Fenómenos de transporte (3007814-2)

Mecanismos de transferencia de calor

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1- Concrete wall, which has a surface area of 20 m^2 and is 0.30 m thick, separates conditioned room air from ambient air. The temperature of the inner surface of the wall is maintained at 25°C, and the thermal conductivity of the concrete is 0.85 W/m K.

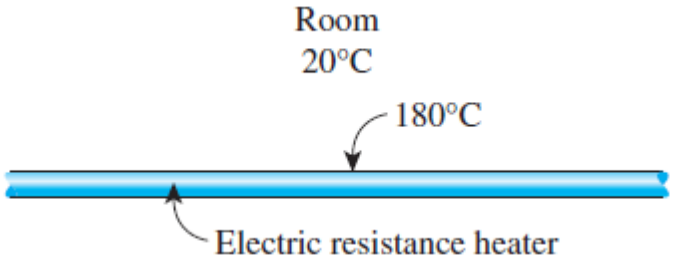
(a) Determine the rate of heat loss through the wall for outer surface temperatures ranging from −15°C to 38°C. Display your results graphically.
(b) Plot the rate of heat loss as a function of the outer surface temperature for wall materials having thermal conductivities of 0.75 and 1.25 W/m · K. Explain the family of curves you have obtained.
(c) Plot the amount of heat loss through the original wall as a function of the wall thickness in the range of 10 cm to 50 cm. Discuss the results.

2-

a) Hot air at 80°C is blown over a 2-m x 4-m flat surface at 30°C. If the average convection heat transfer coefficient is 55 $W/m^2 \cdot K$, determine the rate of heat transfer from the air to the plate, in kW.
b) Plot the rate of heat transfer as a function of the heat transfer coefficient in the range of 20 $W/m^2 \cdot K$ to 100 $W/m^2 \cdot K$. Discuss the results.

3-

a) 2.1-m-long, 0.2-cm-diameter electrical wire extends across a room that is maintained at 20°C. Heat is generated in the wire as a result of resistance heating, and the surface temperature of the wire is measured to be 180°C in steady operation. Also, the voltage drop and electric current through the wire are measured to be 110 V and 3 A, respectively. Disregarding any heat transfer by radiation, determine the convection heat transfer coefficient for heat transfer between the outer surface of the wire and the air in the room.



b) Plot the convection heat transfer coefficient as a function of the wire surface temperature in the range of 100°C to 300°C. Discuss the results.

4- An electronic package in the shape of a sphere with an outer diameter of 100 mm is placed in a large laboratory room. The surface emissivity of the package is 0.25. The walls of the room are maintained at a constant temperature of 77 K. The electronics in this package can only operate in the surface temperature range of 40°C ≤ *Ts* ≤ 85°C. Determine the range of power dissipation for the electronic package over this temperature range [Plot the results in terms of *W* vs. *Ts*(°C)]. Display your results graphically, showing also the effect of variations in the emissivity by considering values of 0.20 and 0.30.