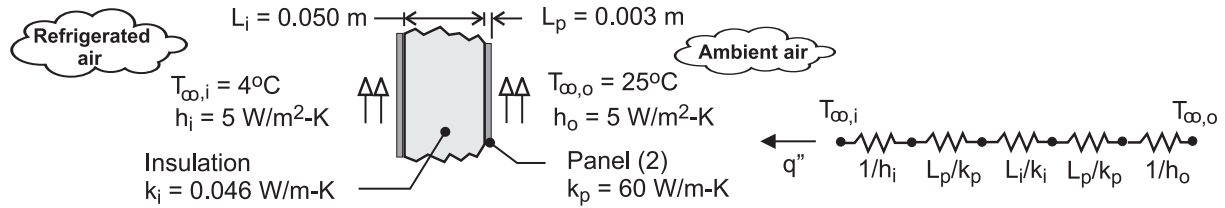# PROBLEM 3.7

KNOWN: Thicknesses and thermal conductivities of refrigerator wall materials. Inner and outer air temperatures and convection coefficients.

FIND: Heat gain per surface area.

SCHEMATIC:

ASSUMPTIONS: (1) One-dimensional heat transfer, (2) Steady-state conditions, (3) Negligible contact resistance, (4) Negligible radiation, (5) Constant properties.

ANALYSIS: From the thermal circuit, the heat gain per unit surface area is

$$q'' = \frac{T_{\infty,o} - T_{\infty,i}}{(1/h_i) + (L_p/k_p) + (L_i/k_i) + (L_p/k_p) + (1/h_o)}$$

$$q'' = \frac{(25-4)°C}{2(1/5\,W/m^2 \cdot K) + 2(0.003m/60\,W/m \cdot K) + (0.050m/0.046\,W/m \cdot K)}$$

$$q'' = \frac{21°C}{(0.4 + 0.0001 + 1.087)\,m^2 \cdot K/W} = 14.1\,W/m^2 \qquad <$$

COMMENTS: Although the contribution of the panels to the total thermal resistance is negligible, that due to convection is not inconsequential and is comparable to the thermal resistance of the insulation.