Given

$T_{Cu} = 300\ °C$

$T_{H_2O} = 20\ °C$

$m_{H_2O} = 1\ kg$

$T_f = 25\ °C$

$c_{H_2O} = 4184\ kcal/kg \cdot K$

$c_{Cu} = 386\ J/kg \cdot K$

Solution

Find the mass of the copper.

Given the heat flow is transferred between the copper and water only then

$$\Delta Q_{H2O} + \Delta Q_{Cu} = 0$$

This is a statement of the conservation of heat energy.

Substituting in the relationship between temperature change and heat flow gives

$$m_{H_2O}c_{H_2O}\left(T_f - T_{H_2O}\right) + m_{Cu}c_{Cu}\left(T_f - T_{Cu}\right) = 0$$

Solving for the mass of copper gives us

$$m_{Cu} = \frac{-m_{H_2O}c_{H_2O}\left(T_f - T_{H_2O}\right)}{c_{Cu}\left(T_f - T_{Cu}\right)}$$

$$m_{Cu} = \frac{-(1\ kg)(4184\ J/kg \cdot K)\left(25\ °C - 20\ °C\right)}{(386\ J/kg \cdot K)\left(25\ °C - 300\ °C\right)}$$

$$m_{Cu} = 0.197kg$$