ScienceCube

Boiling Points of Pure Substances and Mixtures

---

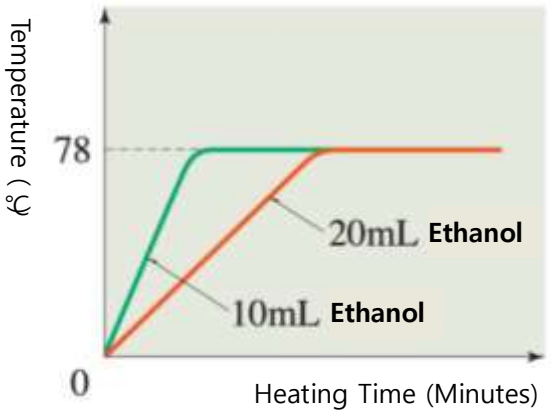
1. **Compare and explain the boiling point curves of pure substances and mixtures.**
2. **Understand and explain the boiling point characteristics of mixtures.**

Fundamental Concept

1. **Pure Substances and Mixtures**

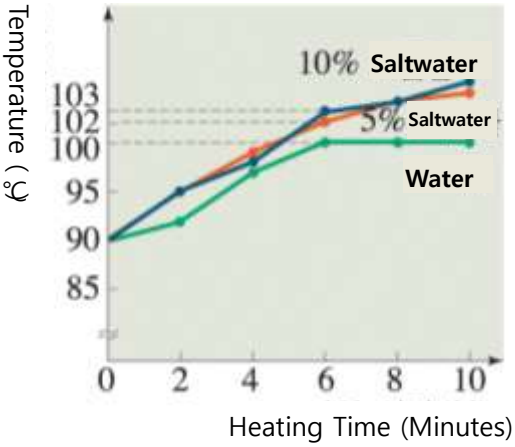
<Pure Substances>

A pure substance is composed of only one type of substance, such as water, ethanol, salt, copper, or oxygen, and has consistent properties like melting point, freezing point, boiling point, and density. In the cooling curve of a pure substance, the temperature remains constant at the melting point or boiling point, showing a distinct horizontal section.



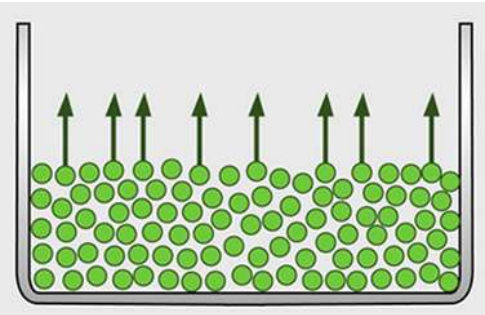
<Mixtures>

A mixture is composed of two or more pure substances. Mixtures can be homogeneous, like sugar water, where the particles are evenly mixed, or heterogeneous, like muddy water, where the particles are not evenly mixed. The melting and boiling points of mixtures vary depending on the mixing ratio, so the temperature does not remain constant during melting or boiling.

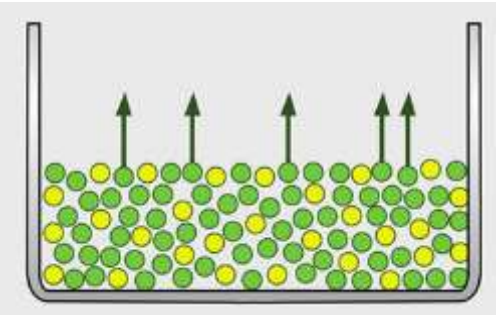


2. **Boiling Point Elevation**

When another substance is dissolved in a liquid, the boiling point increases, a phenomenon known as boiling point elevation. This occurs because the dissolved substance interferes with the liquid's vaporization. The reason boiling point elevation is related to the concentration of the dissolved substance is that the more dissolved substance there is, the greater the interference.



