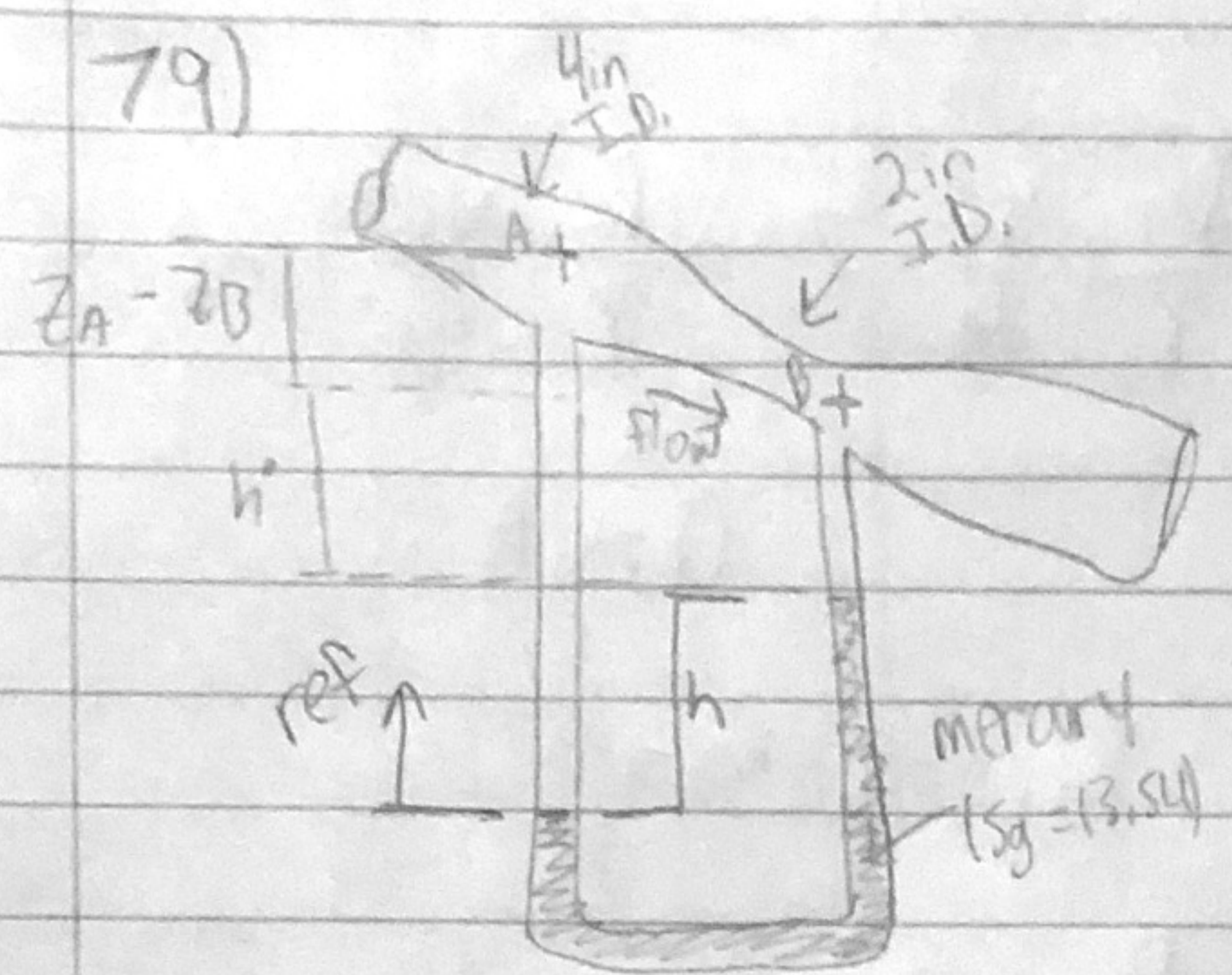
HW 1.3

Fluid Mechanics

Erin FitzPatrick
Hannah Wolfe
Andrew Brosnahan
Tyler Rice

79)



Oil sg = 0.90

h = 28in

mercury sg = 13.54

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

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

$$Q = VA$$

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

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

$$P_A + \gamma_{oil}((Z_A - Z_B) + h' + h) - \gamma_{Hg} h - \gamma_{oil} h' = P_B$$

$$\frac{P_B - P_A}{\gamma_{Hg}} = (Z_A - Z_B) + \left(1 - \frac{\gamma_{Hg}}{\gamma_{oil}}\right) h$$

$$Q = \sqrt{\frac{2g\left(1 - \frac{sg_{Hg}}{sg_{Hg}}\right) h}{\frac{1}{A_A^2} - \frac{1}{A_B^2}}}$$

