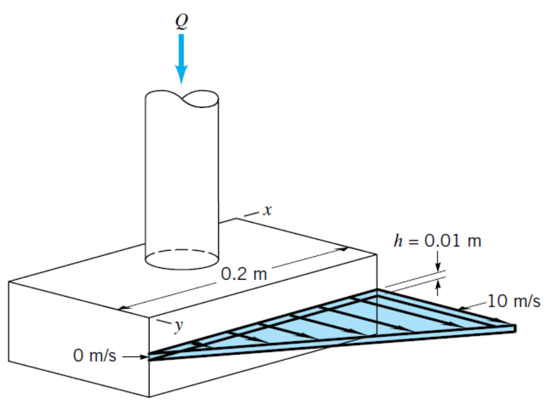
Fluid Mechanics

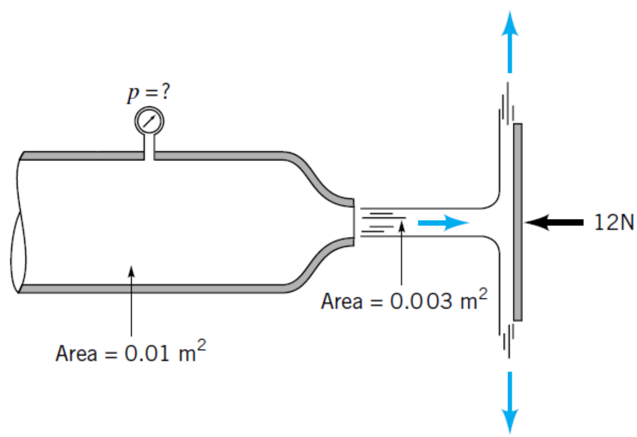
Assignment # 6

5.39 A sheet of water of uniform thickness ($h = 0.01$ m) flows from the device shown in Fig. P5.39. The water enters vertically through the inlet pipe and exits horizontally with a speed that varies linearly from 0 to 10 m/s along the 0.2-m length of the slit. Determine the y component of anchoring force necessary to hold this device stationary.

5.52 Air flows into the atmosphere from a nozzle and strikes a vertical plate as shown in Fig. P5.52. A horizontal force of 12 N is required to hold the plate in place. Determine the reading on the pressure gage. Assume the flow to be incompressible and frictionless.



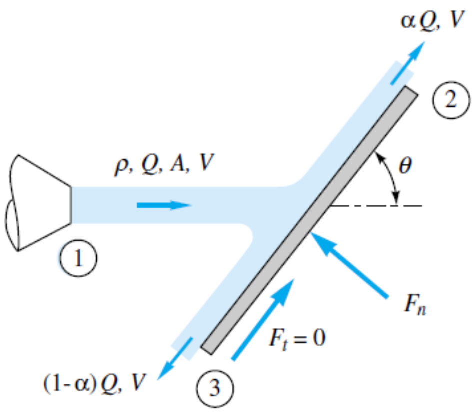
■ FIGURE P5.39



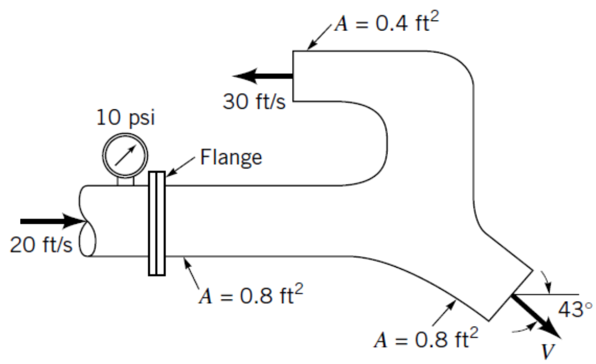
■ FIGURE P5.52

5.59 Water discharges into the atmosphere through the device shown in Fig. P5.59. Determine the x component of force at the flange required to hold the device in place. Neglect the effect of gravity and friction.

