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 computer-interfaced 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.

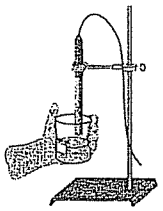
In this experiment, you will

- 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.

MATERIALS

Figure 1

computer
Vernier computer interface
Logger *Pro*
Vernier pH Sensor
wash bottle
distilled water
ring stand
utility clamp
sensor soaking solution
household solutions
7 small test tubes
test-tube rack
red and blue litmus paper
paper towel
stirring rod
red cabbage juice
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 pH Tests

6. Connect the pH Sensor to the computer interface. Prepare the computer to monitor pH by opening the file "21 Household Acids" from the *Chemistry with Computers* folder.

7. Raise the pH Sensor from the sensor storage solution and set the solution aside. Use a wash bottle filled with distilled water to thoroughly rinse the tip of the sensor as demonstrated by your instructor. Catch the rinse water in a 250 mL beaker.

8. Get one of the 7 solutions in the small container supplied by your sensor. Raise the solution to the pH Sensor and swirl the solution about the sensor. When the pH reading stabilizes, record the pH value in your data table.

9. Prepare the pH Sensor for reuse.
   a. Rinse it with distilled water from a wash bottle.
   b. Place the sensor into the sensor soaking solution and swirl the solution about the sensor briefly.
   c. Rinse with distilled water again.

10. Determine the pH of the other solutions using the Step 8 procedure. You must clean the sensor, using the Step 9 procedure, between tests. When you are done, rinse the tip of the sensor with distilled water and return it to the sensor soaking solution.

Part III Red Cabbage Juice Indicator

11. *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.

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.

1) What is the molarity of an HCl solution if 20. milliliters of this acid is needed to neutralize 10. milliliters of a 0.50 M NaOH solution?

A) 0.50 M C) 0.75 M
B) 0.25 M D) 1.0 M

2) Which ion is produced when an Arrhenius base is dissolved in water?

A) H^+, as the only positive ion in solution
B) H^-, as the only negative ion in solution
C) OH^-, as the only negative ion in solution
D) H_3O^+, as the only positive ion in solution

3) Which substance yields hydroxide ion as the only negative ion in aqueous solution?

A) $C_2H_4(OH)_2$ C) $Mg(OH)_2$
B) CH_3Cl D) $MgCl_2$

4) Which substance is an Arrhenius acid?

A) $Mg(OH)_2(aq)$
B) $LiF(aq)$
C) $HBr(aq)$
D) CH_3CHO

5) Given the reaction:

$$HCl(aq) + LiOH(aq) \longrightarrow HOH(\ell) + LiCl(aq)$$

The reaction is *best* described as

A) neutralization
B) decomposition
C) synthesis
D) oxidation-reduction

6) A substance that conducts an electrical current when dissolved in water is called

A) an electrolyte
B) a metalloid
C) a nonelectrolyte
D) a catalyst

7) If 5.0 milliliters of a 0.20 M HCl solution is required to neutralize exactly 10. milliliters of NaOH, what is the concentration of the base?

A) 0.10 M C) 0.30 M
B) 0.20 M D) 0.40 M

8) When 50. milliliters of an HNO_3 solution is exactly neutralized by 150 milliliters of a 0.50 M solution of KOH, what is the concentration of HNO_3?

A) 1.5 M C) 0.5 M
B) 1.0 M D) 3.0 M

9) Which of the following pH values indicates the *highest* concentration of hydronium ions in a solution?

A) pH = 1 C) pH = 3
B) pH = 2 D) pH = 4

10) How many milliliters of 12.0 M HCl(aq) must be diluted with water to make exactly 500. mL of 3.00 M hydrochloric acid?

A) 250. mL C) 100. mL
B) 200. mL D) 125. mL

Name:	Class Period:
Lab Partner	Lab Partner

Chemistry Lab Household Acids and Bases

Purpose _____

_____

_____

Observations:

Trial	Solutions	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. a) _____

_____

b) _____

_____

2. a) _____

_____

b) _____

_____

3. a) _____

_____

b) _____

_____

4. _____

_____

_____

_____

5. a) _____

_____

_____

_____

b) _____

_____

_____

_____

Regents Questions:

1) ____: _____

2) ____: _____

3) ____: _____

4) ____: _____

5) ____: _____

6) ____: _____

7) ____: _____

8) ____: _____

9) ____: _____

10) ____: _____