612-1332 (15-060) Specific Heat Specimens

Warranty and Parts:

We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

Kit Contains:

This kit consists of 3 different metal specimens of equal volume, all 35mm long, 19mm diameter. The purpose of the hook is for handling specimens with tongs.

These specimens are intended for use with **612-1330 Aneroid Calorimeter** from **Science First**. They may be used anywhere specimens of equal volume are needed.

Additional Materials Needed:

Calorimeter
15-120 Calorimeter recommended
Method of heating
Scale

How To Use:

Heat a sample to a known temperature and transfer it to the calorimeter with tongs. Each specimen has a hook for easy handling. Samples can be heated by suspending in boiling water or steam in a watertight container for about 10 minutes. If steam is used, the container should be close to the sample size and metallic with its opening covered with insulation.

Weigh samples first on an accurate scale. Although they have been manufactured to the approximate weights listed, it is best to check the mass before using.

Theory:

Heat capacity is the capability of a material to contain heat energy. The amount of anything a container delivers depends upon the size of the container, how full it is and what is in it. In the case of heat, the capability of a material to contain heat energy can be boiled down to the following relationship:

- Amount of heat delivered is equal to the amount of material delivering heat times constant C times temperature change associated with delivering heat, or:
- $H + M\,C\,\triangle T$

Specific heat (the constant represented by the letter C) measures the heat capacity of a unit mass of material. The specific heat of a certain material equals

the number of calories that 1 g of material must absorb or give out to undergo a temperature change of 1° C. The units of specific heat are cal per g per ° C, or cal/g °C. A similar relationship exists in the English system of units involving Btu, pounds and F.

Therefore, from the way they are defined, the specific heat of a material has the same numerical value in both the metric and English systems.

Part of the reason for the variation of specific heat from substance to substance lies in the different masses of atoms making up each substance. A given mass of a substance such as lead contains only 1/7.7 times as many atoms as the same mass of aluminum. In adding heat to 1 g of lead, you therefore set fewer atoms into motion and need less heat to increase the kinetic energy of individual atoms to account for a 1 °C temperature rise.

The specific heat of water is 1, one of the highest of common substances. For this reason, water is frequently used in heating and cooling systems.

To measure C, it is necessary

to measure the other 3 terms of the equation. M can be measured in two ways: **mass** of the metal sample or **number of gram** atomic weightscontained by the sample. For most elements, the specific heat multiplied by the relative mass of its atoms yields a number that is approximately the same for all. The Law of Dulong and Petit observes that the product of specific heat and atomic weight comes to about 6 calories.

To measure the change in temperature (T) it is necessary to know the temperature to which a sample is heated (for example, 100° C). You then need to know the temperature of the sample after it has released all the heat it can release in a calorimeter.

To measure H, multiply the mass times the specific heat times the change in temperature. Specific heats for common materials, including those in this set, are listed to the right.

Application

To use the specific heat samples, weigh them first on an accurate scale. Heat them in boiling water and drop them into a calorimeter. Stir the water in the calorimeter and measure the highest temperature it reaches. The heat gained by the water equals the heat lost by the metal. Weight of water x (t_2 - t_1) x specific heat of water = weight of metal x (t_3 - t_2) x *specific heat of metal,* where $\mathbf{t_1}$ equals *initial temperature of water*; $\mathbf{t_2}$ the *temperature of the mixture*; and $\mathbf{t_3}$ the *higher temperature of the metals.*

A simple comparison of specific heats of different metals can be made by heating an equal weight of each in boiling water and dropping them onto a large chunk of ice. The metal of largest specific heat will melt the largest amount of ice.

The samples may be identified by weight. The Stainless Steel will weigh much more than the aluminum.

This chart lists sample material, its specific heat and mass, in order of increasing mass.

Metal	Specific Heat	Mass
Aluminum	{.210}	29g
Zinc	{.093}	64g
Copper	{.092}	91g

Specific Heats of Common Materials

Substance	Specific Heat
Brass	0.090
Ice	0.50
Iron	0.117
Nickel	0.103
Alcohol (ethyl)	0.60
Mercury	0.033
Water (defined)	1.00
Air	0.237
Hydrogen	3.41
Steam	0.421

Check out our website at www.sciencefirst.com Download instructions and free articles!

Detailed operations instructions, sample experiment and graphical work-up is included in instructions for **612-1330 Aneroid Calorimeter.**

Related Products:

Science First. *manufactures many low-cost science labs which may be ordered from most science education dealers. For more information, please contact us.*

- **612-1330 Aneroid Calorimeter** - 5 times as sensitive as the conventional calorimeter. Contains l lb. aluminum core in styrofoam insulation.
- **612-1345 Specific Heat Set** (Equal Mass). Same 3 materials as 15-060,plus SS same diameter and length, different mass.
- **612-1300 Steam Generator** - safe, noncorrosive all-aluminum construction. Good source of steam for heat experiments.
- **015-0300 Linear Expansion Apparatus** - only needs warm tap water to study linear expansion of different metals. Available with micrometer or precision dial indicator.

How to Teach with Specific Heat Specimens

Concepts Taught: Heat capacity of a body. Specific heat of a material. Calorimetry principle; determining specific heat using calorimeter - measuring heat loss/heat gain.
Curriculum Fit: Physics Sequence/ Energy. *Unit: Conservation of (heat) energy (Specific Heat)* **Grades 9-10.**

Concepts Taught: Density. Specific Gravity. Buoyancy. Flotation principle.
Curriculum Fit: Physics Sequence & Chemistry Sequence/ Matter. *Unit: Observation and Measurement of Physical Properties.* **Grades 6-8.**

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