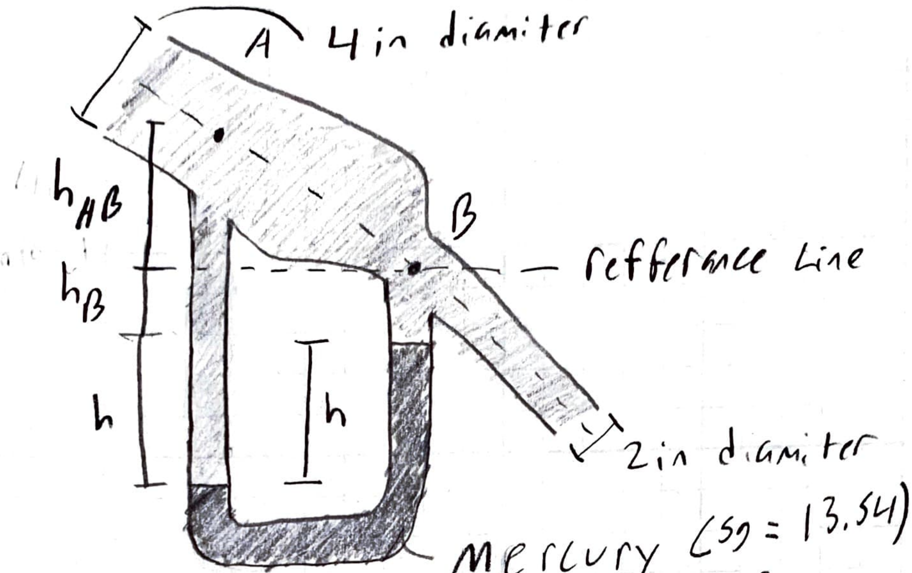
HW 1.3 | MET 330 | 2-1-22

79) Oil with a S.g of 0.9 is flowing downward If h = 28in What is volum flow rate?



$$\cancel{h_A} + \frac{V_A^2}{2g} + \frac{P_A}{\gamma} + Z_A = \frac{P_B}{\gamma} + \frac{V_B^2}{2g} + Z_B + \cancel{h_L} + \cancel{h_R}$$

$Q = V \cdot A$ $\quad$ $V = Q/A$ $\quad$ $A = \frac{\pi d^2}{4}$

$$P_A + \gamma_{oil}(h_{AB} + \cancel{h_B} + h) - \gamma_{Hm}(h) - \cancel{\gamma_{oil}}(\cancel{h_B}) = P_B$$

$$P_A - P_B = -\gamma_{oil}(h_{AB} + h) + \gamma_{Hm}(h)$$ divide by γ_{oil}

$$\frac{P_A - P_B}{\gamma_{oil}} = \frac{\gamma_{Hm}}{\gamma_{oil}}(h) - \frac{\gamma_{oil}}{\gamma_{oil}}(h_{AB} + h) = \frac{\gamma_{Hm}}{\gamma_{oil}}(h) - h_{AB} - h$$

$$Z_A - Z_B = h_{AB}$$

$$\frac{P_A - P_B}{\gamma} + Z_A - Z_B = \frac{V_B^2 - V_A^2}{2g}$$

$$\frac{\gamma_{Hm}}{\gamma_{oil}}(h) - \cancel{h_{AB}} - h + \cancel{h_{AB}} = \frac{1}{2g}\left(\frac{Q^2}{A_B} - \frac{Q^2}{A_A}\right)$$

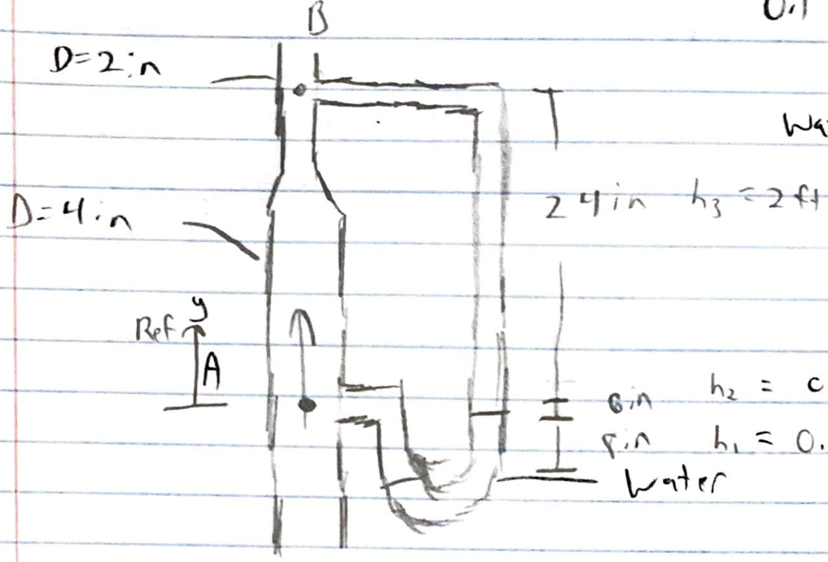
$$\left(\frac{\gamma_{Hm}}{\gamma_{oil}}-1\right)\cdot h = \frac{1}{2g}\left(\frac{1}{A_B^2}-\frac{1}{A_A^2}\right)Q^2$$

$$Q = \sqrt{\frac{\left(\frac{\gamma_{Hm}}{\gamma_{oil}}-1\right)h}{\frac{1}{2g}\left(\frac{1}{A_B^2}-\frac{1}{A_A^2}\right)}} = \sqrt{\frac{\left(\frac{13.54}{0.9}-1\right)2.33\text{ ft}}{\frac{1}{2(32.2\text{ ft}/s^2)}\left(\frac{1}{0.0245^2\text{ ft}^2}-\frac{1}{0.055^2\text{ ft}^2}\right)}}$$

