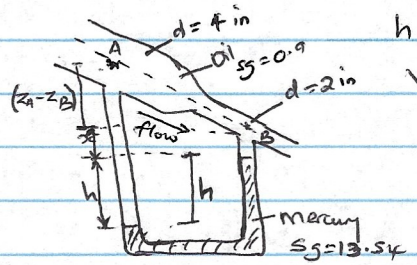
Problem 6.79



h = 28 in

Volume flow rate of oil?

$Q = VA$

$Q_A = Q_B$

$V_A A_A = V_B A_B$

$V_A\left(\frac{\pi}{4}d_A^2\right) = V_B\left(\frac{\pi}{4}d_B^2\right)$

$V_A d_A^2 = V_B d_B^2$

$16V_A = 4V_B$

$V_B = 4V_A$

$V_B^2 = 16V_A^2$

$$\frac{P_A}{\gamma_0} + \frac{V_A^2}{2g} + z_A = \frac{P_B}{\gamma_0} + \frac{V_B^2}{2g} + z_B + h_e + h_L$$

$$\frac{P_A - P_B}{\gamma_0} + (z_A - z_B) = \frac{V_B^2 - V_A^2}{2g} \quad ---- \quad (1)$$

$$P_A + (z_A - z_B)\gamma_0 + x\gamma_0 + h\gamma_0 = h\gamma_g + x\gamma_0 + P_B$$

$$P_A - P_B = h\gamma_g - h\gamma_0 - (z_A - z_B)\gamma_0 \quad ---- \quad (2)$$

Combining (1) and (2)

$$\frac{\left[h(\gamma_g - \gamma_0) - (z_A - z_B)\gamma_0\right]}{\gamma_0} + (z_A - z_B) = \frac{16V_A^2 - V_A^2}{2g}$$

$$h(\gamma_g - \gamma_0) - (z_A - z_B)\gamma_0 + (z_A - z_B)\gamma_0 = \frac{15V_A^2}{2g}\gamma_0$$

$$\frac{28}{12}\text{ft}\,(13.54 - 0.9) \times g = \frac{15V_A^2}{2g} \times 0.9 \times g$$

$$29.493\text{ ft} \times g = 6.75V_A^2$$

$$V_A = \sqrt{\frac{29.493\text{ ft} \times 32.2\text{ ft/s}^2}{6.75}}$$

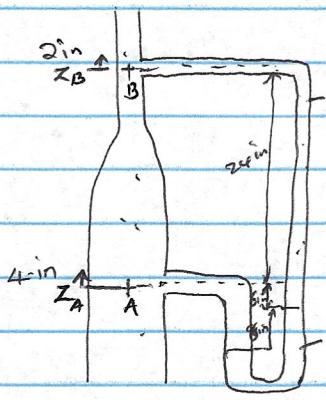
$$V_A = 11.86\text{ ft/s}$$

$$Q = VA = V_A A_A$$

$$Q = 11.86\text{ ft/s} \times \frac{\pi}{4} \times \left(\frac{4}{12}\right)^2\text{ ft}^2$$

$$\boxed{Q = 1.035\text{ ft}^3/\text{s}}$$

Problem 6.82



Specific weight = 55.0 lb/ft³

$\gamma_{oil} = 55.0\ lb/ft^3$

Volume flow rate of oil.

$Q = VA$

$Q_A = Q_B$

$V_A A_A = V_B A_B$ $\quad A = \frac{\pi}{4} d^2$

$V_A d_A^2 = V_B d_B^2$ $\quad d_A = 4$, $d_B = 2$

$16 V_A = 4 V_B$

$V_B = 4 V_A$

$$\cancel{h_A} + \frac{P_A}{\gamma} + \frac{V_A^2}{2g} + \overset{=0}{z_A} = \frac{P_B}{\gamma} + \frac{V_B^2}{2g} + \overset{=24\,in}{z_B} + \cancel{h_A} + \cancel{h_L}$$

