

Answer on Question #72691, Physics / Other

A 0.0025 kg block of an unknown substance is at temperature of 82°C. It is placed in a calorimeter with 0.025 kg of water at 22°C. The system reaches an equilibrium temperature of 27°C. What is the unknown substance?

Solution:

The relationship between heat and temperature change is usually expressed in the form shown below where c is the specific heat.

$$Q = cm\Delta T$$

The temperature change is symbolized by ΔT where

$$\Delta T = \text{Final temperature} - \text{Original temperature}$$

When two or more objects at different temperatures are brought together in an isolated environment, they eventually reach the same temperature by the process of heat exchange. That is, warmer materials transfer heat to colder materials until their temperatures are the same.

$$-Q_x = Q_{\text{water}}$$

$$Q_x = c_x m_1 (27 - 82) = -55 \cdot m_1 \cdot c_x$$

$$Q_{\text{water}} = c_{H_2O} m_{H_2O} (27 - 22) = 5 c_{H_2O} m_{H_2O}$$

where $c_{H_2O} = 4186 \text{ J / kg }^\circ\text{C}$, (specific heat capacity of water)

Thus,

$$55 c_x m_1 = 5 c_{H_2O} m_{H_2O}$$

The specific heat of unknown substance is

$$c_x = \frac{5 c_{H_2O} m_{H_2O}}{55 m_1} = \frac{5 \cdot (4186 \text{ J / kg }^\circ\text{C}) \cdot (0.025 \text{ kg})}{55 \cdot (0.0025 \text{ kg})} \approx 3805 \text{ J / kg }^\circ\text{C}$$

No solid has such value of specific heat.

You need to clarify the input data, in particular the mass of block and water!

I guess that the value should be 380 J / kg °C

Answer: Brass