Name _____ Date _____ Class _____

Assess Your Understanding

Understanding Solutions

How Are Mixtures Classified?

1a. REVIEW What is a solution? _____

_____

b. COMPARE AND CONTRAST How are colloids and suspensions different from solutions? _____

_____

c. INFER Suppose you mix food coloring in water to make it blue. Have you made a solution or a suspension? Explain. _____

_____

_____

_____

got it?

○ **I get it!** Now I know that classifying mixtures as solutions, colloids, and suspensions is based on _____

_____

○ **I need extra help with** _____

_____

How Does a Solution Form?

2. APPLY CONCEPTS Why is salt sprinkled on icy roads and sidewalks? _____

_____

_____

got it?

○ **I get it!** Now I know that in a solution, the particles of solute _____

_____

○ **I need extra help with** _____

_____

Name _____ Date _____ Class _____

Key Concept Summaries

Understanding Solutions

How Are Mixtures Classified?

There are different types of mixtures. **A mixture is classified as a solution, colloid, or suspension based on the size of its largest particles.** A **solution** is a mixture that contains a solvent and at least one solute and has the same properties throughout. The **solvent** is the part of a solution usually present in the greatest amount. It dissolves the other substance(s). The **solute** is the substance that is dissolved by the solvent. The particles of solute in a solution are molecules or ions, and thus cannot be seen with the unaided eye. Solutes can be solids, liquids, or gases, as can solutions. In many common solutions, the solvent is water. Water dissolves so many substances that it is often called the "universal solvent."

A **colloid** is a mixture that contains small, undissolved particles that do not settle out. Colloid particles are too small to be seen without a microscope, yet they are large enough to scatter a beam of light. A **suspension** is a mixture in which particles can be seen and easily separated by settling or filtration. Unlike a solution, a suspension does not have the same properties throughout. It contains visible particles that are larger than the particles in solutions or colloids.

How Does a Solution Form?

A solution forms when particles of the solute separate from each other and become surrounded by particles of the solvent. Solutes are either ionic or molecular in nature. When an ionic solid is mixed with water, the positive and negative ions of the solute are attracted to the partially charged water molecules. The water molecules will eventually surround all of the ions and the solid crystal will be completely dissolved. If the solute is a molecular compound, it will break up into individual neutral molecules when added to water. The polar water molecules will attract the polar molecules of the solute. The solute molecules will move away from each other. The covalent bonds within the molecules remain unbroken.

On a separate sheet of paper, explain what a solution is and how one is formed.

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Name _____ Date _____ Class _____

Lesson Quiz

Understanding Solutions

Write the letter of the correct answer on the line at the left.

1. ___ Which of the statements about the effect of solutes on solutions is true?
   - A Solutes raise the boiling point of a solvent.
   - B Water with a solute dissolved in it will freeze at 0°C.
   - C Solutes raise the freezing point of a solvent.
   - D Antifreeze boils at a lower temperature than pure water.

2. ___ Brass is a solution in which a solid is dissolved in a(n)
   - A liquid
   - B gas
   - C solid
   - D water

3. ___ Which of the following statements about solutions is NOT true?
   - A Solutions are mixtures.
   - B Solutions contain a solvent dissolved in a solute.
   - C A solution has the same properties throughout.
   - D The solute in a solution can be a solid, liquid, or gas.

4. ___ Which of the following statements about the particles in a solution is true?
   - A When an ionic solid mixes with water, its ions repel water molecules.
   - B When a molecular solid mixes with water, the covalent bonds are broken.
   - C When an ionic solid mixes with water, water molecules surround each ion.
   - D When a molecular solid mixes with water, water molecules surround each ion.

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

5. _____ If a suspension is allowed to stand, the particles <u>settle out</u>.

6. _____ Solutions and colloids are similar in that both are <u>suspensions</u>.

7. _____ The largest particles in a colloid are <u>smaller</u> than the largest particles in a solution.

8. _____ The freezing point of a solvent <u>decreases</u> as solute is added.

9. _____ <u>Molecular</u> compounds in water conduct an electric current.

