

Your name \_\_\_\_\_

Lab & Table Number \_\_\_\_\_

Names of students present in your group \_\_\_\_\_  
\_\_\_\_\_

Lab Instructor \_\_\_\_\_

## SCI 265 INVESTIGATION

# HOUSEHOLD CHEMISTRY

Many of the households are acid or bases. *Acids* and *bases* are important compounds in our environment. We are familiar with the hazards of acid rain, but we don't often think of the importance of the delicately balanced composition of our blood and other body fluids. We take antacid tablets to neutralize excess acid in our stomachs; we put sulfuric acid in our car batteries; we put baking soda in our biscuits; we may wash clothes with washing soda; we might put vinegar on our salads. Since we generally speak of *acids* as though they were a class of substances, it is important to find out why we classify them together. The same goes for *bases*. What makes them alike? We can classify these materials by using *indicators*, or dyes, many of which are found in nature.

### Equipment you will need

microstirrer (plastic toothpick)  
96-well plate  
spatula  
50-mL beaker  
2 small test tubes

### Chemicals you will use

#### Part I

##### Solutions of lab acids and bases, 0.1M, in Beral pipets

acetic acid,  $\text{HC}_2\text{H}_3\text{O}_2$   
ammonia,  $\text{NH}_3(aq)$   
calcium hydroxide,  $\text{Ca}(\text{OH})_2$   
hydrochloric acid,  $\text{HCl}$   
nitric acid,  $\text{HNO}_3$   
potassium hydroxide,  $\text{KOH}$   
sodium hydroxide,  $\text{NaOH}$   
sulfuric acid,  $\text{H}_2\text{SO}_4$

##### Solutions of household acids and bases, in Beral pipets

ammonia cleaning solution  
vinegar

#### Part II

##### Some solid lab and household acids and bases

potassium hydrogen tartrate,  $\text{KHC}_4\text{H}_4\text{O}_6$ ,  
(cream of tartar)  
sodium hydrogen carbonate,  $\text{NaHCO}_3$   
(sodium bicarbonate, baking soda)  
antacid tablet, powdered  
aspirin tablet, powdered

#### Indicators

bromothymol blue  
litmus paper, blue and red  
phenolphthalein  
red cabbage juice

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## SAFETY NOTES

1. Wear approved safety goggles at all times in the lab.
2. Acids and bases are CAUSTIC in high concentrations. The solutions you are using are very dilute, but if you should spill any of them on your skin or clothing, rinse with running water and inform your instructor.
3. CAUTION: Do not mix household cleaning products.
4. All chemicals must be handled carefully and treated with respect. The solids and liquids used in this Inquiry are safe for you to use responsibly.
5. Wash your hands before you leave the lab.

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## PROCEDURE

### Part I: Solutions of Laboratory and Household Acids and Bases

1. Set your 96-well plate on a piece of white paper so that you can test each laboratory and household acid and base with laboratory indicators, as shown in the table on p. 4. Start with acetic acid,  $\text{HC}_2\text{H}_3\text{O}_2$ , and put a few drops in each of 4 wells. Continue setting up the well plate with a few drops of each of the acids and bases listed in the table.
2. Put a little water in a small beaker to use for rinsing the capillary tube. Lay a piece of red litmus and a piece of blue litmus paper on a paper towel. Dip the capillary tube in the first well of  $\text{HC}_2\text{H}_3\text{O}_2$ , and touch the piece of red litmus. Observe what happens and record your observations under “red litmus”. Rinse the capillary tube, dip it in the second well, and touch the piece of blue litmus. What happens?
3. Now put a drop of bromothymol blue in the third well of  $\text{HC}_2\text{H}_3\text{O}_3$  and a drop of phenolphthalein in the fourth. Record your observations.
4. Repeat testing each acid and base with the indicators and recording your observations.

### Part II: Solids That May Form Acids or Bases in Solution

1. Put a few crystals or a very small amount (pin head) of one of the solids in each of 5 wells.
2. Add a few drops of water,  $\text{H}_2\text{O}$ , and stir to dissolve the solid. Test with the litmus papers and the other indicators as above. Take careful observations.
3. Repeat the same procedure for the other solids.

