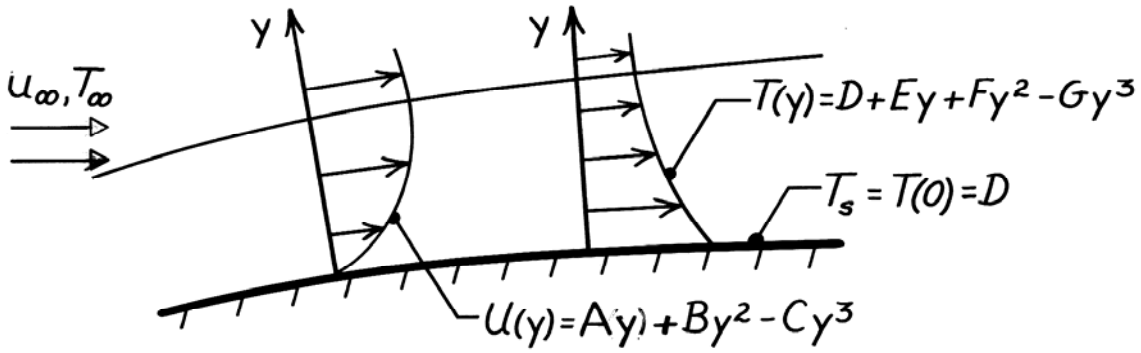
PROBLEM 6.1

KNOWN: Form of the velocity and temperature profiles for flow over a surface.

FIND: Expressions for the friction and convection coefficients.

SCHEMATIC:



ANALYSIS: The shear stress at the wall is

$$\tau_s = \mu \left.\frac{\partial u}{\partial y}\right]_{y=0} = \mu \left[A + 2By - 3Cy^2\right]_{y=0} = A\mu.$$

Hence, the friction coefficient has the form,

$$C_f = \frac{\tau_s}{\rho\, u_\infty^2/2} = \frac{2A\mu}{\rho\, u_\infty^2}$$

$$C_f = \frac{2A\nu}{u_\infty^2}. \qquad <$$

The convection coefficient is

$$h = \frac{-k_f \left(\partial T/\partial y\right)_{y=0}}{T_s - T_\infty} = \frac{-k_f \left[E + 2Fy - 3Gy^2\right]_{y=0}}{D - T_\infty}$$

$$h = \frac{-k_f E}{D - T_\infty}. \qquad <$$

COMMENTS: It is a simple matter to obtain the important surface parameters from knowledge of the corresponding boundary layer profiles. However, it is rarely a simple matter to determine the form of the profile.