

pH/ORP/ISE Temperature Sensor

PS-2147



Included Items
pH/ORP/ISE Temperature Sensor
Fast Response Temperature Probe (PS-2135)
pH Electrode (PS-2573)

Required Items*
PASCO Interface
PASCO Data Acquisition Software

*See the PASCO catalog or the PASCO web site at www.pasco.com for more information.

Recommended Item*
Sensor Extension Cable (PS-2500)

Introduction

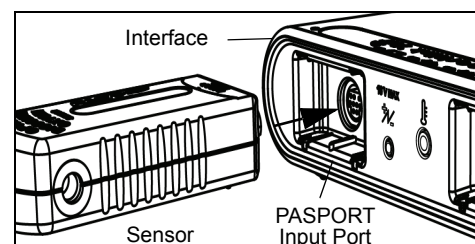
The PS-2147 pH/ORP/ISE Temperature Sensor is a Multi-Measure sensor that accepts standard BNC connectors and works with both PASCO and industry standard electrodes for pH and oxygen-reduction potential as well as ion selective electrodes

(ISE). The sensor is also capable of measuring temperature using the included Fast Response Temperature Probe.

The sensor is designed to work with a PASPORT-compatible interface (such as the UI-5100 850 Universal Interface or PS-2011 SPARKlink Air) and PASCO data acquisition software (such as PASCO Capstone or SPARKvue HD).

Setup the Sensor

- Soak the end of the pH Electrode probe in deionized or distilled water for five to ten minutes.
- Connect the BNC Connector of the pH Electrode to the BNC Port on the sensor and/or connect the 3.6 mm stereo plug of the Temperature Probe to the jack on the sensor.
- Plug the sensor into an input port of a PASPORT-compatible interface.



NOTE: If more distance is needed between the sensor and the interface, plug the sensor into a Sensor Extension Cable (PS-2500, optional) and then plug the cable into the interface.

Safety CAUTION!

Always use eye protection, gloves, and an apron when working with chemicals.

Activity (See Appendix C)

Making Measurements

Using PASCO Capstone Software

- Start the PASCO data acquisition software.
- Click the “Hardware Setup” icon in the Tools palette to open the “Hardware Setup” panel. Confirm that the sensor’s icon appears with the interface’s icon.
- Click one of the display templates in the Capstone workbook page, or double-click an icon in the “Displays” palette to open a specific data display.
- Click “Record” (●) to begin recording data.

Using SPARKvue Software

- Connect the sensor to a SPARKvue-compatible interface and start the software. The sensor parameter screen opens and shows the list of measurements for the sensor.
- In the sensor parameter screen, touch the measurement, and then touch ‘Show’ to open a graph display of the measurement.
- Touch “Start”(▶) to begin recording data.

Using the SPARK Science Learning System

- Connect the sensor to one of the two PASPORT input ports on the top of the SPARK SLS. Turn on the interface.
- In the screen that shows the sensor’s measurements, touch one of the measurements to select it and then touch “Show” to open a Graph display screen.
- In the Graph display screen, touch “Start” (▶) to begin recording data.

Using the Xplorer GLX

- Turn on the Xplorer GLX and connect the sensor to a port on the top. A Digits display of pH opens automatically and shows the data being monitored.
- Press the **Start/Stop** key (▶) to begin recording data. Press the same key again to stop recording.

Temperature

Use this component of the multi-sensor to measure the temperature of a fluid or object. The measurement can be displayed in units of °C, °F, or K. You can use the included Fast Response Temperature Probe or a different probe, such as the Stainless Steel Temperature Probe (PS-2153) or Skin/Surface Temperature Probe (PS-2131). PASCO apparatus containing an embedded 10 kΩ thermistor can also be connected to the

multi-sensor. The multi-sensor automatically detects the presence of a temperature probe, and it will only collect temperature data if a probe is connected.

Measuring Temperature

To measure temperature, connect the probe and start data collection. Immerse the tip of the probe in a fluid or place it in contact with an object. The included stainless steel probe can be used in both dry conditions and in liquids, such as water and other mild chemicals and solutions.

Tip: For better chemical resistance, use a Teflon® cover (CI-6549).

