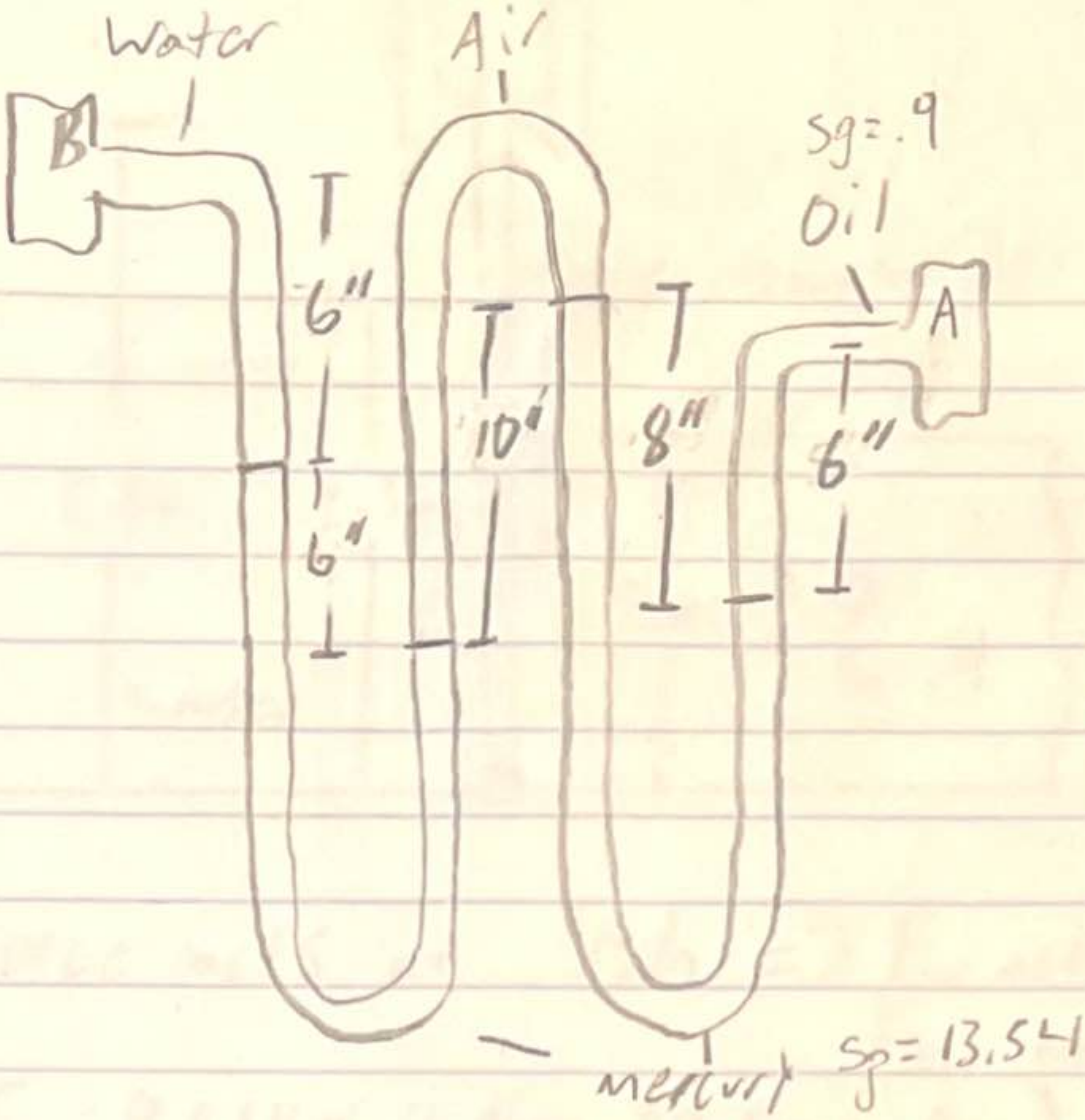
Logan Kooy
6/1/22

1)



