

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 an EasyTemp probe to measure temperature.
- Make a graph of the data.
- Use the graph to make conclusions about boiling.
- Determine the boiling temperature of water.
- Apply the concepts studied to a new situation.

MATERIALS

TI-84 Plus or TI-84 Plus Silver Edition
graphing calculator
Vernier EasyTemp
Vernier EasyData application
hot plate

slit stopper
utility clamp
ring stand
250 mL beaker
water

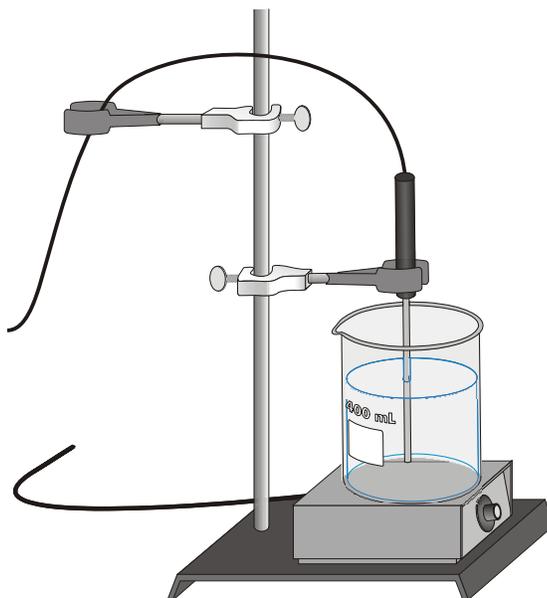


Figure 1

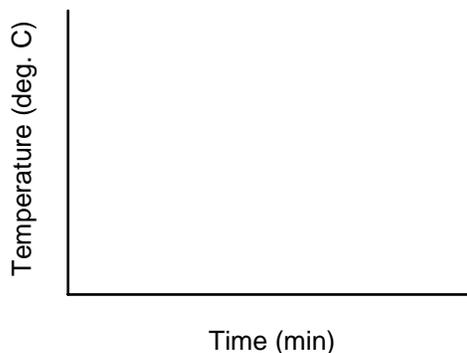
PROCEDURE

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 and slit stopper to suspend an EasyTemp 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. Turn on your TI-84 Plus (or TI-84 Plus Silver Edition) graphing calculator and make sure that it is on the home screen. Plug the EasyTemp probe into the USB port of the graphing calculator. The EasyData application will automatically start and the Main screen will be displayed.
4. Set up the data collection.
 - a. Select **File** from the Main screen, and then select **New**.
 - b. Select $\overline{\text{Setup}}$ from the Main screen.
 - c. Select **Time Graph....**
 - d. Select $\overline{\text{Edit}}$.
 - e. Press $\overline{\text{CLEAR}}$ on the calculator and type **10** as the time between samples in seconds. Select $\overline{\text{Next}}$.
 - f. Press $\overline{\text{CLEAR}}$ on the calculator and type **90** as the number of samples. Select $\overline{\text{Next}}$. The length of the data collection will be 900 seconds (15 minutes).
 - g. Confirm that time graph settings are correct. Select $\overline{\text{OK}}$.
5. Select $\overline{\text{Start}}$ to begin data collection.
6. 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.
7. When data collection is complete, turn off the hot plate and remove the EasyTemp probe from the boiling water. Allow the beaker, water, and hot plate to cool before handling them.
8. A graph of temperature vs. time will be displayed. Use $\overline{\text{D}}$ to examine the data points along the curve. As you move the cursor, the time (X) and temperature (Y) values of each data point are displayed above the graph. Record the temperature readings in your data table. Note that the data table is set up for 30 second intervals.
9. Select $\overline{\text{Main}}$ to return to the Main screen. Select $\overline{\text{Quit}}$ from the Main screen. Select $\overline{\text{OK}}$ to exit the EasyData application.
10. When the equipment has cooled, clean up.

Experiment 2

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. Determine the boiling temperatures of other liquids.