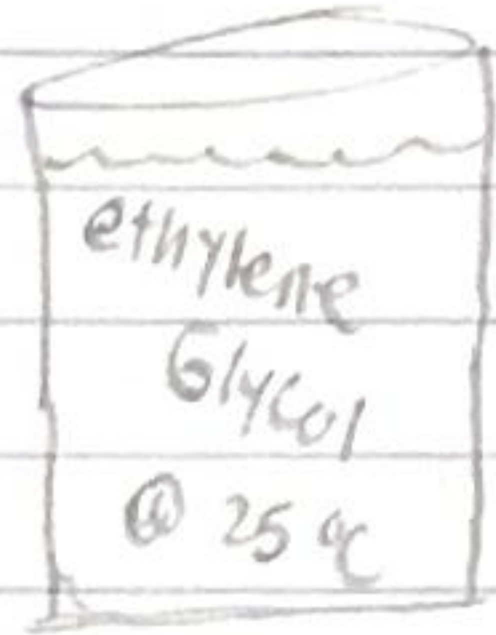
Callaway Marly 9/18 1/5

MET 330

HW 1.3

3.41



find pressure @ depth of 12 m in an open tank of ethylene glycol

depth at 12.0 m

what is pressure?

Using Appendix B

@25 °C → $\gamma = 10.79\ kN/m^3$

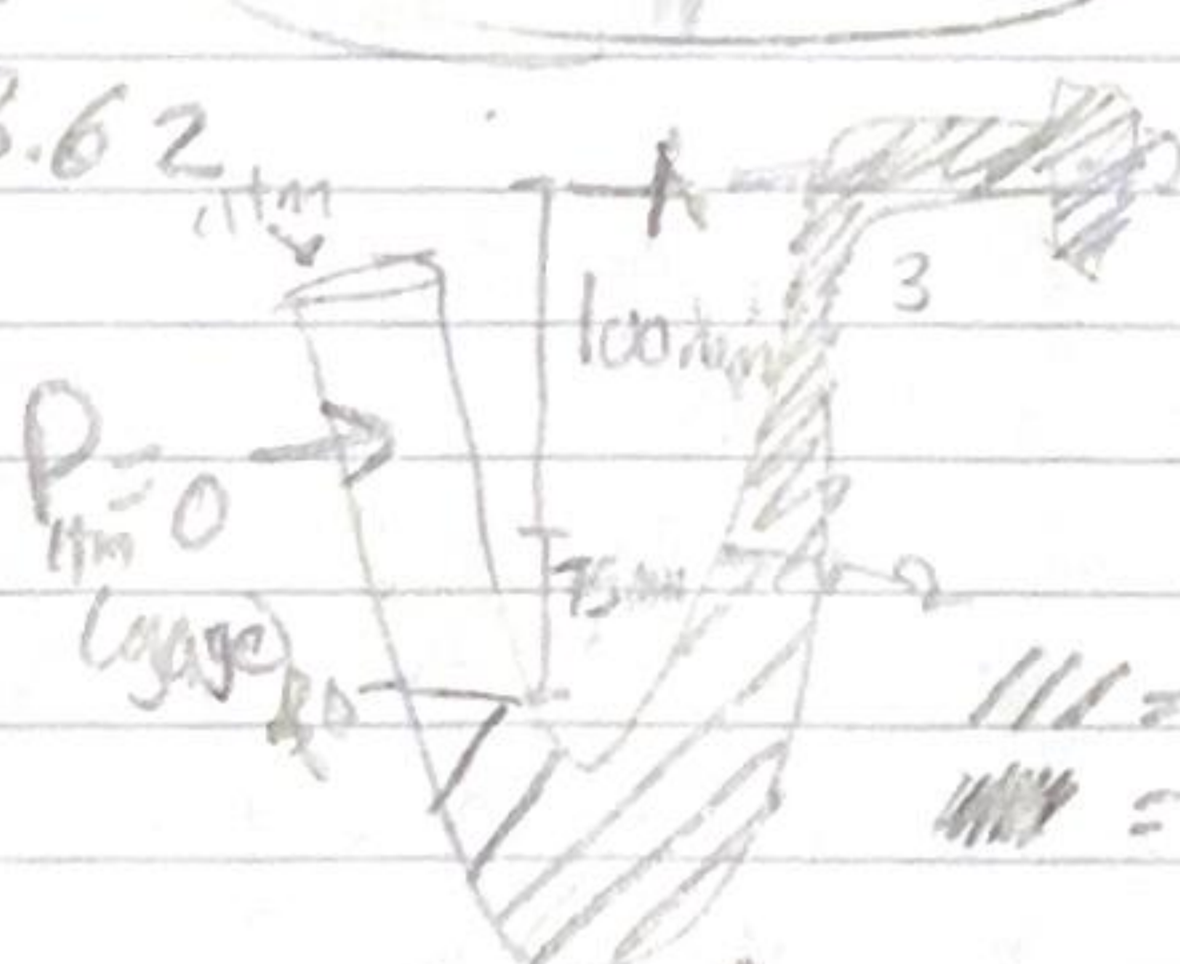
$\Delta P = \gamma h$

$= (12.0 m)\cdot(10.79\ kN/m^3)$

$= 129.5\ kN/m^2 = 129.5\ kPa$

gage pressure 129.5 kPa

3.62



I'm saying this is all at 25 °C

Calculate pressure at A in kPa gage

/// = mercury $sg_m = 13.54$

//// = water

Appendix B

$P_{00_{mm}}$

$P_A = \gamma_w (100 mm) - \gamma_m (75 mm)$

$P_A = 9.78\ kN/m^3 (100 mm)\left(\frac{1 m}{1000 mm}\right) - (132.6\ kN/m^3)\cdot(75 mm)\left(\frac{1 m}{1000 mm}\right)$

$P_A = -8.982\ kN/m^2$