Temperature Calibration

The temperature measurement can be calibrated; however, for most applications calibration is not necessary. Use a two-point calibration with two standards of known temperature. For instructions on calibrating the sensor, see the Appendices.

pH/ISE/ORP

The pH/ISE/ORP input of the multi-sensor is a specialized voltage sensor. Its BNC connector accepts the included pH electrode, as well as ion selective electrodes (ISE) and oxygen reduction potential (ORP) electrodes (see Appendix B). The sensor measures the voltage produced by any of these electrodes. When used with a pH electrode, the sensor also computes the pH based on the measured voltage.

Connect the pH electrode (or other electrode) to the pH/ISE/ORP port and start data collection. On your computer or interface, display the **ISE Voltage** measurement (this measurement is valid for pH and ORP electrodes as well as ISE) or the **pH** measurement for the calculated pH (assuming that the pH electrode is connected).

ISE/ORP Calibration

Specific calibration instructions for the ISE and ORP electrodes are included with the electrodes. You will need to purchase or prepare specific standard solutions for each ISE probe. Standard solutions can be purchased from commercial suppliers of probe chemicals.

Measuring pH

The pH electrode produces a voltage proportional to the pH of the solution that it is immersed in. This voltage is measured by the multi-sensor, which computes pH.

Unscrew and remove the storage bottle from the electrode (be careful not to spill the storage solution). Push the O-ring and bottle cap up the electrode handle. Rinse the electrode tip with distilled water. If you see bubbles in the electrode bulb, gently shake the electrode downward (similar to shaking down a thermometer). Start data collection. Place the tip of the electrode in the solution to be measured and wait for the reading on your computer or interface to stabilize. Rinse the electrode with distilled water before measuring another solution.

pH Calibration

The pH measurement can be calibrated; however, for most applications calibration is not necessary. Perform a two-point

calibration with two buffer solutions of known pH. For instructions on calibrating in the sensor for pH, see the Appendices.

pH Electrode Maintenance and Storage

Cleaning

If the pH electrode becomes contaminated, use one of these methods to clean and restore it. After any of these procedures, soak the electrode in a pH 7 buffer solution for 30 minutes.

- **General Contamination:** Soak the electrode in 0.1 molar hydrochloric acid (HCl) for 15 minutes.
- **Protein Deposits:** Soak the electrode in a solution of 1% pepsin in 0.1 molar HCl.
- **Inorganic Deposits:** Rinse the electrode with 0.1 molar ethylene dinitric tetra-acidic acid (EDTA) tetrasodium solution.
- **Oil and Grease Film:** Wash the electrode carefully in a mild detergent or a solvent known to be effective for the particular film.
- **Unknown Contamination:** Soak the electrode alternately in 12 molar sodium hydroxide (NaOH) and 1 molar HCl. Leave it in each solution for one minute. Rinse completely between soakings. End with HCl. (The NaOH etches the glass and the HCl reestablishes hydrogen ions on the surface.)

If these steps fail to improve the response of the electrode, replace it with a PS-2573 pH Electrode (or equivalent).

Storage

Store the pH electrode in the included electrode storage bottle with one of the following solutions. (Never store the electrode in distilled water.)

- **Short-term** (up to one week): pH 4 buffer solution or tap water.
- **Long-term** (over one week): pH 4 buffer solution with 1 g per 100 mL of potassium chloride (KCl) added.

Restoring the Electrode

Follow this procedure to improve the response of a slow electrode or to rehydrate the membrane after dry storage.

1. Clean the membrane using one or more of these methods:
 - If the electrode is contaminated with proteins, soak the electrode in a solution of 1% pepsin in 0.1 Molar hydrochloric acid (HCl).

- If the electrode is contaminated with inorganic deposits, rinse the electrode with 0.1 M ethylene dinitric tetra-acidic acid (EDTA) tetrasodium solution.
 - If the electrode is contaminated with oil or grease, wash the electrode in a mild detergent or solvent known to be effective for the particular film.
 - If the electrode is not responding quickly, soak the electrode alternately in 12 M NaOH (sodium hydroxide) and 1 M HCl (hydrogen chloride). Leave it in each solution for one minute. Rinse completely between soakings and end with HCl.
2. Soak the electrode in 0.1 M hydrochloric acid (HCl) for 15 minutes.
 3. Soak the electrode in a pH 7 buffer solution for 30 minutes.

