Chapter 16 Problem 57 [†]

Given
$T_{Cu} = 300\ ^\circ C$
$T_{H_2O} = 20\ ^\circ C$
$m_{H_2O} = 1\ kg$
$T_f = 25\ ^\circ C$
$c_{H_2O} = 4184\ kcal/kg \cdot K$
$c_{Cu} = 386\ J/kg \cdot K$

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

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

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

$$m_{Cu} = 0.197 kg$$

[†]Problem from Essential University Physics, Wolfson