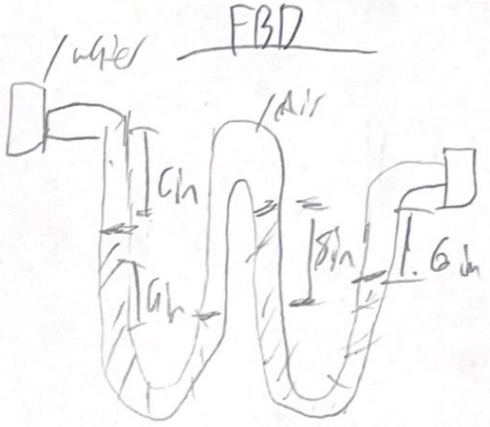
FM unit Exam #1 Kenny

① problem: For the compound differential manometer in the figure, calculate $(P_A - P_S)$. Keep in mind that the pressure in space with air is the same (it does not change with elevation). At some point of the operation of the system the pressure at A drops. That makes the oil column to reduce from 6in to 5in and all other fluids will adjust to the change. Calculate $(P_A - P_S)$ for the New stage of the system.

Given: $SG_{oil} = 0.90$, $SG_{mercury} = 13.54$, height of water above mercon left side 6in, height of oil column above merc on right 6in, height of mercury column is 10-8in

Solution: Fluid Heights

- water column height - 6in,
- Mercury column height - 6in + 10in = 16
- oil column height 6in
- mercury column height (right) - 8in



Finding pressure above Mercury.

$P = \rho g h$

left side = $P_{oil} = \rho_{oil} g h_{oil} \Rightarrow 0.90 \times 1000\ kg/m^3 = 900\ kg/m^3$

$h_{oil} = 6in \times 0.0254\ m/in = 0.1524m$

$P = \rho g h \Rightarrow 900 \times 9.81 \times 0.1524 = 1345.5 Pa$

$P_{water} = 1000\ kg/m^3 \times 9.81 \times 0.1524 = 1495.04 Pa$

Pressure difference in mercury middle

$P = \rho g h$

$\rho_{mercury} = 13.54 \times 1000\ kg/m^3 = 13540\ kg/m^3$

$h_{mercury\ left} = 6 + 10 = 16\ in \times 0.0254\ m/in = 0.4064\ m$

$P_{mercury\ left} = 13540 \times 9.81 \times 0.4064 = 53981.05\ Pa$

$P_{mercury\ right} = 8in \times 0.0254 = 0.2032\ m$

$P_{mercury\ right} = 13540 \times 9.81 \times 0.2032 = 26990.52\ Pa$

calculate $(P_A - P_B)$

$P_A = P_{oil} + P_{mercury\ right}$

$P_B = P_{water} + P_{mercury\ left}$

$P_A - P_B = 7 (1345 + 26990.52) - (1495.044 + 53981.05) = -27140.614\ Pa$

New state

oil height 5in

$h_{oil\ new} = 5in \times 0.0254\ m/in = 0.127m$

$P_{oil} = \rho g h \Rightarrow 900 \times 9.81 \times 0.127 = 1121.283\ Pa$

new heights

left 6+10+1 = 17in, right 8-1in = 7in

$h_{mercury\ left} = 17in \times 0.0254\ m/in = 0.4318\ m$

$h_{mercury\ Right} = 7in \times 0.0254\ in = 0.1778$

New pressures

$13540 \times 9.81 \times 0.4318 = 5734.47$

$13540 \times 9.81 \times 0.1778 = 23616.71$

$P_A = P_{oiseuille} + P_{entering\ Right}$

$P_B = P_B = P_{outlet} + P_{entering\ left}$

$P_A - P_B = > (1126.79 + 2366.71) - (1495.044 + 53981.05) \leftarrow$ **$-30732.594\ Pa$**

Honor Code

Student name: Kenneth Elliott

Signature: ~~[illegible]~~

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