10. _____ A characteristic property of a(n) <u>solution</u> is that it can scatter light.

Name _____ Date _____ Class _____

Assess Your Understanding

Concentration and Solubility

How Is Concentration Changed?

1a. DESCRIBE What is a concentrated solution? _____

_____

b. CALCULATE Find the concentration of a solution with 30 grams of solute in 250 grams of solution. _____

c. CHALLENGE Solution A has twice as much solute as Solution B. Is it possible for the solutions to have the same concentration? Explain. _____

_____

_____

got it?

○ **I get it!** Now I know that the concentration of a solution can be changed by _____

_____

○ **I need extra help with** _____

What Factors Affect Solubility?

2a. REVIEW How can you tell when a solution is saturated? _____

_____

b. CONTROL VARIABLES You are given two white powdery substances. How would you use solubility to identify them? _____

_____

_____

c. ANSWER What determines the properties of a solution? _____

_____

got it?

○ **I get it!** Now I know that the solubility of a substance can be affected by _____

_____

○ **I need extra help with** _____

Name _____ Date _____ Class _____

Key Concept Summaries

Concentration and Solubility

How Is Concentration Changed?

Concentration refers to the amount of solute dissolved in a certain amount of solvent. A **dilute solution** contains only a little solute dissolved in a certain amount of solvent. A **concentrated solution** has a lot of solute dissolved in the solvent. **You can change the concentration of a solution by adding solute. You can also change it by adding or removing solvent.** To calculate the concentration of a solution, compare the amount of solute to the total amount of solution. You can report concentration as the percent of solute in solution by volume or mass. For example, if a 100-gram solution contains 10 grams of solute, the concentration of the solute in the solution is 10 percent.

What Factors Affect Solubility?

Solubility is a measure of how much solute can dissolve in a solvent at a given temperature. **Factors that can affect the solubility of a substance include pressure, the type of solvent, and temperature.** A **saturated solution** is one in which the maximum amount of solute has been dissolved at a given temperature. No more solute will dissolve. An unsaturated solution is one in which more solute will dissolve. Solubility is a characteristic property of matter and can be used to identify a substance.

By changing certain conditions, you can change a substance's solubility. The solubility of a gas solute in a liquid solvent increases as the pressure of the gas over the solution increases. For liquid solutions, ionic and polar compounds will usually dissolve in polar solvents. Nonpolar compounds usually do not dissolve in very polar solvents, but they will dissolve in nonpolar solvents. For most solid solutes, solubility increases with an increase in temperature. A supersaturated solution is formed by cooling a heated saturated solution and letting it remain undisturbed so that the excess solute remains in solution. If a supersaturated solution is disturbed, the excess solute will come out of solution. Unlike most solids, gases become less soluble when the temperature increases.

On a separate sheet of paper, explain the difference between concentration and solubility. Then describe how each can be changed.

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Name _____ Date _____ Class _____

Lesson Quiz

Concentration and Solubility

Fill in the blank to complete each statement.

1. A solution in which more solute can be dissolved is called a(n) _____ solution.

2. A solution in which 50 grams of solute is dissolved in 250 grams of solution has a concentration of _____ percent.

3. When saturated solutions are _____, they usually become unsaturated solutions.

4. Ionic and polar compounds usually dissolve in _____ solvents.

5. The concentration of a solution can be changed by _____ solute.

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

6. _____ A solution in which only a little solute is dissolved in a certain amount of solvent is called a(n) concentrated solution.

7. _____ As the pressure of the gas over a solution decreases, the solubility of a gas solute in a liquid solvent increases.

8. _____ The solubility of table sugar in water increases as the temperature increases.

9. _____ The solubility of a gas dissolved in a liquid increases as the temperature of the liquid increases.

10. _____ Three factors that affect the solubility of a substance are pressure, the type of solvent, and volume.

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Name _____ Date _____ Class _____

Assess Your Understanding

Describing Acids and Bases

What Are the Properties of Acids?

1a. DEFINE What is a compound that changes color in an acid called?

