NOT UNDERSTANDING MY ERRORS

CH. 11 5, 13, 15, 22, 23 JORDAN DAVIS

5) FIND PRESSURE @ A?

GIVEN: $\gamma_0 = 8.8 KN/m^3$, $V_0 = 2.12E^{-5}\ m^2/s$

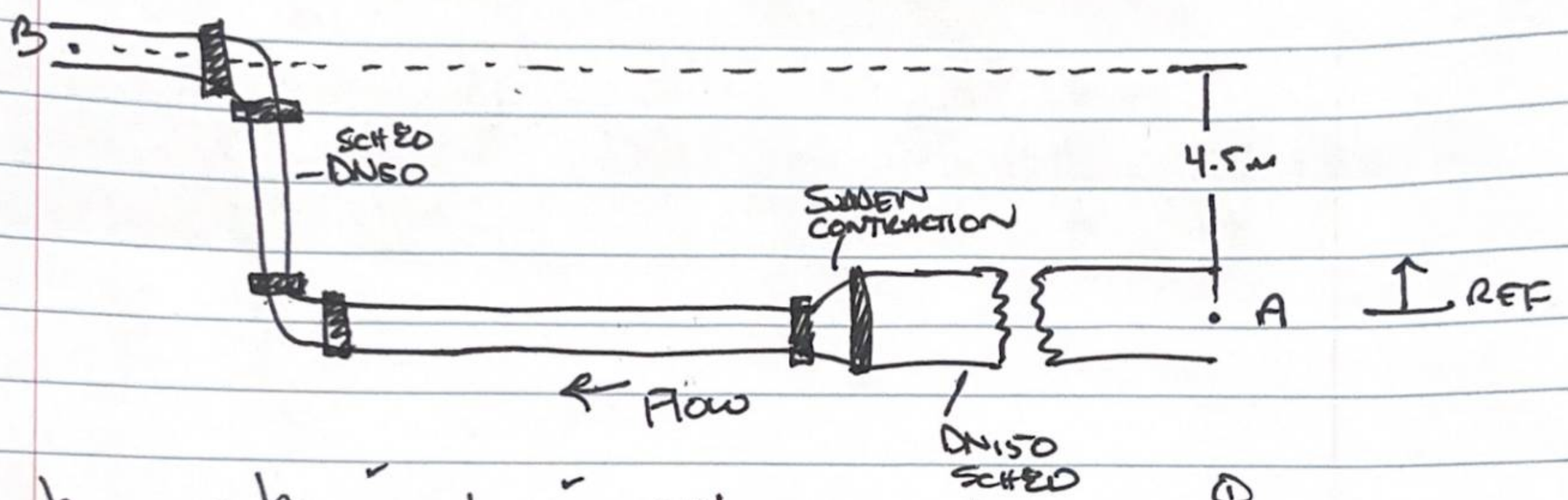
$L_{50} = 80m$, $L_{150} = 180m$

LONG RADIUS TYPE = $Le/D = 20$, $K = 20ft$

$P_B = 12.5 MPA$, $Q = .015\ m^3/s$ $\varepsilon = 4.6E^{-5}\ m$

$DN50 \rightarrow ID = .0493\ m$, $A = 1.905E^{-3}\ m^2$

$DN150 \rightarrow ID = .1463m$, $A = 1.682E^{-2}\ m^2$



$h_{LTOTAL} = h_{L\,PIPE\,50} + h_{L\,PIPE\,150} + 2h_{L\,ELBOW} + h_{L\,REDUCER}$ (1)

DN50

$V = Q/A = \frac{.015 m^3/s}{1.905E^{-3} m^2} = 7.87\ m/s$

$N_R = \frac{VD}{V} = \frac{7.87\ m/s \cdot .0493m}{2.12E^{-5}\ m^2} = 18301$ TURBULENT

$D/\varepsilon = .0493m / 4.6E^{-5}m = 1071.7$

$f = \frac{.25}{\left[\log\left(1/3.7(D/\varepsilon) + 5.74/N_R^{.9}\right)\right]^2} = 0.028$ (EXCEL)

$h_{L50} = \frac{.028}{} \left| \frac{80m}{.0493m} \right| \frac{7.87^2\ m^2/s^2}{2(9.81)\ m/s^2} = 143.4\ m$

DN150

$V = Q/A = \frac{.015 m^3/s}{1.682E^{-2} m^2} = .89\ m/s$ $D/\varepsilon = .1463m / 4.6E^{-5}m = 3180.4$