$\gamma_w = 62.4 \frac{lb}{ft^3}$

$\gamma_{oil} = \gamma_w \cdot .9$

$\gamma_M = \gamma_w \cdot 13.54$

$\gamma_{oil} = 56.16\ lb/ft^3$

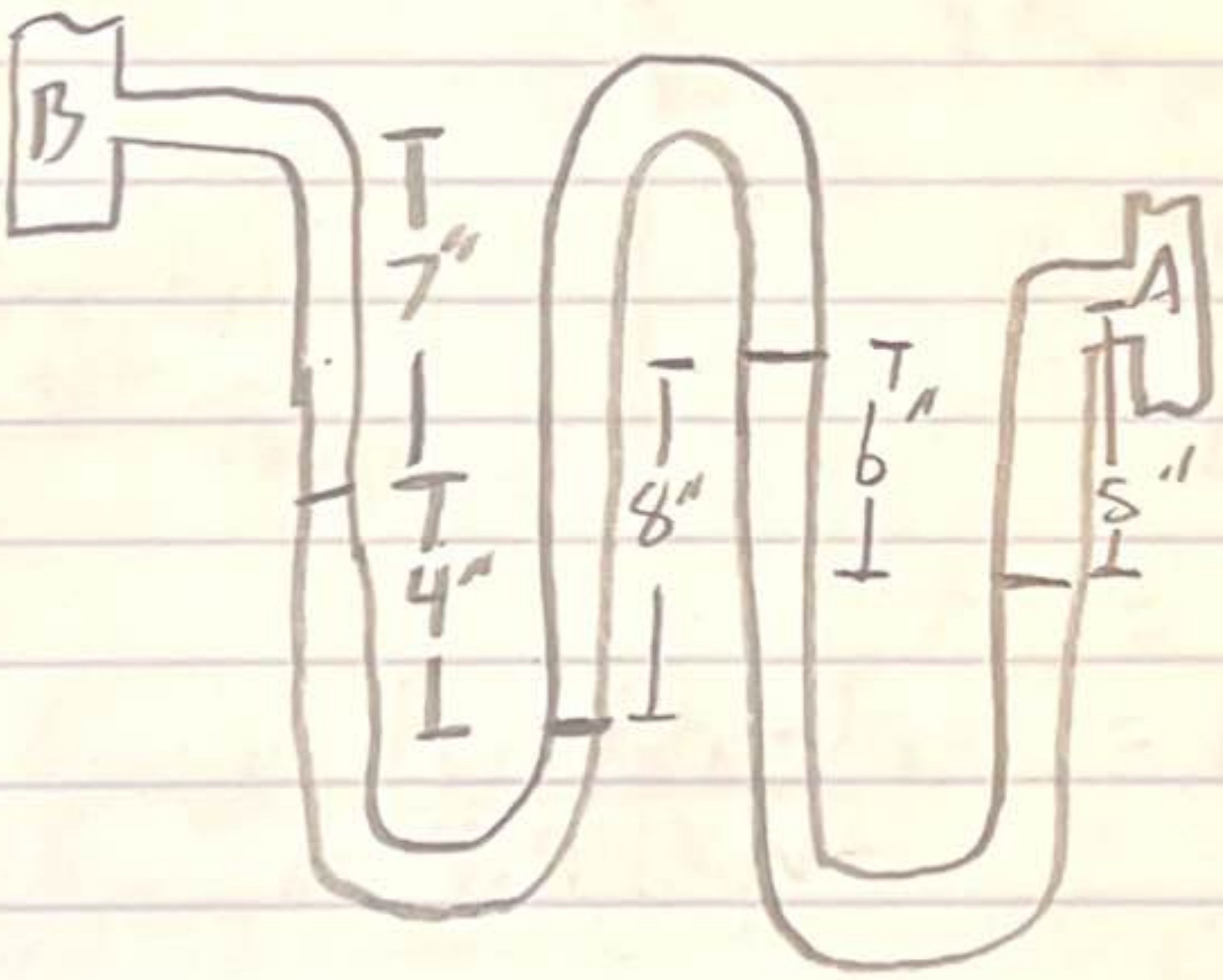
$\gamma_m = 844.9\ lb/ft^3$

$\Delta P = h\gamma$

$P_A + \gamma_{oil} \frac{6}{12} ft - \gamma_m \cdot \frac{8}{12} ft - \gamma_m \frac{6}{12} ft - \gamma_w \frac{6}{12} ft = P_B$

