

## Measuring pH and Concentration

### PROBLEM

What is the effect of dilution on the pH of an acid or a base?

### INTRODUCTION

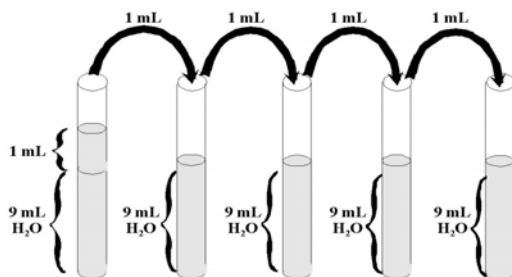
Pure water is neutral. It has a pH of 7. Acids have pH's below 7 while bases have pH's above 7. If an acid or a base is diluted with water, would you expect it to be as strong? What effect do you think addition of water would have on the pH? In this laboratory investigation, you will do a serial dilution of an acid and of a base. Then you will measure the pH's of acids and bases of different concentrations to determine the relationship between pH and concentration.

### MATERIALS (per group)

Graduated cylinder; hydrion (pH) paper; hydrochloric acid; sodium hydroxide; stirring rod; test tube rack; test tubes

### PROCEDURE

1. Place five clean test tubes in a test tube rack. Using a graduated cylinder, transfer 9 mL of water to the each test tube.
2. To the first test tube, add 1 mL of 1 M hydrochloric acid. Mix well with a stirring rod.
3. Using a graduated cylinder, withdraw 1 mL of fluid from the first test tube and add it to the second test tube. Mix well with a stirring rod. Then repeat this procedure from test tube 2 to test tube 3, from test tube 3 to test tube 4, and from test tube 4 to test tube 5 as shown below.

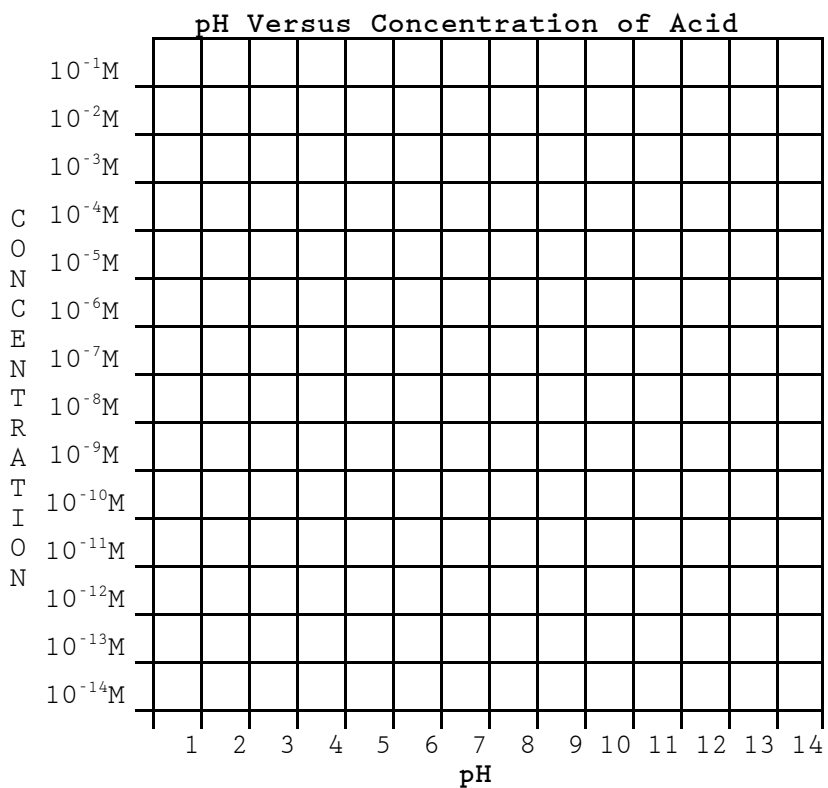


4. Dip a piece of hydrion paper into the first test tube. Note the color. Compare it to the scale on the hydrion paper container to determine the pH. Record your result in the data table on the next page.
5. Repeat step 4 of the procedure with the remaining four test tubes.
6. Calculate the concentration of the acid in each test tube as follows: In the first test tube, 1 out of 10 milliliters is acid. The original concentration of the acid was 1 M. The concentration of the acid in the first test tube is  $\frac{1}{10}$  the original concentration. The concentration of the acid in each subsequent test tube is  $\frac{1}{10}$  the concentration of the acid in the test tube before it. Record your results in the data table on the next page.

- Repeat steps 1-6 of the procedure using 1 mL of 1 M sodium hydroxide instead of hydrochloric acid. Then calculate the concentration of the base in each test tube. From the concentration of base, determine the concentration of acid.
- Prepare a graph of **pH Versus Concentration of Acid** on the graphing space below by plotting the ten points from the data you gathered with respect to pH and concentration of acid. Draw the best straight line.

**OBSERVATIONS**

Test Tube Number		1	2	3	4	5
A C I D	pH					
	Acid Concentration					
B A S E	pH					
	Base Concentration					
	Acid Concentration					



**CONCLUSIONS**

- What did the addition of water do to the pH's of the solutions (both acid and base)?

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- Based on your graph, what is the relationship between the pH and the concentration of acid?

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