○ metal ○ indicator ○ carbonate

b. EXPLAIN Why are acids described as corrosive? _____

_____

c. DRAW CONCLUSIONS How might you tell if a food contains an acid? _____

_____

got it?

○ **I get it!** Now I know that the properties of acids include _____

_____

_____

○ **I need extra help with** _____

_____

What Are the Properties of Bases?

2a. REVIEW The properties of bases are often considered (identical/opposite) to acids.

b. APPLY CONCEPTS In what products are you most likely to find bases in your home? _____

c. POSE QUESTIONS The color of hydrangea flowers depends on the amount of acid or base in the soil. Write a question that helps you determine the cause of a pink hydrangea. _____

_____

got it?

○ **I get it!** Now I know that the properties of bases include _____

_____

○ **I need extra help with** _____

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Name _____ Date _____ Class _____

Key Concept Summaries

Describing Acids and Bases

What Are the Properties of Acids?

Acids are compounds with specific properties. **An acid reacts with metals and carbonates, tastes sour, and turns blue litmus paper red.** Lemons, oranges, tomatoes, and vinegar all contain acids. Hydrochloric acid in your stomach helps with digestion, and sulfuric acid drives many types of batteries.

Acids react with certain metals to produce hydrogen gas. When these metals, including copper, zinc, and iron, react, the metals seem to disappear in the solution. This is one reason acids are described as **corrosive,** meaning they "wear away" other materials. Acids also react with carbonate ions. One product of the reaction of an acid with a carbonate is the gas carbon dioxide. Geologists use this property of acids to identify rocks such as limestone that include carbonate ions.

Although sour taste is a characteristic of many acids, it is not one you should use to identify a compound as an acid. It is never safe to taste unknown chemicals. Chemists use indicators to test for acids. Litmus paper is an example of an **indicator,** a compound that changes color when it comes in contact with an acid or a base. Acids turn blue litmus paper red.

What Are the Properties of Bases?

Bases are compounds that, like acids, have specific properties. The properties of bases are sometimes described as being the "opposite" of those of acids. **A base tastes bitter, feels slippery, and turns red litmus paper blue.** Ammonia, baking soda, and many soaps and detergents are bases.

Bases have a slippery feel. The slippery feel of your shampoo is a property of the bases it contains. Just as you avoid tasting an unknown substance, you wouldn't want to touch one either. Strong bases can irritate your skin. A safer way to identify bases is by their other properties. Unlike acids, bases do not react with metals or with carbonates. But they do react with acids in a chemical reaction called neutralization. Bases turn red litmus paper blue.

On a separate sheet of paper, describe how acids and bases are alike and how they are different.

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Name _____ Date _____ Class _____

Lesson Quiz

Describing Acids and Bases

Write the letter of the correct answer on the line at the left.

1. ___ Which of the following is NOT a property of an acid?
   - A An acid is corrosive.
   - B An acid turns red litmus paper blue.
   - C An acid reacts with metals and carbonates.
   - D An acid tastes sour.

2. ___ Because it wears away certain materials, an acid is described as
   - A concentrated
   - B contaminated
   - C corrosive
   - D carbonated

3. ___ Which of the following best describes bases?
   - A They feel slippery and taste sour.
   - B They turn red litmus paper blue and react with metals.
   - C They taste bitter and react with carbonates.
   - D They turn red litmus paper blue and taste bitter.

4. ___ Which of the following best describes acids?
   - A They taste sour and react with metals.
   - B They taste bitter and react with carbonates.
   - C They feel slippery and turn blue litmus paper red.
   - D They react with metals but not with carbonates.

Fill in the blank to complete each statement.

5. A compound that changes color when it comes into contact with an acid or a base is a(n) _____.

6. A base _____ react with carbonates.

7. If carbon dioxide gas is produced when dilute acid is applied to a rock's surface, the rock is most likely made of _____.

8. Because vinegar contains a(n) _____, it tastes sour.

9. Many soaps and detergents contain _____.

10. The acid in the human stomach that aids in digestion is _____ acid.

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Name _____ Date _____ Class _____

Assess Your Understanding

Acids and Bases in Solution

What Ions Do Acids and Bases Form in Water?