$P_A - P_B = 844.9 \frac{lb}{ft^3} \times 1.167 ft + 62.4 \frac{lb}{ft^3} \times .5 ft - 56.16 \frac{lb}{ft^3} \times .5 ft$

$\boxed{P_A - P_B = 988.84 \frac{lb}{ft^2}}$ or $\frac{ft^2}{144 in^2} = \boxed{6.87 psi}$

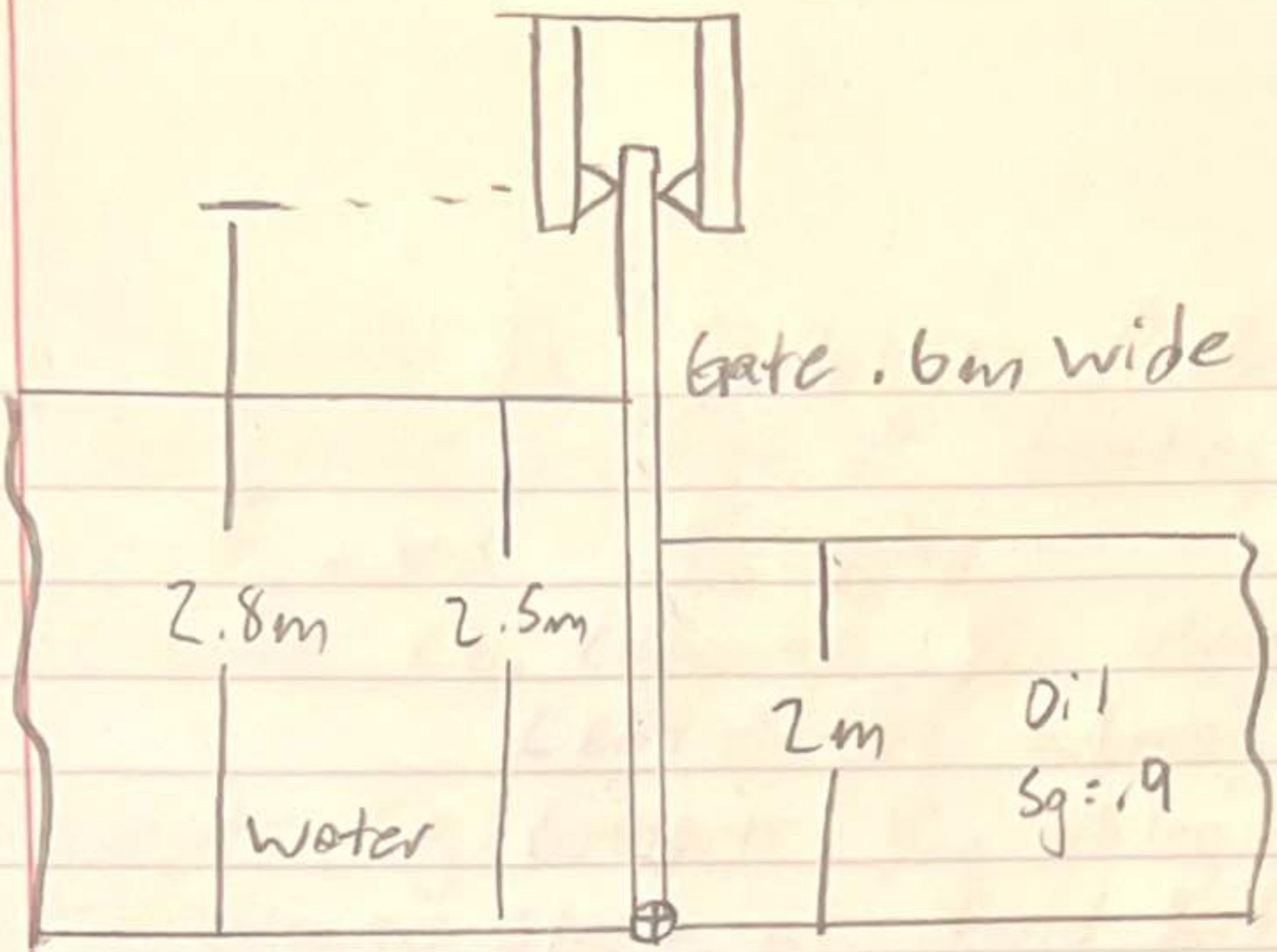


New fluid heights

$P_A + \gamma_{oil} \frac{5}{12} ft - \gamma_m \left(\frac{6+4}{12}\right) ft - \gamma_w\ 7/12\ ft = P_B$

