

Invisible Ink Experiment

Introduction

Commonly acids and bases are used as invisible ink, and these are subsequently revealed by indicators. An acid is traditionally considered any chemical compound that, when dissolved in water, gives a solution with a pH less than 7.0, with the generic formula $\text{HA}[\text{H}^+\text{A}^-]$. Common examples include acetic acid (in vinegar) and sulphuric acid (in car batteries).

Bases can be thought of as the chemical opposite of acids. This is because the effect of an acid is to increase the hydronium ion (H_3O^+) concentration in water, and the effect of a base is to reduce it. Common examples are sodium hydroxide and ammonia.

A pH indicator is a chemical compound that is added in small amounts to a solution so that the pH of the solution can be determined easily; hence a pH indicator is a chemical detector for hydronium ions.

Normally the indicator causes the colour of the solution to change depending on the pH. pH values above 7.0 are basic and pH values below 7.0 are acidic. Solutions with a pH value of 7.0 are neutral. pH indicators themselves are frequently weak acids or bases. When introduced to a solution, they may bind with H^+ (hydrogen ions) or OH^- (hydroxide ions). The different electron configurations of the bound indicator cause the indicator's colour to change.

Many plants or plant parts contain chemicals from the naturally coloured anthocyanin family of compounds. They are red in acidic solutions and blue in basic.

In this experiment you are going to investigate creating "invisible inks" by using indicators and acids and bases.

Practical:

1. Prepare 10ml a 0.00125M solution of sodium hydroxide by diluting an existing solution of sodium hydroxide, or by preparing your own solution from sodium hydroxide pellets and water.
2. Add phenolphthalein solution to the 0.00125M sodium hydroxide solution until it is dark red.
3. Using a paintbrush, write a message on a piece of paper using the red solution and wait for it to disappear and dry. (Nb. Dry for no longer than 5 minutes after the purple colour fades for best results).
4. Re-develop the ink using a wash of bromothymol blue or methyl red indicator.

Questions:

1. What is an indicator? Write down the pH range for phenolphthalein, bromothymol blue and methyl red:

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2. What happens when an acid and a base react together? What is the name of this reaction?

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3. Write an equation for the reaction of sodium hydroxide with hydrochloric acid:

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4. Next to each of these everyday items, write down whether they are acidic, neutral or basic:

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|-------------|-------|--------------|-------|
| • Vinegar | | • Lemon | |
| • Coca Cola | | • Lime Water | |
| • Water | | • Bleach | |
| • Soap | | | |