65. Let h be the thickness of the slab and A be its area. Then, the rate of heat flow through the slab is

$$P_{\text{cond}} = \frac{kA\,(T_H - T_C)}{h}$$

where k is the thermal conductivity of ice, T_H is the temperature of the water (0°C), and T_C is the temperature of the air above the ice (−10°C). The heat leaving the water freezes it, the heat required to freeze mass m of water being $Q = L_F m$, where L_F is the heat of fusion for water. Differentiate with respect to time and recognize that $dQ/dt = P_{\text{cond}}$ to obtain

$$P_{\text{cond}} = L_F \frac{dm}{dt} \ .$$

Now, the mass of the ice is given by $m = \rho A h$, where ρ is the density of ice and h is the thickness of the ice slab, so $dm/dt = \rho A(dh/dt)$ and

$$P_{\text{cond}} = L_F \rho A \frac{dh}{dt} \ .$$

We equate the two expressions for P_{cond} and solve for $dh/\mathrm{d}t$:

$$\frac{dh}{dt} = \frac{k(T_H - T_C)}{L_F \rho h} \ .$$

Since $1\,\text{cal} = 4.186\,\text{J}$ and $1\,\text{cm} = 1 \times 10^{-2}\,\text{m}$, the thermal conductivity of ice has the SI value $k = (0.0040\,\text{cal/s}\cdot\text{cm}\cdot\text{K})(4.186\,\text{J/cal})/(1{\times}10^{-2}\,\text{m/cm}) = 1.674\,\text{W/m}\cdot\text{K}$. The density of ice is $\rho = 0.92\,\text{g/cm}^3 = 0.92 \times 10^3\,\text{kg/m}^3$. Thus,

$$\frac{dh}{dt} = \frac{(1.674\,\text{W/m}\cdot\text{K})(0°\text{C} + 10°\text{C})}{(333 \times 10^3\,\text{J/kg})(0.92 \times 10^3\,\text{kg/m}^3)(0.050\,\text{m})} = 1.1 \times 10^{-6}\,\text{m/s} = 0.40\ \text{cm/h} \ .$$