

64. The effect of temperature on reaction rate

Topic

Rate of reaction.

Timing

60 min.

Description

Sodium thiosulfate solution is reacted with acid, a precipitate of sulfur forms. The time taken for a certain amount of sulfur to form is used to indicate the rate of the reaction. The effect of temperature on the rate of reaction can be investigated.

Apparatus and equipment (per group)

- ▼ 250 cm³ Conical flask
- ▼ 10 cm³ Measuring cylinder
- ▼ 50 cm³ Measuring cylinder.

Chemicals (per group)

- ▼ Sodium thiosulfate solution 40 g dm⁻³
- ▼ Hydrochloric acid 2 mol dm⁻³ (**Irritant**).

Teaching tips

The method for this experiment is best understood when the teacher demonstrates it first. The end-point can be measured with a light sensor connected to a data-logger.

A light sensor set up as a colorimeter can be used to monitor the precipitation on a computer – clamp a light sensor against a plastic cuvette filled with the reactants. The result, in the form of graphs on the computer, provides very useful material for analysis using data logging software. The software shows the change on a graph and this tends to yield more detail than the end-point approach used in this experiment. The rate of change can be measured from the graph slope or the time taken for a change to occur.

Background theory

Basic collision theory.

Safety

Wear eye protection. Sulfur dioxide (**Toxic gas**) forms as a by-product. Ensure good ventilation. Warn asthmatics, who should preferably use a fume cupboard.

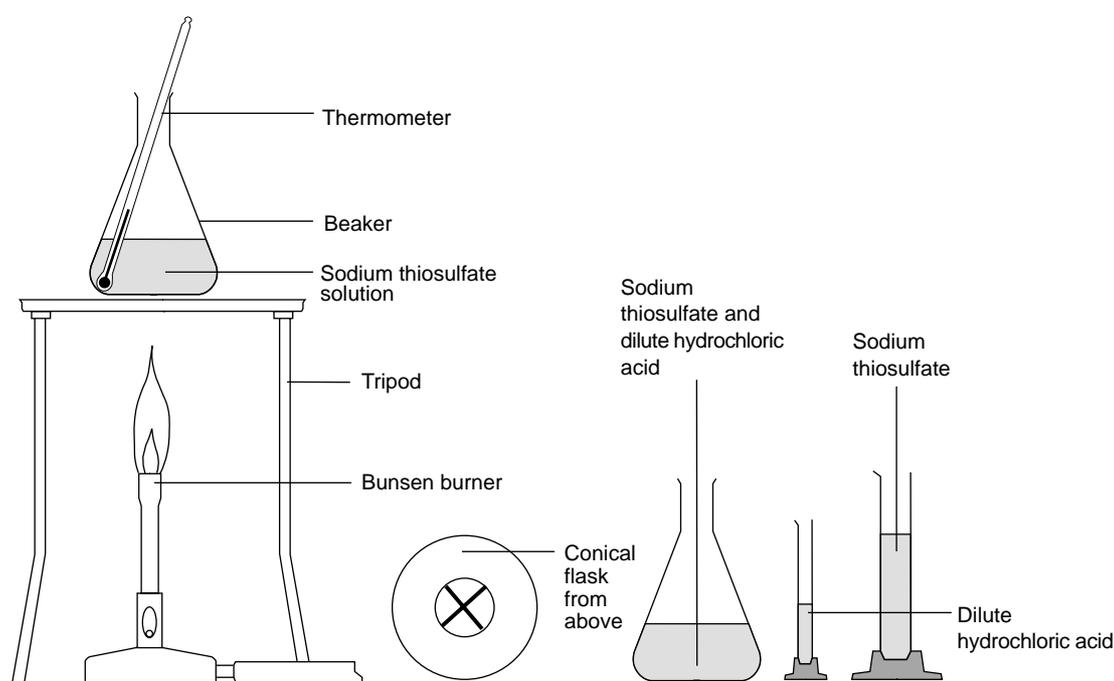
As soon as the reaction is complete pour the solutions away, preferably into the fume cupboard sink. Wash away with plenty of water. This is particularly important with solutions used at higher temperatures.

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The effect of temperature on reaction rate

Introduction

In this experiment the effect of temperature on the rate of reaction between sodium thiosulfate and hydrochloric acid is investigated.



What to record

Record your results in the table.

Initial temperature of the mixture in the flask/ $^{\circ}\text{C}$	Final temperature of the mixture in the flask/ $^{\circ}\text{C}$	Average temperature of the mixture in the flask/ $^{\circ}\text{C}$	Time taken for the cross to disappear/s	$1/\text{time taken} / \text{s}^{-1}$

What to do

- Put 10 cm^3 of sodium thiosulfate solution and 40 cm^3 of water into a conical flask. Measure 5 cm^3 of dilute hydrochloric acid in a small measuring cylinder.
- Warm the thiosulfate solution in the flask if necessary to bring it to the required temperature. The object is to repeat the experiment five times with temperatures in the range $15\text{--}65 \text{ }^{\circ}\text{C}$.
- Put the conical flask over a piece of paper with a cross drawn on it.

4. Add the acid and start the clock. Swirl the flask to mix the solutions and place it on a piece of white paper marked with a cross. Take the initial temperature of the mixture.
5. Look down at the cross from above. When the cross disappears, stop the clock and note the time taken. Record the final temperature of the mixture in the flask.
6. As soon as possible, pour the solution down the sink (in the fume cupboard if possible) and wash away.

Safety

Wear eye protection. Take care not to inhale fumes.

Questions

1. For each set of results, calculate the value of $1/\text{time}$. (This value can be taken as a measure of the rate of reaction for this experiment).
2. Plot a graph of $1/\text{time}$ on the vertical (y) axis and average temperature on the horizontal (x) axis.