

RS•C

26. Melting and freezing

Topic

Change of state, solids, liquids and gases, physical changes.

Timing

45–60 min.

Description

Students heat stearic acid and measure the temperature, observing when it melts, then allow it to cool, record the temperature and note when it starts to solidify. They then plot a graph.

Apparatus and equipment (per group)

- ▼ Test-tube
- ▼ Graph paper
- ▼ 250 cm³ Beaker
- ▼ Stop clock
- ▼ Tripod and gauze
- ▼ Spatula
- ▼ Thermometer (0–100 °C)
- ▼ Clamp, boss, and stand
- ▼ Bunsen burner.

Chemicals (per group)

- ▼ Stearic acid (octadecanoic acid).

Teaching tips

Energy must be supplied to melt a solid, this same energy is released when the liquid resolidifies. Remind students not to attempt to move the thermometer in the solid stearic acid, as it will break. Collect in the test-tubes with thermometers frozen and these can be released later by melting.

This presents a good opportunity to demonstrate how to maintain a steady temperature using a Bunsen burner. This can be achieved by sliding the Bunsen burner aside as the boiling becomes too vigorous, slide it back as the water stops boiling. It is not essential that the water bath is boiling. Students can be provided with another thermometer, and asked to maintain a lower temperature, say 80 °C.

A temperature sensor attached to a computer can be used in place of a thermometer. It can plot the temperature change on a graph and show this as it occurs. A slight modification of the experiment can yield an intriguing result: when the test-tube is cooling place it in an insulated cup containing a few cm³ of water. Use a second temperature sensor to monitor the temperature of the water. The water temperature should rise as the stearic acid cools and it should continue to rise even as it changes state.

Background theory

States of matter, particulate theory of matter.

Safety

Wear eye protection.

Answers

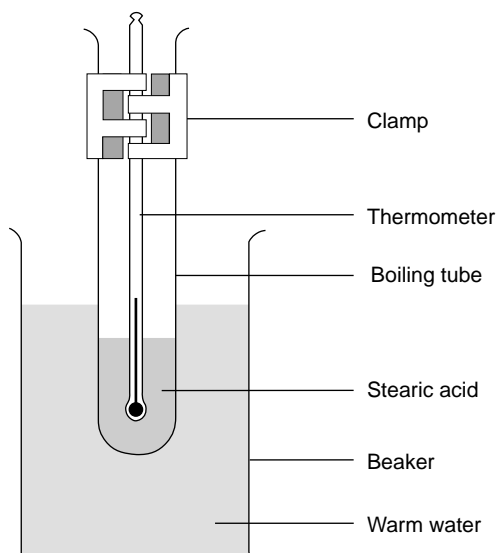
1. About 60 °C
2. The same as melting temperature.
3. The temperature stays the same for a while, both solid and liquid are present, this is the melting/freezing point. When the solid is melting the energy is used to separate the particles from each other. When the liquid is freezing, energy is given out as forces begin to hold the particles together.

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Melting and freezing

Introduction

In this experiment, a solid turns into a liquid and then the liquid turns into a solid. The energy changes are examined.



What to record

Complete the table.

Time/min	Temperature/°C

What to do

1. Fill a 250 cm³ beaker with about 150 cm³ tap water.
2. Heat it on a tripod and gauze until the water just starts to boil.
3. Set up the apparatus as shown in the diagram and start the timer.
4. Try and maintain the temperature of the water. It should be just boiling but not boiling vigorously.
5. Record the temperature every minute as the stearic acid heats up, until it reaches about 70 °C. Show in your table the temperature where the solid starts to melt.
6. Use the clamp stand to lift the tube from the hot water. Record the temperature every minute as the stearic acid cools down until it reaches about 50 °C. Note the temperature in your table when the first signs of solid formation are observed.
7. Plot a line graph of your results. Put time along the bottom and temperature up the side. Label your graph to show where stearic acid is a solid, a liquid or present in both states.

Safety

Wear eye protection.

Questions

1. What is the melting point of stearic acid?
2. What is the freezing point of stearic acid?
3. Why are there flat sections on your graph? Explain this in terms of the forces between particles.