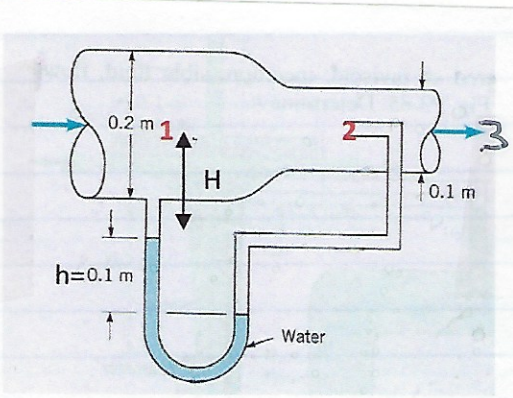
Air flows steadily through the variable area pipe shown in the figure. Determine the flow rate Q if viscous and compressibility effects are negligible. (γ_a=12 N/m^3; γ_w=9800 N/m^3)



$Q = AV$

ie $A_1 V_1 = A_3 V_3$

$V_2 = 0$ stagnation tube

$z_1 = z_2 = z_3$

$$\frac{p_1}{\gamma_a} + \frac{V_1^2}{2g} + z_1 = \frac{p_2}{\gamma_a} + \frac{V_2^2}{2g} + z_2$$

$$\frac{(Q/A_1)^2}{2g} = \frac{p_2 - p_1}{\gamma_a}$$

$$Q = \frac{\pi d_1^2}{4} \sqrt{\frac{p_2 - p_1}{\gamma_a} \times 2g}$$

$$p_1 + \rho_a g H + \rho_w g h - \rho_a g (h + H) = p_2$$

$$p_2 - p_1 = h(\gamma_w - \gamma_a)$$

$$Q = 1.257 \ \frac{m^3}{s}$$