

Measurement of Energy in a Closed System

Purpose: To determine if heat lost equals heat gained.

Materials: Coffee cups (2)
Thermometer
Hot water
Cold water

Method:

1. Put one coffee cup on the balance and zero the balance. Add some cold water to it and record the mass. Measure the temperature of the cold water and record.
2. Put the other coffee cup on the balance and zero the balance. Add some hot water to it and record the mass. Measure the temperature of the hot water and record.
3. Pour contents of one cup into the other. Swirl gently to mix. Measure the final temperature when thermal equilibrium has been attained and record.

Repeat two times for a total of three trials.

Measured Values:

	Hot	Water	Cold	Water	
	Mass	Temperature	Mass	Temperature	Final Temperature
Trial 1					
Trial 2					
Trial 3					

Calculated Values:

$$q = mc\Delta T$$

specific heat capacity of water = 4.184 J / g - °C

	Energy Lost (Hot water)	Energy Gained (Cold water)
Trial 1		
Trial 2		
Trial 3		

Does energy gained equal energy lost?

$$q = -q$$

$$(m_1) (c_1) (T_f - T_{i1}) = - (m_2) (c_2) (T_f - T_{i2})$$

In the case of both substances being the same ($c_1 = c_2$), divide both sides by c :

$$(m_1) (T_f - T_{i1}) = - (m_2) (T_f - T_{i2})$$

Solve for T_f :

$$m_1 T_f - m_1 T_{i1} = - m_2 T_f + m_2 T_{i2}$$

$$m_1 T_f + m_2 T_f = m_1 T_{i1} + m_2 T_{i2}$$

$$(m_1 + m_2) T_f = m_1 T_{i1} + m_2 T_{i2}$$

$$T_f = (m_1 T_{i1} + m_2 T_{i2}) / (m_1 + m_2)$$