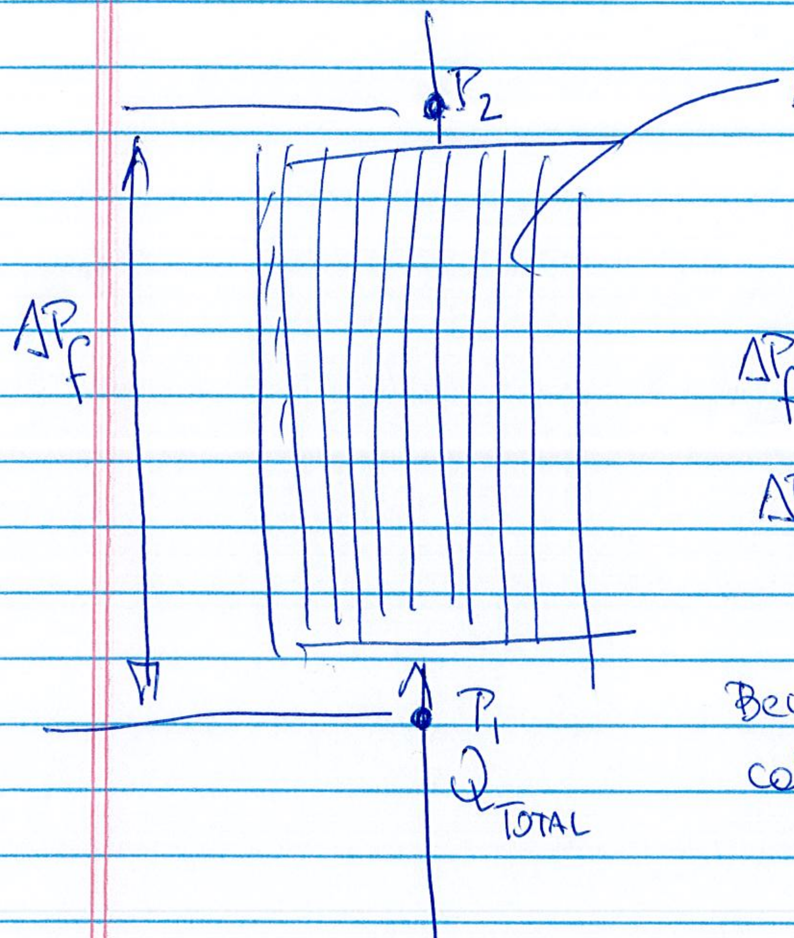
OFFICE HOURS 11/13/2017



$$\Delta P_f = P_1 - P_2$$

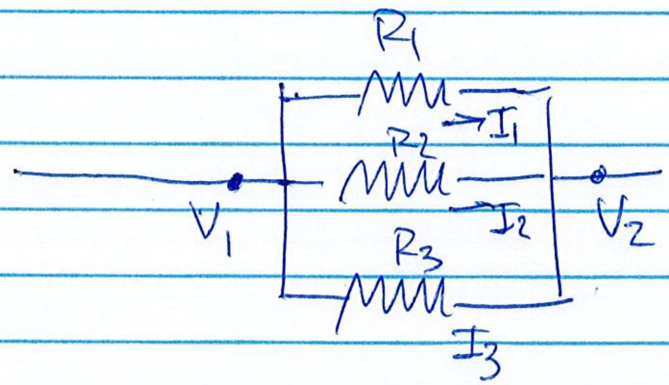
Flow

$$\Delta P_f = \frac{2LK}{R}\left[\frac{3n+1}{4n}\right]^n \left(\frac{4Q}{\pi R^3}\right)^n$$

