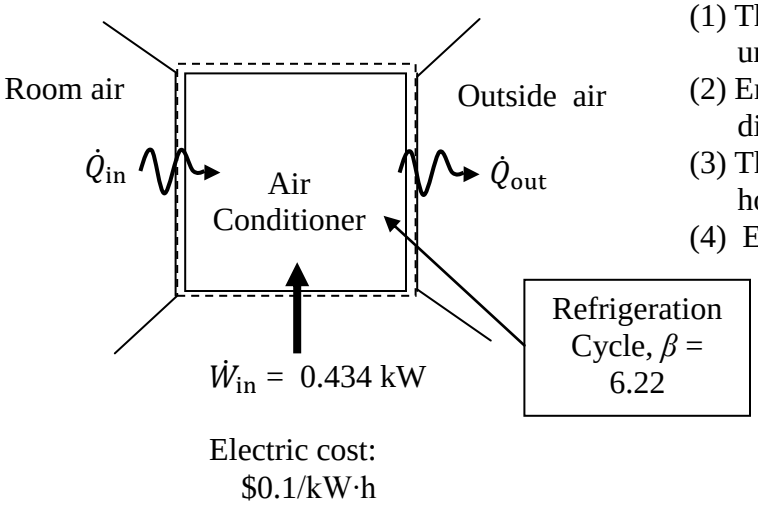
Problem 2.92

A window-mounted room air conditioner removes energy by heat transfer from a room and rejects energy by heat transfer to the outside air. For steady operation, the air conditioner cycle requires a power input of 0.434 kW and has a coefficient of performance of 6.22. Determine the rate that energy is removed from the room air, in kW. If electricity is valued at \$0.1/kW·h, determine the cost of operation for 24 hours of operation.

KNOWN: Steady-state operating data are provided for an air conditioner.

FIND: Determine the rate energy is removed from the room and air the cost of 24 hours of operation.

SCHEMATIC AND GIVEN DATA:



ENGINEERING MODEL:
(1) The system shown in the schematic undergoes a refrigeration cycle.
(2) Energy transfers are positive in the directions of the arrows.
(3) The cycle operates steadily for 24 hours.
(4) Electricity is valued at \$0.1/kW·h.

ANALYSIS: Using Eq. 2.45 on a time rate basis

$$\beta = \frac{\dot{Q}_{in}}{\dot{W}_{cycle}} \quad \rightarrow \quad \dot{Q}_{in} = \beta \dot{W}_{cycle} = (6.22)(0.434 \text{ kW}) = 2.70 \text{ kW} \longleftarrow$$

The total amount of electric energy input by work for 24 h of operation is

$$W_{cycle} = \dot{W}_{cycle} \Delta t = (0.434 \text{ kW})(24 \text{ h}) = 10.42 \text{ kW·h}$$

Thus, the total cost is

Total cost = (10.42 kW·h)(\$0.1/kW·h) = \$1.04 (for 24 hours) ⟵