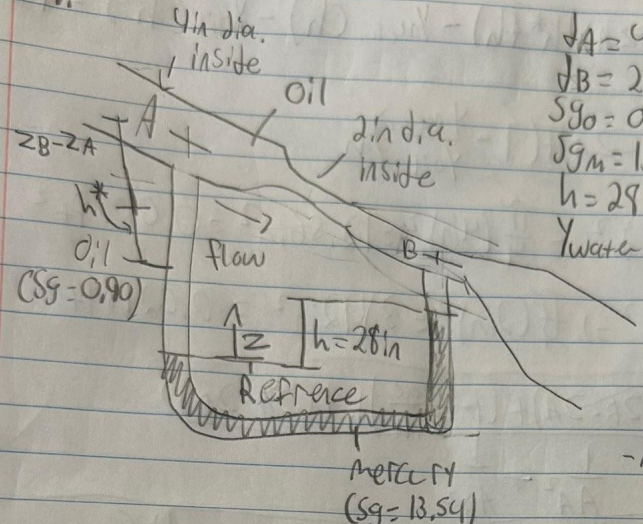
For the problems in the lecture notes, we discussed calculating values for pipes with flowing fluids. The notes and lectures for the past week have discussed using Bernoulli's equation to find the requested values of properties. When using Bernoulli's equation, it is critical to identify a reference point for elevation and place points on the system where we either know the most information and/or where we need to find information. Once said points are identified, Bernoulli's equation should be used to solve the problem based on what the question is asking for; this ensures that the equation is used correctly instead of using the equation to solve for assumed values.

For the problems in the lecture notes we have covered, we have used the volume, pressure, and elevation head value in the equation, but we have yet to use the pump, turbine, or friction head. When using Bernoulli's equation, it is essential to identify the values and concepts to substitute the relative equations to solve for the unknowns. Regarding specific specs for the tank volume head, the volume can be negligible to the large volume of the water in the tank. For the pressure head, anything exposed to the atmosphere is zero and negligible.

HW #3

A.



$d_A = 4in$ flow rate equation
$d_B = 2in$ $Q = VA$
$Sg_o = 0.90$ the fluid in the ^ tubes below are not
$Sg_m = 13.54$ moving so $\Delta P = \gamma h$
$h = 28in$
$\gamma_{water} = 9.81 \frac{kN}{m^3}$
$Q = ?$
$V = \frac{Q}{A}$

- no energy loss = no h_L or friction

$$\cancel{h_A} + \frac{P_1}{\gamma} + \frac{V_A^2}{2g} + z_1 = \frac{V_1^2}{2} = \frac{P_2}{\gamma} + \frac{V_B^2}{2g} + z_2 + \cancel{h_R} + \cancel{h_L}$$

$$\frac{P_1}{\gamma} + \frac{V_A^2}{2g} + z_1 = \frac{P_2}{\gamma} + \frac{V_B^2}{2g} + z_2$$

$$\frac{P_A}{\gamma} + \frac{\left(\frac{Q}{A_A}\right)^2}{2g} + z_A = \frac{P_B}{\gamma} + \frac{\left(\frac{Q}{A_B}\right)^2}{2g} + z_B$$

group then minus

find this

$$Q = \frac{\frac{Q^2}{2g}\left(\frac{1}{A_A^2} - \frac{1}{A_B^2}\right)}{\frac{1}{A_A^2} - \frac{1}{A_B^2}} = \frac{P_A - P_B}{\gamma} + (z_A - z_B)$$

$$2g \cdot \frac{Q^2}{2g} = \frac{\frac{P_A - P_B}{\gamma} + (z_A - z_B)}{\frac{1}{A_A^2} - \frac{1}{A_B^2}}$$

dont know so find this

$$Q = \sqrt{\frac{2g\left(\frac{P_B - P_A}{\gamma} + (z_A - z_B)\right)}{\frac{1}{A_A^2} - \frac{1}{A_B^2}}}$$