Specifications

Sensor Specifications	
<p>pH: Range: 0 to 14 Accuracy: ± 0.1 Resolution: 0.01 Temperature Range: -4°C to $+80^{\circ}\text{C}$</p>	<p>ORP and ISE: Range: -2000 mV to $+2000\text{ mV}$ Accuracy: $\pm 2.0\text{ mV}$ Resolution: 0.05 mV</p>
Probe Specifications	
<p>Fast Response Temperature (PS-2135): Range: -10°C to $+70^{\circ}\text{C}$ Accuracy: $\pm 0.5^{\circ}\text{C}$ Resolution: 0.0025°C Construction: The waterproof PVC tip houses a $10\text{K}\Omega$ thermistor.</p>	<p>pH Electrode (PS-2573): Range: 0 to 12 Accuracy: ± 0.1 after calibration Resolution: 0.01 Construction: Double junction electrode with gel-filled reference.</p>

More Information

For the latest information about the sensor, visit www.pasco.com and enter "PS-2147" in the Search window.

Technical Support

For assistance with any PASCO product, contact PASCO at:

Address: PASCO scientific
10101 Foothills Blvd.
Roseville, CA 95747-7100

Phone: +1 916-462-8384 (worldwide)
877-373-0300 (U.S.)

E-mail: support@pasco.com

Web: www.pasco.com

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Product End of Life Disposal Instructions:

This electronic product is subject to disposal and recycling regulations that vary by country and region. It is your responsibility to recycle your electronic equipment per your local environmental laws and regulations to ensure that it will be recycled in a manner that protects human health and the environment. To find out where you can drop off your waste equipment for recycling, please contact your local waste recycle/disposal service, or the place where you purchased the product.

The European Union WEEE (Waste Electronic and Electrical Equipment) symbol (to the right) and on the product or its packaging indicates that this product must not be disposed of in a standard waste container.



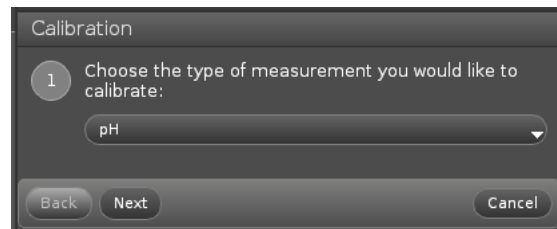
Appendix A: Calibration

Calibration is not always necessary, especially if you are interesting in measuring a change in pH rather than absolute pH values. For accurate measurements, first calibrate the sensor. You will need two different buffer solutions (pH 4 and pH 7 in this example) and distilled water. The solutions should be at the same temperature as the solutions that you will measure later.

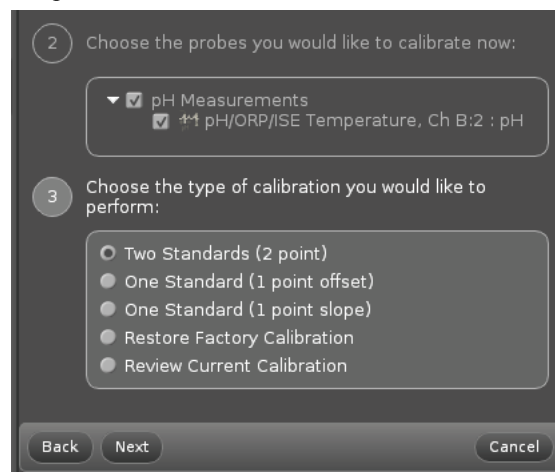
The calibration procedures vary depending on which software or hand-held datalogger you are using.

PASCO Capstone Calibration

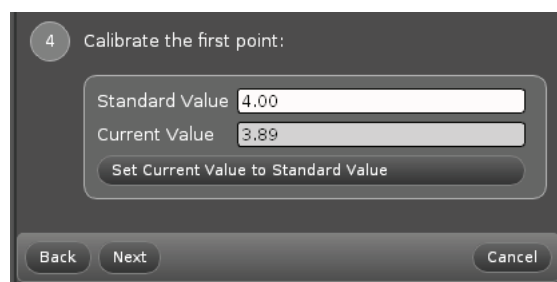
In the PASCO Capstone software, click the “Calibration” icon in the Tools palette to open the “Calibration” panel.



- In Step 1, the measurement of “pH” is automatically selected. Click “Next” to open the second and third steps.

