16. In coming to equilibrium, the heat lost by the $100\,\mathrm{cm}^3$ of liquid water (of mass $m_w = 100$ g and specific heat capacity $c_w = 4190\,\mathrm{J/kg{\cdot}K}$) is absorbed by the ice (of mass m_i which melts and reaches $T_f > 0°\mathrm{C}$). We begin by finding the equilibrium temperature:

$$\begin{aligned} \sum Q &= 0 \\ Q_{\text{warm water cools}} + Q_{\text{ice warms to }0°} + Q_{\text{ice melts}} + Q_{\text{melted ice warms}} &= 0 \\ c_w m_w \left(T_f - 20°\right) + c_i m_i \left(0° - (-10°)\right) + L_F\, m_i + c_w m_i \left(T_f - 0°\right) &= 0 \end{aligned}$$

which yields, after using $L_F = 333000$ J/kg and values cited in the problem, $T_f = 12.24°$ which is equivalent to $T_f = 285.39$ K. Sample Problem 20-2 shows that

$$\Delta S_{\text{temp change}} = mc\,\ln\left(\frac{T_2}{T_1}\right)$$

for processes where $\Delta T = T_2 - T_1$, and Eq. 21-2 gives

$$\Delta S_{\text{melt}} = \frac{L_F\, m}{T_{\text{o}}}$$

for the phase change experienced by the ice (with $T_{\text{o}} = 273.15$ K). The total entropy change is (with T in Kelvins)

$$\begin{aligned} \Delta S_{\text{system}} &= m_w c_w \ln\left(\frac{285.39}{293.15}\right) + m_i c_i \ln\left(\frac{273.15}{263.15}\right) + m_i c_w \ln\left(\frac{285.39}{273.15}\right) + \frac{L_F\, m_i}{273.15} \\ &= -11.24 + 0.66 + 1.47 + 9.75 \;=\; 0.64\ \mathrm{J/K}\ . \end{aligned}$$