

Chapter 17 Problem 53 [†]

Given

$$m_p = 16 \text{ kg}$$

$$T_p = 25 \text{ }^\circ\text{C}$$

$$T_f = 0 \text{ }^\circ\text{C}$$

$$L_f = 334 \text{ kJ/kg}$$

$$c_p = 4.184 \text{ kJ/kg} \cdot \text{K}$$

Solution

Find the amount of ice to cool the punch to $0 \text{ }^\circ\text{C}$.

As the ice is added, the heat will flow from the punch to the ice.

$$\Delta Q_{ice} + \Delta Q_p = 0$$

Since the ice is melting, it is gaining energy.

$$m_{ice}L_f + m_p c_p (T_f - T_i) = 0$$

Solving for the mass of ice gives us

$$m_{ice} = \frac{-m_p c_p (T_f - T_i)}{L_f}$$

Substituting in the given values we have

$$m_{ice} = \frac{-(16 \text{ kg})(4.184 \text{ kJ/kg} \cdot \text{K})(0 - 25^\circ\text{C})}{(334 \text{ kJ/kg})}$$

$$m_{ice} = 5.01 \text{ kg}$$

[†]Problem from Essential University Physics, Wolfson