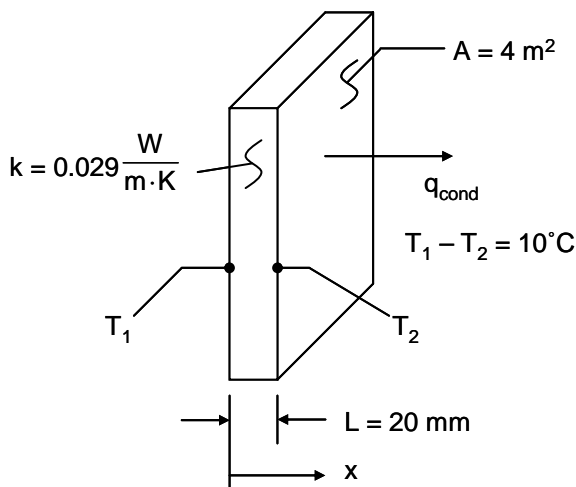


## PROBLEM 1.1

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

**FIND:** (a) The heat flux through a  $2\text{ m} \times 2\text{ m}$  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,

$$q_x'' = 0.029 \frac{\text{W}}{\text{m} \cdot \text{K}} \times \frac{10 \text{ K}}{0.02 \text{ m}}$$

$$q_x'' = 14.5 \frac{\text{W}}{\text{m}^2} \quad <$$

The heat rate is

$$q_x = q_x'' \cdot A = 14.5 \frac{\text{W}}{\text{m}^2} \times 4 \text{ m}^2 = 58 \text{ W} \quad <$$

**COMMENTS:** (1) Be sure to keep in mind the important distinction between the heat flux ( $\text{W}/\text{m}^2$ ) and the heat rate ( $\text{W}$ ). (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.