

ACIDS and BASES- pH Experiment

Purpose

In this experiment you will learn to use pH paper to test the pH of common household substances, and investigate the pH behavior of several natural indicators.

Introduction

Many common substances are either acids or bases. Some acids, like stomach acid are necessary for our health, while others, like sulfuric acid are dangerous and can cause burns and other injuries. Baking soda is a common, weak base used in our homes, while sodium hydroxide, a strong base, is hazardous to skin and eyes.

The easiest way to determine if a substance is acidic or a basic is to use an indicator. Indicators are organic molecules that change color in an acid or a base. When an indicator is placed on paper, it provides a fast way to determine if a substance has acidic or basic properties. The most common acid/base indicator paper is called litmus paper, so a litmus test is the first test used to determine acidic or basic properties. If the litmus paper does not change color, the substance is neutral,

Indicators work because they are weak acids which, when in solution, exist in equilibrium with their conjugate base. The acid and its conjugate base each have different colors, and as the equilibrium shifts from one direction to the other, the color of the indicator solution changes. Red cabbage contains a pigment molecule called flavin (an anthocyanin). This water-soluble pigment is also found in apple skin, plums, poppies, cornflowers, and grapes. Very acidic solutions appear red-ish, neutral solutions purplish, and bases appear greenish yellow.

pH paper consists of strips of filter paper which have been soaked in an indicator. A drop of an unknown solution can be placed on the pH paper, and the resulting color compared to a chart. By matching the color of the paper to a color on the chart, the pH of the solution can be determined. The strength of an acid or base is measured in pH, which is the concentration of the hydrogen ion (H^+). A high pH indicates a strong base, while a low pH indicates a strong acid. A pH of seven indicates a neutral substance (like water).

Objectives

The Students will:

- Use an indicator (litmus paper & red cabbage extract) to test for an acid, base or neutral substance.
- Use pH paper to test for the pH of a substance.
- Explain the difference between test using litmus paper and pH paper.
- Collect and evaluate the data in a *data table, pH chart and lab report*.

Materials

- **Safety Equipment (goggles & apron must be worn at all times!)**
- Litmus paper (pink and blue)
- pH paper
- Red Cabbage Indicator
- pH color chart made by you
- Various substances to test
- Beakers, test tubes, pipettes

Discussion:

Answer the following questions completely and include them in the final lab report.

1. Which has a higher concentration of H^+ , acids or bases?
2. Which pH has a higher numerical value, acids or bases?
3. How does an increase in the concentration of H^+ affect the number on the pH scale?
4. Even though a tiny amount of water does break down into H^+ and OH^- why is it neutral.
5. What is the pH of pure water?
6. Explain why changes in pH can affect biological systems.
7. Which substances are acids? Which of your substances is the strongest acid?
8. Which substances are bases? Which of your substances is the strongest base?
9. Why would it be important for humans to have a balanced pH in saliva or other bodily fluids? What is the significance of organisms being high or low on the pH scale?
10. How would lakes and rivers be affected by fluctuating pH?

Data Analysis

Construct tables and graphs of your data, which summarize your results for the lab. Graphs are encouraged. Include the results for the pH of each of the compounds and household substances, ranked from **lowest to highest** pH (0-14) using a pH diagram (like the pH chart above and/or the diagram in your notes). Include the corresponding color of the pH paper and its number in your diagram.

Relate your experimental data to the real world. Critical Thinking - Choose one of the following:

1. Design an experiment in which you could investigate which of two antacids is more effective in neutralizing stomach acid.
2. Suppose you are manufacturing a certain type of cosmetic. You know that it can be slightly acidic, but it should not be strongly acidic. Which of the indicators you have just studied will help you determine the degree of acidity? How would you use this information to make a quality product? Explain your answer.