$P_A - P_B = 844.9 \frac{lb}{ft^3} \times .833 ft + 62.4 \frac{lb}{ft^3} \times .583 ft - 56.16 \frac{lb}{ft^3} \times .417 ft$

$\boxed{P_A - P_B = 717.08 \frac{lb}{ft^2} \text{ or } 4.98 psi}$



$F_{Fluid} = \gamma_f \cdot h_c \cdot A$

$\gamma_w = 9.81 KN/m^3$

$\gamma_{oil} = .9 \times 9.81 = 8.83 KN/m^3$

$h_c = \frac{1}{2} h$

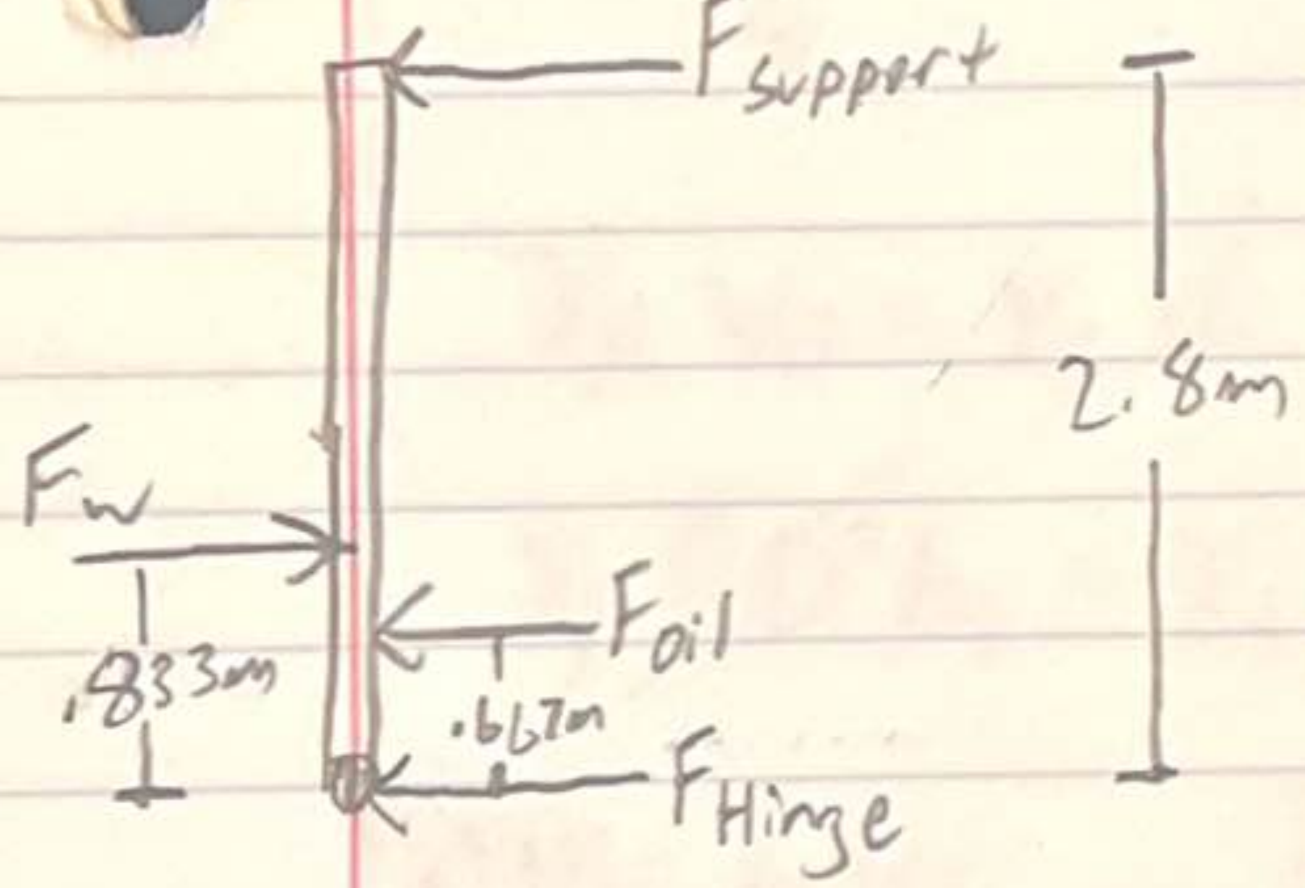
Force acts at $\frac{1}{3}h \Rightarrow F_w$ acts at $\frac{1}{3}h_w$

