

Name \_\_\_\_\_

Course/Section \_\_\_\_\_

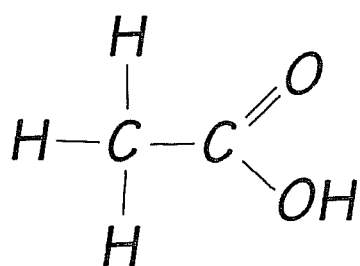
Date \_\_\_\_\_

Professor/TA \_\_\_\_\_



### Activity 3.1 A Quick Review of the Properties of Water

1. Compounds that have the capacity to form hydrogen bonds with water are said to be hydrophilic (water loving). Those without this capacity are hydrophobic (water fearing).

	<p>Is the molecule on the left hydrophilic or hydrophobic? Explain your answer.</p>
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2. In addition to being polar, water molecules can dissociate into hydronium ions ( $\text{H}_3\text{O}^+$ , often described simply as  $\text{H}^+$ ) and hydroxide ions ( $\text{OH}^-$ ). The concentration of each of these ions in pure water is  $10^{-7}$ . Another way to say this is that the concentration of hydronium ions, or  $\text{H}^+$  ions, is one out of every 10 million molecules. Similarly, the concentration of  $\text{OH}^-$  ions is one in 10 million molecules.

a. The  $\text{H}^+$  ion concentration of a solution can be represented as its pH value. The pH of a solution is defined as the negative  $\log_{10}$  of the hydrogen ion concentration. What is the pH of pure water?

b. Refer to the diagram of the molecule of acetic acid in question 1. The  $\text{COOH}$  group can ionize to release a  $\text{H}^+$  ion into solution. If you add acetic acid to water and raise the concentration of  $\text{H}^+$  ions to  $10^{-4}$ , what is the pH of this solution?

3. Life as we know it could not exist without water. All the chemical reactions of life occur in aqueous solution. Water molecules are polar and are capable of forming hydrogen bonds with other polar or charged molecules. As a result, water has the following properties:

- A. H<sub>2</sub>O molecules are cohesive; they form hydrogen bonds with each other.
- B. H<sub>2</sub>O molecules are adhesive; they form hydrogen bonds with polar surfaces.
- C. Water is a liquid at normal physiological (or body) temperatures.
- D. Water has a high specific heat.
- E. Water has a high heat of vaporization.
- F. Water's greatest density occurs at 4°C.

Explain how these properties of water are related to the phenomena described in parts a–h below. More than one property may be used to explain a given phenomenon.

- a. During the winter, air temperatures in the northern United States can remain below 0°C for months; however, the fish and other animals living in the lakes survive.
- b. Many substances—for example, salt (NaCl) and sucrose—dissolve quickly in water.
- c. When you pour water into a 25-ml graduated cylinder, a meniscus forms at the top of the water column.
- d. Sweating and the evaporation of sweat from the body surface help reduce a human's body temperature.
- e. A bottle contains a liquid mixture of equal parts water and mineral oil. You shake the bottle vigorously and then set it on the table. Although the law of entropy favors maximum randomness, this mixture separates into layers of oil over water.
- f. Water drops that fall on a surface tend to form rounded drops or beads.
- g. Water drops that fall on your car tend to bead or round up more after you polish (or wax) the car than before you polished it.
- h. If you touch the edge of a paper towel to a drop of colored water, the water will move up into (or be absorbed by) the towel.