Because the pressure is calculated for 1 tube

$$Q = \frac{Q_{TOTAL}}{N_T}$$

Electrical problem



$$V_1 - V_2 = R_1 \times I_1$$

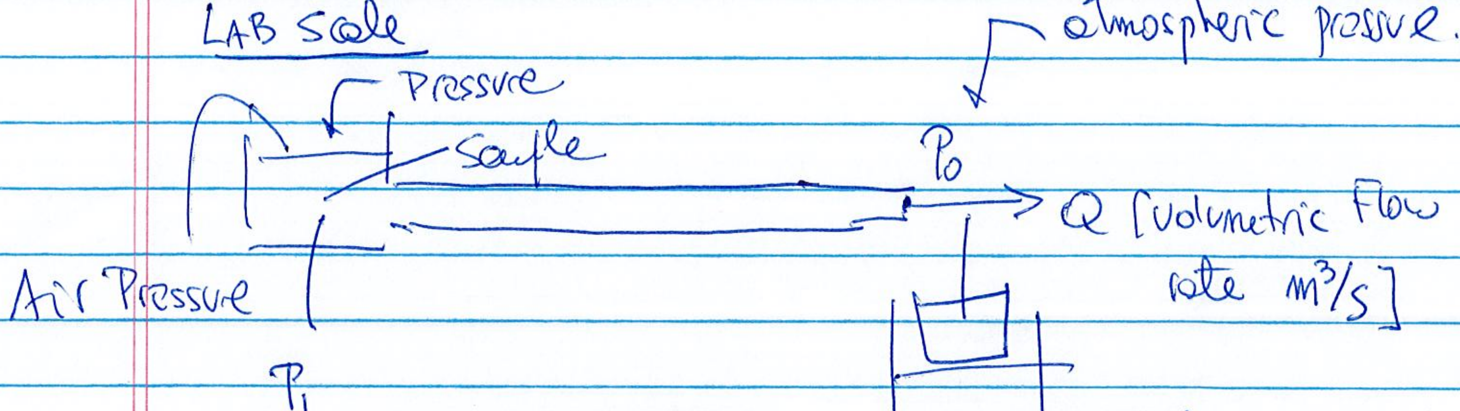
$$V_1 - V_2 = R_2 \times I_2$$

$$V_1 - V_2 = R_3 \times I_3$$

Question 2

Scale-up Process

LAB Scale



RHEOLOGICAL PROPERTIES OF THE MATERIAL.

