Specific Heat of Brass Pipe Fittings

Introduction:

The amount of heat required to raise the temperature of a solid body depends on its change in temperature (ΔT), its mass (m), and an intrinsic characteristic of the material forming the body called specific heat (C). The heat is calculated from the equation

$$Q = m \times C \times \Delta T$$

Historically, heat (Q) was measured in terms of calories. The calorie was defined as the amount of heat required to raise the temperature of 1 gram of water by 1 °C. With this definition, the specific heat of water is 1.00 cal/(g·°C). The joule (J) has become the more favored unit in recent years. Thus, the units for C that we will use are J/(g·°C). The specific heat of water is then 4.18 J/(g·°C).

When two bodies initially at different temperatures, are placed in intimate contact with each other, in time they will come to equilibrium at some common intermediate temperature. Because of energy conservation, **the quantity of heat lost by the hot object is equal to that gained by the cold object**: $\mathbf{Q_{hot\ object} = -Q_{cold\ water}}$ This is the basis for the method of calorimetry.

A metal sample whose specific heat is to be determined is heated in boiling water to 100 °C. It is then quickly transferred to a Styrofoam calorimeter cup that contains a known volume of water of known temperature. When the metal specimen and the calorimeter (including the water) come to equilibrium, the final temperature is measured with a thermometer.

It is assumed that the heat loss to the Styrofoam cup and thermometer is negligible and if the heat exchange with the environment is kept small, then the heat lost by the metal sample is equal to the total heat gained by the water.

Purpose:

To apply the experimental methods of calorimetry in the determination of the specific heat of brass.

Materials:

Brass plumbing fixtures	Thermometer	Styrofoam cup
Milligram balance	100 mL graduated cylinder	Crucible tongs
Hot plate		

PROCEDURE:

1) Boil approximately 200 mL of water in a 400 mL glass beaker.

2) Get a brass object from the counter. Determine its mass, and **record the results** in the data section.

3) Lower the brass object into the water with your crucible tongs. Be careful not to drop the piece of brass into the beaker (you might crack the beaker).

4) Add 50.0 mL of cold water to your Styrofoam cup. R**ecord the mass of the water** in your data table. *(Remember that the density of water is 1 g/mL)*

5) Place a thermometer in the Styrofoam cup to get an **initial temperature** for the cold water. **Record this value (initial, T_1)** in your data table.

6) When the brass object has been in the boiling water for 3 minutes, quickly move the piece of brass to the calorimeter using your tongs. DO NOT try to handle the brass object with your hands. Do not allow the thermometer to come in direct contact with the piece of brass.

7) Continue observing the temperature on the thermometer as the heat is transferred to the water. Note the **highest temperature** reached for the water (final, T_2). **Record this value** in your data table.

8) Repeat the ENTIRE procedure two more times (three total) recording new values for change in temperature.

Data:

Trial #1	
Mass of the brass object	grams
Volume of water in the calorimeter	mL
Mass of water in the calorimeter	grams
Initial temperature of water in calorimeter (T1)	°C
Final (Highest) temperature of water in calorimeter (T2)	°C

Trial #2	
Mass of the brass object	grams
Volume of water in the calorimeter	mL
Mass of water in the calorimeter	grams
Initial temperature of water in calorimeter (T1)	°C
Final (Highest) temperature of water in calorimeter (T2)	°C

Trial #3	
Mass of the brass object	grams
Volume of water in the calorimeter	mL
Mass of water in the calorimeter	grams
Initial temperature of water in calorimeter (T1)	°C
Final (Highest) temperature of water in calorimeter (T2)	°C