Acids & Bases

Testing for Acids and Bases

OVERVIEW

Acids and bases have a number of characteristic properties. Bases, for example, typically have a slippery feel and a bitter taste whereas acids are typically sour. Tasting and feeling unknown substances in order to determine whether or not a substance might be acidic or basis is generally not a recommended approach however.

Measuring pH is often a more useful way to classify a substance as an acid or base. pH, which measures H^+ concentration (more specifically H_3O^+ concentration) can be determined using chemical indicators. An indicator is a dye that will change colour at different pH values. By noting the colour of the indicator in a solution with an unknown pH and comparing it to the indicator's known colour range, the pH of the solution may be determined.

In this lab you will test the pH of a number of common substances.

Another property of both acids and bases is that they neutralize each other. During this lab you will examine how a neutralization reaction may be detected by a commonly used indicator, phenolphthalein.

PURPOSE

- To identify common substances as either an acid or base using chemical indicators
- To prepare an indicator solution and use it to determine pH
- To observe how a neutralization reaction may be detected by an indicator

SAFETY

Use caution when testing the HCl and NaOH solutions and the household cleaning products. All are highly corrosive substances. Avoid contact with eyes and skin. Goggles should be worn.

EQUIPMENT AND MATERIALS

Your teacher will provide you with several different indicators.

Some suggested indicators:

pH paper
litmus paper – both red and blue
phenolphthalein solution
bromothymol blue
universal indicator solution
red cabbage leaves

Suggested Solutions to Test

antacids
apple juice
baking soda solution
clear soft drink (e.g. Sprite)
coffee
Drano
ethanol
household ammonia
Javex
ketchup
lemon juice
methanol
milk
orange juice
oven cleaner
Pepto Bismol
saliva
sodium chloride solution
tea
tomato juice
vinegar
window cleaner

1*M* HCl
0.5*M* NaOH

Other Equipment

Spot plate
small test tubes
dropper pipets, 2
250 mL beaker to use for water bath
Bunsen burner
electronic pH meters if available

PROCEDURE

Part A. Using Indicators to Determine pH

1. Prepare a data chart in your notebook to record your results. Include a column for each indicator you have available to you and list all test solutions you will be using. See Table 1 as a sample.

2. Place a few drops of one of the test solution into the wells on the spot plates. Use a separate well for each of the indicators available to you.

3. For the indicator papers, dip the paper into the solution and record the colour. For the pH paper, use the colour chart provided with the pH paper to determine the pH of the solution and record that value in your table.
   For the indicator solutions, add one drop of indicator into each test well. Be careful not to let the dropper touch the drops of solution already in the test wells. Record the colour.

4. If an electronic pH meter is available, use it to test the pH of all test solutions.

Part B. Red Cabbage Indicator

1. Fill a 250-mL beaker roughly half-full with torn red cabbage leaves. Add approximately 100 mL of water. Boil the leaves until the water turns a deep purple. Allow to cool and filter the liquid to use as your indicator.

   Your teacher may have you prepare indicator paper from your cabbage solution. To do this soak coffee filters or filter paper in the solution. After drying, cut the filter into strips that can then be used for your tests.

2. Retest the samples you tested in Part A using your cabbage indicator. Record your results in Table 2.

Part C. Using Phenolphthalein to test Neutralization Reactions

1. Using a clean dropper pipet add 10 drops of 1*M* HCl to a clean test tube and add one drop of phenolphthalein. Note the colour in Table 3. Swirl the test tube to mix.

   Test the pH of this solution using the pH paper and record the pH. You may find it easier to test the pH by adding a few drops of the HCl to a spot plate test well.

2. Using a clean dropper pipet place a few drops of 0.5 *M* NaOH to spot plate test well and add one drop of phenolphthalein. Note the colour.

   Test the pH of this solution using the pH paper and record the pH.

3. Using the NaOH dropper pipet add 0.5*M* NaOH drop by drop to the test tube containing the HCl until a colour change occurs. Swirl the test tube to mix after the addition of each drop. Record the number of drops required, and record the new colour.

4. Once the colour change has occurred, use pH paper to determine the pH of the new mixture.

RESULTS

Table 1. Indicator Tests

Solution	Red litmus	Blue litmus	phenol-phthalein	pH paper
vingar				
lemon juice				
tomato juice				
1*M* HCl				
0.5*M* NaOH				

Table 2. Red Cabbage Indicator Tests

Solution	Cabbage indicator colour
original cabbage solution	
vingar	
lemon juice	
etc.	

Table 3. Neutralization Reaction

Solution	phenolphthalein colour	pH
1.0*M* HCl only		
0.5*M* NaOH only		
After addition of NaOH to HCl causes colour change		

CONCLUSIONS AND QUESTIONS

1. List all substances you tested and classify each as an acid or a base. Were any substances neutral (or nearly so)?

   Consider the food items tested – what conclusion, if any, can you make concerning their pH? What conclusions can be made about the cleaning products in general?

2. What colour does the cabbage indicator turn when in an acid? in a base? Did all results correspond well with your results for Part A?

   Prepare a results table for the cabbage indicator – identify the pH range for each cabbage solution colour you noted during the lab. You'll need to refer back to your results for pH paper results (Table 1).

3. Summarize the change in colour of phenolphthalein during the neutralization reaction – how can it be used to indicate when the acid-base solution reaches the point where neutralization occurs?

   How many drops of NaOH were required to neutralize the 10 drops of HCl?