$\dot{m}$ MASS FLOW RATE $\frac{Kg}{min.}$

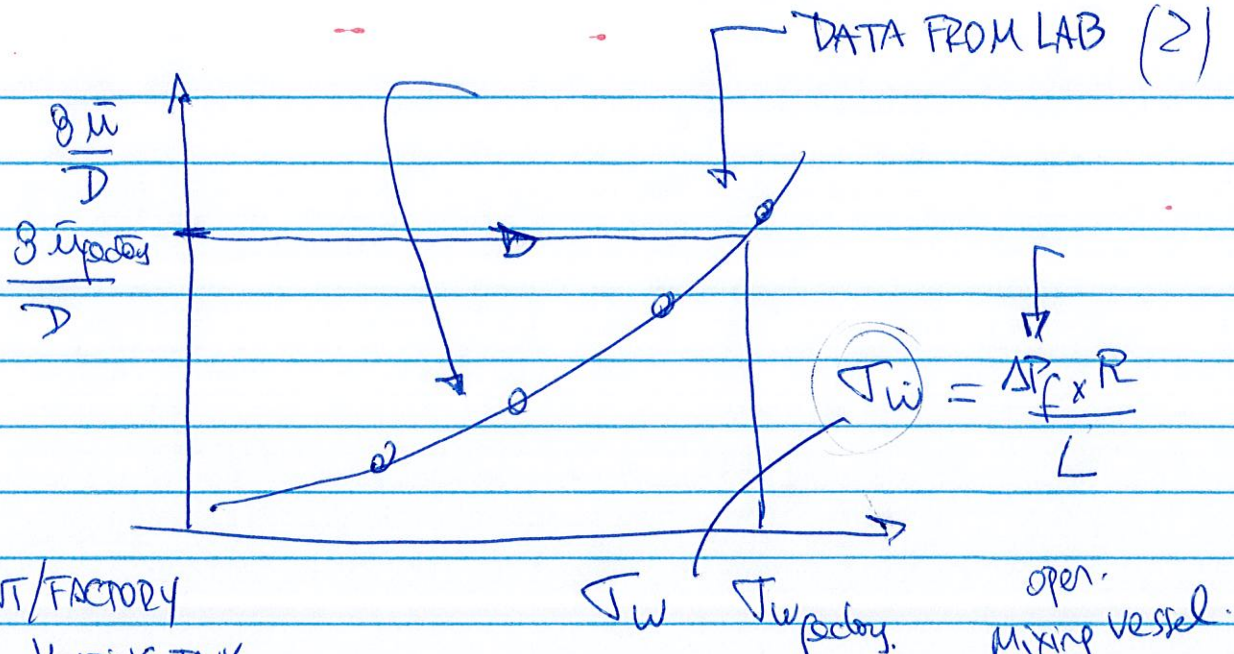
(P_0) ΔP	Q (m^3/s)
–	–
–	–
–	–
–	–
–	–

$$\frac{\dot{m}}{\rho_{fluid}} = Q$$

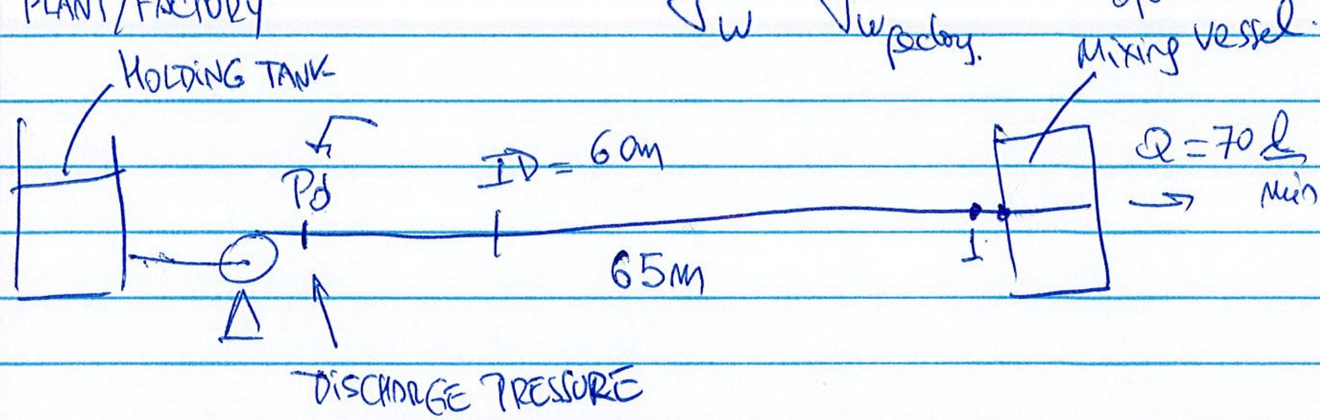
$$\frac{8\bar{u}}{D} \quad \text{["shear rate"]}$$

$$\bar{u} = \frac{Q}{\pi R^2}$$

$$\tau_W = \frac{\Delta P \times R}{L}$$



PLANT/FACTORY



MECHANICAL ENERGY BALANCE BETWEEN "d" [discharge of the pump] and location "1"

equal if diameter of pipe is same

$$\Delta P_{pump} = (P_1 - P_d) + \rho g (h_1 - h_d) + \rho \frac{\bar{u}_d^2 - \bar{u}_1^2}{2\alpha} + \Delta P_{f\, d \to 1}$$

$P_{atm} = 0 \leftarrow$ gauge pressure

$$0 = P_1 - P_d + 0 + 0 + \Delta P_{f\, d \to 1} \quad (1)$$

$h_1 = h_d$

THERE IS NO PUMP BETWEEN "d" and "1"

From Eq.(1) (3)

$$\boxed{P_d = \Delta P_{f\,d\to 1}}$$

FACTORY

$$Q_{factory} = 70\,\frac{l}{min.} = 70\,\frac{\cancel{l}}{\cancel{min}} \times \frac{1\,\cancel{min}}{60\,sec.} \times \frac{1\,m^3}{1000\,\cancel{l}} = \frac{70}{60{,}000}\,\frac{m^3}{s}$$

$$\bar{u}_{factory.} = \frac{Q_{factory}}{\pi R^2_{factory}}$$

$\frac{70}{60{,}000}$

? $R = \frac{0.06\,m}{2}$

$\frac{8\,\bar{u}_{factory}}{D_{factory.}}$ From Plot $\cancel{\Delta P_{f,factory}}$ $\tau_{w,\,factory.}$

√ From factory conditions.

