

7-46E The COP and the refrigeration rate of an ice machine are given. The power consumption is to be determined.

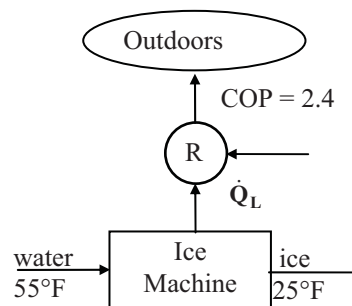
Assumptions The ice machine operates steadily.

Analysis The cooling load of this ice machine is

$$\dot{Q}_L = \dot{m}q_L = (28 \text{ lbm/h})(169 \text{ Btu/lbm}) = 4732 \text{ Btu/h}$$

Using the definition of the coefficient of performance, the power input to the ice machine system is determined to be

$$\dot{W}_{\text{net,in}} = \frac{\dot{Q}_L}{\text{COP}_R} = \frac{4732 \text{ Btu/h}}{2.4} \left(\frac{1 \text{ hp}}{2545 \text{ Btu/h}} \right) = \mathbf{0.775 \text{ hp}}$$



7-47 The COP and the power consumption of a refrigerator are given. The time it will take to cool 5 watermelons is to be determined.

Assumptions 1 The refrigerator operates steadily. 2 The heat gain of the refrigerator through its walls, door, etc. is negligible. 3 The watermelons are the only items in the refrigerator to be cooled.

Properties The specific heat of watermelons is given to be $c = 4.2 \text{ kJ/kg}\cdot^\circ\text{C}$.

Analysis The total amount of heat that needs to be removed from the watermelons is

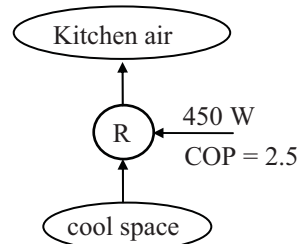
$$Q_L = (mc\Delta T)_{\text{watermelons}} = 5 \times (10 \text{ kg})(4.2 \text{ kJ/kg}\cdot^\circ\text{C})(20 - 8)^\circ\text{C} = 2520 \text{ kJ}$$

The rate at which this refrigerator removes heat is

$$\dot{Q}_L = (\text{COP}_R)(\dot{W}_{\text{net,in}}) = (2.5)(0.45 \text{ kW}) = 1.125 \text{ kW}$$

That is, this refrigerator can remove 1.125 kJ of heat per second. Thus the time required to remove 2520 kJ of heat is

$$\Delta t = \frac{Q_L}{\dot{Q}_L} = \frac{2520 \text{ kJ}}{1.125 \text{ kJ/s}} = 2240 \text{ s} = \mathbf{37.3 \text{ min}}$$



This answer is optimistic since the refrigerated space will gain some heat during this process from the surrounding air, which will increase the work load. Thus, in reality, it will take longer to cool the watermelons.