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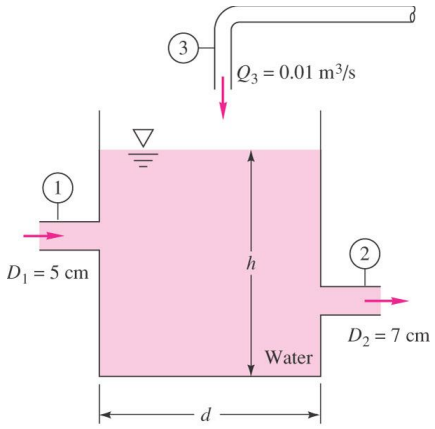
NAME

Fluids-ID

Quiz 6. The open tank shown below contains water at 20°C and is being filled through sections 1 and 3. Assume incompressible flow. If the water level h is constant, i.e. dh/dt = 0, determine the exit velocity V_2 for the given data V_1 = 3 m/s and Q_3 = 0.01 m^3/s.



Continuity equation:

$$\frac{\partial}{\partial t}\int_{CV}\rho dV = \sum\dot{m}_{out} - \sum\dot{m}_{in}$$

where

$$\dot{m} = \rho Q = \rho AV$$

Solution:

For a control volume enclosing the tank,

$$\frac{\partial}{\partial t}\int_{CV}\rho dV = \rho(Q_2 - Q_1 - Q_3)$$

or

$$\rho\frac{\pi d^2}{4}\frac{dh}{dt} = \rho(Q_2 - Q_1 - Q_3) = 0 \qquad \text{(+5 points)}$$

Then,

$$Q_2 = Q_1 + Q_3 = \frac{\pi D_1^2}{4}\times V_1 + Q_3 = \left(\frac{\pi(0.05)^2}{4}\right)(3) + 0.01 = 0.0159\ \text{m}^3/\text{s} \qquad \text{(+3 points)}$$

$$\therefore V_2 = \frac{Q_2}{A_2} = Q_2\left(\frac{\pi D_2^2}{4}\right)^{-1} = (0.0159)\left(\frac{\pi(0.07)^2}{4}\right)^{-1} = \mathbf{4.13\ m/s} \qquad \text{(+2 points)}$$