September 26, 2016

NAME

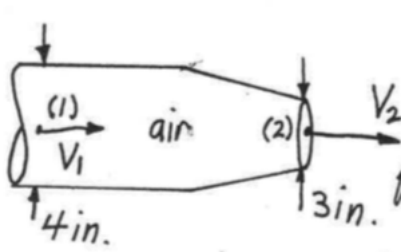
Quiz 4. Air flow steadily through a horizontal 4-in. diameter pipe and exits into the atmosphere through a 3 in. diameter nozzle. The velocity at the nozzle exit is *150 ft/s*. Determine the pressure in the pipe (p_1) if viscous effect is negligible. ($\rho = 0.00238\ slugs/ft^3$, $1\ lb = 1\ slug\ ft/s^2$)

- Bernoulli Equation:

$$p_1 + \frac{\rho V_1^2}{2} + \gamma z_1 = p_2 + \frac{\rho V_2^2}{2} + \gamma z_2$$

- Continuity Equation*:*

$$A_1 V_1 = A_2 V_2$$



Figure

Note: Attendance (+2 points), Format (+1 Points)

Solution:

Conservation of mass

$$Q = A_1 V_1 = A_2 V_2$$

$$V_1 = \frac{\frac{\pi D_2^2}{4}}{\frac{\pi D_1^2}{4}} V_2 = \left(\frac{D_2}{D_1}\right)^2 V_2$$ (+ 1 points)

$$V_1 = \left(\frac{3\ in}{4\ in}\right)^2 \left(150 \frac{ft}{s}\right) = 84.4\ ft/s$$ (+ 1 points)

Bernoulli Eq. $z_1 = z_2 = 0,\ p_2 = 0, V_2 = 150\ ft/s$

$$p_1 + \frac{\rho V_1^2}{2} = \frac{\rho V_2^2}{2}$$ (+ 4 points)

$$p_1 = \frac{\rho}{2}(V_2 - V_1)^2 = \frac{1}{2}\left(0.00238 \frac{slugs}{ft^3}\right)\left[\left(150 \frac{ft}{s}\right)^2 - \left(\frac{84.4 ft}{s}\right)^2\right] = 18.3 \frac{lb}{ft^2} = 0.127\ psi$$ (+1 points)