F_{oil} acts at $\frac{1}{3}h_{oil}$

$F_w = 9.81\frac{KN}{m^3} \cdot \frac{2.5m}{2} \cdot (2.5m \cdot .6m)$

$F_w = 18.39 KN$

$F_{oil} = 8.83\frac{KN}{m^3} \cdot \frac{2m}{2}(2m \cdot .6m)$ $F_{oil} = 10.6 KN$



$\Sigma F = 0 \quad \Sigma M = 0$

$\Sigma M_{Hinge} = 0 = F_w \times .833m - F_{sup} \times 2.8m - F_{oil} \times .667m$

$18.39KN \cdot .833m = 2.8m F_{sup} + 10.6KN \cdot .667m$

$\boxed{F_{sup} = 2.95 KN}$

$F_w = F_{sup} + F_{oil} + F_{Hinge}$

$F_{Hinge} = F_w - F_{oil} - F_{sup} = 18.39KN - 10.6KN - 2.95KN$

$\boxed{F_{Hinge} = 4.84 KN}$

$F_{net} = F_w - F_{oil}$

$= 18.39KN - 10.6KN$

$\boxed{F_{net} = 7.8 KN}$

Procedure for Stability Problems:

1) Determine position of floating body

$F_b = W \qquad F_b = \gamma_f V_d \qquad W = \gamma_{solid} \cdot V$