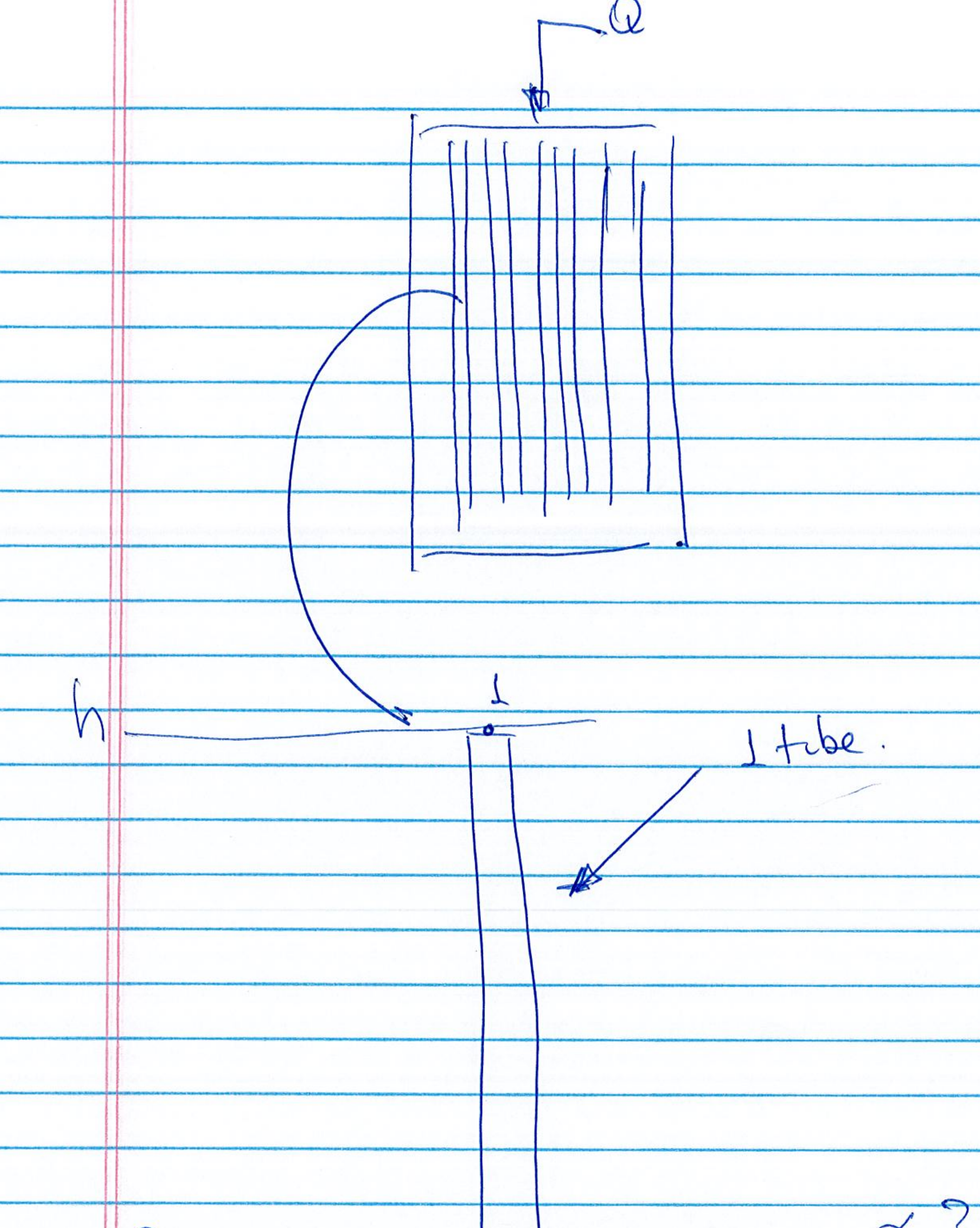
$$\Delta P_{f\,d\to 1} = \frac{\tau_w \times L}{R}$$

65 m

0.03 m

$$P_d = \Delta P_{f\,d\to 1}$$

(4)

