

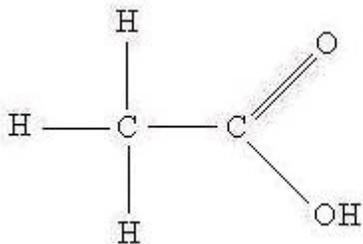
Name:

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## 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).

a. Do you think this molecule is hydrophilic or hydrophobic? Explain your answer (and remember, “like dissolves like”).



2. Water molecules can dissociate into hydronium ions ( $\text{H}_3\text{O}^+$ , often just called  $\text{H}^+$  for shorthand) and hydroxide ions ( $\text{OH}^-$ ). The concentration of each of these ions in pure water is  $10^{-7}$ . In other words, in pure water one out of every 10 million molecules is dissociated into a hydroxide ion and a hydronium ion.

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 (“ $[\text{H}^+]$ ” in shorthand). 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 an  $\text{H}^+$  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?

c. What is the pH of a solution with a  $[\text{H}^+] = 10^{-8}$ ?

d. What is the pH of a solution with a  $[\text{OH}^-]$  of  $10^{-2}$ ?

e. The pH of a solution is 6.5. What are the  $[\text{H}^+]$  and  $[\text{OH}^-]$  of the 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 temperature (ie. body temperature).
- 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, such as NaCl and sucrose, dissolve quickly in water.

C. When you pour water into a 25ml 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, the mixture still separates into layers of oil and 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) your 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 into (be absorbed by) the towel.