2) Locate cb; compute y_{cb} using bottom of solid as reference

centroid of submerged portion

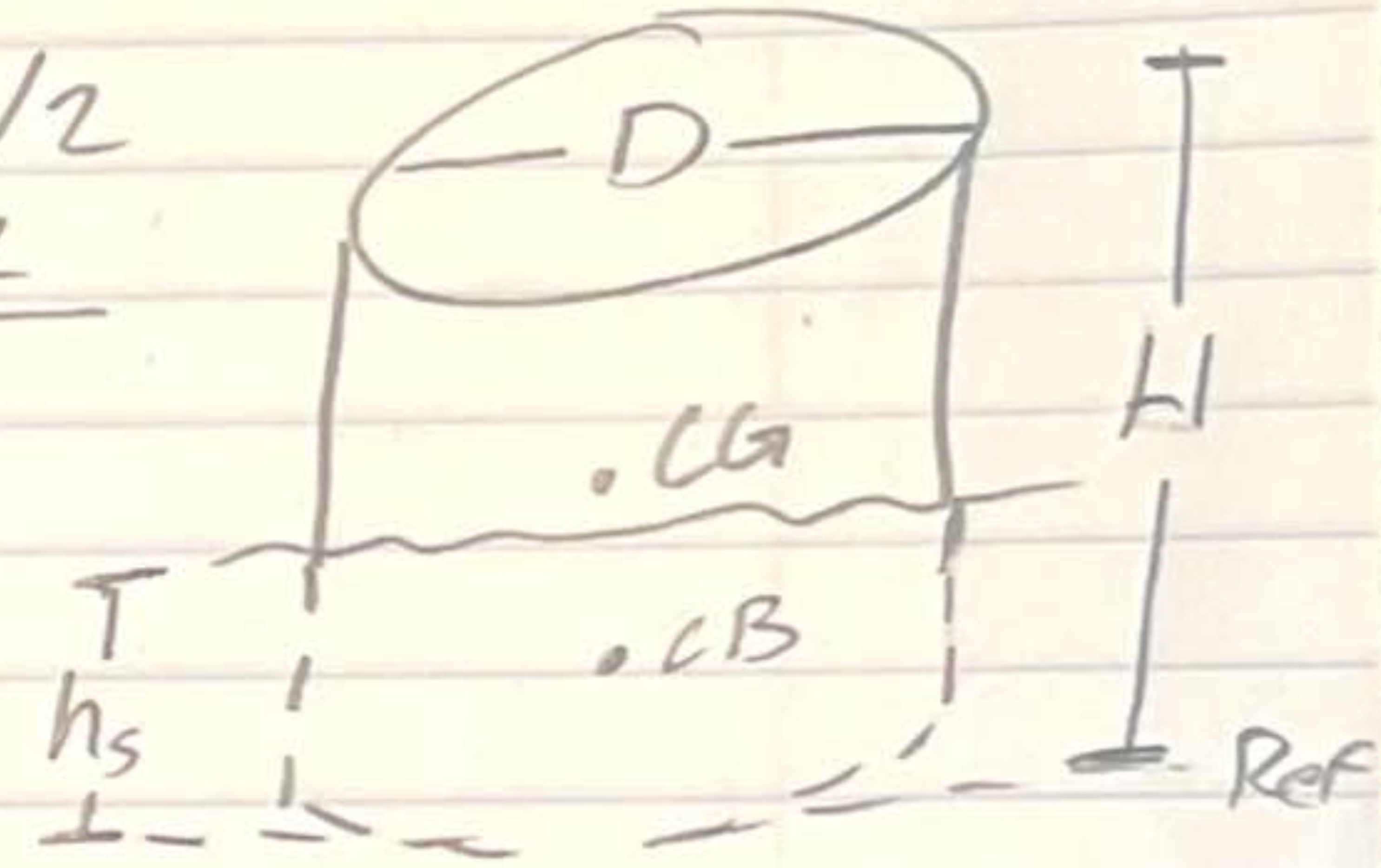
3) Locate cg; compute y_{cg} using same reference
4) Determine shape at fluid surface + compute I
5) compute V_d
6) Compute $MB = I/V_d$
7) Compute $y_{mc} = y_{cb} + MB$
8) If $y_{mc} > y_{cg}$ stable if $y_{mc} < y_{cg}$ unstable

$V_{solid} = \frac{\pi}{4} D^2 \cdot H$

$V_D = \frac{\pi}{4} D^2 h_s$

$y_{CB} = h_s/2$

$y_{CG} = H/2$



$\gamma_f V_d = \gamma_s V_s$

$\gamma_f \cancel{\frac{\pi}{4}} \cancel{D^2} h_s = \gamma_s \cancel{\frac{\pi}{4}} \cancel{D^2} H \qquad \gamma_f h_s = \gamma_s H \qquad h_s = \frac{\gamma_s H}{\gamma_f}$

$MB = I/V_d \qquad I = \frac{1}{64} \pi D^4$

$MB = \frac{\pi D^4}{64} \cdot \frac{4}{\pi D^2 h_s} \qquad MB = \frac{D^2}{16 \cdot h_s}$