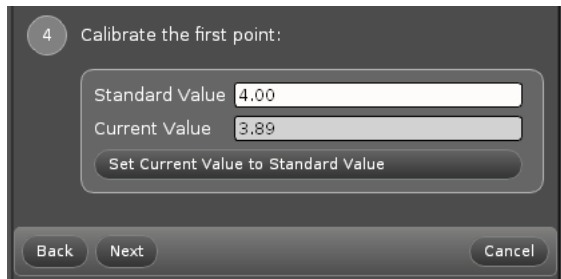


- In Step 2, the “pH/ORP/ISE Temperature” sensor is selected already.
- In Step 3, check that the “Two Standards (2 point)” calibration is the choice that is selected. Click “Next” to open the fourth step.

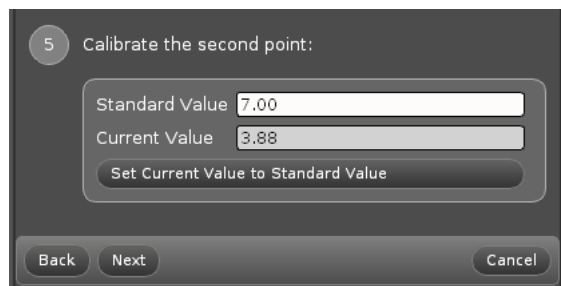


- In Step 4, the task is to calibrate the first point. Put the pH electrode into the pH 4 buffer solution. Wait until the current value stabilizes, and then click “Set Current

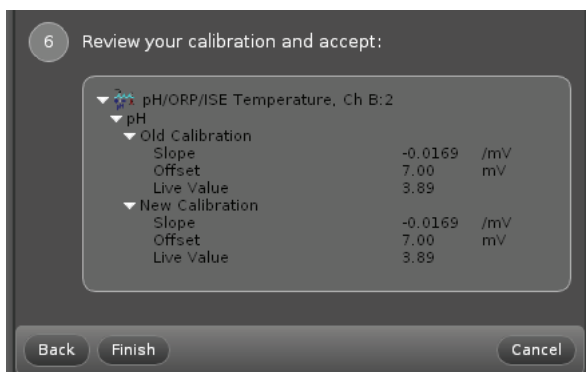
Value to Standard Value”. Click “Next” to go to the fifth step.



- In Step 5, the task is to calibrate the second point. Put the pH electrode into the pH 7 buffer solution. Wait until the current value stabilizes, and then click “Set Current Value to Standard Value”. Click “Next”.



- In Step 6, the task is to review the calibration. After reviewing, click “Finish”.



- Click the “Calibration” icon in the Tools palette to close the Calibration panel.

SPARKvue HD Calibration

You can use the SPARKvue HD software if you are using the pH/ORP/ISE Temperature Sensor with a PASPORT-compatible interface connected to a computer, or with a mobile device paired with a PASCO wireless interface, such as the AirLink2 or SPARKlink Air.

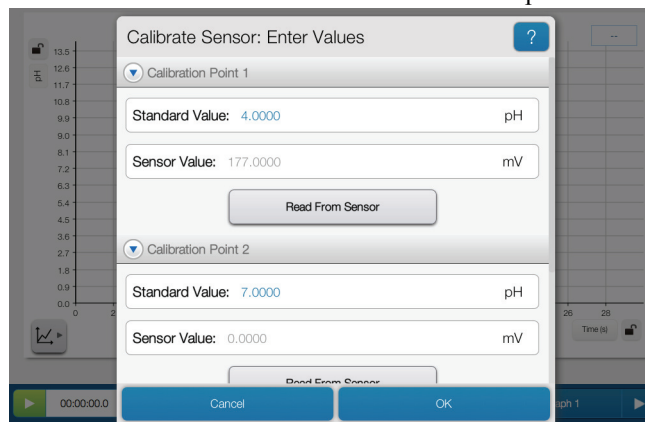
If the sensor is connected to a PASPORT-compatible interface, start the SPARKvue software on the computer. If the sensor is connected to a PASPORT-compatible interface, start the interface.

- After startup, the screen will show the list of measurements. for the sensor.
- Touch ‘pH’ and then touch “Show” to open a Graph display screen.

- Touch the Experiment Tools icon to open the Experiment Tools menu. Touch “Calibrate Sensor” and then touch “Next”.
- The Calibrate Sensor: Select Measurement screen shows the Sensor (pH/ORP/ISE Temperature), the Measurement (pH), and the type of Calibration (2 point (Adjust Slope and Offset)). Touch ‘Next’,



- The Calibrate Sensor: Enter Values screen opens.