$N_R = \frac{.89m/s \cdot .1463m}{2.12E^{-5} m^2} = 6141.8$ TURB

$f = 0.036$ (EXCEL) $h_{L150} = \frac{.036}{} \left| \frac{180m}{.1463m} \right| \frac{.89^2\ m^2/s^2}{2(9.81)\ m/s^2} = 1.79m$

5 CONT) $h_{L\,ELBOW} = K(v^2/2g)$, $D/\varepsilon = .0493\,m / 4.6\varepsilon^{-5}\,m = 1071.7$

$$\Rightarrow f_T = \frac{.25}{\log(1/3.7(D/\varepsilon))} = .0193$$

$$\Rightarrow K = 20(.0193) = .386$$

$$\Rightarrow h_{L\,ELBOW} \quad .386(\text{[illegible]}) \quad .386(7.87\,m/s)^2 / 2(9.81\,m/s^2) = \underline{1.22\,m}$$

$h_{L\,REDUCER} = K(v^2/2g)$, $D_1/D_2 = 2.96 \approx 3$, $v = 7.87\,m/s \approx 8$

$$\Rightarrow K = 0.37$$

$$\Rightarrow h_{L\,RED} = \frac{0.37(7.87)^2\,m^2/s^2}{2(9.81\,m/s^2)} = \underline{1.17\,m}$$

$$\Rightarrow \frac{P_A}{\gamma} + \frac{v_A^2}{2g} + \overset{REF}{\cancel{z_A}} = \frac{P_B}{\gamma} + \frac{v_B^2}{2g} + z_B + h_L$$

$$\Rightarrow P_A = \gamma_o\left(\frac{P_B}{\gamma} + \frac{v^2_B}{2g} + z_B + h_L - \frac{v_A^2}{2g}\right) \quad \text{THRU EXCEL}$$

$$\Rightarrow \underline{P_A = 13.87\,MPa}$$

13) FIND VELOCITY w/ P_A @ 20 psig & 80 psig

GIVEN: NOZZLE $K = .15$, $D_{NOZZLE} = .021\,ft$

SMOOTH ALUMINUM → $ID = .042\,ft$

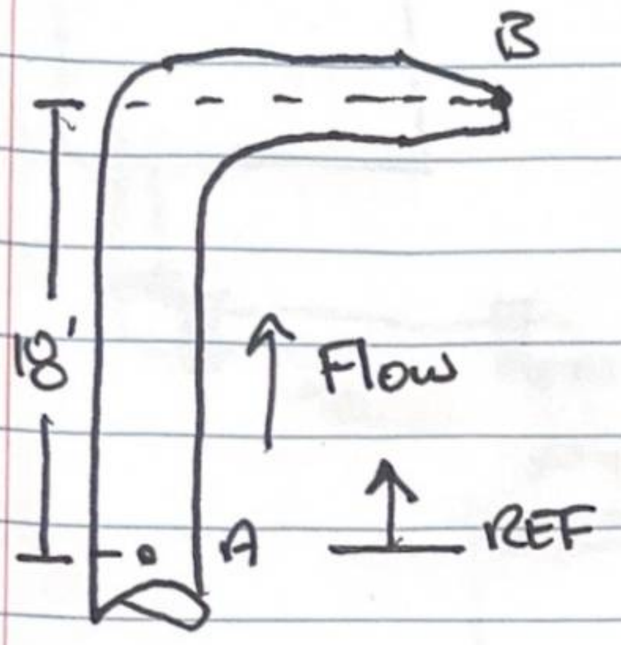
$\varepsilon_{(ASSUMED)} = 5E^{-6}\,ft$

$L = 20\,ft$

90° BEND RADIUS $= .5\,ft$

H_2O @ 100°F → $\gamma = 62\,lb/ft^3$

$\nu = 7.37E^{-6}\,ft^2/s$



$$\frac{P_A}{\gamma} + \frac{v_A^2}{2g} + \cancel{z_A}^{REF} = \frac{\cancel{P_B}^{ATM}}{\gamma} + \frac{v_B^2}{2g} + z_B + h_L$$

$$h_{L\,PIPE} = \frac{fLv^2}{2Dg} \quad , \quad h_{BEND\text{-}NOZZLE} = \frac{Kv^2}{2g}$$

$V = Q/A$

$$\Rightarrow Q = \sqrt{\frac{P_A/\gamma - z_B}{8/g\pi^2 D_B^4 - 8/g\pi^2 D_A^4 + \frac{8fL}{D^5 g\pi^2} + \frac{K_{NOZZ}\,8}{\pi^2 D^4 g} + \frac{K_{BEND}\,8}{\pi^2 D^4 g}}}$$

ON EXCEL: ⇒ @ 20 psig $v = 40.54\,ft/s$

@ 80 psig $v = 98.45\,ft/s$

15) DETERMINE Q?