~~almost~~ 9 kPa gage, this shows a vacuum?

−8.98 kPa gage

3.83/

barometer reading in inches of mercury for an atm pressure of 14.2 psia

normal is like 14.7 psia ← from my brain

normal hg for that is 29.92 Hg
I checked,

$P_{atm} = \gamma_m (h)$

totally linear with height change using SI values

So: $\frac{h_m}{14.2 \text{ psia}} = \frac{29.92 \text{ inhg}}{14.7 \text{ psia}}$

$h_m = 28.90 \text{ inhg}$

3.90/ Vacuum chamber pressure is -12.6 psi gage. whats that in in hg

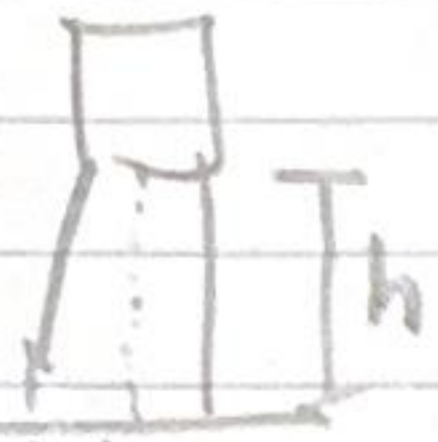
psi → inhg

in Section 3.8 it gives 1.0 inhg = .491 psi

$\frac{x \text{ in hg}}{-12.6 \text{ psi}} = \frac{1 \text{ in hg}}{.491 \text{ psi}}$ ⇒ it is -25.66 in

-25.66 in-Hg

3.94



flow to roller

h = elevation of tank ← inches of water?