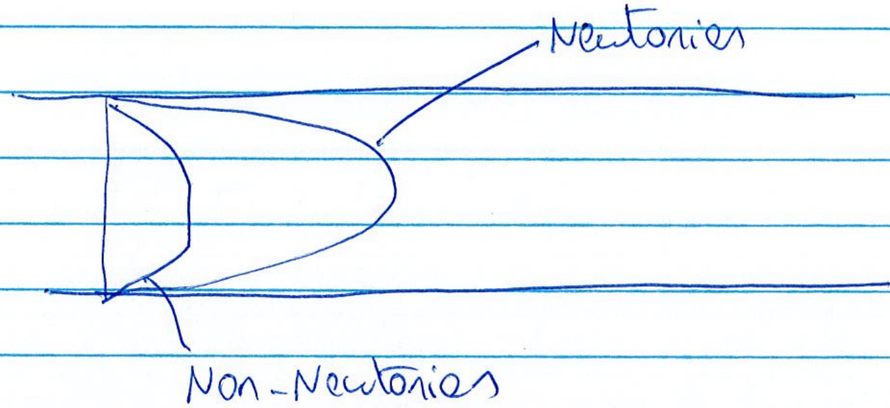


ENERGY BALANCE BETWEEN 1 & 2

$$\cancel{\Delta P_{pump}} = \cancel{(P_2 - P_1)} + \rho g\,(h_2 - h_1) + \cancel{\frac{\rho}{2\alpha}\left(\bar{u}_2^{\,2} - \bar{u}_1^{\,2}\right)} + \Delta P_{f\,1\to 2}$$

$h_2 \to 0 \qquad h_1 \to 0 + h$

Why we are using α ?



$$\text{Kinetic Energy Change} = \frac{1}{2\alpha}\rho\left(\bar{u}_2^2 - \bar{u}_1^2\right)$$

Correction for Rheology. [check Notes for Equations for different fluids

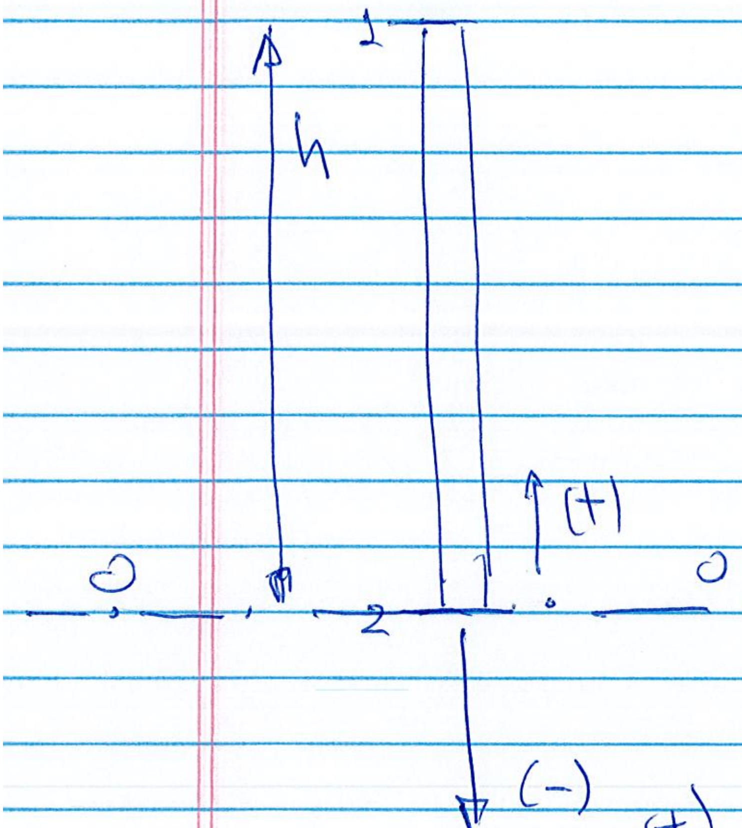
if needed it will provided in the exam

$$\Delta P_{f\,1\to 2} = \rho g h$$

$$\boxed{\frac{2\cancel{h}K}{R}\left(\frac{3n+1}{4n}\right)\left[\frac{4Q}{\pi R^3}\right]^n = \rho g \cancel{h}}$$