1a. IDENTIFY What type of solution has a pH of 7?

○ acidic ○ basic ○ neutral

b. INTERPRET DATA Solution A has a pH of 1.6. Solution B has a pH of 4. Which solution has a greater concentration of hydrogen ions? Explain. _____

_____

_____

got it?

○ **I get it!** Now I know that, in water, acids produce _____ _____ and bases produce _____.

○ **I need extra help with** _____

_____

What Are the Products of Neutralization?

2a. DEFINE How is the scientific meaning of salt different from the common meaning of salt? _____

_____

_____

b. MAKE GENERALIZATIONS Is the pH of an acid-base neutralization always 7? Why or why not? _____

_____

_____

got it?

○ **I get it!** Now I know that a neutralization reaction produces _____

_____

○ **I need extra help with** _____

_____

Name _____ Date _____ Class _____

Key Concept Summaries

Acids and Bases in Solution

What Ions Do Acids and Bases Form in Water?

In a solution with water, most acids separate into hydrogen ions and negative ions. A **hydrogen ion (H^+)** is an atom of hydrogen that has lost its electron. The production of hydrogen ions helps define an acid. **An acid produces hydrogen ions (H^+) in water.** The hydrogen ions are responsible for corroding metals and turning blue litmus paper red.

Acids may be strong or weak. Strength depends on how well the acid dissociates, or separates into ions, in water. A strong acid dissociates to a high degree; a weak acid, less so.

Bases also dissociate in solution. **A base produces hydroxide ions (OH^-) in water.** The **hydroxide ion (OH^-)** is a negative ion made up of oxygen and hydrogen. Hydroxide ions are responsible for the bitter taste and slippery feel of bases, and for turning red litmus paper blue. Strong bases readily produce hydroxide ions in water; weak bases do not.

To determine the strength of an acid or base, the pH scale is used. The **pH scale** ranges from 0 to 14 and expresses the concentration of hydrogen ions in a solution. The most acidic substances are found at the low end of the scale; the most basic substances at the high end. A pH of 7 is neutral.

What Are the Products of Neutralization?

When an acid and a base are mixed, the reaction produces a salt and water. The reaction between an acid and a base is called **neutralization** because the resulting mixture is not as acidic or basic as the individual starting solutions were. The final pH depends on the volumes, concentrations, and strengths of the reacting acid and base. The **salt** that forms from a neutralization reaction is any ionic compound made from the positive ion of a base and the negative ion of an acid. **In a neutralization reaction, an acid reacts with a base to produce a salt and water.**

On a separate sheet of paper, use the reaction between hydrochloric acid (HCl) and potassium hydroxide (KOH) to describe a neutralization reaction in terms of reactants, products, litmus paper, and pH.

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Name _____ Date _____ Class _____

Lesson Quiz

Acids and Bases in Solution

Write the letter of the correct answer on the line at the left.

1. ___ Which of the following substances is NOT an acid?
   - A HCl
   - B H_2SO_4
   - C NaOH
   - D HNO_3

2. ___ The negative ion found in bases is the
   - A hydroxide ion
   - B hydrogen ion
   - C carbonate ion
   - D water ion

3. ___ Which of the following substances is most likely to have a pH close to 7?
   - A lemon
   - B antacid
   - C baking soda
   - D vinegar

4. ___ Which of the following statements is NOT true about neutralization?
   - A An acid and a base are the reactants.
   - B A salt and water are the products.
   - C There is no color change in litmus paper when the reaction is over.
   - D It produces an acid-base mixture that is more acidic than both the individual starting solutions.

Fill in the blank to complete each statement.

5. A solution with a pH of 2 is _____ acidic than a solution with a pH of 6.

6. Chemists use the _____ to express the concentration of hydrogen ions in solution.

7. An acid produces _____ ions in water.

8. Substances with pH values close to 14 are strong _____.

9. A strip of blue litmus paper placed in a beaker of vinegar will turn _____.

10. A base produces _____ ions in water.