

me263 – Fluids and Heat Transfer

Conductive Heat Transfer – A Small Reminder Problem

The Question

Multilayered
ski jacket



FIGURE P8-86

8-86 Clothing made of several thin layers of fabric with trapped air in between, often called ski clothing, is commonly used in cold climates because it is light, fashionable, and a very effective thermal insulator. So it is no surprise that such clothing has largely replaced thick and heavy old-fashioned coats.

Consider coat made of five layers of 0.1-mm-thick synthetic fabric [$k = 0.13 \text{ W}/(\text{m} \cdot ^\circ\text{C})$] with 1.5-mm-thick air space [$k = 0.026 \text{ W}/(\text{m} \cdot ^\circ\text{C})$] between the layers. Assuming the inner surface temperature of the jacket to be 28°C and the surface area to be 1.1 m^2 , determine the rate of heat loss through the jacket when the temperature of the outdoors is -5°C and the heat transfer coefficient at the outer surface is $25 \text{ W}/(\text{m}^2 \cdot ^\circ\text{C})$.

What would your response be if the jacket were made of a single layer of 0.5-mm-thick synthetic fabric? What should the thickness of a wool fabric [$k = 0.035 \text{ W}/(\text{m} \cdot ^\circ\text{C})$] be if the person is to achieve the same level of thermal comfort wearing a thick wool coat instead of a ski jacket?