< Pure Substances >



< Mixtures >

Experiment

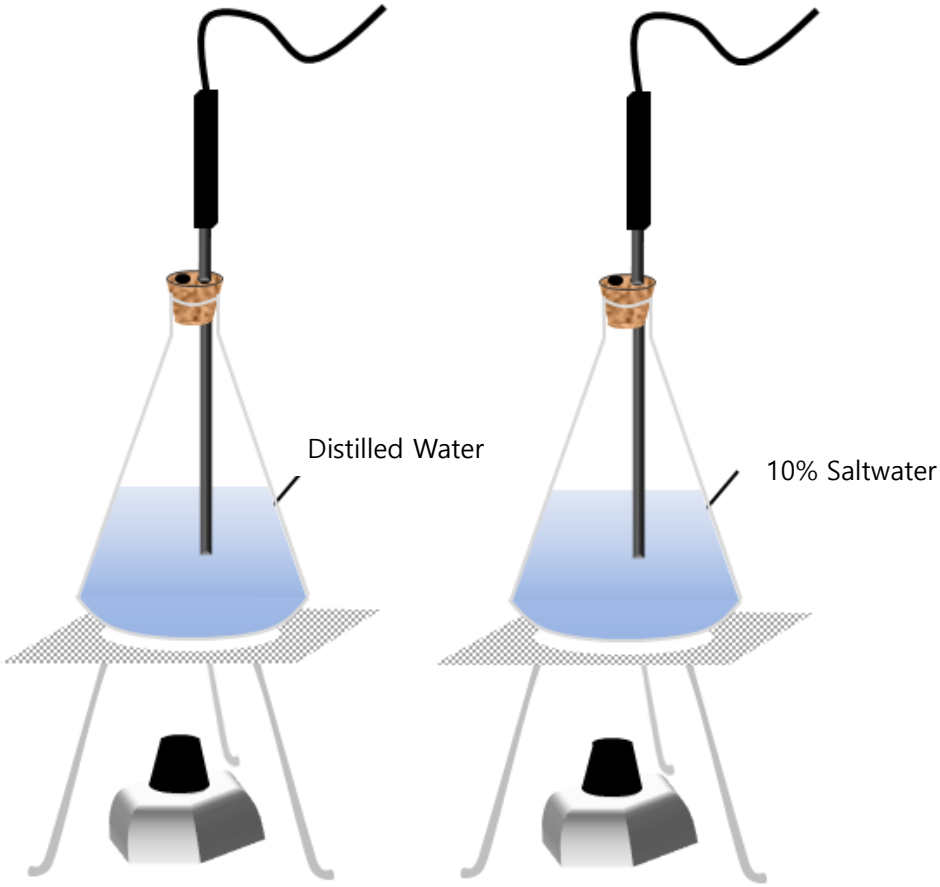
Materials Needed

Interface, Science# program, Temperature sensors (2), Salt, Two 50 mL Erlenmeyer flasks, Two cork stoppers, Two alcohol lamps, Lighter, Two 100 mL beakers, Electronic scale, Distilled water, Dropper, Glass rod, Two tripods, Two wire gauzes