Minimum static gage pressure of 16.0 kPa

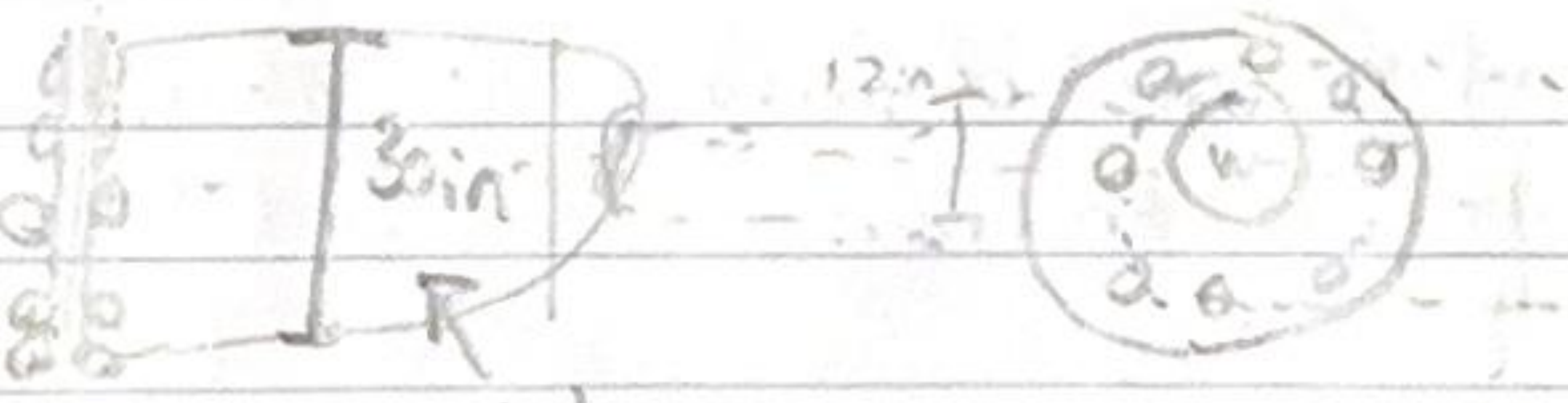
Using Appendix K, under pressure.

$249.1 \text{ Pa} = 1 \text{ in} \cdot H_2O$

$$\frac{.2491 \text{ kPa}}{1 \text{ in} \cdot H_2O} = \frac{160 \text{ kPa}}{X \text{ in } H_2O} \qquad X \text{ in } H_2O = 642.3 \text{ in water}$$

$$642 \text{ in} \left(\frac{1 \text{ ft}}{12 \text{ in}}\right) = 53.5 \text{ ft}$$ minimum to bottom of tank

4.2 Fig P4.1



internal pressure is 23.6 psig. total force resisted by bolts, upon flange?

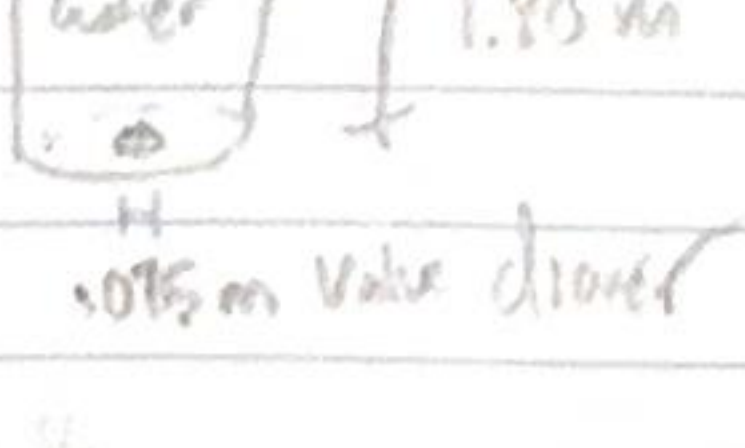
$A = \pi r^2$
$= (\tfrac{30}{2} \text{ in})^2 \pi$
$= 707 \text{ in}^2$

$P = F/A \Rightarrow F = PA$

$F = 23.6 \text{ psi} \cdot (707 \text{ in}^2)$

$F = 16682 \text{ lbs}$

4.16



.075 m valve diameter

how much force to open valve?