P3.46 When a jet strikes an inclined fixed plate, as in Fig. P3.46, it breaks into two jets at 2 and 3 of equal velocity $V = V_{jet}$ but unequal fluxes αQ at 2 and $(1 - \alpha)Q$ at section 3, α being a fraction. The reason is that for frictionless flow the fluid can exert no tangential force F_t on the plate. The condition $F_t = 0$ enables us to solve for α. Perform this analysis, and find α as a function of the plate angle θ. Why doesn't the answer depend upon the properties of the jet?



P3.46



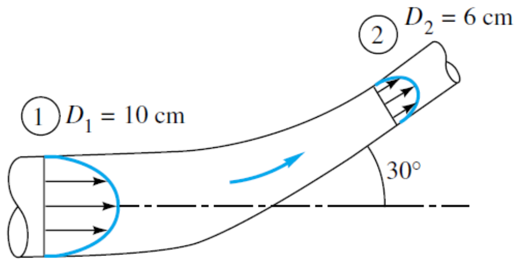
■ FIGURE P5.59

P3.39 For the elbow duct in Fig. P3.39, SAE 30 oil at 20°C enters section 1 at 350 N/s, where the flow is laminar, and exits at section 2, where the flow is turbulent:

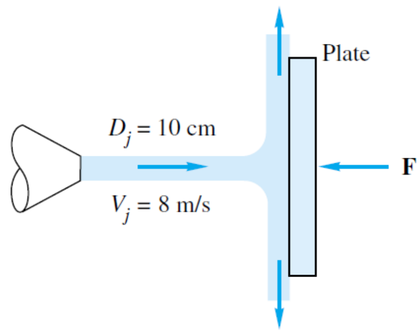
$$u_1 \approx V_{av,1}\left(1 - \frac{r^2}{R_1^2}\right) \qquad u_2 \approx V_{av,2}\left(1 - \frac{r}{R_2}\right)^{1/7}$$

Assuming steady incompressible flow, compute the force, and its direction, of the oil on the elbow due to momentum change only (no pressure change or friction effects) for (*a*) unit momentum-flux correction factors and (*b*) actual correction factors β_1 and β_2.

P3.40 The water jet in Fig. P3.40 strikes normal to a fixed plate. Neglect gravity and friction, and compute the force F in newtons required to hold the plate fixed.



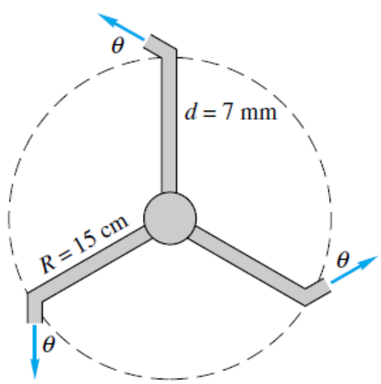
P3.39



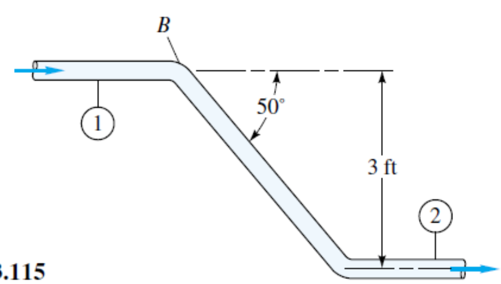
P3.40

P3.114 The three-arm lawn sprinkler of Fig. P3.114 receives 20°C water through the center at 2.7 m^3/h. If collar friction is negligible, what is the steady rotation rate in r/min for (*a*) $\theta = 0°$ and (*b*) $\theta = 40°$?

P3.115 Water at 20°C flows at 30 gal/min through the 0.75-in-diameter double pipe bend of Fig. P3.115. The pressures are $p_1 = 30$ lbf/in^2 and $p_2 = 24$ lbf/in^2. Compute the torque T at point B necessary to keep the pipe from rotating.



P3.114



P3.115