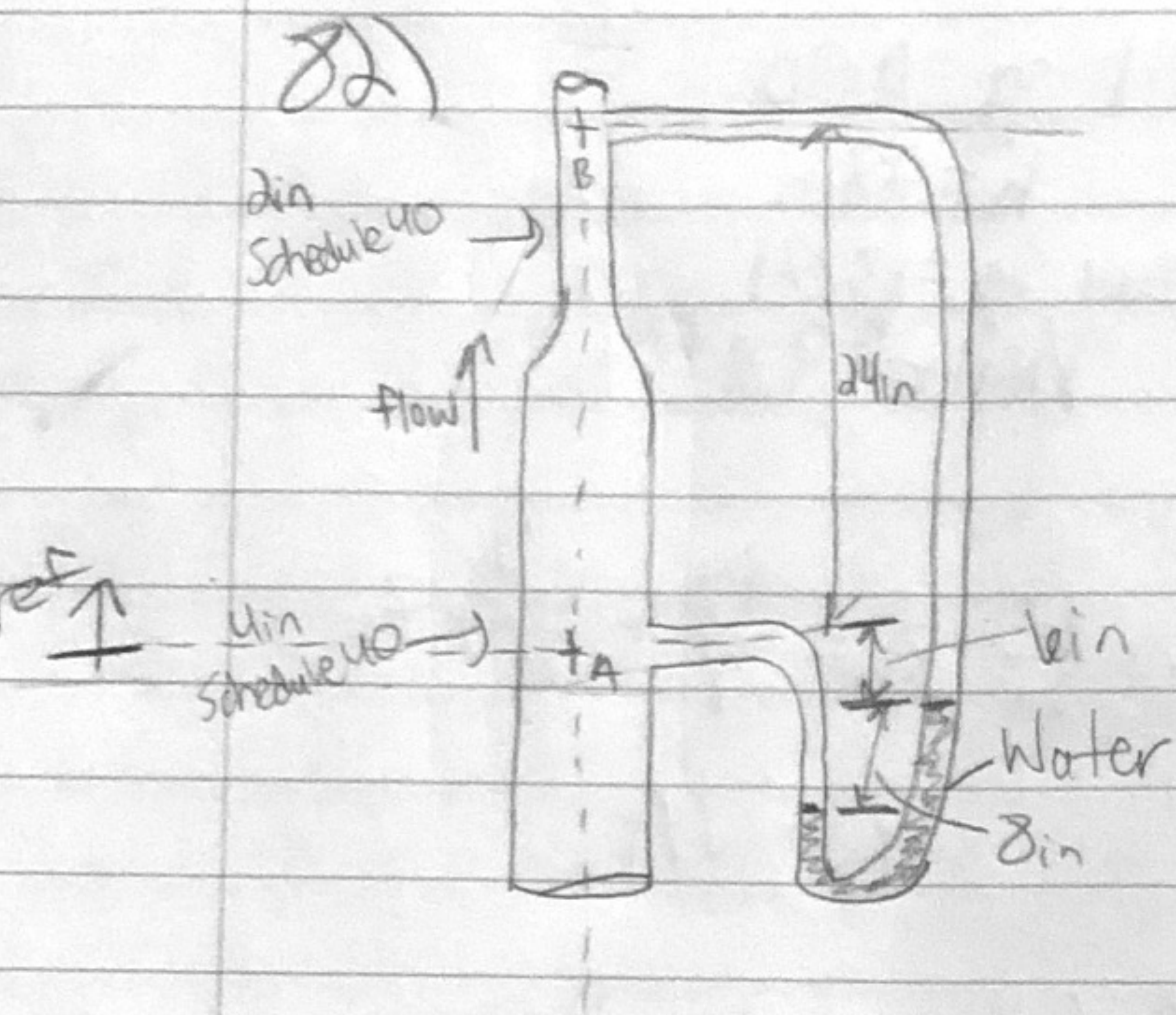
$$A_A = \pi/4\, D_A^2 = 0.0873 ft^2$$

$$A_B = \pi/4\, D_B^2 = 0.0218 ft^2$$

$$Q = \sqrt{\frac{2 \cdot 32.2 \frac{ft}{s}\left(1 - \frac{13.54}{0.90}\right)(28)(1/12)}{\frac{1}{(0.0873 ft^2)^2} - \frac{1}{(0.0218 ft^2)^2}}}$$

$$\boxed{Q = 1.07\ ft^3/s}$$

82)