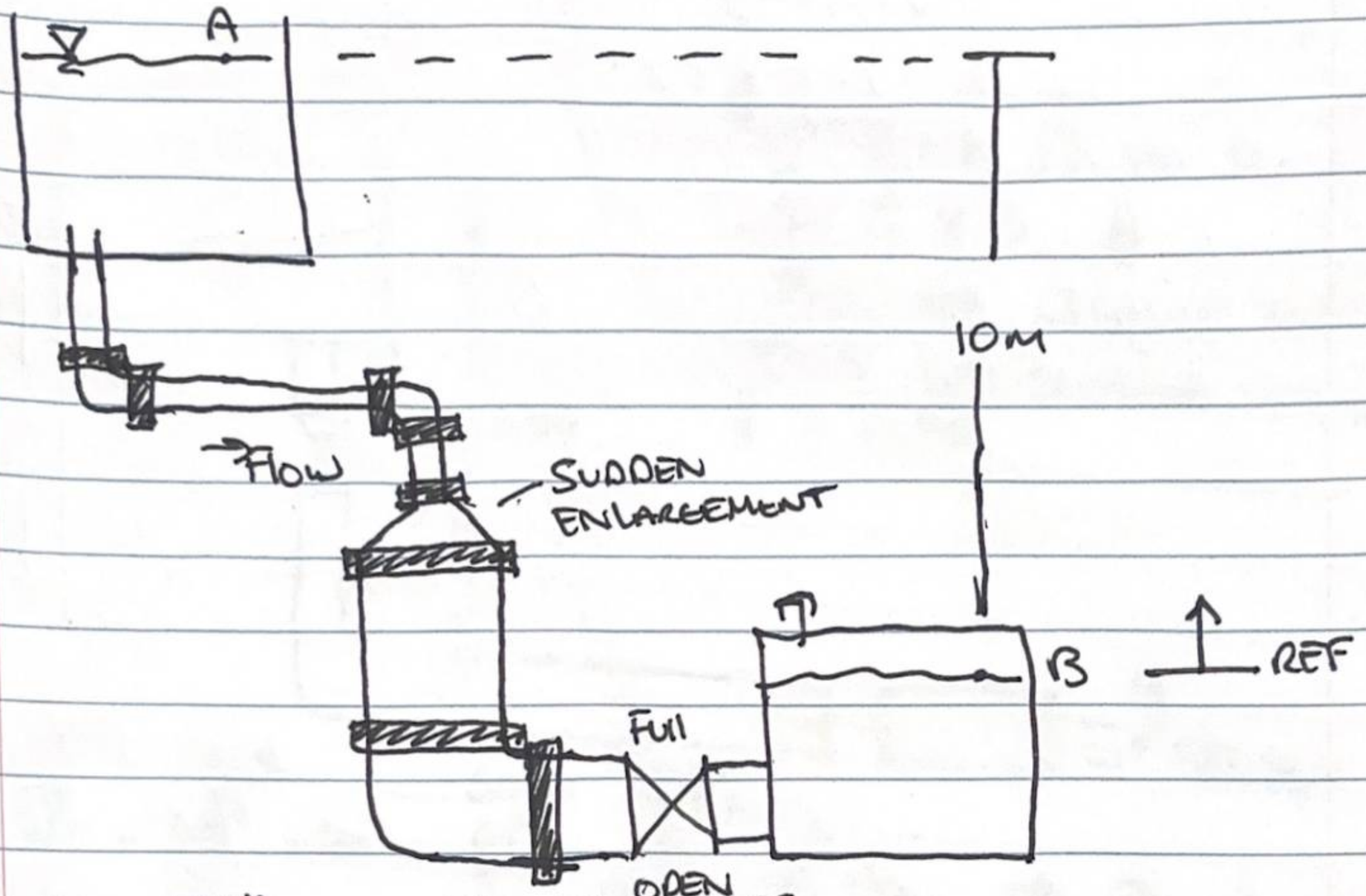
GIVEN: WATER @ 40°C → $\nu = 6.56E^{-7}\ m^2/s$

