# Alka-Seltzer® Rainbow

## Introduction

Produce a quick and moving rainbow of colours with an Alka-Seltzer® tablet and a little vinegar.

## Concepts

- Acid–base reactions
- pH indicators

## Materials

Alka-Seltzer, 1 tablet
Sodium hydroxide, NaOH, 0.1 M, 100 mL
Universal indicator, 10 mL
Water, distilled, 350 mL
Vinegar, $CH_3CO_2H$, 10 mL
Beaker, 600-mL
Graduated cylinders; 500-mL, 100-mL and 10-mL
Stirring rod

## *Safety Precautions*

*Sodium hydroxide solution causes skin and eye irritation. Universal indicator is an alcohol-based solution and thus a flammable liquid and vapour. Keep away from heat, sparks, open flames, and hot surfaces. May be harmful if swallowed or in contact with skin. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Safety Data Sheets for additional safety, handling, and disposal information.*

## Preparation

1. Measure out approximately 350 mL of distilled water in a 600-mL beaker.
2. Add 100 mL of 0.1 M sodium hydroxide solution.
3. Add 10 mL of the universal indicator solution and stir. The solution should now be a dark purple.
4. Pour the solution into a 500-mL graduated cylinder.
5. Use a clean graduated cylinder to measure out 10 mL of vinegar.

## Procedure

1. Drop an Alka-Seltzer tablet into the 500-mL graduated cylinder. Colour changes should begin to occur as soon as the first carbon dioxide bubbles are formed.
2. When the tablet rises to the top, add about 10 mL of vinegar to the solution. The solution should now be red on the top.

## Disposal

It is recommended that you consult your local school board and/or municipal regulations for proper disposal methods that may apply before proceeding.

## Tips

- The Alka-Seltzer tablet may be placed in the graduated cylinder before adding the sodium hydroxide solution. The reaction occurs immediately as the solution is added, producing a rainbow of colours with more motion.
- Hydrometer cylinders or 600-mL tall form beakers can also be used. This demonstration can also be scaled down using half the reagents and a 250-mL graduated cylinder.
- To get the best rainbow of colours, add the vinegar as soon as the yellow colour appears.



Publication No. 10456CA
051018

## Discussion

The Alka-Seltzer tablets contain sodium bicarbonate and citric acid. As the Alka-Seltzer tablet dissolves in water, the citric acid reacts with the sodium bicarbonate to produce carbonic acid (Equation 1) and carbon dioxide (Equation 2). The carbonic acid then reacts with the basic sodium hydroxide to change the pH of the solution (Equations 3 and 4). As the base is consumed, the solution will slowly become more acidic, resulting in the colour changes.

$$HCO_3^- + H^+ \rightarrow H_2CO_3 \qquad \textit{Equation 1}$$

$$H_2CO_3 \leftrightharpoons H_2O + CO_2 \qquad \textit{Equation 2}$$

$$H_2CO_3 + OH^- \rightarrow HCO_3^- + H_2O \qquad \textit{Equation 3}$$

$$HCO_3^- + OH^- \rightarrow CO_3^{2-} + H_2O \qquad \textit{Equation 4}$$

The Alka-Seltzer tablet initially sinks to the bottom of the cylinder. As the carbon dioxide bubbles adhere to the tablet, the tablet begins to rise and eventually floats. The buoyancy of the tablet and the final addition of vinegar (a weak acid) lead to a pH gradient. Universal indicator makes the pH gradient visible and produces the characteristic rainbow of colours.

## Acknowledgement

Special thanks to Charles Ophardt, Ph.D., E.C, for bringing this demo to our attention.

## Materials for *Alka-Seltzer® Rainbow* are available from Flinn Scientific Canada, Inc.

| Catalogue No. | Description |
|---|---|
| SJ0149 | Sodium Hydroxide, 0.1 M, 500 mL |
| UJ0002 | Universal Indicator, 500 mL |

Consult www.flinnsci.ca or your *Flinn Scientific Canada Catalogue/Reference Manual* for current prices.