F_w force of water $= p \cdot A = A(9.81 \text{ kN/m}^3 \cdot 1.8 \text{ m})$
$\gamma_w \cdot h = P_w$

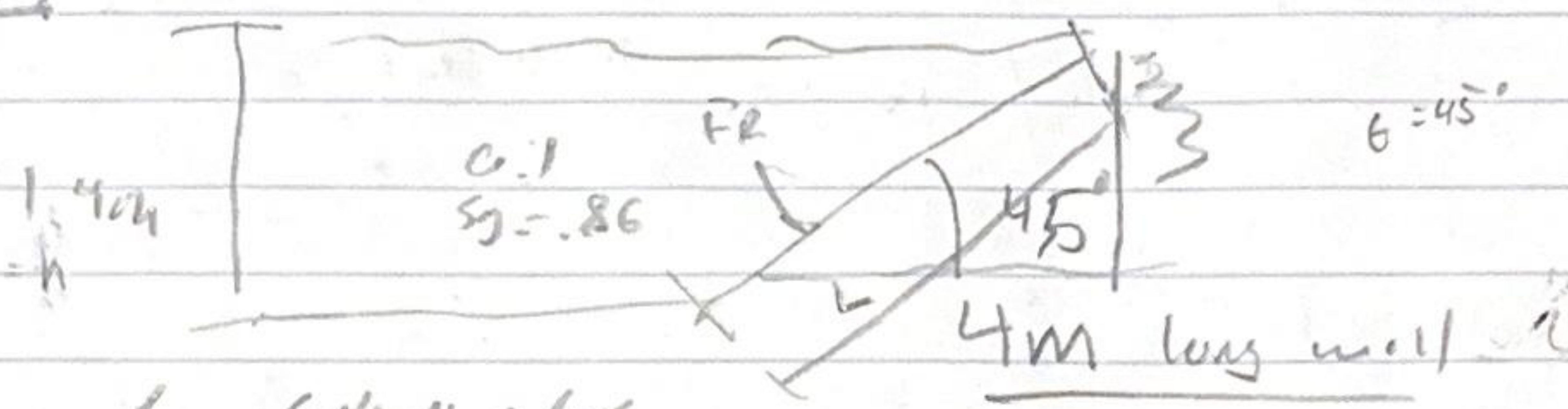
$A = (.075 \text{ m}/2)^2 \cdot \pi$

$A = 4.42 \times 10^{-3} \text{ m}^2$

9.81 kN/m³ · 1.8 m · 4.42×10⁻³ m²

$F = 78 \text{ N}$

4 17



from section 4 in book

Sol

$$F_R = \gamma (h/2) A$$

$\sin\theta = h/L$

