

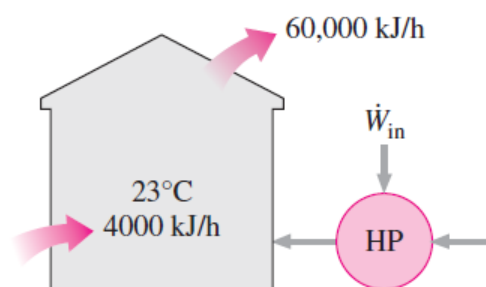
## Chapter 6

**6–20** A steam power plant with a power output of 150 MW consumes coal at a rate of 60 tons/h. If the heating value of the coal is 30,000 kJ/kg, determine the overall efficiency of this plant. *Answer: 30.0 percent*

**6–40** An air conditioner removes heat steadily from a house at a rate of 750 kJ/min while drawing electric power at a rate of 6 kW. Determine (a) the COP of this air conditioner and (b) the rate of heat transfer to the outside air. *Answers: (a) 2.08, (b) 1110 kJ/min*

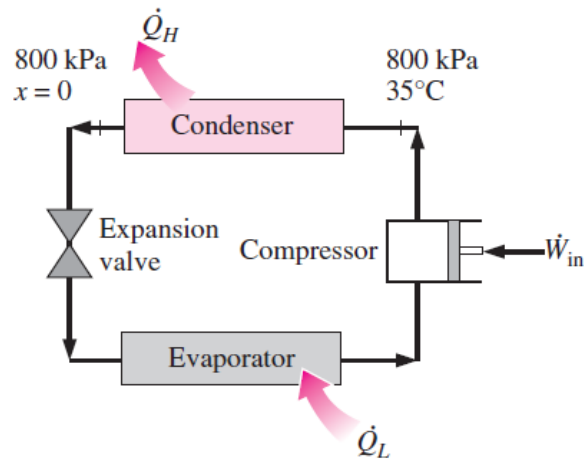
**6–43** A household refrigerator that has a power input of 450 W and a COP of 2.5 is to cool five large watermelons, 10 kg each, to 8°C. If the watermelons are initially at 20°C, determine how long it will take for the refrigerator to cool them. The watermelons can be treated as water whose specific heat is 4.2 kJ/kg · °C. Is your answer realistic or optimistic? Explain. *Answer: 2240 s*

**6–51** A heat pump is used to maintain a house at a constant temperature of 23°C. The house is losing heat to the outside air through the walls and the windows at a rate of 60,000 kJ/h while the energy generated within the house from people, lights, and appliances amounts to 4000 kJ/h. For a COP of 2.5, determine the required power input to the heat pump. *Answer: 6.22 kW*



**FIGURE 6–51**

**6–54** Refrigerant-134a enters the condenser of a residential heat pump at 800 kPa and 35°C at a rate of 0.018 kg/s and leaves at 800 kPa as a saturated liquid. If the compressor consumes 1.2 kW of power, determine (a) the COP of the heat pump and (b) the rate of heat absorption from the outside air.



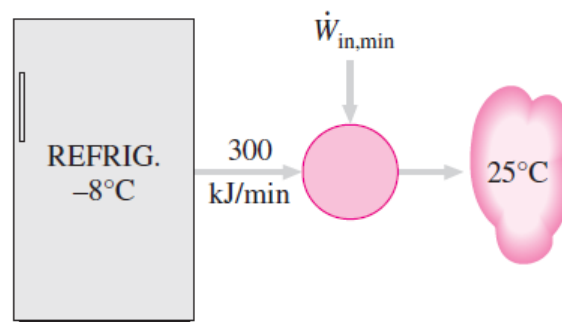
**FIGURE 6–54**

**6–71** A Carnot heat engine operates between a source at 1000 K and a sink at 300 K. If the heat engine is supplied with heat at a rate of 800 kJ/min, determine (a) the thermal efficiency and (b) the power output of this heat engine. *Answers: (a) 70 percent, (b) 9.33 kW*

**6–72** A Carnot heat engine receives 650 kJ of heat from a source of unknown temperature and rejects 250 kJ of it to a sink at 24°C. Determine (a) the temperature of the source and (b) the thermal efficiency of the heat engine.

**6–86** A Carnot refrigerator operates in a room in which the temperature is 22°C and consumes 2 kW of power when operating. If the food compartment of the refrigerator is to be maintained at 3°C, determine the rate of heat removal from the food compartment.

**6–87** A refrigerator is to remove heat from the cooled space at a rate of 300 kJ/min to maintain its temperature at  $-8^{\circ}\text{C}$ . If the air surrounding the refrigerator is at 25°C, determine the minimum power input required for this refrigerator. *Answer: 0.623 kW*



**FIGURE 6–87**