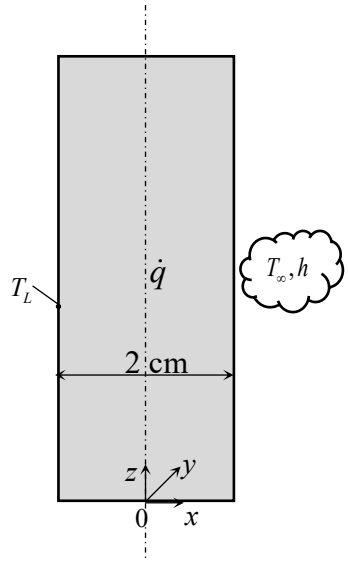
Heat Transfer - 2

A 2-cm-thick planar wall, with a thermal conductivity of 3.1 W/m·K, has a uniform volumetric heat generation $\dot{q}$ = 5.6×10^6 W/m^3 within the wall. The temperature at the left surface is maintained at T_L = 105 °C. The right surface is subject to free convection with T_∞ = 30 °C and h = 95 W/m^2·K.



The 3-D heat conduction equation is given by:

$$\frac{\rho c_p}{k}\frac{\partial T}{\partial t} = \frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} + \frac{\partial^2 T}{\partial z^2} + \frac{\dot{q}}{k}.$$

Assume steady-state conditions.

1. **(50 points)** Obtain the temperature distribution in the wall.
2. **(20 points)** Find the maximum temperature and its location.
3. **(20 points)** Determine the heat fluxes on the left and right surfaces of the wall; Show how these fluxes are related to the overall heat generation.
4. **(10 points)** Sketch the temperature distribution.