$\rightarrow Q$

ASIDE how we determine the value of h

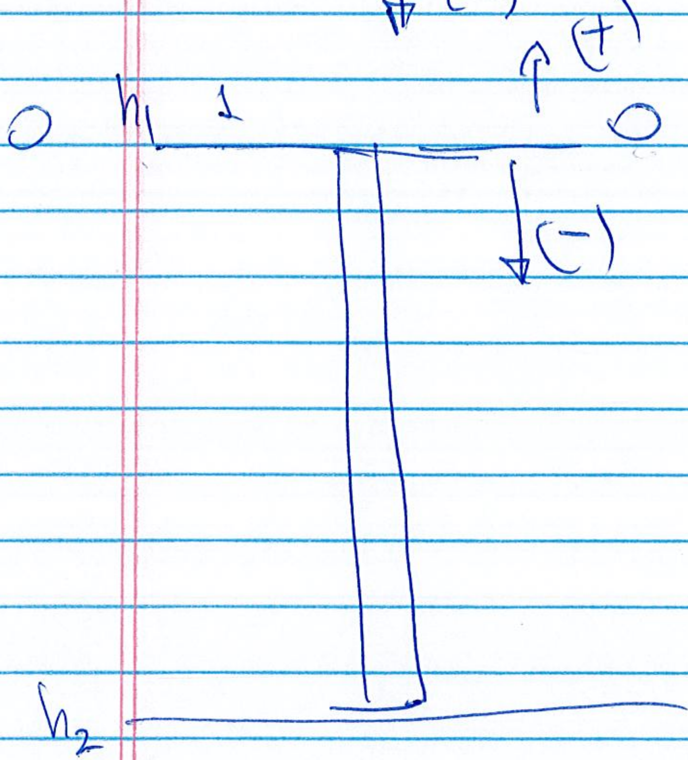


$$\rho g (h_2 - h_1)$$

$$\rho g (0 - h) = -\rho g h$$

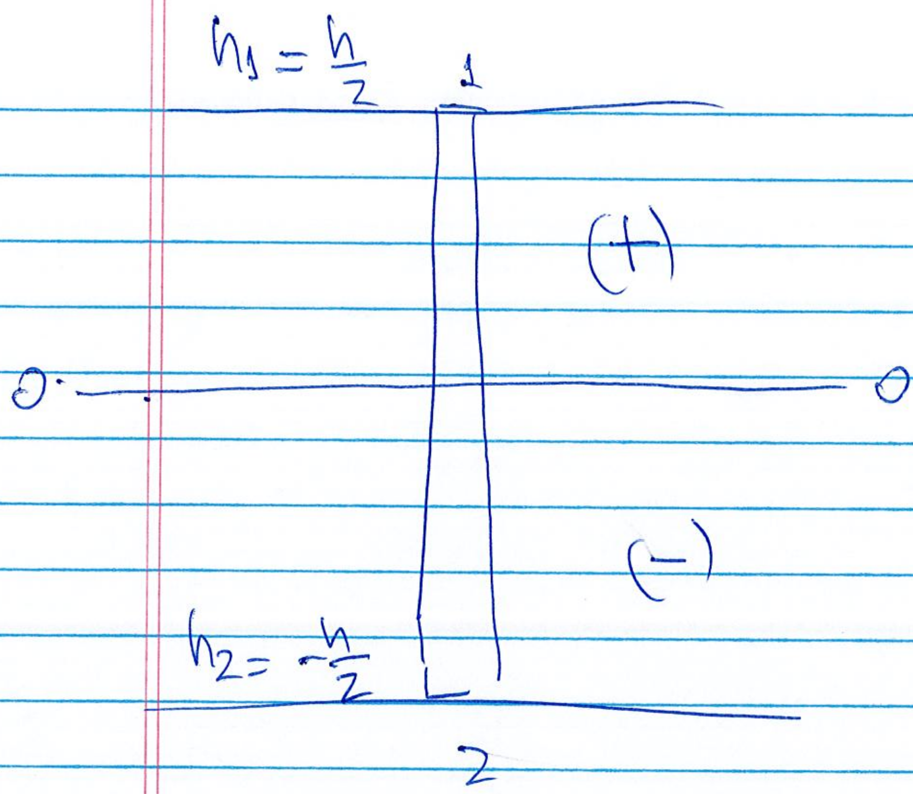
$h_2 = 0$

$$\rho g (h_2 - h_1) = -\rho g h$$



$h_1 = 0$

$h_2 = -h$



$$\rho g (h_2 - h_1) =$$

$$= \rho g \left(-\frac{h}{2} - \frac{h}{2}\right) =$$

$$= -\rho g h$$

$$\Delta P_{pump} = (P_2 - P_1) + \underline{\underline{\rho g (h_2 - h_1)}} + \frac{1}{2\alpha}\rho\,(\bar{u}_2^2 - \bar{u}_1^2) + \Delta P_{f\,1\to 2}$$