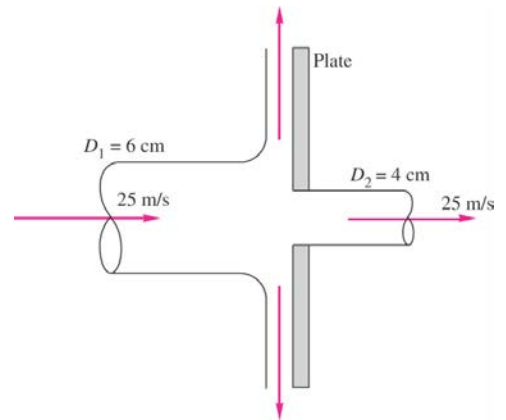NAME

Quiz 7. A 6-cm-diameter 20°C water jet strikes a plate containing a hole of 4-cm diameter. Part of the jet passes through the hole, and part is deflected. Determine the <u>horizontal</u> force *F* required to hold the plate. (ρ = 998 kg/m³)

$$\sum \underline{F} = \sum_{CS} \underline{V}(\rho \underline{V} \cdot \underline{A})$$

Note: Attendance (+2 points), format (+1 point)

Solution:

Horizontal component of the momentum equation,

$$\sum F_x = \sum_{CS} u(\rho u \cdot A)$$

For a CV enclosing the plate and the two jets,

$$-F = u_{hole}(\rho u_{hole} A_{hole}) - u_{in}(\rho u_{in} A_{in})$$

(+4 points)

With $u_{hole} = u_{in} = 25\frac{m}{s}$, $A_{in} = \frac{\pi}{4}D_{in}^2$, and $A_{hole} = \frac{\pi}{4}D_{hole}^2$,

$$F = u^2\rho(A_{in} - A_{hole}) = \frac{u^2\rho\pi}{4}(D_{in}^2 - D_{hole}^2)$$

(+2 points)

$$F = 25^2 \times 998 \times \frac{\pi}{4}(0.06^2 - 0.04^2)$$

$$\therefore F = 980\ N \text{ (to left)}$$

(+1 point)