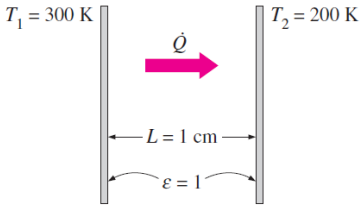
Tutorial One – Part B

Exercise 1.10

The inner and outer surfaces of a **0.5-cm thick 2-m x 2-m** window glass in winter are **10°C** and **3°C**, respectively. If the thermal conductivity of the glass is **0.78 W/m·K**, determine the amount of heat loss through the glass over a period of **5 h**. What would your answer be if the glass were **1 cm** thick?

Exercise 1.11

Consider steady heat transfer between two large parallel plates at constant temperatures of T_1 **= 300 K** and T_2 **= 200 K** that are **L = 1 cm** apart, as shown in **Fig. 1–7**. Assuming the surfaces to be black (**emissivity ε = 1**), determine the rate of heat transfer between the plates per unit surface area assuming the gap between the plates is



(Figure 1–7)

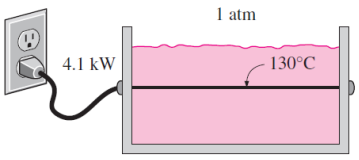
a) filled with atmospheric air (**k = 0.0219 W/m·K**),
b) evacuated,
c) filled with urethane insulation (**k = 0.026 W/m·K**), and
d) filled with superinsulation that has an apparent thermal conductivity of **0.00002 W/m·K**.

Exercise 1.12

A **5-cm-diameter** spherical ball whose surface is maintained at a temperature of **70°C** is suspended in the middle of a room at **20°C**. If the convection heat transfer coefficient is **15 W/m^2·°C** and the emissivity of the surface is **0.8**, determine the total rate of heat transfer from the ball.

Exercise 1.13

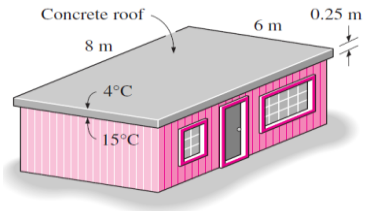
A **50-cm-long**, **2-mm-diameter** electric resistance wire submerged in water is used to determine the boiling heat transfer coefficient in water at **1 atm** experimentally. The wire temperature is measured to be **130°C** when a wattmeter the electric power consumed to be **4.1 kW**. Using Newton's law of cooling, determine the boiling heat transfer coefficient.



(Figure 1–8)

Exercise 1.14

The roof of an electrically heated home is **6-m-long**, **8-m-wide**, and **0.25-m-thick**, and is made of a flat layer of concrete whose thermal conductivity is **k = 0.8 W/m·°C** (**Fig. 1–9**). The temperatures of the inner and the outer surfaces of the roof one night are measured to be **15°C** and **4°C**, respectively, for a period of **10 hours**. Determine



(Figure 1–9)

a) the rate of heat loss through the roof that night, and,
b) the cost of that heat loss to the home owner if the cost of electricity is $0.08/kWh.