

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 pH equal to 7.

OBJECTIVES

In this experiment, you will

- test household solutions with litmus paper
- test household solutions using red-cabbage juice indicator
- use a computer to determine the pH values of household solutions
- classify household substances as acids or bases
- determine the different red cabbage juice indicator colors over the entire pH range
- use red cabbage juice indicator to test other household substances
- use a pipet to explore titration and neutralization

MATERIALS

Power Macintosh or Windows PC
Vernier computer interface
LoggerPro
Vernier pH Sensor
wash bottle filled with distilled water
household solutions
ring stand
10 ml graduated cylinder
utility clamp

10 small test tubes
test-tube rack
red and blue litmus paper
paper towels
stirring rod
red cabbage juice
250-mL beaker - for waste
pipet
temporary storage solution



Experiment 28

PROCEDURE

1. Obtain and wear goggles and a lab apron.

Part I Litmus Tests

2. Label 10 test tubes with the numbers 1 to 10 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 2-10 to about the same level with its 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.
5. Test solutions 2-10 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 10 test tubes. Record your observations with colored pencils and then dispose of the test tube contents by pouring them down the drain with plenty of water. Keep your cups for part 3.

Part III pH Tests

7. Prepare the computer for data collection by opening the file in the Experiment 28 folder of *Physical Science with Computers*.
8. Raise the pH Sensor from the “Temporary Storage Solution” and set the solution aside. Use a wash bottle filled with distilled water to thoroughly rinse the pH Sensor as demonstrated by your teacher. Catch the rinse water in a 250-mL beaker. (waste)
9. Get one of the 10 solutions in the small container. Raise the cup of solution to the pH Sensor and swirl the solution about the sensor. When the pH reading stabilizes after about one minute, record the pH value.
10. Prepare the pH Sensor for reuse.
 - a. Rinse it with distilled water from a wash bottle over the wash cup.
 - b. Place the Sensor into the “Temporary Storage Solution” and swirl the solution about the Sensor briefly.
 - c. Rinse with distilled water again.
11. Determine the pH of the other solutions using the Step 9 procedure. You must clean the Sensor, using the Step 10 procedure, between tests. When you are done, wash the Sensor with distilled water and return it to the “Temporary Storage Solution.”

DATA AND OBSERVATIONS FOR PARTS I, II, III

Test Tube	Solution	Blue Litmus	Red Litmus	Red Cabbage Juice	pH
1	Vinegar				
2	Ammonia				
3	Lemon Juice				
4	Soda Pop				
5	Drain Cleaner				
6	Detergent				
7	Baking Soda				
8	Aspirin water				
9	Alcohol				
10	Salt water				
	Other solutions				

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Part IV - Neutralization - after you have determined the pH of the solutions

- Put 3 ml of cabbage juice in 3 different test tubes
- Put 3 ml of drain cleaner in those same test tubes
- Use the pipet to deliver milliliters of neutralization solution to the test tube. Try lemon juice, vinegar and aspirin water. Record the number of milliliters of acid it takes to neutralize the drano solution.

Acid type	Number of milliliters to neutralize	concentration

Which acid is the most concentrated and why?

PROCESSING THE DATA

- Which of the household solutions tested are acids? How can you tell?
- Which of the solutions are bases? How can you tell?
- 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.
6. What did you learn from the neutralization activities about the relative strengths of acids and bases? about

EXTENSIONS

1. Test other household substances to determine if they are acidic or basic.
2. Research and try some other “home-made” indicators obtained from plants. Red rose, red dahlia, and blue cornflower are some possibilities to consider.
3. Test your answer to Question 4 by adding red cabbage juice indicator to an array of colorless solutions with known pH values. Solutions with pH 2, 4, 6, 8, 10, and 12 might be used. Show the results to the class.