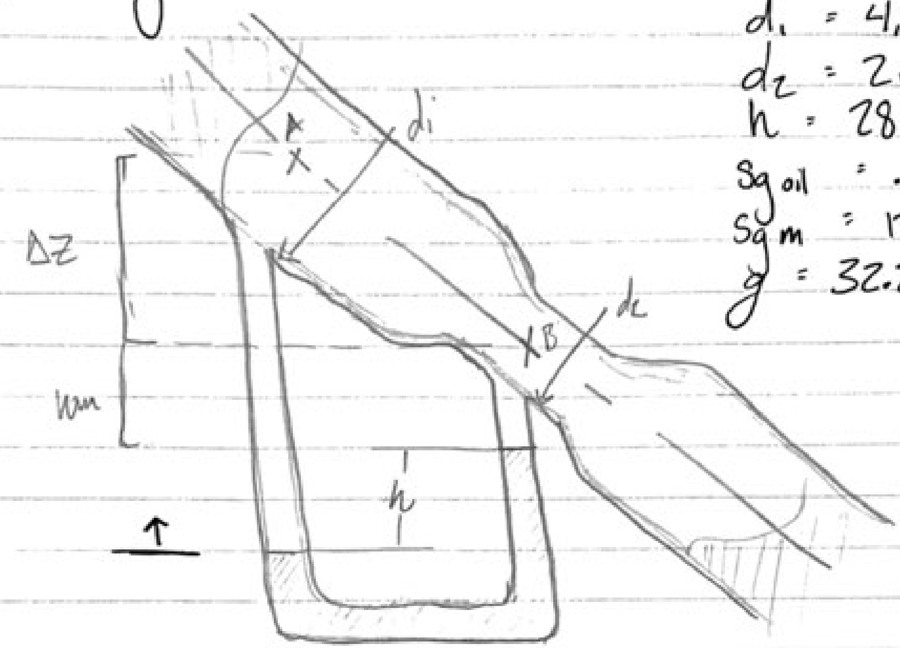
6.79 ~~purpose~~ purpose: the volume flow rate ~~down~~ the Venturi meter

Drawing:



Data:

$d_1 = 4\text{in}\ (1/3\ \text{ft})$

$d_2 = 2\text{in}\ (1/6\ \text{ft})$

$h = 28\text{in}\ (7/3\ \text{ft})$

$sg_{oil} = .90$

$sg_m = 13.54$

$g = 32.2\ \text{ft/s}^2$

Equations:

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

$Q = V * A$

$\Delta P = \gamma \cdot h$

$V = \left(\frac{A}{Q}\right)^2$

Calculations

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

$$\frac{(A_A/Q)^2}{2g} \quad \frac{(A_B/Q)^2}{2g} \quad -\frac{P_A}{\gamma} + \frac{P_B}{\gamma} + (\underbrace{z_B - z_A}_{\Delta z})$$

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

$$\Delta Z = Z_A - Z_B = \cancel{\left(\frac{P_B - P_A}{\gamma_{oil}}\right)}$$

$$\Delta p_m = \gamma_m \cdot 28$$

$$\Delta p_{m \to B} = \gamma_{oil} \cdot h_{m \cdot B}$$

$$\Delta p_{B \to A} = \gamma_{oil} \cdot Z_{AB}$$

$$P_A - (\gamma_{oil} \cdot \Delta Z) - (\gamma_{oil} \cdot (h_{mB} + 7/3)) - (\gamma_{Hg} \cdot 7/3) - (\gamma_{oil} \cdot h_{mB}) = P_B$$

$$\frac{P_B - P_A}{\gamma_{hg}} = (\Delta Z) + \left(1 - \frac{\gamma_{Hg}}{\gamma_{oil}}\right)h$$

$$\frac{Q^2}{2(32.2)}\left(\frac{1}{(1/6^2\pi)^2} - \frac{1}{(1/2^2\pi)^2}\right) = \cancel{\Delta Z} + \left(1 - \frac{13.54}{0.90}\right) \cdot 7/3 + \cancel{Z_A - Z_B}$$