Experimental Setup

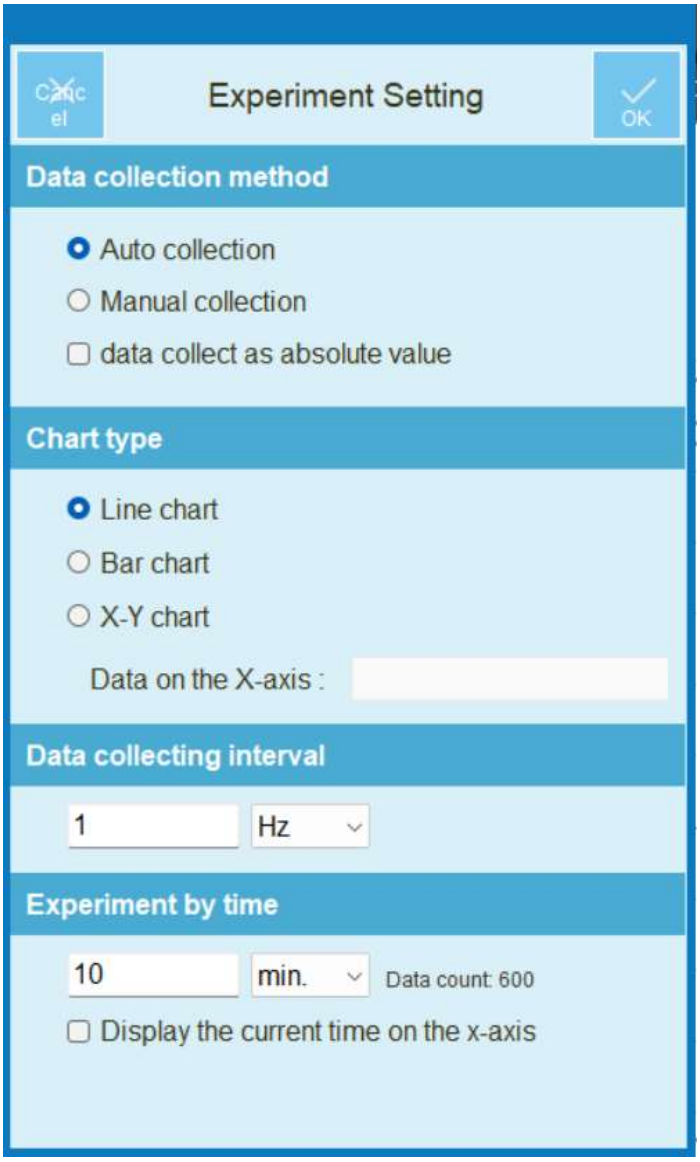
1. Prepare a 10% salt solution by adding 4g of salt to 40mL of distilled water in a beaker.
2. Pour the prepared salt solution and 40mL of distilled water into two separate Erlenmeyer flasks.
3. Drill two holes in each of the two cork stoppers.
4. Seal the two Erlenmeyer flasks with the cork stoppers and insert a temperature sensor into one of the holes in each stopper.
5. Adjust and fix the temperature sensors so that the ends do not touch the bottom of the flasks and are submerged at the same height in the liquids.

6. Set up the tripods and wire gauzes as shown in the diagram and place the Erlenmeyer flasks on top.
7. Adjust the wick sizes of the two alcohol lamps to be similar and place them under the tripods.



Interface Setup

1. Run Science#.
2. Connect the two temperature sensors to the interface.
3. Press the button to set up the experimental environment as shown below or press the button for automatic setup.



 Automatic Setup

Data Collection

1. Press the button  to start data collection.
2. Use the lighter to ignite the wicks of the alcohol lamps.
3. Once data collection is complete, close the lids to extinguish the flames of the alcohol lamps.

Data Analysis

Recording Data

1. Draw a graph showing the temperature changes over time for distilled water and saltwater..

2. Based on the above graph, complete the table below.

Category	Distilled Water	Saltwater
Initial Temp (°C)		
Boiling Point Start Temp (°C)		
Final Temp (°C)		

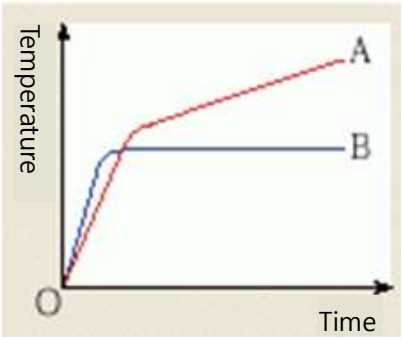
Data Application and Extended Activities

1. Compare and explain the heating curves of distilled water and saltwater over time

2. Explain why the heating curves of saltwater and distilled water show the above results

.

3. The following diagram shows the heating curves of pure water and saltwater. Identify the incorrect statement and explain.



① A is the heating curve of saltwater.

② The boiling point of saltwater is higher than that of water.

③ The temperature of saltwater continues to rise while boiling.

④ The concentration of saltwater does not change while boiling.

⑤ The heating curve of a liquid can distinguish between pure substances and mixtures.

Correct Answer:

4. Find and describe similar phenomena in your surroundings as shown in the example.

< Example >
Adding salt to water when cooking noodles makes them cook faster.

Correct Answer:

5. Suggest other methods to distinguish between distilled water and saltwater.

Correct Answer:

.