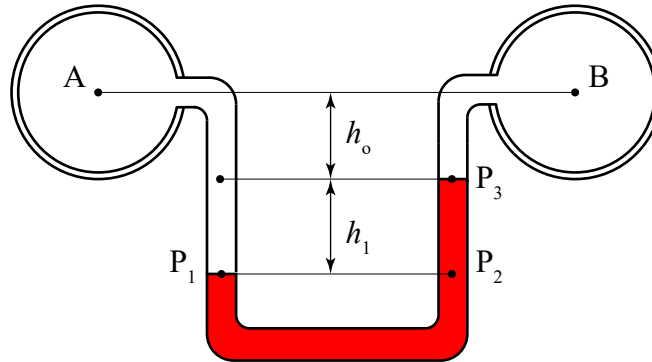


MEMS0071 - Introduction to Fluid Mechanics
Quiz #2

Problem #1

Determine the pressure difference ($P_A - P_B$), given that the red fluid is mercury, the white fluid is air, h_o is 10 [cm] and h is 20 [cm]. Units are taken as [kPa].



Starting at P_A and solving for P_1 , then P_3 and P_B :

$$P_1 = P_A + \rho_{\text{air}} g(h_o + h_1)$$

$$P_2 = P_1$$

$$P_3 = P_2 - \rho_{\text{Hg}} g h_1$$

$$P_B = P_3 - \rho_{\text{air}} g h_o$$

Substituting in the equations:

$$P_B = P_A + \rho_{\text{air}} g(h_o + h_1) - \rho_{\text{Hg}} g h_1 - \rho_{\text{air}} g h_o$$

Rearranging:

$$P_A - P_B = g(\rho_{\text{Hg}} h_1 - \rho_{\text{air}} h_1)$$

Substituting in numeric values:

$$P_A - P_B = (9.81 \text{ [m/s}^2\text{]})\{(13,600 \text{ [kg/m}^3\text{)]}(0.20 \text{ [m]}) - (1.225 \text{ [kg/m}^3\text{)]}(0.10 \text{ [m]})\} = 26.681 \text{ [kPa]}$$

If you neglect air:

$$P_A - P_B = (9.81 \text{ [m/s}^2\text{]})\{(13,600 \text{ [kg/m}^3\text{)]}(0.20 \text{ [m]})\} = 26.683 \text{ [kPa]}$$

Thus a generous tolerance of 0.1 [kPa] was built into the answer.