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NAME

Fluids-ID

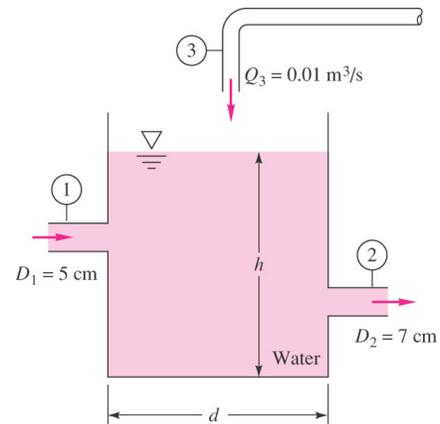
Quiz 5

An open tank 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 $Q_3 = 0.01$ m³/s.

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

where

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

Solution:

For a control volume enclosing the tank,

$$\frac{\partial}{\partial t} \int_{CV} \rho dV = \dot{m}_2 - (\dot{m}_1 + \dot{m}_3)$$

or

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

Then,

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

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