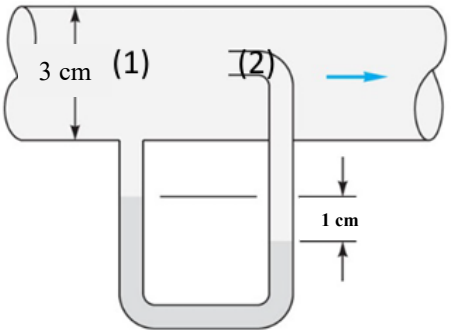
Name:_____ **Quiz: No. 2** **Time: 15 minutes**

ME:5160, Fall 2026

The exam is closed book and closed notes.

The manometer fluid in the Figure below is mercury ($\rho = 13{,}550\ kg/m^3$) and the flowing fluid is gasoline ($\rho = 680\ kg/m^3$). Neglecting friction, estimate the volume flow rate in the tube.



Bernoulli's Equation: $\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2$

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Attendance (2)

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Solution

KNOWN: $h, D, \rho_{gasoline}, \rho_{mercury}$

FIND: Q

ASSUMPTIONS: frictionless, steady, incompressible flow

ANALYSIS:
Pressure difference between point 1 and point 2 from manometer reading:

$$P_2 - P_1 = (\rho_{mercury} - \rho_{gasoline})gh \quad (3)$$

$$P_2 - P_1 = \left[(13{,}550\ kg/m^3) - (680\ kg/m^3)\right](9.81 m/s^2)(1 \times 10^{-2} m) = 1262.547\ \text{Pa} \quad (1)$$

Elevation difference between the two points is zero, and point 2 is stagnation with $V_2 = 0$:

$$\frac{p_1}{\rho g} + \frac{V_1^2}{2g} = \frac{p_2}{\rho g} \quad (1)$$

$$V_1 = \sqrt{2(P_2 - P_1)/\rho_{gasoline}}$$

$$V_1 = \sqrt{2(1262.547)/(680)} = 1.927\ m/s \quad (1)$$

$$Q = V_1 A_1 = V_1 \frac{\pi}{4} D_1^2 \quad (1)$$

$$Q = (1.927\ m/s)\frac{\pi}{4}(3 \times 10^{-2}\ m)^2 = 1.362 \times 10^{-3}\ m^3/s \quad (1)$$