## **PROBLEM 1.10**

**KNOWN:** Thickness, diameter and inner surface temperature of bottom of pan used to boil water. Rate of heat transfer to the pan.

FIND: Outer surface temperature of pan for an aluminum and a copper bottom.

## **SCHEMATIC:**



ASSUMPTIONS: (1) One-dimensional, steady-state conduction through bottom of pan.

**ANALYSIS:** From Fourier's law, the rate of heat transfer by conduction through the bottom of the pan is

$$q = kA \frac{T_1 - T_2}{L}$$

Hence,

$$T_1 = T_2 + \frac{qL}{kA}$$

where  $A = \pi D^2 / 4 = \pi (0.2m)^2 / 4 = 0.0314 m^2$ .

Aluminum: 
$$T_1 = 110 \ ^{\circ}C + \frac{600W(0.005 \text{ m})}{240 \text{ W/m} \cdot \text{K}(0.0314 \text{ m}^2)} = 110.40 \ ^{\circ}C$$

*Copper*: 
$$T_1 = 110 \ ^{\circ}C + \frac{600W(0.005 \text{ m})}{390 \text{ W/m} \cdot \text{K}(0.0314 \text{ m}^2)} = 110.24 \ ^{\circ}C$$
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**COMMENTS:** Although the temperature drop across the bottom is slightly larger for aluminum (due to its smaller thermal conductivity), it is sufficiently small to be negligible for both materials. To a good approximation, the bottom may be considered *isothermal* at T  $\approx$  110 °C, which is a desirable feature of pots and pans.

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