$y_{mc} = y_{CB} + MB$

$$y_{mc} = \frac{h_s}{2} + \frac{D^2}{16 h_s}$$

If $y_{mc} - y_{CG}$ is positive => stable

If $y_{mc} - y_{CG}$ is Negative => unstable

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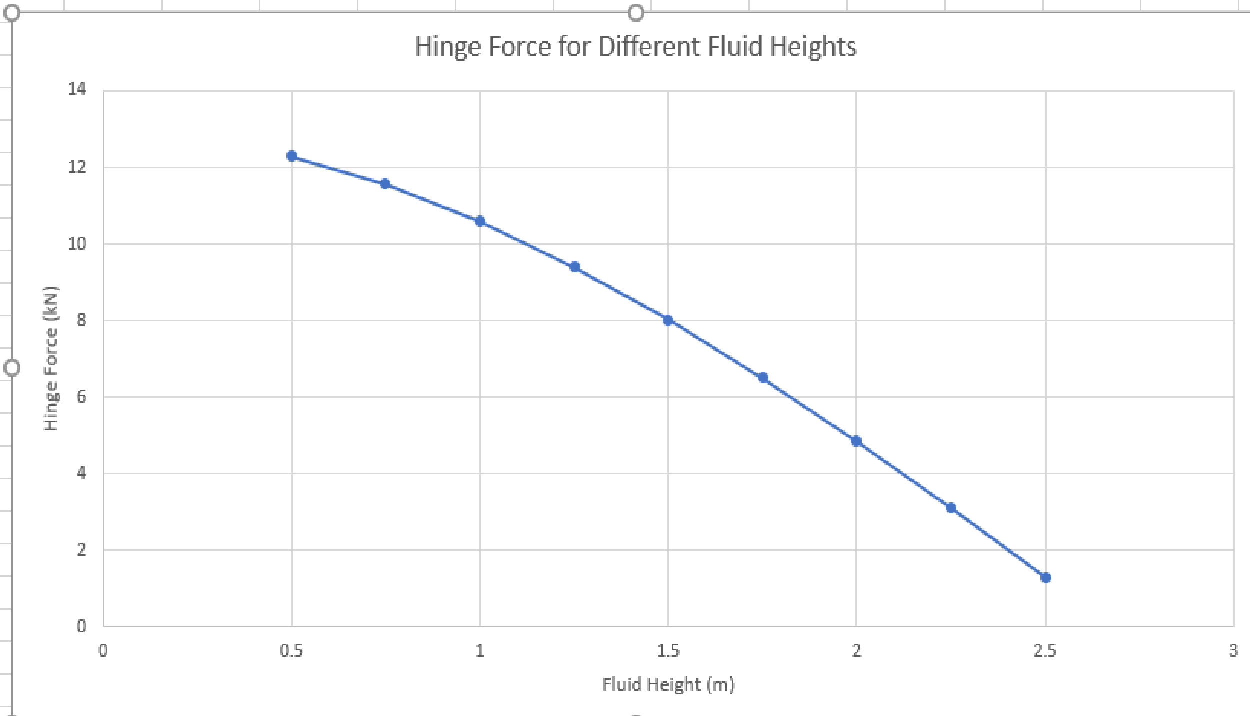
Chart 3

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Height 1	2.5	meters		Height 2	2	meters					Height 2	F hinge
2	Gamma 1	9.81	kN/m3		Gamma 2	8.83	kN/m3		Height Su|	2.8	m	2.5	1.291
3	Width	0.6	m						F support	2.951473	kN	2.25	3.101
4	Hc1	1.25	m		Hc2	1	m		F net	7.79775		2	4.846
5	Area 1	1.5	m2		Area 2	1.2	m2		F hinge	4.846277	kN	1.75	6.497
6	Force 1	18.39375	kN		Force 2	10.596	kN					1.5	8.024
7												1.25	9.396
8	Hp1	0.833333	m		Hp2	0.666667	m					1	10.586
9												0.75	11.562
10												0.5	12.297



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Gamma S	3	kN/m3		h_s	0.550459	m	H	Y_cb	Y-mc		H	Y_cb	Y_mc
2	Gamma F	9.81	kN/m3					0.5	0.076	0.179		1	0.153	0.357
3	Diameter	1	m		Y_cg	0.9	m	0.6	0.092	0.177		1.2	0.183	0.354
4	Height	1.8	m		Y_cb	0.275229	m	0.7	0.107	0.18		1.4	0.214	0.36
5					Y_mc	0.388771	m	0.8	0.122	0.186		1.6	0.245	0.372
6								0.9	0.138	0.294		1.8	0.275	0.389
7					Stable?	0.113542