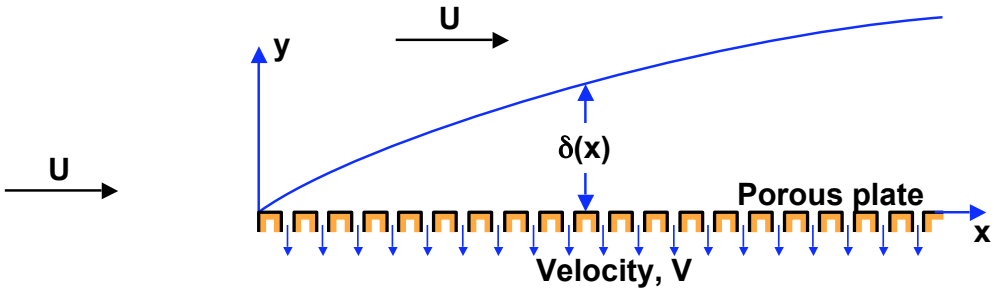
Problem 250B

A laminar boundary layer forms on a porous flat plate. Fluid is removed through the porous flat plate at a uniform velocity, V .



In other words, the volume of fluid removed through the porous plate per unit plate length, per unit breadth (perpendicular to figure) and per unit time is equal to V. The thickness of the boundary layer is denoted by $\delta(x)$ and the velocity outside the boundary layer is a constant, U. Using approximate boundary layer methods assuming similarity of the velocity profile (in other words that $u/U = F(y/\delta)$ where the function F is not a function of x) find a relation between the coefficient of friction ($= 2\tau_w/\rho U^2$) and the quantities V, U, $d\delta/dx$ and α where α is the profile parameter

$$\alpha \;=\; \int_0^1 F(1-F)\; d(y/\delta) \tag{1}$$