$$P_A + \frac{6}{12}\gamma_o + \frac{8}{12}\gamma_o - \frac{8}{12}\gamma_w - \frac{6}{12}\gamma_o - \frac{24}{12}\gamma_o = P_B$$

$$P_A - P_B = 2\gamma_o - \tfrac{8}{12}\gamma_o + \tfrac{8}{12}\gamma_w$$

$$P_A - P_B = \tfrac{4}{3}\gamma_{oil} + \tfrac{8}{12}\gamma_w \longrightarrow$$

$$\frac{P_A - P_B}{\gamma_{oil}} + (z_A - z_B) = \frac{V_B^2 - V_A^2}{2g}$$

$$\frac{\left(\frac{4}{3}\gamma_{oil} + \frac{8}{12}\gamma_w\right)}{\gamma_{oil}} + \left(-\frac{24}{12}ft\right) = \frac{V_B^2 - V_A^2}{2g}$$

$$\tfrac{8}{12}\left(\frac{\gamma_w}{\gamma_{oil}}\right) = \tfrac{8}{12}\left(\frac{62.4\ lb/ft^3}{55.0\ lb/ft^3}\right) = 0.756\ ft \longrightarrow$$

$$\tfrac{4}{3}ft + \tfrac{8}{12}\left(\frac{\gamma_w}{\gamma_{oil}}\right) - 2ft = \frac{V_B^2 - V_A^2}{2g}$$

$$0.0897\ ft = \frac{V_B^2 - V_A^2}{2g}$$

$V_B = 4V_A$

$V_B^2 = 16 V_A^2$ $\longrightarrow$

$$0.0897\ ft = \frac{16V_A^2 - V_A^2}{2g}$$

$$15 V_A^2 = 0.0897\ ft \times 2g$$

$$V_A = \sqrt{\frac{0.0897\ ft \times 2 \times 32.2\ ft/s^2}{15}}$$

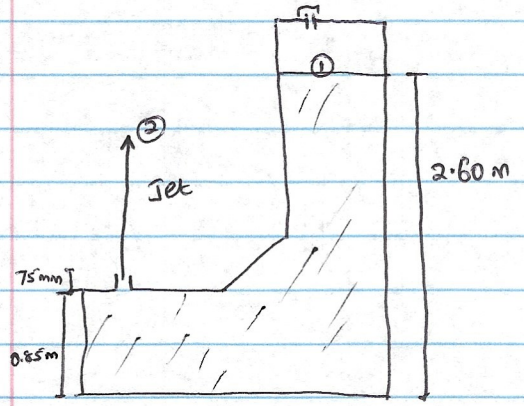
$$V_A = 0.62\ ft/s$$

$Q = V_A A$

$$Q_A = V_A A_1 = 0.62\ ft/s \times \frac{\pi}{4}\left(\frac{4}{12}\right)^2 ft^2$$

$$\boxed{Q = 0.054\ ft^3/s}$$

Problem 6.91



$$\cancel{h_A} + \frac{p_1}{\gamma}^{=0(\text{gage})} + \frac{V_1^2}{2g}^{\approx 0} + z_1 = \frac{p_2}{\gamma}^{=0(\text{gage})} + \frac{V_2^2}{2g}^{=0} + z_2 + \cancel{h_R} + \cancel{h_L}$$

$$z_1 = z_2$$

The jet will rise to the height of the liquid in the tank.

The highest point the jet will reach is 2.60 m

Homework 1.3 Paragraph

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I feel I have learned a lot from the example problems presented. One thing I learned was how versatile the Bernoulli's equation is. It is interesting how the equation reaches so far in fluid dynamics and how many other equations relate to it. There is also the fact that in most problems presented so far, several of the variables can be outright removed in the beginning. I also learned that the flow rate could be found without knowing velocities, as long as we know the pipe configuration and pressure differences. This week's lectures also had very interesting concepts, such as the maximum height of a jet is whatever the elevation of the water supplying it. While currently we are only getting into fluid dynamics, the fact there will not be many more equations to know is nice. This week has shown that understanding and mastering how to manipulate the Bernoulli's equation in one of the most important things we can do.