057:20 TEST # 1 Fall 2004

1. The velocity distribution for the flow of crude oil at 100 °F ($\mu = 8\times10^{-5} lbf\cdot s/ft^2$) between two walls is given by $u = 100y(0.1-y)\ ft/s$, where y is measured in feet and space between the walls is $0.1 ft$. Determine the shear stress at the walls and at the centerline.

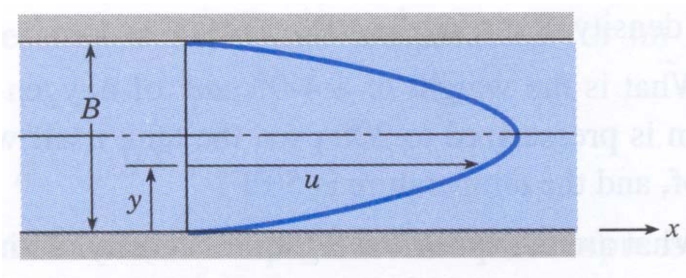

Figure 1 (for Problem 1)

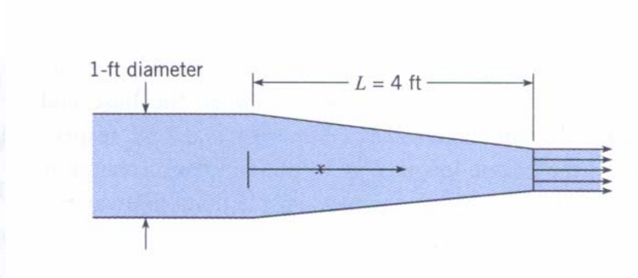

Figure 2 (for Problem 2)

2. The velocity of water flow in the nozzle shown is given by the following expression: $V = 2t/(1-0.5x/L)^2$, where V = velocity in feet per second, t = time in seconds, x = distance along the nozzle, and L = length of the nozzle $= 4 ft$. When $x = 0.5L$ and $t = 3s$, what is the local acceleration along the centerline? What is the convective acceleration? Assume one-dimensional flow prevails.

3. The plane rectangular gate can pivot about the support at B. The rectangular gate is 1m wide. Calculate the hydrostatic force acting on the gate. For the conditions given, is it stable or unstable? Neglect the weight of the gate.

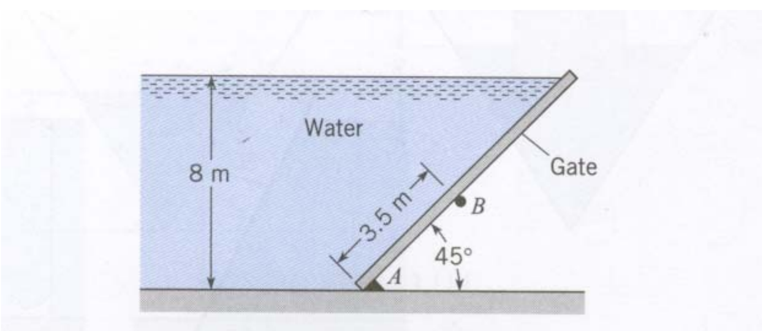

Figure 3 (for Problem 3)

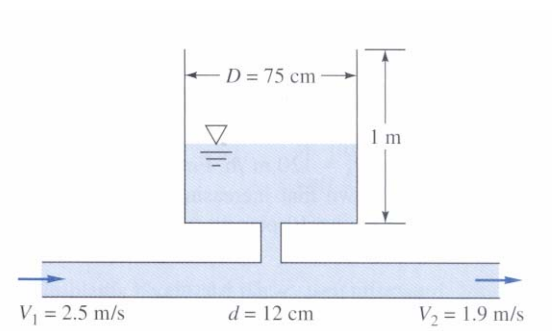

Figure 4 (for Problem 4)

4. The pipe flow in Figure 4 fills a cylindrical tank as shown. At time $t = 0$, the water depth in the tank is $30cm$. Estimate the time required to fill the remainder of the tank.