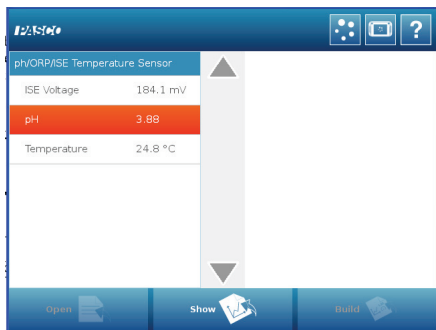
- Calibrate Point 1. Put the pH electrode into the pH 4 buffer solution. Wait until the Sensor Value stabilizes, and then touch “Read From Sensor”.
- Calibrate Point 2. Put the pH electrode into the pH 7 buffer solution. Wait until the Sensor Value stabilizes, and then touch “Read From Sensor”. Touch “OK” pt return to the Graph display screen.

SPARK SLS Calibration

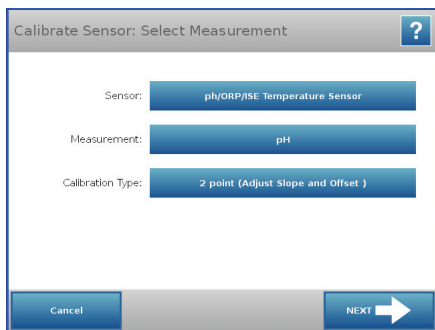
If the sensor is connected to a SPARK SLS interface used as a standalone data-logger, start the interface.

After startup, the SPARK SLS screen will show the list of measurements for the sensor.

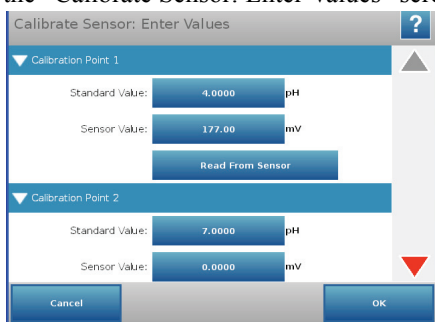
- For example, touch “pH” and then touch “Show”.



- The screen will show a Graph display of Temperature and Time.
- Touch “Experiment Tools” (⊗) to open the Experiment Tools screen.
 - In the Experiment Tools screen, touch “Calibrate Sensor” to open the Calibrate Sensor: Select Measurement screen.



The screen shows the Sensor (pH/ORP/ISE Temperature), the Measurement (pH), and the Calibration Type (2 point (Adjust Slope and Offset)). Touch “Next” to open the “Calibrate Sensor: Enter Values” screen.

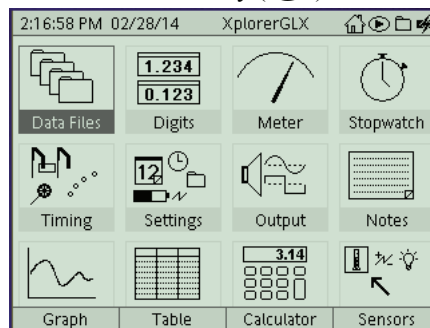


- For Calibration Point 1, place the sensor’s probe into the first “known standard”, the pH 4 buffer solution. Wait a few moments and then touch “Read From Sensor”.
- For Calibration Point 2, place the probe into the second “known standard”, the pH 7 buffer solution. Touch the down arrow to scroll down. Wait a few moments and then touch “Read From Sensor”
- Click “OK” until the screen of the Graph display returns.

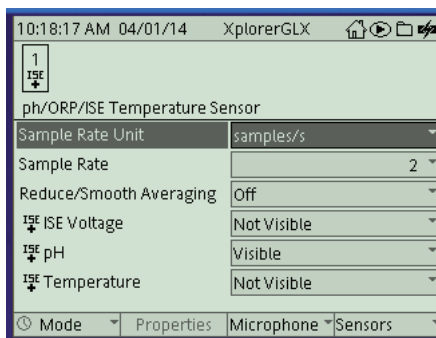
Xplorer GLX Calibration

Turn on the Xplorer GLX hand-held datalogger. Connect the sensor to one of the PASPORT input ports on the top end of GLX.

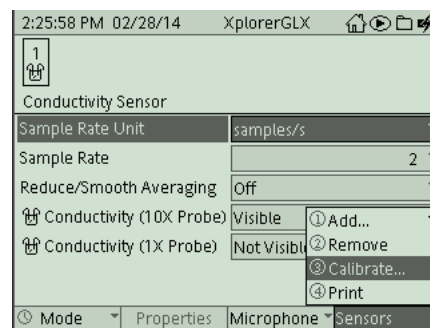
- Press the **Home Screen** key (⌂).