$$\cancel{1969.68} = -32.77 \;/\; 1969.68$$

$$\frac{Q^2}{2(32.2)} = -0.0166$$

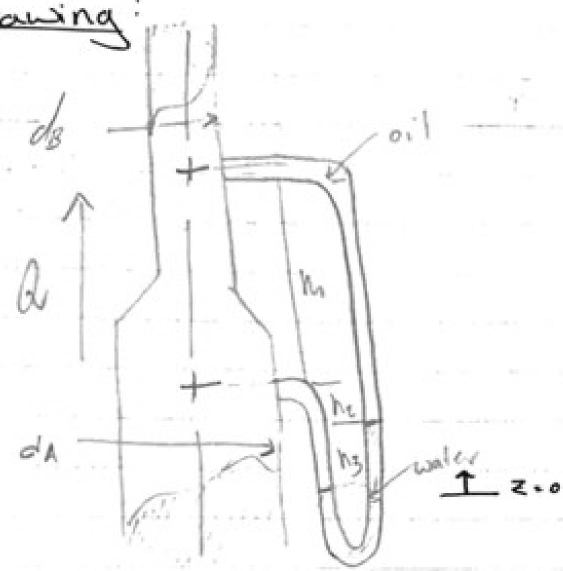
$$Q^2 = 1.07 \Rightarrow Q = 1.035 \ lb/ft^2$$

Procedure: first remove the information (variables) from Bernolli's equation that you know are zero or cancel. then using the pressure change in elevation through the mercury find an equation that gives you P_A & P_B leaving the only unknown as z and solve.

6.82

~~purpose~~ purpose: Calculate Volume flow rate (Q)

Drawing:



Data:

d_A = 2in (1/6 ft)
d_B = 4in (1/3 ft)
h_1 = 24 in (2 ft)
h_2 = 6in (1/2 ft)
h_3 = 8in (2/3 ft)
γ_{oil} = 55.0 (lb/ft³)
γ_{water} = 62.4 (lb/ft³)

Formula:

$$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + z_2 \qquad (\Delta P) = \gamma(\Delta h)$$

$$Q = VA$$

Calculations:

$$P_A - (1.16ft \cdot \gamma_{oil}) + (.5ft \cdot \gamma_w) + (2ft\ \gamma_{oil}) = P_B$$

$$\Delta P = 77.033$$

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

$$\frac{Q}{2(32.2)}(11.459 - 45.837) = \frac{77.033}{55.0} + 2ft$$

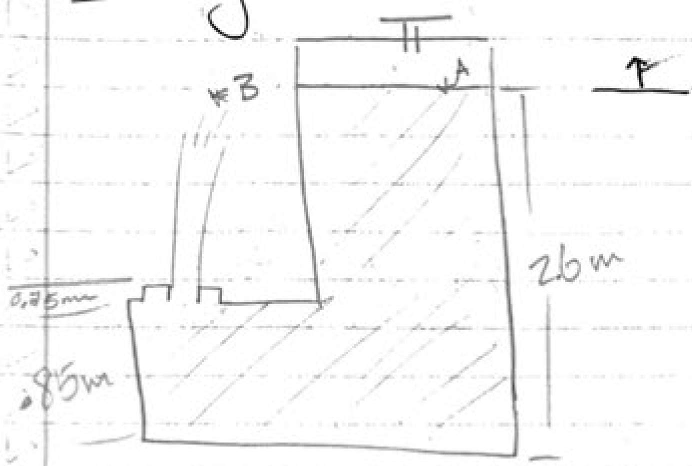
$$\frac{Q^2}{2(32.2)} = -0.0989 \qquad Q = 2.523\ lb/ft^2$$

Procedure: ~~by~~ using the change of h in the water the ~~?~~ ΔP in the system ~~also~~ could be found then by plug-in and altering Bernoulli's the Q flow rate could be solved for

6.91

Purpose: find height of jet.

Drawing:



Data

γ: 9.81

$h_1 = 2.6m$

$h_2 = .85m$

$h_3 : 0.075m$

Equations:

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

Calculations: $z_1 = z_2 = 0$

Procedure: By looking @ Bernolli's Law as well as our figure we could conclude the following Since the water is not moving the variable (V) Velocity can be canceled and since we know the point B top of the jet will have a pressure = atm & PA is open to atm the pressure is the same leaving z as the only variables and w/out losses equal to eachother.

What was learned

from the Class & the solved problems in
the notes we learned the Basics of the
Bernoulli's equation. the Bernoulli's equation is
the key stone to fluid movement and
it interactions with pressure, specific gravity,
Velocity, flow rate, area, gravity & elevation.
later on the variables of pump head,
turbine head & energy loss will become
far more important. we learned much
more beyond a simple equation as
seen in many of the homework problems &
the equations for flow rate and pressure
change become especially important, as
they tie in to how we re-arrange
Bernoulli's equation when doing Calculations.
in many of the problems the Δ Pressure
became a main variable, used instead
of pressures A & B. same occured w/ flow
rate as the Variables Q & A (area) were
substituted for Velocity. when studying bernoulli's
equation we drew from our knowledge of
enthalpy, conservation of mass and thermodynamics
especially conservation of energy. using these
we proved the Basis for Bernoulli's and
showed a greater depth of understanding for the
Caracteristics of fluid movement