$$L = h/\sin\theta = 1.4m / \sin 45° = 1.98m$$

$$A = h \cdot 4 = (1.98m) \cdot (4m) = 7.92 m^2$$

So $F_R = \gamma (h/2) A = (Sg) \cdot (9.81 kN/m^3)(h/2) A$

$$= (.86)(9.81 kN/m^3) \cdot (1.4m/2)(7.92 m^2)$$

$F_R = 46.77 kN$

Step 2, also from book

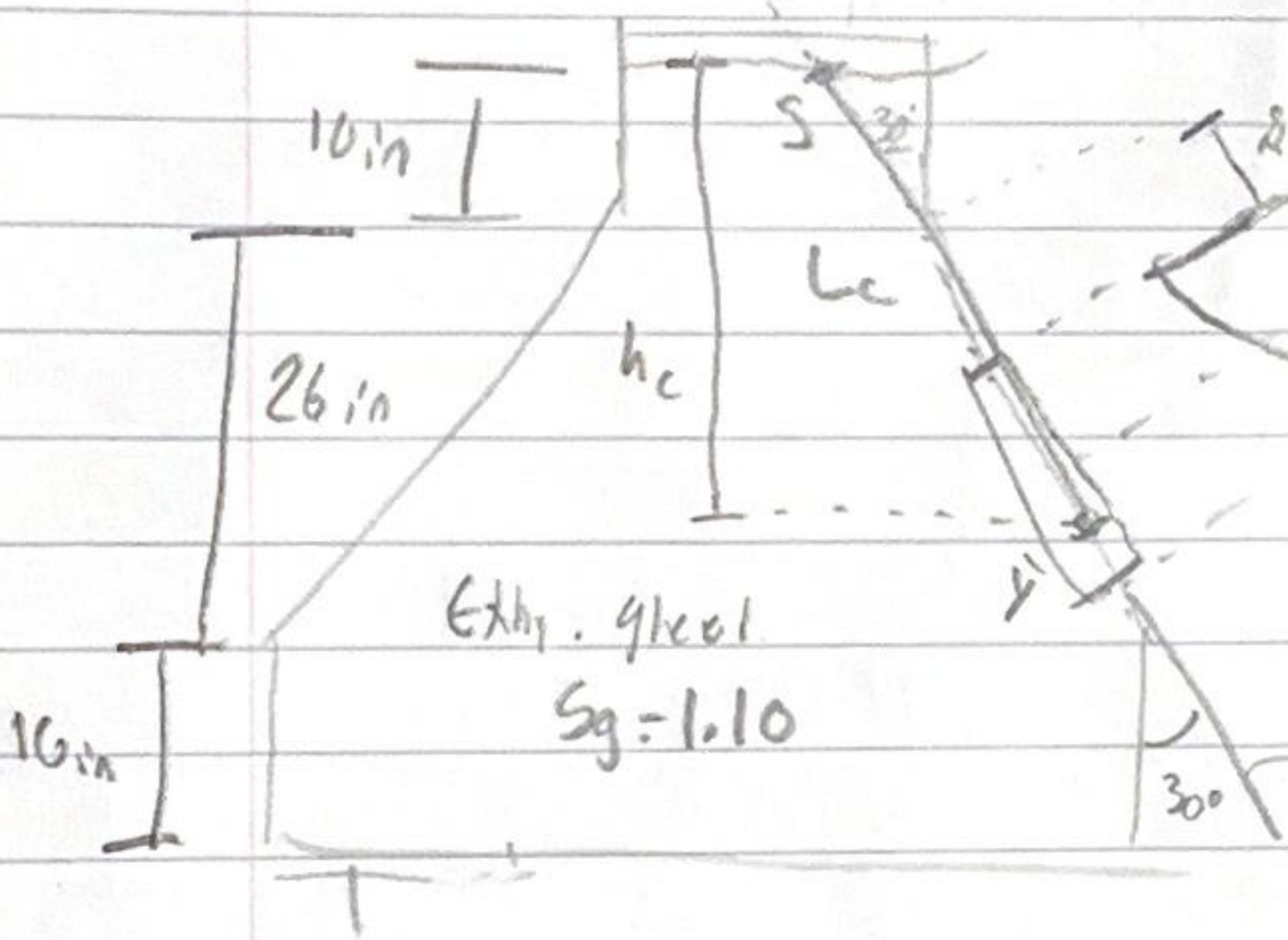
vertical pressure center located at $h/3$: $1.4m/3 = .4\bar{6}$ m

