

Chemical Kinetics

Rate of Cooling of Water

Overview

In this lab a sample of hot water is allowed to cool, with the temperature of the water being recorded every 30 s until the water reaches room temperature. A graph of the data is prepared. The rate of cooling is calculated for various time periods – over the full course of the experiment; during the first ten minutes; and during the last ten minutes. The calculated rates of cooling are then compared.

Purpose

- To graph the data for the cooling of water.
- To calculate rate of cooling
- To compare rates of cooling for different time periods.

Equipment and Materials

- thermometer
- heat source – Bunsen burner or hot plate
- large beaker or other container for the water
- approximately 500 mL of water

Procedure

1. Heat the water until it begins to boil, then carefully remove it from the heat source.
2. Record the water temperature every 30 s as it cools. Continue recording until the water temperature reaches room temperature or slightly above room temperature.

Sample Data Table for the Cooling of Water

Cooling Data for Water	
Time (min)	Temperature (°C)
0	
0.5	
1.0	
1.5	
2.0	
2.5	
3.0	
3.5	
4.0	
4.5	
5.0	
5.5	
6.0	
6.5	
7.0	
7.5	
8.0	
8.5	
9.0	
9.5	
.	
.	
(continue)	

Results

Prepare a graph that shows the results of the data. The graph should be a plot of Temperature (°C) versus Time (min). Students are **strongly encouraged** to use the graphing capabilities of a spreadsheet such as Excel or Quatro Pro to create the graph. Computer generated graphs are preferable to hand-drawn graphs.

The following items apply to creating graphs:

- All graphs require an appropriate, descriptive title. The name of the substance used in the experiment should be included in the title. Please include your name on all graphs.
- Both axes must be labeled, including the units of measurement ($^{\circ}\text{C}$ and min)
- Graphs should fill the page, except for 1 inch margins on all sides.

Conclusions and Questions

1. You will calculate the rate of cooling for three time periods:
 - the entire cooling period
 - the first ten minutes
 - the last ten minutes

To calculate a rate, determine how much the temperature changed within the desired time period, and divide by the time.

For example, if the water temperature dropped 15 degrees during the first five minutes, the rate would be calculated as:

$$\text{Rate} = \frac{15^{\circ}\text{C}}{5\text{ min}} = 3^{\circ}\text{C}/\text{min}$$

2. How do the three rates compare? Why?