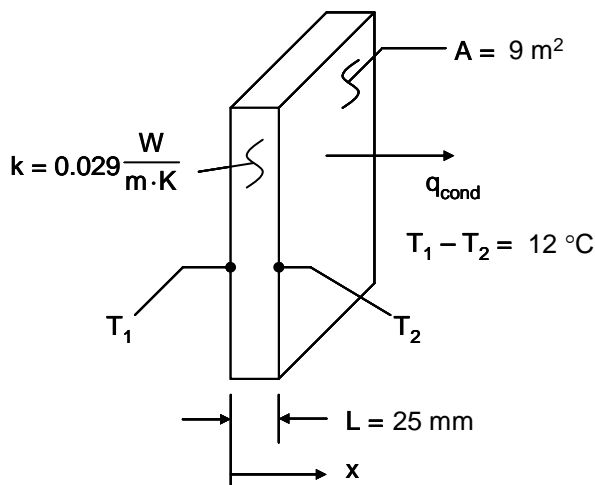# PROBLEM 1.1

KNOWN: Thermal conductivity, thickness and temperature difference across a sheet of rigid extruded insulation.

FIND: (a) The heat flux through a 3 m × 3 m sheet of the insulation, and (b) The heat rate through the sheet.

SCHEMATIC:

ASSUMPTIONS: (1) One-dimensional conduction in the x-direction, (2) Steady-state conditions, (3) Constant properties.

ANALYSIS: From Equation 1.2 the heat flux is

$$q_x'' = -k\frac{dT}{dx} = k\frac{T_1 - T_2}{L}$$

Solving,

$$q_x'' = 0.029\frac{W}{m \cdot K} \times \frac{12\ K}{0.025\ m}$$

$$q_x'' = 13.9\frac{W}{m^2}$$ <

The heat rate is

$$q_x = q_x'' \cdot A = 13.9\frac{W}{m^2} \times 9\ m^2 = 125\ W$$ <

COMMENTS: (1) Be sure to keep in mind the important distinction between the heat flux (W/m^2) and the heat rate (W). (2) The direction of heat flow is from hot to cold. (3) Note that a temperature *difference* may be expressed in kelvins or degrees Celsius.