{H}_{3} \mathrm{O}^{+}(a q)+\mathrm{OH}^{-}(a q) \rightarrow 2 \mathrm{H}_{2} \mathrm{O}(l)$
33. $\mathrm{HIO}_{3}, \mathrm{HIO}, \mathrm{HIO}_{4}$
34. $\mathrm{HIO}, \mathrm{HIO}_{3}, \mathrm{HIO}_{4}$
35. A strong acid ionizes completely in an aqueous solution. A weak acid does not ionize completely in aqueous solution. Its aqueous solution contains hydronium ions, anions, and dissolved acid molecules.
36. Sulfur trioxide, $\mathrm{SO}_{3}$, is produced as a gas and dissolves in atmospheric
water to produce a sulfuric acid solution that falls to the ground as rain or snow. $\mathrm{SO}_{3}(g)+\mathrm{H}_{2} \mathrm{O}(l) \rightarrow \mathrm{H}_{2} \mathrm{SO}_{4}(a q)$
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. $\mathrm{H}_{3} \mathrm{PO}_{4}(a q)+\mathrm{H}_{2} \mathrm{O}(l) \rightleftarrows$

$$
\mathrm{H}_{3} \mathrm{O}^{+}(a q)+\mathrm{H}_{2} \mathrm{PO}_{4}^{-}(a q)
$$

$\mathrm{H}_{2} \mathrm{PO}_{4}^{-}(a q)+\mathrm{H}_{2} \mathrm{O}(l) \rightleftarrows \mathrm{H}_{3} \mathrm{O}^{+}(a q)+$ $\mathrm{HPO}_{4}^{2-}(a q)$ $\mathrm{HPO}_{4}^{2-}(a q)+\mathrm{H}_{2} \mathrm{O}(l) \rightleftarrows \mathrm{H}_{3} \mathrm{O}^{+}(a q)+$ $\mathrm{PO}_{4}^{3-}(a q)$

## 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. c
11. b
12. a
13. d
14. d
15. d
16. d
17. a
18. c
19. c
20. d
21. b
22. c
23. d
24. 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. $\mathrm{HIn}+\mathrm{H}_{2} \mathrm{O} \rightleftarrows \mathrm{H}_{3} \mathrm{O}^{+}+\mathrm{In}^{-}$or $\mathrm{HIn} \rightleftarrows$ $\mathrm{H}^{+}+\mathrm{In}^{-}$
In acidic solutions, the $\mathrm{H}_{3} \mathrm{O}^{+}$ions in solution drive the equation toward the nonionized form. HIn is present in largely nonionized form in acidic solutions, and $\mathrm{In}^{-}$ions are present in largely ionized form in basic solutions. HIn is a different color than the $\mathrm{In}^{-}$ ion.
29. acidic
30. neutral
31. basic
32. basic
33. basic
34. $\left[\mathrm{H}_{3} \mathrm{O}^{+}\right]=1 \times 10^{-4} \mathrm{M}$; $\left[\mathrm{OH}^{-}\right]=1 \times 10^{-10} \mathrm{M}$
35. $\left[\mathrm{H}_{3} \mathrm{O}^{+}\right]=1.0 \times 10^{-10} \mathrm{M}$; $\left[\mathrm{OH}^{-}\right]=1.0 \times 10^{-4} \mathrm{M}$
36. $\left[\mathrm{H}_{3} \mathrm{O}^{+}\right]=5.0 \times 10^{-11} \mathrm{M}$; $\left[\mathrm{OH}^{-}\right]=2.0 \times 10^{-4} \mathrm{M}$
37. $\left[\mathrm{H}_{3} \mathrm{O}^{+}\right]=1 \times 10^{-4} \mathrm{M}$; $\left[\mathrm{OH}^{-}\right]=1 \times 10^{-10} \mathrm{M}$
38. $\left[\mathrm{H}_{3} \mathrm{O}^{+}\right]=5 \times 10^{-3} \mathrm{M}$; $\left[\mathrm{OH}^{-}\right]=2 \times 10^{-12} \mathrm{M}$
39. $1 \times 10^{-5} \mathrm{M}$
40. 4.0
41. $2.5 \times 10^{-2} \mathrm{M}$
42. 0.232 M
43. 2.01 M
44. 0.0175 M

## 16 Reaction Energy,

pp. 144-153

## TEST A

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