Lab #9 Name:_____
Chem 100

Lab Experiment #9 - ACID/BASE INDICATORS

Purpose: In this laboratory we will investigate how **indicators** can be used to **test for the presence of acids or bases** in a number of common materials.

Background: Very early in the development of chemistry, solutions were classified as **acidic, basic or neutral**. A number of materials were found which exhibited **different colors** depending on whether they were placed in acidic, basic or neutral solutions. These materials are known as **indicators** since they **indicate the acid-base properties** of other substances.

Acids and Bases: Acids and bases can be classified as **strong** or **weak** depending on the intensity of their acid-base properties.

Indicators: In this experiment, we will use known acids and bases to determine the color of various **commercial indicators** in the presence of those strong and weak acids and bases. These indicators include red and blue litmus paper, universal indicator paper, and cabbage leaves.

Overview of Experiments:
1. Red and Blue Litmus Paper: If a solution is acidic, then blue litmus paper will turn red. If a solution is basic then red litmus paper will turn blue. We will use this information to determine if a solution is acidic or basic.

2. UNIVERSAL INDICATOR PAPER: (shown left) Universal indicator paper can be used to determine the pH of solutions. Using this indicator paper, we will determine the relationship between pH and acid-base properties. The color of the indicator paper will change depending on the pH of the sample.

3. Cabbage Leaves: We will prepare an **indicator** from a natural source, **cabbage leaves**, and observe its color in the presence of acids and bases.

4. pH of household chemicals: We will investigate the acid-base properties of a number of common household chemicals using all of the indicators.

5. FUN EXPERIMENT with ALUM !!!!

PROCEDURES

Start Making the Cabbage Indicator

Prepare a solution of the pigments in red cabbage (to be used later in the experiment) as follows:

a. Weigh out approximately **10 grams** of red cabbage leaves.
b. Cut (or tear) the cabbage leaves into small dime-sized pieces.
c. Put the leaves into a 250 mL beaker and add 60 mL of distilled water.
d. Slowly **heat** this mixture using a bunsen burner until the temperature reaches **90-95^{o}C**.

DO NOT BOIL THE SOLUTION! Use your thermometer to check the temperature of the mixture and continue to heat the solution until it becomes deep purple.

e. Allow the mixture to **cool**. While it is cooling, continue with the next part.

PROCEDURE FOR TESTING WITH INDICATOR PAPER

1. Place a piece of paper towel on the bench top.
2. Tear one piece of each type of indicator paper (**red litmus, blue litmus and universal indicator)** into thirds and place the pieces on the paper towel.
3. Using the dropper bottle labeled **concentrated HCl**, test each type of indicator paper by placing one drop of solution on one piece of each of the papers and recording the color.
4. Repeat this test using **dilute HCl**, **distilled water**, **dilute NaOH**, and **concentrated NaOH.**
5. Put your results in the table below.
6. What is the approximate pH value of each of the five solutions?

SOLUTION	COLORS			
	Red Litmus	Blue Litmus	Universal Indicator	pH
Concentrated HCl				
Dilute HCl				
Distilled Water				
Dilute NaOH				
Concentrated NaOH				

Note: You have now determined the pH of the acids and bases. In the next section you will use these to determine the color of the cabbage indicator at various pH's.

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QUESTIONS

1. What pH values are considered acidic?

2. What pH values are considered basic?

3. Which of the indicators above could NOT be used to distinguish between the substances in each of the following pairs? Explain your answer briefly.

a. a strong acid (conc. HCl) and a weak base (dilute NaOH)

b. a weak acid (dilute HCl) and a strong acid (conc. HCl)

CABBAGE INDICATOR – relationship between color and pH

1**. Filter the mixture** from the boiled cabbage into a 100 mL beaker.
2. Using a 10 mL graduated cylinder, add 2 mL of the filtered cabbage solution to each of 5 small test tubes supported in a rack. Save the rest of the cabbage solution until later.
3. Add **3 drops of 1 M KCl** solution to each of the test tubes and GENTLY mix the solutions.
4. Add one of the acid or base solutions to each test tube as follows:

a. To tube # 1 add 10 drops concentrated HCl
b. To tube # 2 add 10 drops dilute HCl
c. To tube # 3 add 10 drops distilled water
d. To tube # 4 add 10 drops dilute NaOH
e. To tube # 5 add 10 drops concentrated NaOH

5. Mix each of the solutions, then record its color and the pH value of the solution (which you previously determined in part 1) in the table below.