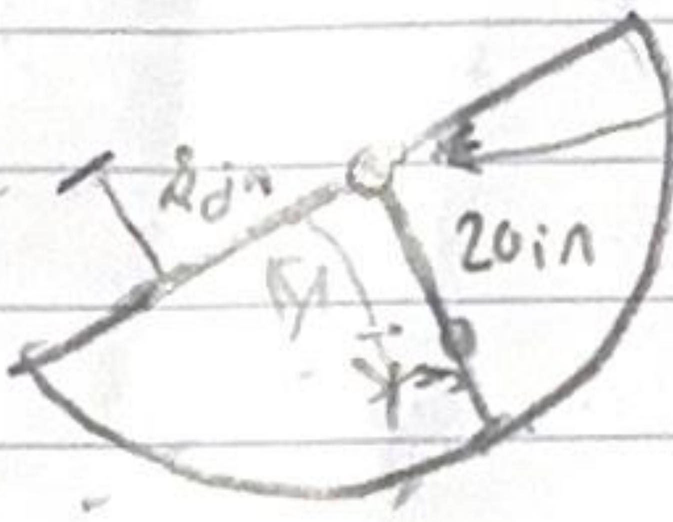
horizontal pressure center is at $L/3$: $1.98m/3 = .66$ m

from depth

the center of pressure is at a height of .46 meters measured from the bottom (depth), or .66 m up the surface of the dam, (using the dam surface as the measurement surface)

4.28) Compute magnitude of F_R on indicated area @ location of center of pressure, show F_R and clearly dimension.

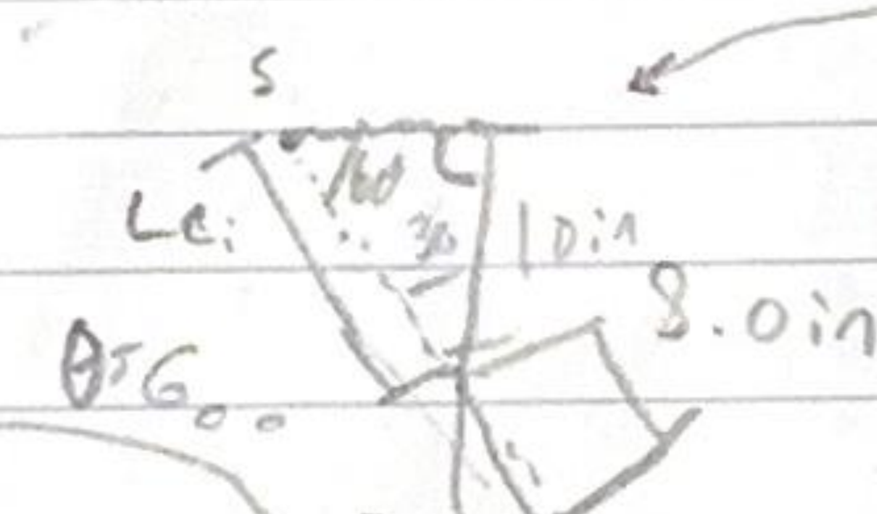




$\bar{Y}$ = Centroid

$\bar{Y}$ for semicircle $= 4r/3\pi$ from

$= \frac{4(20\text{ in})}{3\pi} = 8.49\text{ in}$



$L_c = 8.49\text{ in} + 8.0\text{ in} + 20\text{ in} = 36.49\text{ in} = 36.5\text{ in}$

$\cos 60° = 10/L_c \Rightarrow L_c = 20\text{ in}$

$h_c = L_c(\sin\theta) = 31.6\text{ in}$

$F_R = \gamma h_c A$

$F_R = (1.10)\cdot(62.4\text{ lb/ft}^3)\cdot(31.6\text{ in})\cdot(\tfrac{1}{2}\pi(20\text{ in})^2)$

$= (68.64\text{ lb/ft}^3)\cdot(19854.8\text{ in}^3)\cdot(1\text{ ft}^3/1728\text{ in}^3)$

