

People lacking fireproof cooking pots often heated liquids by placing hot stones in a container holding liquid. Indigenous peoples of North America concentrated maple sap to syrup using this method. If a hot rock with specific heat of $843 \text{ J/kg}^\circ\text{C}$, mass of 0.48 kg , and initial temperature of 223°C is placed in water, the final temperature of the rock and water in thermal equilibrium is 28°C . What is the mass of the water?

$$*m_w = ?$$

$$C_w = 4180 \frac{\text{J}}{\text{kg}^\circ\text{C}}$$

$$T_f = 28^\circ\text{C}$$

$$T_{iw} = 15^\circ\text{C}$$

$$m_R = 0.48 \text{ kg} \text{ at } 15^\circ\text{C}$$

$$C_R = 843 \frac{\text{J}}{\text{kg}^\circ\text{C}}$$

$$T_{iR} = 223^\circ\text{C}$$

$$\textcircled{m_w} C_w (T_f - T_{iw}) = -m_R C_R (T_f - T_{iR})$$

$$= \frac{-0.48 \text{ kg} \times 843 \frac{\text{J}}{\text{kg}^\circ\text{C}} \times (28 - 223^\circ\text{C})}{C_w (T_f - T_{iw})}$$

$$= \frac{(4180 \frac{\text{J}}{\text{kg}^\circ\text{C}} \times (28 - 15^\circ\text{C}))}{}$$

$$= 1.5 \text{ kg}$$

An insulated cup contains 75.0 g of water at 24.00°C. A 26.00 g sample of metal at 82.25°C is added. The final temperature of the water and metal is 28.34°C. What is the specific heat of the metal?

$$\begin{aligned}
 m_w &= 75.0 \text{ g} \\
 \bar{T}_f &= 28.34 \text{ }^\circ\text{C} \\
 \bar{T}_w &= 24.00 \text{ }^\circ\text{C} \\
 m_m &= 26.00 \text{ g} \\
 \bar{T}_{im} &= 82.25 \text{ }^\circ\text{C} \\
 C_m &= ?
 \end{aligned}$$

$$\begin{aligned}
 m_w C_w (\bar{T}_f - \bar{T}_w) &= -m_m C_m (\bar{T}_f - \bar{T}_{im}) \\
 \frac{m_w C_w (\bar{T}_f - \bar{T}_w)}{-m_m (\bar{T}_f - \bar{T}_{im})} &= \frac{-m_m C_m (\bar{T}_f - \bar{T}_{im})}{-m_m (\bar{T}_f - \bar{T}_{im})} \\
 &= \frac{75.0 \cancel{\text{g}} \times 4.18 \cancel{\frac{\text{J}}{\text{g}^\circ\text{C}}} (28.34 - 24.00 \cancel{^\circ\text{C}})}{-26.00 \cancel{\text{g}} (28.34 - 82.25 \cancel{^\circ\text{C}})} \\
 &= 0.971 \frac{\text{J}}{\text{g}^\circ\text{C}}
 \end{aligned}$$