

32 A 235g lead ball at a temp. of 84.2 °C is placed in a light calorimeter containing 177g of water at 21.5 °C. Find the equilibrium temperature.

lead

$$c = 128 \frac{J}{kg \cdot K}$$

$$m = 0.235 \text{ kg}$$

$$T_i = 84.2^\circ C$$

water

$$c = 4186 \frac{J}{kg \cdot K}$$

$$m = 0.177 \text{ kg}$$

$$T_i = 21.5^\circ C$$

$$\Delta Q_{\text{Total}} = 0 \quad \text{Energy conservation}$$

$$\Delta Q_{\text{Total}} = \Delta Q_{\text{lead}} + \Delta Q_{\text{water}}$$

(2)

$$0 = m_L c_L \Delta T_L + m_W c_W \Delta T_W$$

$$0 = m_L c_L (T - T_{iL}) + m_W c_W (T - T_{iW})$$

$$0 = m_L c_L T + (-m_L c_L T_{iL}) + m_W c_W T + (-m_W c_W T_{iW})$$

$$m_L c_L T_{iL} + m_W c_W T_{iW} = m_L c_L T + m_W c_W T$$

$$m_L c_L T_{iL} + m_W c_W T_{iW} = (m_L c_L + m_W c_W) T$$

$$\frac{m_L c_L T_{iL} + m_W c_W T_{iW}}{m_L c_L + m_W c_W} = T$$

$$\frac{0.235 \text{ kg} \left(128 \frac{\text{J}}{\text{kg} \cdot \text{K}} \right) 84.2^\circ \text{C} + 0.177 \text{ kg} \left(4186 \frac{\text{J}}{\text{kg} \cdot \text{K}} \right) 21.5^\circ \text{C}}{0.235 \text{ kg} \left(128 \frac{\text{J}}{\text{kg} \cdot \text{K}} \right) + 0.177 \text{ kg} \left(4186 \frac{\text{J}}{\text{kg} \cdot \text{K}} \right)} = T$$

$$0.235 \text{ kg} \left(128 \frac{\text{J}}{\text{kg} \cdot \text{K}} \right) + 0.177 \text{ kg} \left(4186 \frac{\text{J}}{\text{kg} \cdot \text{K}} \right)$$

$$\boxed{23.9^\circ \text{C} = T}$$