Answer to Review Questions 5.6:

The heat required to convert 1kg of water from ice to water is its latent heat of fusion, Lf.

1. **Given**: $m_m = 1.0$ kg, $T_m = 400.0°C$, $m_w = 2.0$ kg, $T_w = 15.0°C$, $T = 20.8°C$

    From the calorimetry principle,

    $$-Q_{lost} = Q_{gain}$$

    $$-m_m c_m (T - T_m) = m_w c_w (T - T_w)$$

    $$c_m = \frac{m_w c_w (T - T_w)}{m_m (T_m - T)}$$

    $$c_m = \frac{2kg \times 4186J / kg.°C \times (20.8°C - 15°C)}{1kg \times (400°C - 20.8°C)} = 128.05J/kg.°C$$

    From the table of specific heat capacity, we can see that the type of the metal is lead.

2. **Given**: $m_c = 250$ g $= 0.25$kg, $m_w = 200$ g $= 0.2$kg, P = 1000 W, t = 5 min=300s, T = 80°C, $T_w = 20$ °C

    We use the principle of calorimetry,

    $$Pt = m_c c_c (T - T_w) + m_w c_w (T - T_m)$$

    $$c_c = \frac{1}{m_c} \left(\frac{Pt}{T - T_w} - m_w c_w \right)$$

    $$c_s = 0.25kg \times \left(\frac{1000w \times 300s}{80°C - 20°C} - 0.2kg \times 4186J / kg.°C \right)$$

    $$c_s = 16651.2J/kg.°C$$

3. Given: $m_m = 0.25 \text{ kg}$, $T_m = 200°C$, $m_c = 0.02 \text{ kg}$, $V_w = 150 \text{ cm}^3$,
$T_w = 25°C$, $T = 40°C$

$$-m_m c_m (T - T_m) = m_c c_c (T - T_w) + m_w c_w (T - T_w)$$

Mass of water, $m_w = \rho_w V_w = 1g/\text{cm}^3 \times 150\text{cm}^3 = 150g = 0.15\text{kg}$, then

$$c_m = \frac{(m_c c_c + m_w c_w)(T - T_w)}{m_m (T_m - T)}$$

$$c_m = \frac{(0.02\text{kg} \times 385\text{J/kg.°C} + 0.15\text{kg} \times 4186\text{J/kg.°C})(40°C - 25°C)}{0.25\text{kg} \times (200°C - 40°C)}$$

$$c_m = 238.35\text{J/kg.°C}$$

If some heat is lost to the surroundings, then the value of specific heat capacity will be less than the actual value.

4. **Given**: $m_{Cu} = 20 \text{ kg}$, $T_{Cu} = 500°C$, $L_{f,w} = 3.33 \times 10^5 \text{J/kg}$

$$m_i L_i = m_{Cu} c_{Cu} (T_{Cu} - T)$$

$$m_i = \frac{m_{Cu} c_{Cu} (T_{Cu} - T)}{L_i} = \frac{20\text{kg} \times 385\text{J/kg.°C} \times (500°C - 0°C)}{3.33 \times 10^5 \text{J/kg}}$$

$$m_i = 115.62\text{kg}$$