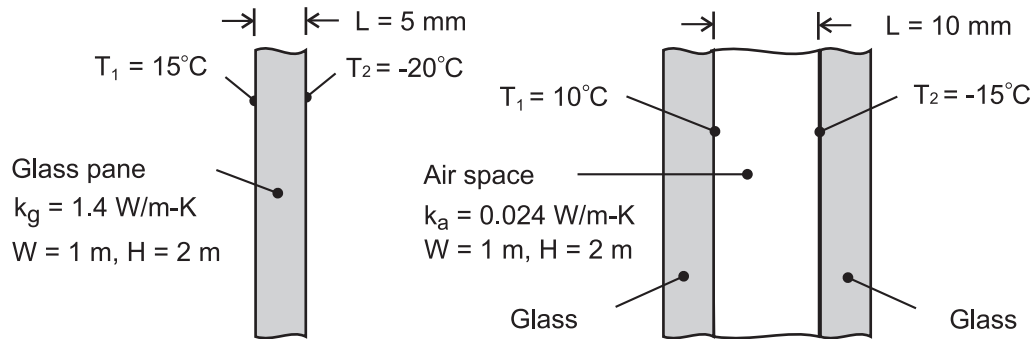# PROBLEM 1.9

KNOWN: Width, height, thickness and thermal conductivity of a single pane window and the air space of a double pane window. Representative winter surface temperatures of single pane and air space.

FIND: Heat loss through single and double pane windows.

SCHEMATIC:

ASSUMPTIONS: (1) One-dimensional conduction through glass or air, (2) Steady-state conditions, (3) Enclosed air of double pane window is stagnant (negligible buoyancy induced motion).

ANALYSIS: From Fourier's law, the heat losses are

Single Pane: $q_g = k_g A \dfrac{T_1 - T_2}{L} = 1.4 \text{ W/m} \cdot \text{K} \left(2\text{m}^2\right) \dfrac{35\ ^\circ\text{C}}{0.005\text{m}} = 19,600 \text{ W}$ $<$

Double Pane: $q_a = k_a A \dfrac{T_1 - T_2}{L} = 0.024 \left(2\text{m}^2\right) \dfrac{25\ ^\circ\text{C}}{0.010 \text{ m}} = 120 \text{ W}$ $<$

COMMENTS: Losses associated with a single pane are unacceptable and would remain excessive, even if the thickness of the glass were doubled to match that of the air space. The principal advantage of the double pane construction resides with the low thermal conductivity of air (~ 60 times smaller than that of glass). For a fixed ambient outside air temperature, use of the double pane construction would also increase the surface temperature of the glass exposed to the room (inside) air.