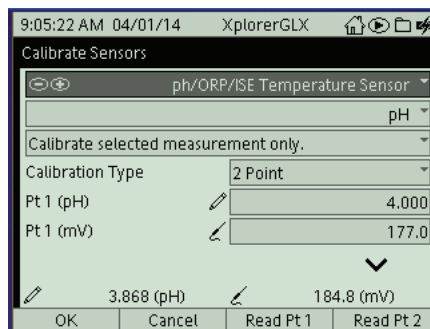
- On the keypad, press **F4** (F4) to open the **Sensors** screen.




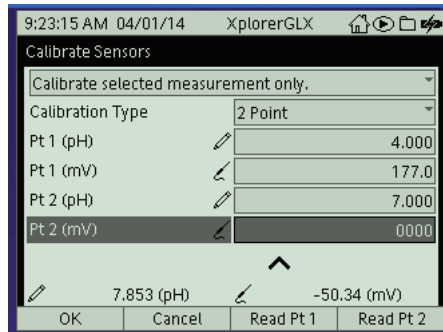
- On the keypad, press **F4** (F4) again to open the **Sensors** menu. Use the down arrow key (⏴) to select “Calibrate” from the menu.







- In the **Calibrate Sensors** screen, the highlighted selection is “pH/ORP/ISE Temperature Sensor” and the choice for Calibration Type is “2 Point”.



- For convenience, use the down arrow () to scroll down to show the “Pt 2 (pH)” and Pt 2 (mV) text areas.



- For “Pt 1”, place the sensor’s probe into the first “known standard”, the pH 4 buffer solution. Wait a few moments and then press **F3** () to “Read Pt 1”.
- For “Pt 2”, place the sensor’s probe into the second “known standard”, the pH 7 buffer solution. Wait a few moments and then press **F4** () to “Read Pt 2”.
- Press **F1** () to select “OK”. Press the **Home Screen** key () to return to the Home Screen.

Appendix B: PASCO Equipment Used with the Sensor

Temperature Probes	Ion Selective Electrodes
Stainless Steel Temperature Probe PS-2153	Chloride CI-6732
Skin/Surface Temperature Probe PS-2131	Fluoride CI-6728
Related Sensor	Lead CI-6736
High Accuracy Drop Counter PS-2117	Nitrate CI-6736
Ion Selective Electrodes	Oxygen-Reduction-Potential CI-6716
Ammonium ISE CI-6717	Potassium CI-6733
Calcium ISE CI-6727	Sodium CI-6734
Carbon Dioxide (aqueous) ISE CI-6726	

Appendix C: Activity

Enthalpy of Neutralization with pH Measurement

Items Needed:

PS-2147 pH/ORP/ISE Sensor, pH electrode, Fast Response Temperature Probe, PASCO Interface and Data Acquisition Software, ring stand, clamp for pH electrode, stirring machine, stir bar, calorimeter (or two styrofoam cups stacked together), 1 mL pipette, citric acid powder, balance to measure ± 0.01 g, 100 mL graduated cylinder, deionized water. (Optional): vinegar solution for stable pH, 0.1 M NaOH solution

Procedure:

1. Set out chemicals a few hours before the experiment to allow the chemicals time to come to room temperature.
2. Prepare 0.6 mM acetic acid by adding 0.5 mL vinegar to 1.00 L of deionized water and adjusting to pH 7.0 with drops of 0.1 M NaOH. Add 100 mL of this 0.6 mM acetic acid to the calorimeter and stir until the temperature is stable.
3. Place the temperature probe and pH electrode into the solution. In the data acquisition software, monitor the temperature of the solution.
4. Weigh 10 millimoles (about 1.9 g) of citric acid powder.
5. When the temperature is steady, stop monitoring the temperature.
6. Start recording data and wait one minute to establish a baseline. Then add the citric acid powder to the stirring solution.
7. After about two minutes, the temperature and pH should become level, and you can stop the experiment.
8. (Optional): To find the amount of heat absorbed by the calorimeter, stir bar, and pH electrode, repeat steps 1-5. In place of step 6, add a known volume of water that is slightly cooled and follow the cooling curve after mixing the known amount of cool water. Combining this information with the above data can allow a description of the heat absorbed per mole citrate.