

Electric Calorimeter

Product Number: ENCALMT



Overview

The einstein™ Electric Calorimeter incorporates a heat source and a calorimetry vessel designed for investigating heat and energy changes. It can be used for both electrical calorimetry and standard calorimetry experiments, including heat transfer, heat capacity, specific heat and energy changes in chemical reactions.

Used with the einstein™ Temperature Sensor (ENTMP029), a compatible einstein™ data logger and MiLABEx software, the Calorimeter enables students to investigate the enthalpy of neutralization by continuously recording the temperature change of a reaction such as diluted hydrochloric acid (HCl) with sodium hydroxide (NaOH).

Typical experiments



Chemistry

- Enthalpy of neutralization
- Enthalpy of chemical reactions
- Thermochemistry
- Experimental data analysis



Heat and Energy

- Heat and energy interchange
- Heat and temperature
- Heat capacity and specific heat
- Latent heat

Calorimeter specification*

Diameter:	10cm
Height (calorimeter only):	11cm
Overall height:	15cm
Liquid capacity (inner can):	175mL
Heat capacity (inner can):	Approx. 25J/°C
Weight:	205g
Electrical requirement:	6V DC, up to 2A
Coil resistance:	2.5 to 3Ω

*Dimensions and specifications may vary according to supplier changes.

Note: The blue circular component shown with the Calorimeter is part of the Calorimeter assembly. Temperature is measured with the einstein™ Temperature Sensor (ENTMP029), sold separately.



How it works

The temperature of the reaction mixture is measured continuously before, during and after the reaction. The recorded temperature change is then used together with the experimental quantities to calculate the heat released and determine the molar enthalpy of neutralization.

The resulting temperature-time curve shows the initial temperature, the temperature increase during neutralization, the maximum temperature, the temperature change (ΔT) and the cooling behavior after the reaction.

Required equipment

Item	Product Number	Function
einstein™ Electric Calorimeter	ENCALMT	Calorimetry experiment
einstein™ Temperature Sensor -40°C to 140°C	ENTMP029	Temperature measurement
Compatible einstein™ data logger	See einsteinworld.com	Continuous data recording
MiLABEx software	Software	Data display, graphs and analysis
Computer or tablet	Customer supplied	Software operation

Note: temperature sensor and data logger sold separately

For electrical calorimetry experiments, a DC power supply matching the electrical requirement (6V DC, up to 2A) is also required.

Temperature sensor specification

einstein™ Temperature Sensor, Product Number ENTMP029

Range:	-40°C to 140°C (-40°F to 284°F)
Accuracy:	±2% over entire range
Resolution (12-bit):	0.03°C
Default Sample Rate:	10 samples per second
Response Time (90% of reading):	20 seconds in liquid; 40 to 60 seconds in air
Probe:	Stainless steel with protective covering; sensing element in the tip

Technical Notes

- Use the Temperature sensor only in mild chemical solutions.
- Do not place the sensor's cable in liquid.
- Do not place the sensor in a flame or on a hot plate.
- The liquid capacity of the inner can is 175mL.
- For electrical calorimetry, use a DC power supply within the electrical requirement: 6V DC, up to 2A.

Calibration

The Temperature sensor requires no calibration.

Data logging and analysis

MiLABEx™ Android

1. Take your einstein™ Tablet OR pair your einstein™ LabMate with your Android or iOS tablet via Bluetooth
2. Insert the Temperature sensor cable into one of the sensor ports
3. Launch MiLABEx and then tap LAB to start an experiment

4. MiLABEx will automatically detect the sensor
5. You are ready to experiment!

MiLABEx™ Desktop

1. Pair your einstein™ LabMate with your PC, MAC, or Linux machine via Bluetooth, or connect it via the USB cable (found in the einstein™ LabMate box)
2. Insert the Temperature sensor cable into one of the sensor ports
3. Launch MiLABEx and then click LAB to start an experiment
4. MiLABEx will automatically detect the sensor and show it in the Current Setup Summary window
5. Click Full Setup, located at the bottom of the Current Setup Summary window, to program the data logger's sample rate, number of samples, units of measurement, and other options

Example of using the Calorimeter

Enthalpy of neutralization: $\text{HCl} + \text{NaOH}$

1. Prepare: prepare the required quantities and concentrations of diluted HCl and NaOH.
2. Measure: place the temperature sensor in the reaction mixture and establish the initial temperature.
3. Start recording: begin continuous temperature recording using the einstein™ data logger and MiLABEx.
4. Perform the neutralization: combine the acid and base while continuing to record the temperature.
5. Monitor: observe the temperature increase and identify the maximum temperature reached.
6. Analyze: use the recorded temperature change together with the experimental quantities to calculate the heat released and determine the enthalpy of neutralization.

With this experiment, students can

- Measure the initial temperature of the reactants
- Monitor temperature throughout the reaction
- Record the complete temperature-time curve
- Determine the maximum temperature change
- Calculate the heat released by the reaction
- Determine the molar enthalpy of neutralization
- Compare experimental results with theoretical values
- Analyze experimental accuracy and sources of error

Troubleshooting

If the Temperature sensor isn't automatically recognized by MiLABEx, please contact Fourier Education's technical support.

Technical support

For technical support, you can contact the Fourier Education's technical support team at:

Web: www.einsteinworld.com/support

Email: support@fourieredu.com

Copyright and Warranty

All standard Fourier Systems sensors carry a one (1) year warranty, which states that for a period of twelve months after the date of delivery to you, it will be substantially free from significant defects in materials and workmanship.

This warranty does not cover breakage of the product caused by misuse or abuse.

This warranty does not cover Fourier Systems consumables such as electrodes, batteries, EKG stickers, cuvettes and storage solutions or buffers.

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