

# Download File PDF Foundation Of Heat Transfer Solution

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**Foundation Of Heat Transfer Solution**

**PROBLEM 1.1**

**KNOWN:** Heat rate,  $q$ , through one-dimensional wall of area  $A$ , thickness  $L$ , thermal conductivity  $k$  and inner temperature,  $T_1$ .

**FIND:** The outer temperature of the wall,  $T_2$ .

**SCHEMATIC:**

$k = 0.2 \text{ W/m}\cdot\text{K}$   
 $T_1 = 415^\circ\text{C}$   
 $L = 2.5 \text{ cm}$   
 $A = 10 \text{ m}^2$   
 $q_{\text{cond}} = 3 \text{ kW}$

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

**ANALYSIS:** The rate equation for conduction through the wall is given by Fourier's law,

$$q_{\text{cond}} = q_1 = q_2 = k \frac{dT}{dx} = kA \frac{T_1 - T_2}{L}$$

Solving for  $T_2$  gives

$$T_2 = T_1 - \frac{q_{\text{cond}} L}{kA}$$

Substituting numerical values, find

$$T_2 = 415^\circ\text{C} - \frac{3000 \text{ W} \times 0.025 \text{ m}}{0.2 \text{ W/m}\cdot\text{K} \times 10 \text{ m}^2}$$
$$T_2 = 415^\circ\text{C} - 37.5^\circ\text{C}$$
$$T_2 = 378^\circ\text{C}$$

**COMMENTS:** Note direction of heat flow and fact that  $T_2$  must be less than  $T_1$ .