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

$$Q=VA$$

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

$$\frac{P_1}{\gamma}+\frac{V_1^2}{2g}=\frac{P_2}{\gamma}+\frac{V_2^2}{2g}+24$$

$$A=\frac{\pi D^2}{4}$$

$$A_A=\frac{\pi(0.33)^2}{4}=$$

$$A_A=0.086\ ft^2$$

$$Q=V_B A_B=2.53(0.023)$$

$$=\boxed{0.058\ ft^3/s}$$

$$A_B=\frac{\pi(0.167)^2}{4}=0.023ft^2$$

$$0.086V_A=0.023V_B$$

$$V_A=0.27V_B$$

$$P_A-P_B=-1.167\gamma_{oil}+0.67\gamma_{H_2O}+2.5\gamma_{oil}$$

$$P_A-P_B=-1.167(55)+0.67(62.43)+2.5(55)$$

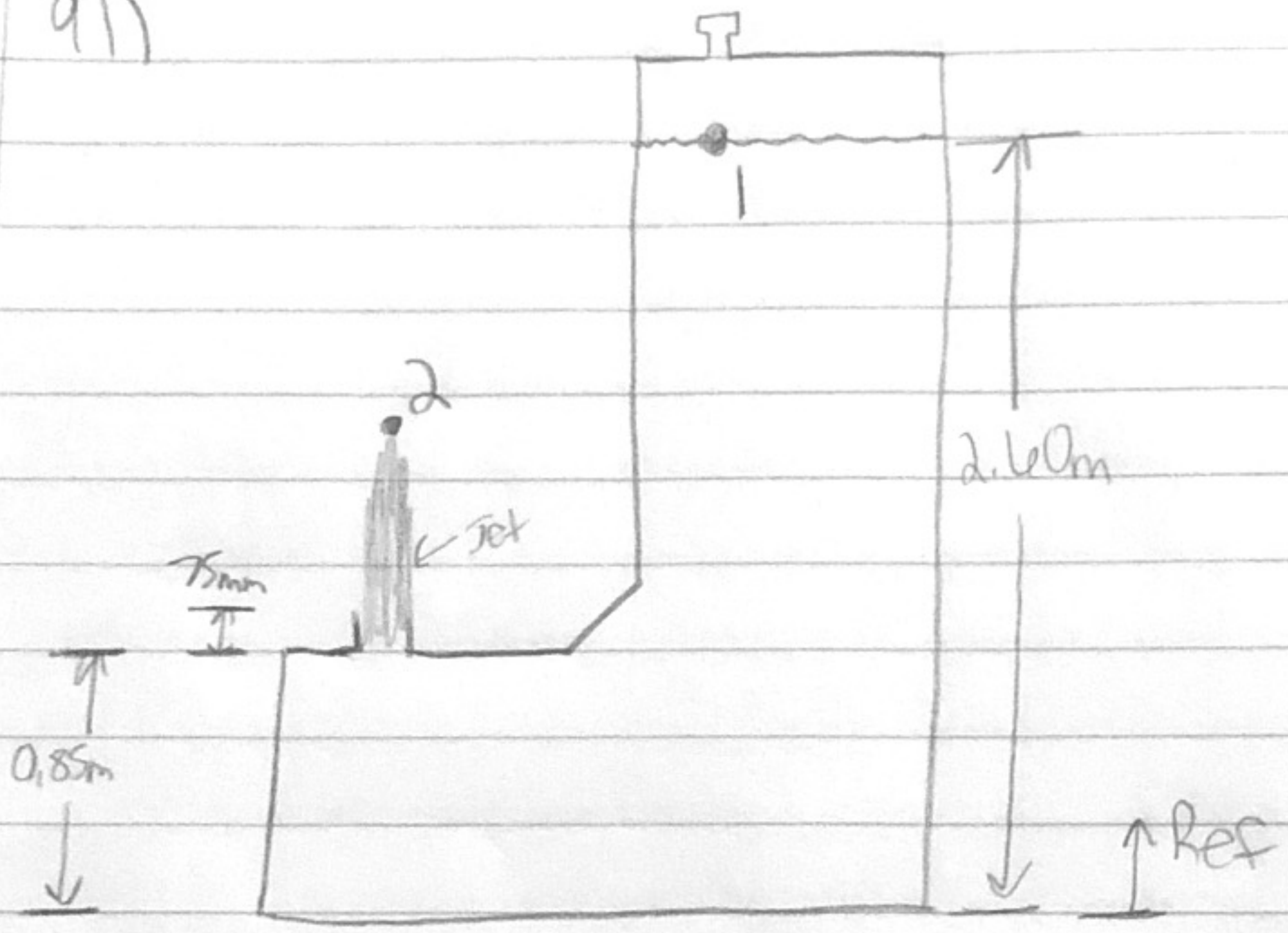
$$=115.143$$

$$\frac{P_A-P_B}{\gamma_{oil}}-Z_2=\frac{V_B^2-(0.25V_B)^2}{2g}=\frac{115.143}{55}-2=\frac{0.9375V_B^2}{64.4\ ft/s^2}$$

$$2.09ft-2ft=0.0146V_B^2 \qquad V_B^2=6.405\ \frac{ft^2}{s^2}$$

$$\boxed{V_B=2.53\ \frac{ft}{s}}$$

91)



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

$$z_2=\frac{P_1-P_2}{\gamma}+\frac{\cancel{V_1^2}^{\,0}-\cancel{V_2^2}^{\,0}}{2g}+z_1$$

$$z_2=\frac{\cancel{P_1}^{\,0}-\cancel{P_2}^{\,0}}{\gamma}+z_1$$

$$z_2=z_1$$

$$\boxed{z_2=2.6\text{m}}$$

Based on problems from class discussion and lecture, we learned how to manipulate Bernoulli's equation for various types of problems. First and foremost we had to know that before approaching any problem, you MUST draw a picture or diagram. The next steps were to define a reference, followed by the points. Points are chosen based on where you know the most information, or where you need to know something. We were given various examples and asked to find things like flow rate, pressure, height, energy loss, or power, all of which are found using Bernoulli's equation, Q=VA, and various tables online or in the textbook.