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

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

$$V_A A_A = V_B A_B$$

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

$$V_A\left(\frac{\pi}{4}(4.026)^2\right) = V_B\left(\frac{\pi}{4}(4.067)^2\right)$$

$$V_A(12.731) = V_B(12.983)$$

$$V_B = 3.79\,V_A$$

$$P_A + \gamma_{oil}(14\,in) - \gamma_{water}(8\,in) - \gamma_{oil}(30\,in) = P_B$$

$$P_B - P_A = 55\,lb/ft^3(14\,in) - (62.4\,lb/ft^3)(8\,in) - 55\,lb/ft^3(30\,in)$$

$$\frac{P_B - P_A}{\gamma} = -16\,in + \frac{(62.4\,lb/ft^3)(8\,in)}{55\,lb/ft^3}$$

$$\frac{P_B - P_A}{\gamma} = 25.08\,in$$

$$25.08\,in = \frac{(3.79V_A)^2 - V_A^2}{2(32.2\,ft/s^2)} + \frac{(24\,in)}{12\,in}$$

$$V_A = 0.659\,ft/s$$

$$Q = V_A A_A$$

$$Q = (0.659\,ft/s)\left(\frac{\pi\left(\frac{4.026}{12}\right)^2}{4}\right) = 0.$$

$$Q = 0.058\,ft^3/s$$

$$P_A + \gamma_{oil}((z_B - z_A) + h^* + h) - \gamma_{merc.}(h) - \gamma_{oil}(h^*) = P_B$$

$$\frac{P_B - P_A}{\gamma_{HG}} = (z_B - z_A) + \left(1 - \frac{\gamma_{merc.}}{\gamma_{oil}}\right)h$$

$$A_A = \frac{\pi}{4} d^2 = \frac{\pi}{4}(4in)^2 = 12.561in^2 = 0.087ft^2$$

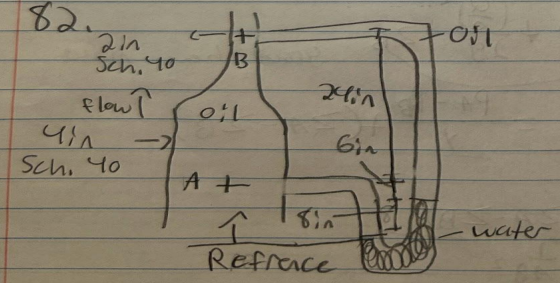
$$A_B = \frac{\pi}{4} d^2 \Rightarrow \frac{\pi}{4}(2in)^2 = 3.142in^2 = 0.0218ft^2$$

$$Q = \sqrt{\frac{2g\left((z_B - z_A) + \left(1 - \frac{\gamma_{merc.}}{\gamma_{oil}}\right)h + (z_A - z_B)\right)}{\frac{1}{A_A^2} - \frac{1}{A_B^2}}}$$

$$Q = \sqrt{\frac{2g\left(1 - \frac{\gamma_{merc.}}{\gamma_{oil}}\right)h}{\frac{1}{A_A^2} - \frac{1}{A_B^2}}} \Rightarrow \sqrt{\frac{2(32.2\frac{ft}{s^2})\left(1 - \frac{13.54}{0.90}\right)2.8ft}{\frac{1}{(0.087ft^2)^2} - \frac{1}{(0.0218ft^2)^2}}}$$

$$Q = 1.027\frac{ft^3}{s}$$

82.



$d_A = 4.026in$

$d_B = 2.067in$

$S_{go:l} = 55.0\ lb/ft^3$

$S_{water} = 9.81\frac{N}{s^2} = 62.4499\ lb/ft^3$

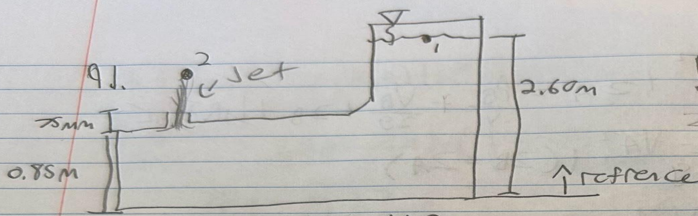
flow rate =

$Q = VA$

$V = \frac{Q}{A}$

$z_A = 14in = 1.167ft$

$z_B = 38in = 3.167ft$



since open to atmosphere

$P = 0$ psig

$\gamma_{water} = 9.81\ kN/m^3$

$Z_h = Z_2 = ?$

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

negligible because tank is large

0 because top of jet loses velocity or stops

$$Z_2 = \frac{P_1 - P_2}{\gamma} + \frac{V_1^2 - V_2^2}{2g} + Z_1$$

0 0 because gauge pressure

$$Z_2 = \frac{P_1 - P_2}{\gamma} + Z_1 + h = 0$$

add all lengths for total length

$Z_2 = Z_1$

$2.60m = 0.075m + 0.8m + h$

$h = 1.675$