$g = 9.81\ m/s^2$

$\varepsilon = 1.2E^{-4}$, $h = 10m$

4" DIAMETER = .1059m , 6" DIAMETER = .1593

$L = 55m$ $L = 30m$



$$\frac{P_A}{\gamma}^{ATM} + \frac{V_A^2}{2g}^{TANK} + Z_A = \frac{P_B}{\gamma}^{ATM} + \frac{V_B^2}{2g}^{TANK\ OPEN} + Z_B^{REF} + h_L \Rightarrow Z_A = h_{L_{TOTAL}}$$

$$h_{L_{TOTAL}} = h_{L_{PIPE4}} + h_{L_{PIPE6}} + h_{L_{ENT}} + h_{L_{EXIT}} + h_{L_{ELB6}} + 2h_{L_{ELB4}} + h_{L_{SE}} + h_{L_{GV}}$$

$$\Rightarrow Q = \sqrt{\frac{Z_A}{h_{L_{TOTAL}}}} \rightsquigarrow \text{ON EXCEL}$$

$$\boxed{Q = 0.035\ m^3/s}$$

22) FIND PIPE DIAMETER → SCH 40

GIVEN: $Q = .891\ ft^3/s$

$Z_A = 12\ ft$

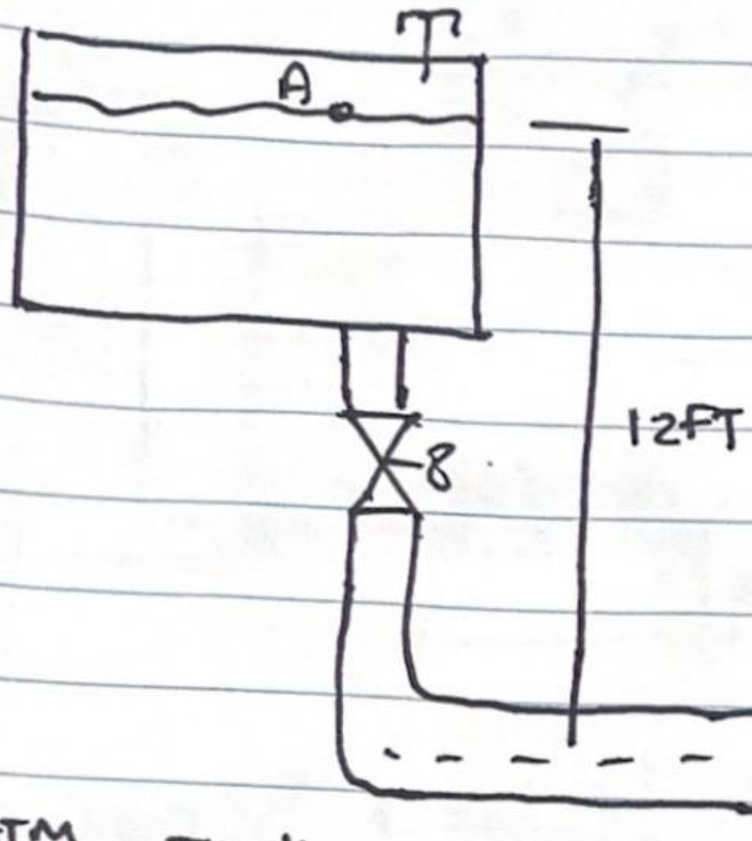
GLOBE VALVE : $K = 340 f_T$

ELBOW : $30 f_T$

$V @ 60°F = 1.21 E^{-5}\ ft^2/s$

ENTRACE LOSS : $K = .5$

$\varepsilon = 1.5 \varepsilon^{-4}$



* GUESSING ID TO FIND f_T & K's. *
- FINDING CLOSEST NPS BASED ON CRITICAL VELOCITY & % DIFF.

$$\frac{P_A}{\gamma}^{\text{ATM}} + \frac{V_A^2}{2g}^{\text{TANK}} + Z_A = \frac{P_B}{\gamma}^{\text{SEWER}} + \frac{V_B}{2g}^{\text{LARGE TANK/SEWER}} + Z_B^{\text{REF}} + h_L \Rightarrow Z_A = h_{L\,TOTAL}$$