$$Q = 1.04\text{ ft}^3/s$$

HW 6.82

Oil $\gamma = 55.0\ lb/ft^3$



Water $\gamma = 63.4\ lb/ft^3$

Find Vol flow rate

$h_2 = 0.5$ ft

$h_1 = 0.66$ ft

$z_A = 0$

$z_B = 24$ in

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

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

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

$$\frac{P_A - P_B}{\gamma} - z_B = \frac{V_B^2 - V_A^2}{2g}$$

$\downarrow$

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

$P_A + \gamma \cdot (h_1 + h_2) = P_B + \gamma \cdot (h_2 + h_3) + \underset{\text{water}}{\gamma} g h_1$

• take out P_A, P_B

$P_A - P_B = \gamma(h_2 + h_3) + \underset{\text{Water}}{\gamma} g h_1 - \gamma(h_1 + h_2)$

$\Delta P = 55(0.5 + 2) + (63.4 \cdot 32.2 \cdot 0.66) - 55(0.66 + 0.5)$

$\Delta P = 1421.08\ ft/lb^2$

HW 6.82 (Continued)

$$\frac{\Delta P}{\gamma} - z_B = \frac{1}{2g}\left(\frac{1}{A_B^2} - \frac{1}{A_A^2}\right) \cdot Q^2$$

2 in = 0.166 ft   4 in = 0.333 ft

$A_B^2 = \frac{\pi}{4} \cdot (0.166)^2 = 0.0216 \ ft^2 \rightarrow 2143.347$

$A_A^2 = \frac{\pi}{4} \cdot (0.333)^2 = 0.0871 \ ft^2 \rightarrow 131.81$

$$\frac{1421.08 \ ft/lb^2}{55} - 24 = \frac{1}{64.4}(2011.53) \cdot Q^2$$

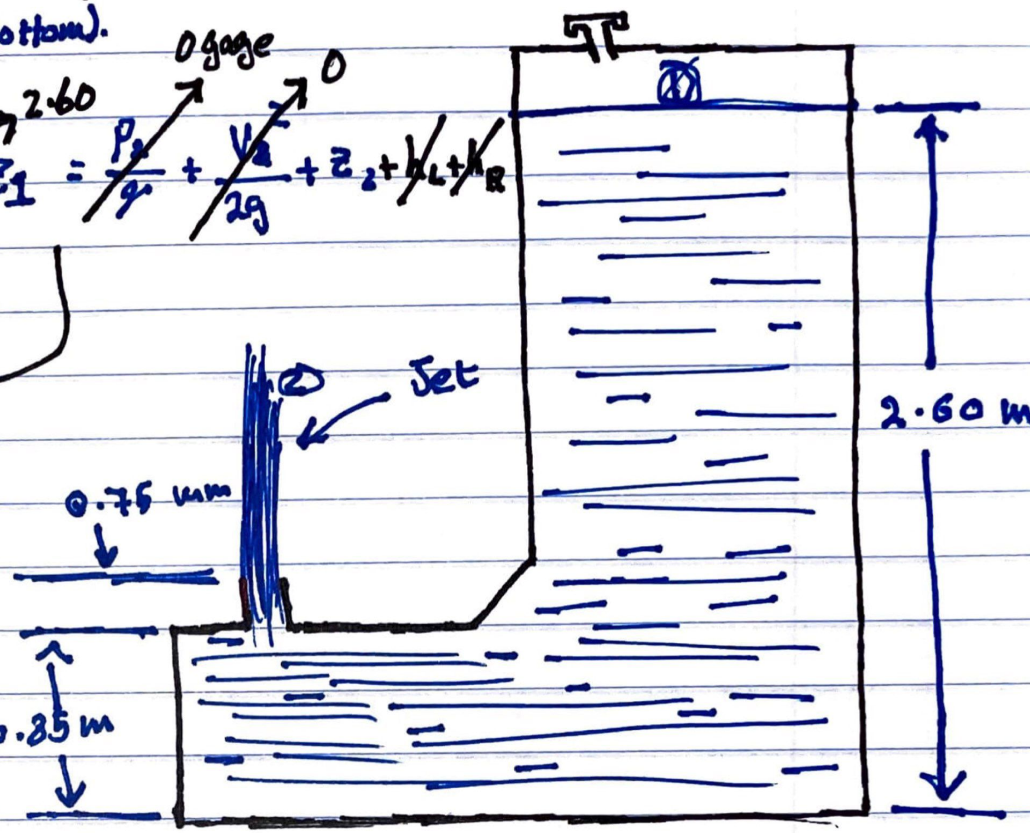
$$\boxed{Q = 0.2426 \ in^3/s}$$

* every time we have a tank, assume velocity is neglectable.

6.91) To what height will the jet of fluid rise for the conditions shown in the figure.

Reference always (the Bottom).

$$\underbrace{\cancel{h_A}}_{0\ gage} + \underbrace{\cancel{\frac{P_1}{\gamma}}}_{0} + \underbrace{\cancel{\frac{V_1^2}{2g}}}_{\text{negglectable}} + \overset{2.60}{Z_1} = \overset{0\ gage}{\cancel{\frac{P_2}{\gamma}}} + \overset{0}{\cancel{\frac{V_2^2}{2g}}} + Z_2 + \cancel{h_L} + \cancel{h_R}$$



$$\underline{Z_1 = Z_2}$$

$$\underline{Z_2 = 2.60\ m}$$