Boiling Temperature of Water

The physical properties of a pure substance can be used to identify the substance and distinguish it from other pure substances. Boiling temperature is one such physical property. Boiling is characterized by the formation of vapor bubbles within the liquid phase as a substance changes from a liquid to a gas. In this experiment, you will study the boiling of water.

OBJECTIVES

In this experiment, you will

- Observe the boiling of water.
- Use a computer to make measurements.
- Analyze the data.
- Graph the data.
- Use the graph to make conclusions about boiling.
- Determine the boiling temperature of water.
- Apply the concepts studied in a new situation.

MATERIALS

computer
Vernier computer interface
Logger*Pro*
Vernier Temperature Probe
250 mL beaker
ring stand
utility clamp
hot plate
water

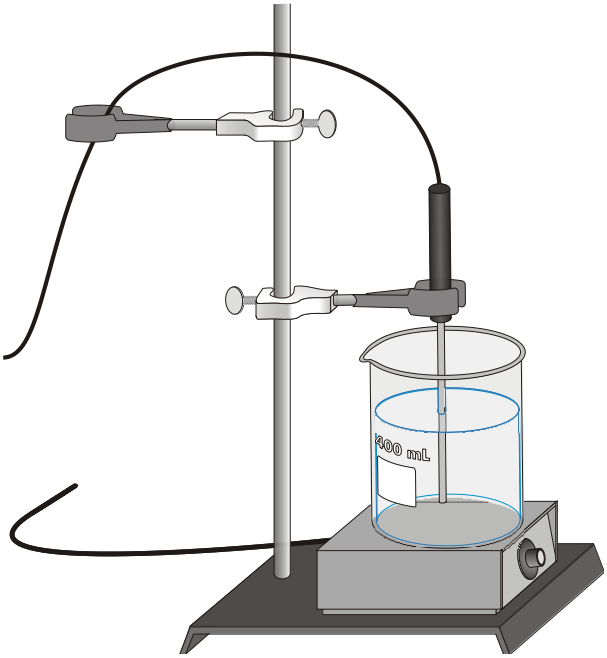


Figure 1

PROCEDURE

1. Obtain and wear goggles. **CAUTION:** Handle hot water and hot equipment with care throughout the experiment.
2. Prepare the water sample.
   a. Arrange a hot plate next to the base of a ring stand.
   b. Fill a 250 mL beaker 2/3 full with hot tap water.
   c. Place the 250 mL beaker on the hot plate. Turn the hot plate to the temperature setting suggested by your teacher.
   d. Use a utility clamp to suspend a Temperature Probe on the ring stand as shown in Figure 1. The tip of the probe should be 1-2 cm above the bottom of the beaker. **CAUTION:** *Do not burn yourself or melt a probe wire with the hot plate*!
3. Connect the Temperature Probe to the computer interface. Prepare the computer for data collection by opening the file "02 Boiling Temperature" from the *Physical Science w Vernier* folder.
4. Click ▸ Collect to begin data collection.
5. Record your observations as the water is heated to its boiling temperature and boils. When the water begins to boil, turn the hot plate setting down to a setting just high enough to maintain boiling.
6. When the water has boiled with noticeable bubbling for six minutes, click ■ Stop to end data collection. Turn off the hot plate and remove the Temperature Probe from the boiling water. Allow the beaker, water, and hot plate to cool before handling them.
7. On the displayed graph, analyze the flat part of the curve to determine the boiling temperature of water:
   a. Move the mouse pointer to the beginning of the graph's flat part. Press the mouse button and hold it down as you drag across the flat part to *select* it.
   b. Click on the Statistics button, . The mean temperature value for the selected data is listed in the statistics box on the graph. Record this value as the boiling temperature in your data table.
8. Print copies of the graph as directed by your teacher.

OBSERVATIONS

DATA

Boiling temperature of water _____ °C

PROCESSING THE DATA

1. Describe your temperature *vs.* time graph.

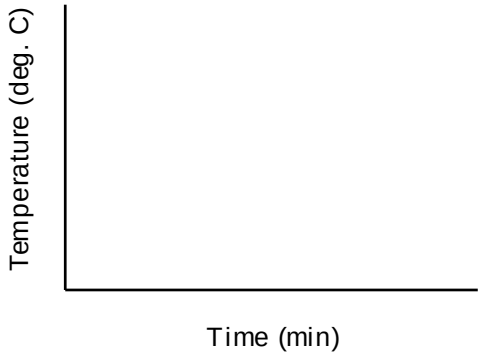
2. What happened to the temperature of the water as it was heated prior to boiling?

3. What happened to the temperature of the water as it boiled?

4. According to your data, what is the boiling temperature of water?

5. Your water sample experienced a wide range of temperatures during this experiment, yet we can correctly speak of its boiling "temperature." Explain.

6. The normal boiling temperature of isopropyl alcohol is 82°C. In the space to the right, sketch and label a graph for the boiling of isopropyl alcohol. Use a starting temperature of 20°C. Identify the boiling temperature on the graph.



EXTENSION

1. What is the atmospheric pressure during the lab? Your answer will be expressed as inches of mercury, as the barometric pressure is reported in a weather report.

2. What is the normal reading for barometric pressure? (What is the average barometric pressure for Wiggins, Co? What is "*Standard Pressure*?")

3. What is the accepted boiling temperature of water?

4. What did you find as the boiling temperature of water in the lab?

5. Explain any discrepancy between your answer in #3 and #4?

6. What would you expect to happen to the boiling point tomorrow if…

   A the barometric pressure goes higher.

   b. the barometric pressure goes lower.

7. Make a vector diagram to illustrate the boiling point of water outside the bell jar, and the boiling point of the water inside the bell jar after the air was removed.

EXTENSION: BOILING POINT AND SALT CONCENTRATION

8. Describe the colligative property of a solution.

9. Collect the results from the other lab groups in the class and enter the boiling points for each salt concentration.

	Tap Water	1% Salt Solution	5% Salt Solution	10% Salt Solution
Boiling Pt.				

10. Write a brief conclusion describing the effect of salt on the boiling point of water.

11. Construct a graph to illustrate the relationship between the boiling point of water and the salt concentrations IN EACH RUN.
