

Temperature Probe Response Time

In this experiment you will investigate the response time of the EasyTemp temperature probe, and you will learn more about the EasyData program.

OBJECTIVES

In this experiment, you will

- Use a TI-84 Plus graphing calculator and an EasyTemp probe to measure temperature.
- Set up the sensor for a different unit of measure.
- Change the time graph data collection parameters.

MATERIALS

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

two 250 mL beakers
cold water (cooled with ice)
hot water

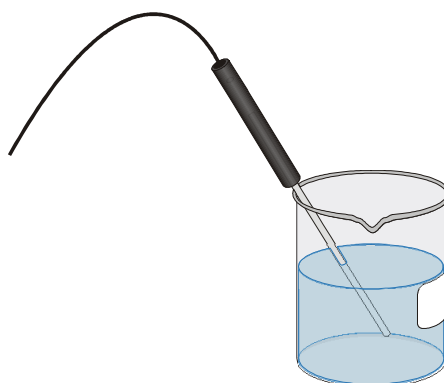


Figure 1

PROCEDURE

1. Place about 100 mL of tap water into a 250 mL beaker. Add two or three ice cubes.
2. Place the EasyTemp probe into the cold water and stir briefly. Position the probe in the beaker of cold water as is shown in Figure 1.
3. Turn the calculator on and make sure that the calculator is on the home screen. Plug EasyTemp into the calculator's USB port. The EasyData application will automatically start and the Main screen will be displayed.
4. Select $\overline{\text{F1}}$ from the Main screen and then select **New**.
5. Notice on the Main screen that the program is set up to measure temperature in °C. Let's change the program to measure in °F.
 - a. Select $\overline{\text{F2}}$ from the main screen.
 - b. Select **CH1:Temp**.

- c. Select $\overline{\text{Units}}$.
 - d. Select **F** (Fahrenheit) and choose $\overline{\text{OFF}}$.
6. The default experiment length is 180 seconds, but let's change that to 100 second.
 - a. Select $\overline{\text{Setup}}$ from the main screen.
 - b. Select **Time Graph....**
 - c. Select $\overline{\text{Edit}}$.
 - d. Press the $\overline{\text{CLEAR}}$ key on the calculator and enter **4** as the sample interval, in seconds.
 - e. Select $\overline{\text{Next}}$.
 - f. Press the $\overline{\text{CLEAR}}$ on the calculator and enter **25** as the number of samples.
 - g. Select $\overline{\text{Next}}$.
 - h. Confirm that the time graph settings are correct and select $\overline{\text{OFF}}$.
 7. Put about 150 mL of hot water in a second 250 mL beaker.

Note: In Step 8, you will switch the EasyTemp probe from the cold water to the hot water at exactly 20 seconds after data collection has begun. This will be done as the fifth data point appears on the calculator screen (5×4 seconds = 20 seconds).
 8. When everything is ready, select $\overline{\text{Start}}$ to begin data collection. Do not stir or move the water.
 9. When exactly 20 seconds have gone by (when the fifth data point appears on the calculator screen), quickly move the Temperature Probe to the beaker containing hot water and continue data collection. Do not stir the water or move the Temperature Probe during the remainder of the data-collection period.
 10. When data collection is complete, a graph of temperature vs. time will be displayed. Use the $\overline{\text{D}}$ or $\overline{\text{L}}$ keys to examine the data points along the displayed curve of temperature vs. time. As you move the cursor right or left, the time (X) and temperature (Y) values of each data point are displayed below the graph. Record the time when the maximum temperature was reached.

DATA

Time when maximum temperature reached = _____

PROCESSING THE DATA

1. Describe the appearance of the curve on your graph.
2. Why is time plotted on the horizontal axis in this experiment?
3. Why is temperature plotted on the vertical axis?
4. The response time of your Temperature Probe is the time it takes to reach the maximum temperature after being switched from cold water to hot water. Determine your probe's response time by subtracting 20 seconds from your value for the elapsed time when the maximum temperature was reached—found in your data table above.