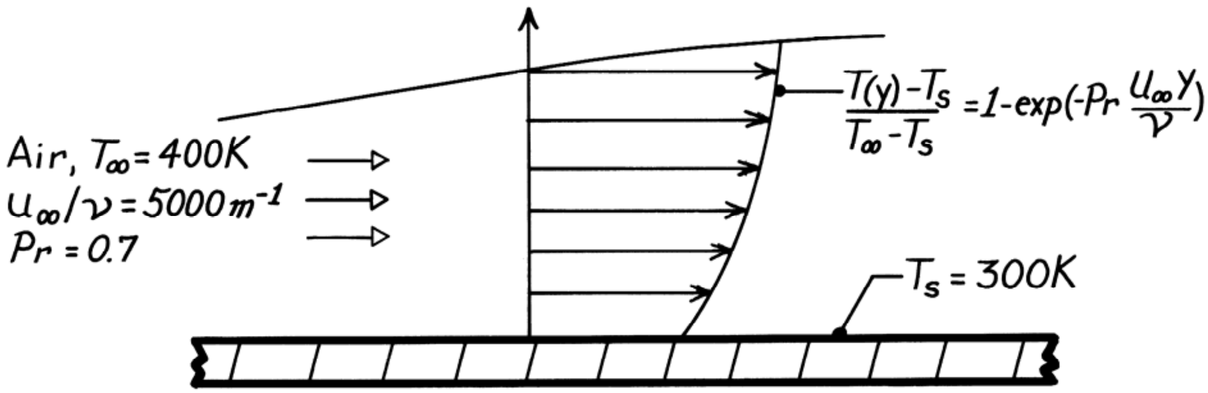
PROBLEM 6.3

KNOWN: Boundary layer temperature distribution.

FIND: Surface heat flux.

SCHEMATIC:



PROPERTIES: *Table A-4*, Air (T_s = 300K): k = 0.0263 W/m·K.

ANALYSIS: Applying Fourier's law at y = 0, the heat flux is

$$q''_s = -k\frac{\partial T}{\partial y}\bigg|_{y=0} = -k\left(T_\infty - T_s\right)\left[Pr\frac{u_\infty}{\nu}\right]\exp\left[-Pr\frac{u_\infty y}{\nu}\right]\bigg|_{y=0}$$

$$q''_s = -k\left(T_\infty - T_s\right)Pr\frac{u_\infty}{\nu}$$

$$q''_s = -0.0263\ W/m\cdot K\left(100K\right)0.7\times 5000\ 1/m.$$

$$q''_s = -9205\ W/m^2.$$ <

COMMENTS: (1) Negative flux implies convection heat transfer to the surface.

(2) Note use of k at T_s to evaluate q''_s from Fourier's law.