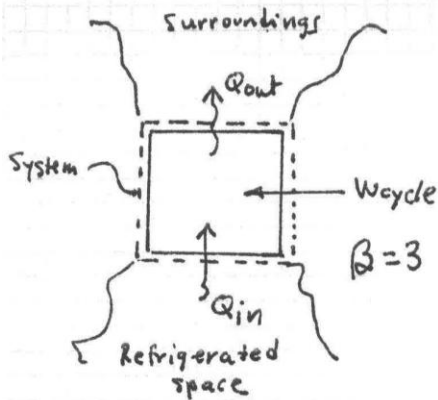


PROBLEM 2.91

KNOWN: Operating and cost data are provided for a household refrigerator.

FIND: Determine the refrigerator's annual electricity requirement, in kW·h, and the amount of energy removed from its refrigerated space annually, in MJ.

SCHEMATIC & GIVEN DATA:



Annual cost of electricity = \$55.
Unit cost of electricity = 8 cents per kW·h

ENGINEERING MODEL:

1. The system undergoes a refrigeration cycle.
2. Energy transfers are positive in the direction of arrows on the schematic.
3. Electricity is valued at 8 cents per kW·h.

ANALYSIS:

(a)
$$\left[\begin{array}{c} \text{Annual} \\ \text{Cost of} \\ \text{Electricity} \end{array} \right] = W_{\text{cycle}} \left[\frac{\text{\$0.08}}{\text{kW}\cdot\text{h}} \right]$$

$\text{\$55} = W_{\text{cycle}} \left[\frac{\text{\$0.08}}{\text{kW}\cdot\text{h}} \right]$

$\therefore W_{\text{cycle}} = \left[\frac{\text{\$55}}{\text{\$0.08/kW}\cdot\text{h}} \right]$

$= 687.5 \text{ kW}\cdot\text{h (annually)}$

(b) With Eq 2.45,

$$\beta = \frac{Q_{\text{in}}}{W_{\text{cycle}}}$$

$$\therefore Q_{\text{in}} = \beta W_{\text{cycle}}$$

$$= (3)(687.5 \text{ kW}\cdot\text{h}) \left| \frac{1 \text{ kJ/s}}{1 \text{ kW}} \right| \left| \frac{3600 \text{ s}}{1 \text{ h}} \right| \left| \frac{1 \text{ MJ}}{10^3 \text{ kJ}} \right|$$

$$= 7425 \text{ MJ (annually)}$$