$F_R = 788\text{ lb}$

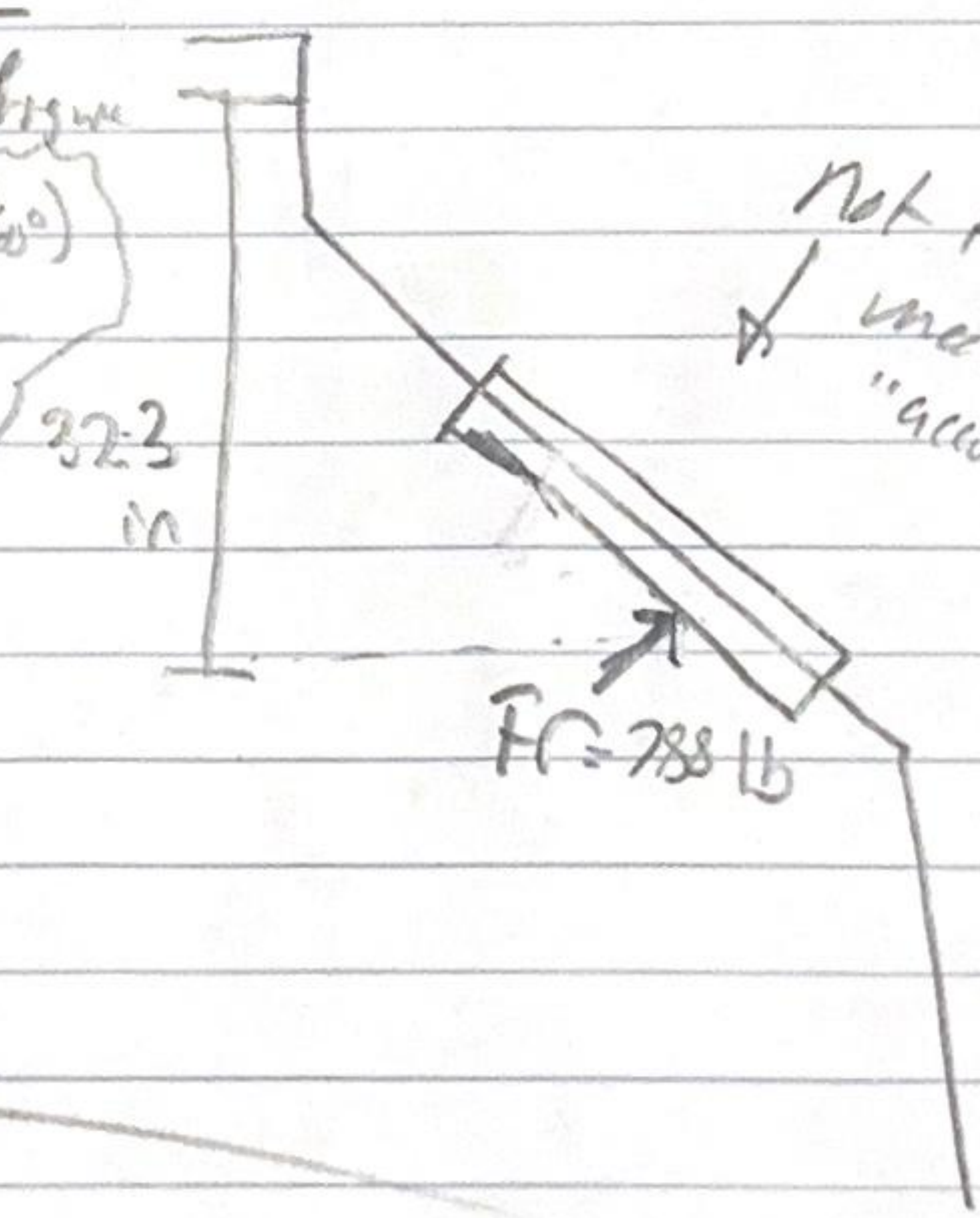
$h_p = h_c + \frac{I_c \sin^2\theta}{h_c A}$ ~~step~~ on figure

Ic from APPL

$= 31.6\text{ in} + \frac{[(6.86\times10^{-3})(40\text{ in})^4]\cdot\sin^2(60°)}{(31.6\text{ in})(\tfrac{1}{2}\pi(20\text{ in})^2)}$

vertical $h_p = 32.3$ in

* Center of pressure as a depth from surface of liquid



Not to scale, measurements "accurate"