$h_{L\,TOTAL} = h_{L\,PIPE} + h_{L\,EN} + h_{L\,ELBOW} + h_{L\,ENTR.}$

ON EXCEL → .442 ft DIAMETER w/ .153 ft^2

⇒ NPS 6 CHOSEN

23) FIND DEPTH h of TANK? $\rho V = 4.22E^{-7} m^2/s$, $\gamma = 6670 N/m^3$

GIVEN: GAS @ 25°C → Sg .68 , NEGLECT PIPE LOSSES

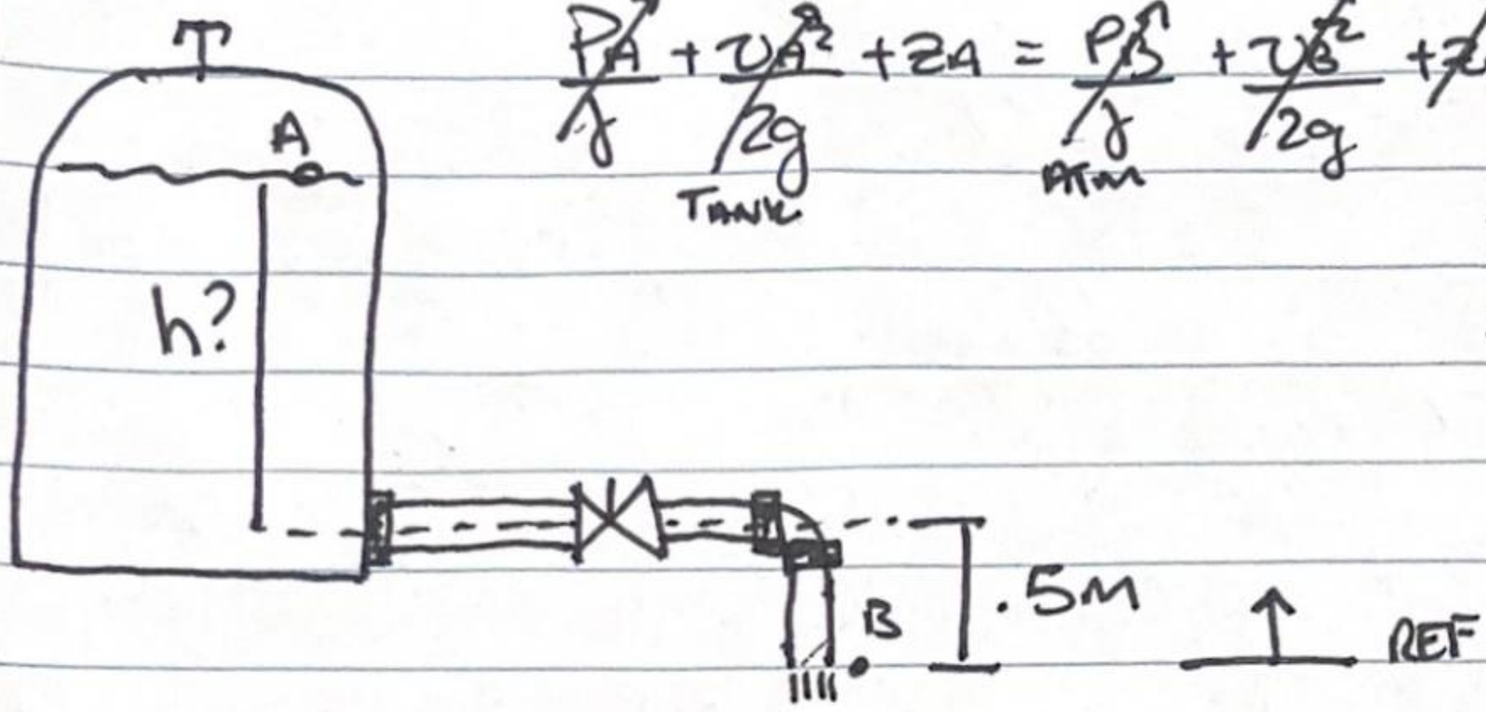
$Q = 1500 L/MIN \rightarrow .025 m^3/s$

GATE VALVE 1/2 OPEN → $k = 160 ft$, ELBOW = $k = 30 ft$

DN 90 STEEL PIPE → ID = .0901 m

SCH 40 $A = 6.381E^{-3} m^2$

$\varepsilon = 4.6E^{-5} m$



$$\frac{P_A}{\gamma}^{ATM} + \frac{V_A^2}{2g}^{TANK} + Z_A = \frac{P_B}{\gamma}^{ATM} + \frac{V_B^2}{2g}^{TRUCK\ TANK} + Z_B^{REF} + h_L$$

$\Rightarrow Z_A = h_L$

$\Rightarrow Z_A = .5m + h = h_L$

$$h_L = \frac{K_{ENT} V^2}{2g} + \frac{K_{GV} V^2}{2g} + \frac{K_{ELBOW} V^2}{2g}$$

EXCEL

$f_T = .25 / (\log(1/3.7(D/\varepsilon)))^2 = 0.017$

$\Rightarrow h = h_{L TOTAL} + .5m =$ [illegible] 3.3851 m