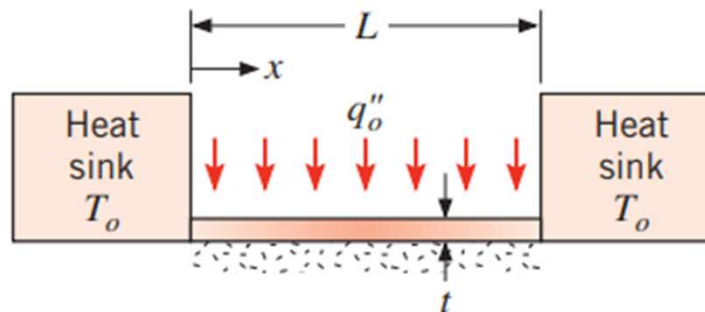


Question 1.

A thin flat plate of length L , thickness t , and width $w \gg L$ is thermally joined to two large heat sinks that are maintained at a temperature T_o . The bottom of the plate is well insulated, while the net heat flux to the top surface of the plate is known to have a uniform value of q''_o .

- (a) Derive the differential equation that determines the steady-state temperature distribution $T(x)$ in the plate.
- (b) Solve the foregoing equation for the temperature distribution, and obtain an expression for the rate of heat transfer from the plate to the heat sinks.



Question 3.

A very long rod of 5-mm diameter and uniform thermal conductivity $k = 25 \text{ W/m} \cdot \text{K}$ is subjected to a heat treatment process. The center, 30-mm-long portion of the rod within the induction heating coil experiences uniform volumetric heat generation of $7.5 \times 10^6 \text{ W/m}^3$.

The unheated portions of the rod, which protrude from the heating coil on either side, experience convection with the ambient air at $T_\infty = 20^\circ\text{C}$ and $h = 10 \text{ W/m}^2 \cdot \text{K}$. Assume that there is no convection from the surface of the rod within the coil.

- (a) Calculate the steady-state temperature T_o of the rod at the midpoint of the heated portion.
- (b) Calculate the temperature of the rod T_b at the edge of the heated portion

