

pH Lab

Purpose:

Students will gain knowledge about pH, pH indicators, and will determine the pH of an unknown substance

Equipment and Materials:

2 cups of red cabbage

Knife

Distilled water Blender, optional

Measuring cups (or graduated cylinder)

Measuring spoons (or graduated cylinder)

Strainer

Ziplock bags

Hammer (or mortar and pestle)

Clear plastic cups (or beakers)

Variety of Household Substances:

1. Lemon juice (pH = 2)
2. Vinegar (pH = 3)
3. Aspirin (pH = 5)
4. Milk (pH = 6)
5. Distilled water (pH = 7)
6. Baking soda (pH = 8)
7. Milk of magnesia (pH = 10)
8. Clear ammonia (pH = 11)
9. 7up
10. Borax

Safety:

Goggles are necessary to ensure eye safety.

Overview:

The pH is a measure of the H ion (H^+) concentration (Molarity or moles per liter) or the acidity of a solution and is expressed mathematically as $-\log[H^+]$. As the H^+ increases the acidity increases, and the pH decreases. A pH of 7 is considered neutral, less than 7 is acidic and greater than 7 is basic. Foods tend to be acidic and household cleaners tend to be basic.

The pH is accurately measured using a pH meter and an electrode that is sensitive to the H^+ concentration. The pH can be estimated by using an indicator which is a chemical compound that has a specific color at one pH and another color at a different pH.

Some indicators change colors several times over a larger pH range. Red cabbage extract is a natural indicator that is red at a very acidic pH (about 1-3) and yellow in very basic solutions

(about 12-14). Several other colors are observed at different pH values in between these extremes. The chemical in cabbage that changes color as pH changes is anthocyanin.

Procedures:

1. Chop the cabbage into 1-inch pieces.
2. Put 2 cups of chopped cabbage and 1 cup of distilled water in blender. Blend for 1-3 minutes until cabbage is finely chopped. If a blender is not accessible, boil cabbage until cabbage loses some of its firmness.
3. Strain. Keep the liquid, discard the cabbage. The liquid will be called the indicator liquid.
5. Put 10mL (2tsp) each of the ten household substances listed under equipment and materials in labeled clear cups or beakers. Add 5mL (1 tsp) of indicator liquid to each of the substances. Record the color on report sheet. Aspirin, baking soda, and borax can be crushed by placing in a Ziploc bag and carefully crushing with a hammer. Dissolve crushed solid in small amount of distilled water.
6. Estimate the pH of 7up and borax based on the observations of the other eight substances. If you think an unknown color is between the colors of two pH standards, for example, between 2 and 3, you may state the pH to the nearest 0.5 which in this example would be 2.5. DO NOT give a pH range.
7. Complete report sheet and make picture of yourself with the completed lab.

References

"Acid-Base Indicators Extracted from Plants," Chemical Demonstrations, Vol. 3 pp. 50-57.
Shank, Lowell. Chemistry 101 Laboratory Manual.

pH (Acid/Base) Lab

EXAMINATION OF HOUSEHOLD ACIDS AND BASES

Report Sheet

Name _____

1. State the mathematical expression for pH _____.
2. State the units for H^+ concentration (other than molarity) _____.
3. A pH of 4 is acidic, basic, or neutral?
4. What is the pH of vinegar? _____ $Mg(OH)_2$ (milk of magnesia) _____
5. Using your internet find the pH of black coffee _____ and bleach _____.
6. What natural indicator are we using? _____

7. Indicate the color of each household substance.

<u>Substance</u>	<u>Color</u>
1. Lemon juice (pH = 2)	
2. Vinegar (pH = 3)	
3. Aspirin (pH = 5)	
4. Milk (pH = 6)	
5. Distilled water (pH = 7)	
6. Baking soda (pH = 8)	
7. Milk of magnesia (pH = 10)	
8. Clear ammonia (pH = 11)	
9. 7up	
10. Borax	

8. Indicate your estimated pH of the unknowns.

<u>Unknowns</u>	<u>pH</u>
7up	
Borax	