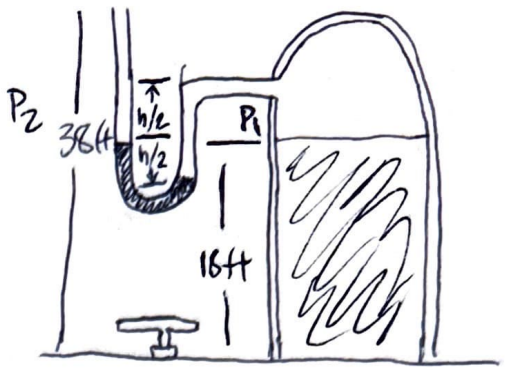
Ramzie Abbas
MET 330 - Test 1



1) Given:

$Q = 250$ gal/min

Density of ethyl alcohol @ 77F = 49.01 lbm/ft³

$\mu = 1.5017 \times 10^{-5}$

Required:

Air pressure, $P = ?$

Solution:

$$\frac{V_1^2}{2g} + \frac{P_1}{\gamma} + z_1 - h_L = \frac{V_2^2}{2g} + \frac{P_2}{\gamma} + z_2$$

Solving for the velocity:

$Q = VA$

$$V = \frac{Q}{A} = \frac{250 \cdot 0.1337}{\frac{\pi\left(\frac{2}{12}\right)^2}{4}}$$

$V = 1532.09 \frac{ft}{min}$

$V = 25.53 \frac{ft}{sec}$

$\frac{V_1^2}{2g} = 0$ (negligible)

$V_2 = 25.53$ ft/sec

$g = 32.2$ ft/s²

$\gamma = 49.01$ lbf/ft³

$z_1 = 18$ft

$z_2 = 38$ft

$P_1 = ?$

$P_2 = 40$ lb/in²

$h_L = 2.112$ ft

$$h_L = f \frac{L}{D} \frac{V^2}{2g}, \quad f = \frac{64}{Re}, \quad Re = \frac{VD}{\mu}$$

$$Re = \frac{25.53 \cdot \left(\frac{2}{12}\right)}{1.5017 \times 10^{-5}} \qquad f = \frac{64}{283345.54}$$

$Re = 283345.54$ $\quad f = 0.00022588$

$$h_L = \frac{0.00022588\,(154)}{0.1667} \cdot \frac{(25.53)^2}{2(32.2)}$$

$h_L = 2.112$ ft

$$\frac{V_1^2}{2g} + \frac{P_1}{\gamma} + z_1 - h_L = \frac{V_2^2}{2g} + \frac{P_2}{\gamma} + z_2$$

$40 \frac{lb}{in^2} = 5760 \frac{lb}{ft^2}$

$$\frac{P_1}{49.01} + 18 - 2.112 = \frac{(25.53)^2}{2(32.2)} + \frac{5760}{49.01} + 38$$

$P_1 = 7339.73$ lb/ft²

$\boxed{P_1 = 50.97 \text{psig}}$

$P_1 = P_2 + \rho g h$

$50.972\,(144) = 40(144) + 848.02\,(h)$

$\boxed{h = 1.863 \text{ ft}}$