

Household Acids and Bases

Many common household solutions contain acids and bases. Acid-base indicators, such as litmus and red cabbage juice, turn different colors in acidic and basic solutions. They can, therefore, be used to show if a solution is acidic or basic. An acid turns blue litmus paper red, and a base turns red litmus paper blue. The acidity of a solution can be expressed using the pH scale. Acidic solutions have pH values less than 7, basic solutions have pH values greater than 7, and neutral solutions have a pH value equal to 7.

In this experiment, you will use litmus and a pH Sensor to determine the pH values of household substances. After adding red cabbage juice to the same substances, you will determine the different red cabbage juice indicator colors over the entire pH range.

OBJECTIVES

In this experiment, you will

- Use litmus paper and a pH Sensor to determine the pH values of household substances.
- Add cabbage juice to the same substances and determine different red cabbage juice indicator colors over the entire pH range.

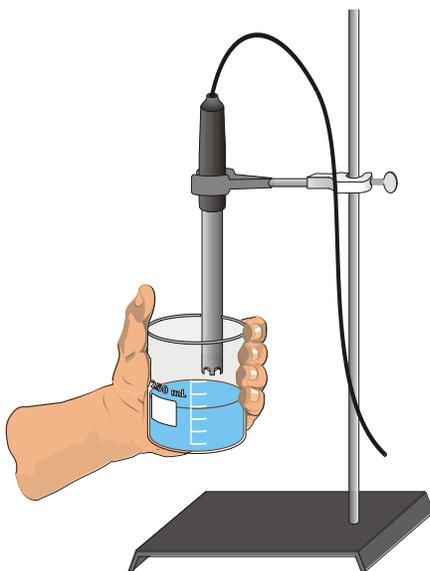


Figure 1

MATERIALS

TI-Nspire handheld or computer and TI-Nspire software	household solutions
data-collection interface	7 small test tubes
Vernier pH Sensor	test-tube rack
wash bottle	red and blue litmus paper
distilled water	paper towel
ring stand	stirring rod
utility clamp	red cabbage juice
sensor soaking solution	250 mL beaker

PROCEDURE

1. Obtain and wear goggles. **CAUTION:** Do not eat or drink in the laboratory.

Part I Litmus Tests

2. Label 7 test tubes with the numbers 1–7 and place them in a test tube rack.
3. Measure 3 mL of vinegar into test tube #1. Refer to the data table and fill each of the test tubes 2–7 to about the same level with its respective solution. **CAUTION:** *Ammonia solution is toxic. Its liquid and vapor are extremely irritating, especially to eyes. Drain cleaner solution is corrosive. Handle these solutions with care. Do not allow the solutions to contact your skin or clothing. Wear goggles at all times. Notify your teacher immediately in the event of an accident.*
4. Use a stirring rod to transfer one drop of vinegar to a small piece of blue litmus paper on a paper towel. Transfer one drop to a piece of red litmus paper on a paper towel. Record the results. Clean and dry the stirring rod each time.
5. Test solutions 2–7 using the same procedure. Be sure to clean and dry the stirring rod each time.

Part II Red Cabbage Juice Indicator

6. *After* you have finished the Part I litmus tests, add 3 mL of red cabbage juice indicator to each of the 7 test tubes. Record your observations. Dispose of the test-tube contents as directed by your teacher.

Part III pH Tests

7. Prepare the pH Sensor for data collection.
 - a. Connect the pH Sensor to the data-collection interface. Connect the interface to the TI-Nspire handheld or computer.
 - b. Remove the pH Sensor from the sensor storage solution bottle by unscrewing the lid. Carefully remove the bottle, leaving the cap on the sensor body.
 - c. Rinse the tip of the sensor with distilled water and place the sensor tip into a beaker containing sensor soaking solution. Use a utility clamp to fasten the pH Sensor to a ring stand, as shown in Figure 1.

8. Set up Events with Entry data collection.
 - a. Choose New Experiment from the  Experiment menu.
 - b. Choose Collection Mode ► Events with Entry from the  Experiment menu.
 - c. Enter **Chemical** as the Name and leave the Units field blank.
 - d. Select OK.
 - e. Start data collection (.
9. Raise the pH Sensor from the sensor soaking solution and set the solution aside. Use a wash bottle filled with distilled water to thoroughly rinse the pH Sensor. Catch the rinse water in a 250 mL beaker.
10. Obtain one of the 7 solutions in the small container supplied by your teacher. Raise the solution to the pH Sensor and swirl the solution about the sensor. When the pH reading stabilizes, click the Keep button , enter the name of the chemical tested, and select OK.
11. Prepare the pH Sensor for reuse.
 - a. Rinse it with distilled water from a wash bottle.
 - b. Place the sensor into the soaking solution and swirl the solution about the sensor briefly.
 - c. Rinse with distilled water again.
12. Repeat Steps 10 and 11 to determine the pH of the remaining solutions. You must clean the pH Sensor between tests.
13. When you are done, stop data collection (). Click the Table View tab () to switch to Table View. Enter your results in the Data Table.
14. Rinse the sensor with distilled water and return it to the soaking solution.

DATA TABLE

Test Tube	Solution	Blue Litmus	Red Litmus	Red Cabbage Juice	pH
1	vinegar				
2	ammonia				
3	lemon juice				
4	soft drink				
5	drain cleaner				
6	detergent				
7	baking soda				

PROCESSING THE DATA

1. Which of the household solutions tested are acids? How can you tell?
2. Which of the solutions are bases? How can you tell?
3. What color(s) is red cabbage juice indicator in acids? In bases?
4. Can red cabbage juice indicator be used to determine the strength of acids and bases? Explain.
5. List advantages and disadvantages of litmus and red cabbage juice indicators.