### Part III: Foods as indicators.

1. In your bin there are 2 small test tubes. Put about 1/3 inch of red cabbage juice in one test tube. Add 10-15 drops of hydrochloric acid, HCl(aq), shaking after each few drops, until there is a color change. Record your observations. Using the second test tube, repeat with sodium hydroxide, NaOH(aq). Record your observations and rinse the test tubes.
2. Using a microspatula or the plastic stirrer, obtain a small amount of turmeric, a spice that is also a dye. Put it in a clean test tube and add about 0.5 inch of water. Shake to mix the turmeric with the water. Prepare a second test tube with turmeric and water. To the first test tube add several drops of hydrochloric acid, HCl(aq), shake the test tube, and record your observations. In the second test tube, repeat using sodium hydroxide, NaOH(aq). Record your observations.

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## CLEANUP

(All Cleanup suggestions are subject to local laws governing waste from laboratories. The following are suggestions only and may be changed by your instructor. Space has been provided for additional instructions.)

1. Wash the well plate by filling the wells with water, shaking the plate and emptying it in the sink. Repeat several times to be sure it's clean.
2. Wash the beaker and the test tubes.
2. Return all chemicals to their proper places in the lab, and wash and dry your lab bench. Please wash your hands before you leave.
3. Additional instructions:

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## OBSERVATIONS

In Parts I and II below, record your observations in the columns containing the names of indicators. After you have completed your observations, analyze your data and write “acid” or “base” in the final column.

### Part I: Solutions of Laboratory and Household Acids and Bases

<b>Indicators</b> → <b>Materials to test</b> ↓	<b>red litmus paper</b>	<b>blue litmus paper</b>	<b>bromo- thymol blue</b>	<b>phenol- phthalein</b>	<b>acid or base?</b>
<b>Lab acids &amp; bases</b>					
acetic acid, $\text{HC}_2\text{H}_3\text{O}_2$					
ammonia, $\text{NH}_3(aq)$					
calcium hydroxide, $\text{Ca}(\text{OH})_2$					
hydrochloric acid, $\text{HCl}$					
nitric acid, $\text{HNO}_3$					
potassium hydroxide, $\text{KOH}$					
sodium hydroxide, $\text{NaOH}$					
sulfuric acid, $\text{H}_2\text{SO}_4$					
<b>Household acids &amp; bases</b>					
vinegar					
bleach					
ammonia cleaning solution					

**Part II: Solids that form acids or bases in water**

Indicators → Materials to test ↓	red litmus paper	blue litmus paper	bromo-thymol blue	phenolphthalein	acid or base?
<b>acids &amp; bases</b>					
potassium hydrogen tartrate, $\text{KHC}_4\text{H}_4\text{O}_6$					
sodium hydrogen carbonate, $\text{NaHCO}_3$					
antacid tablet, powdered					
aspirin tablet, powdered					

**Part III: Foods as indicators.**

	Red cabbage juice	Turmeric
Hydrochloric acid, $\text{HCl}$		
Sodium hydroxide, $\text{NaOH}$		

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1. What is an acid? Give some examples.
  2. What is a base? Give some examples.
  3. What generalizations can you make
    - (a) about the element with which most of the acid formulas begin?
    - (b) about the properties of an acid?
  4. Were there any exceptions to your generalizations about the formula of an acid? If so, describe them.
  5. What generalizations can you make
    - (a) about the last two elements of the formulas you've identified as bases?
    - (b) about the properties of a base?
  6. Were there any exceptions to your generalizations about the formula of a base? If so, describe them.
  7. Your instructor will write on the board an equation for the reaction of ammonia,  $\text{NH}_3(g)$ , with water. Copy the equation here. Underline the ion in the equation that accounts for aqueous ammonia's basic character.

8. (a) Is  $\text{NaHCO}_3$  an acid or a base? Explain how you know.

(b) What ion do you think is produced when sodium hydrogen carbonate,  $\text{NaHCO}_3$ , is dissolved in water?

9. (a) What household acids and bases do you think elementary students could test safely?

(b) What indicator(s) would you use?