TUBE	SOLUTION	pH (determined in part 1)	COLOR of cabbage juice
1	Concentrated HCl		
2	Dilute HCl		
3	Distilled Water		
4	Dilute NaOH		
5	Concentrated NaOH		

6. Describe the color changes that the cabbage extract would undergo if the pH is gradually changed from 1 to 14.

Household Products – Is it Acidic or Basic????

The final part of this lab will involve testing a number of household items for their acid/base characteristics. Test each of the following household chemicals with indicator paper (red, blue, AND universal) and with 2 mL of the cabbage indicator solution in a small test tube. For those chemicals in the dropper bottles, put one drop on the indicator paper or into the test tube. For those chemicals that are a solid/liquid mixture, use the glass rod, or one of your medicine droppers, to put one drop on the indicator paper.

BE VERY CAREFUL!! SOME OF THESE CHEMICALS ARE DANGEROUS!!

BE SURE TO CLEAN UP ALL SPILLS!!

Record any unusual observations that occur during these tests! Can you explain these observations? You should record the initial colors because some of them may change with time.

Chemical	Red Litmus	Blue Litmus	Universal Indicator	Cabbage	ACID or BASE?
Vinegar					
Soft drink					
Bleach					
Aspirin (in 5ml of water)					
Lemon juice					
Glass cleaner					
Milk of Magnesia					
Mouth wash					
Drain cleaner					
Liquid detergent					

Observations:

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FUN EXPERIMENT with ALUM!!!

I. Take half a porcelain spoonful (a pea-sized lump) of YOUR alum crystals from the previous experiment and place them in a test tube.

1. Add about 5 mL of water and mix thoroughly.

2. Using a glass stirring rod to transfer a drop of solution to the paper, test this solution with indicator paper (red, blue, AND universal).

a. What color does the solution turn the red litmus paper?

b. What color does the solution turn the blue litmus paper?

c. What color is the universal indicator paper?

d. Is the solution acidic or basic? Strong or weak?

II. Take half a porcelain spoonful of baking soda and put in test tube.

1. Add about 5 mL of water and mix thoroughly. **KEEP for step IV!!!!!**

2. Using a glass stirring rod, test this solution with indicator paper (red, blue, AND universal).

a. What color does the solution turn the red litmus paper?

b. What color does the solution turn the blue litmus paper?

c. What color is the universal indicator paper?

d. Is the solution acidic or basic? Strong or weak?

III. Take half a porcelain spoonful of baking powder and place it in a test tube.

1. Add about 5 mL of water and mix thoroughly.

2. Using a glass stirring rod, test this solution with indicator paper (red, blue, AND universal).

a. What color does the solution turn the red litmus paper?

b. What color does the solution turn the blue litmus paper?

c. What color is the universal indicator paper?

d. Is the solution acidic or basic? Strong or weak?

IV. Add half a porcelain spoonful of your alum crystals to the test tube containing the baking soda.

1. Carefully note any changes!

2. . Using a glass stirring rod, test this solution with indicator paper (red, blue, AND universal).

a. What color does the solution turn the red litmus paper?

b. What color does the solution turn the blue litmus paper?

c. What color is the universal indicator paper?

d. Is the solution acidic or basic? Strong or weak?

3. What did you make when you added the alum to the baking soda????

HINT: Read the label on the baking powder can. What ingredients are present? The chemical name for alum is potassium aluminum sulfate [$KAl(SO_4)_2.12H_2O$].