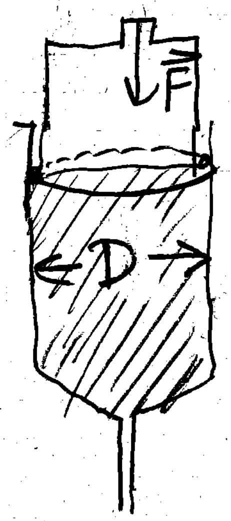
1. RHK4 17.1



$D = 1.12\ cm = 0.0112\ m$

$F = 42.3\ N$

$$P = \frac{F}{A} = \boxed{\frac{F}{\pi (D/2)^2}}$$

$$= \frac{42.3}{\pi (0.0112/2)^2}$$

$$= 4.29 \cdot 10^5\ \frac{N}{m^2}$$

$$= \boxed{4.29 \cdot 10^5\ Pa}$$

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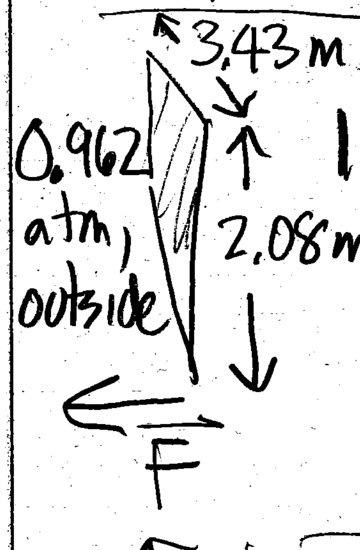
2. RHK4 17.3



$\Delta p = 1 - 0.962$

$= 0.038\ atm$

$1\ atm = 1.01 \cdot 10^5\ Pa$

$\Delta p = 0.038 \cdot 1.01 \cdot 10^5\ Pa$

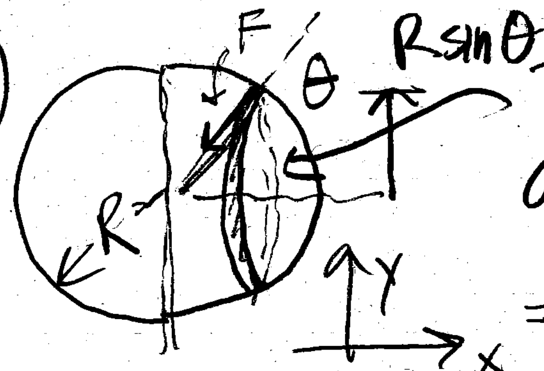
$= 3840\ Pa$

$$\boxed{F = \Delta p A} = 3840 \cdot (3.43 \times 2.08)$$

$$\boxed{F = 27{,}400\ N}\ !$$

3. RHK4 17.6

(a)



This annulus has area: $(R\,d\theta)\cdot(R\sin\theta)$

$= 2\pi R^2 \sin\theta \, d\theta$

$F = 2\pi \Delta p \cdot R^2 \sin\theta \, d\theta$

but vertical components cancel,

$dF_x = -F\cos\theta$

$dF_x = -2\pi \Delta p R^2 \sin\theta \cos\theta \, d\theta$

on $\frac{1}{2}$ of hemi: $F_x = -2\pi\Delta p R^2 \underbrace{\int_0^{\pi/2} \sin\theta\cos\theta\, d\theta}_{\frac{1}{2}\sin^2\theta \Big|_0^{\pi/2} = \frac{1}{2}}$

$$\boxed{F_x = -\pi R^2 \Delta p \quad \text{(not } 2\pi R^2 \Delta p!)}$$

(b) $|F_x| = -\pi (0.305)^2 ((1-0.1)\cdot 1.01\cdot 10^5)$

$$\boxed{|F_x| = 26{,}600 \text{ N}}$$

(c) Two teams: more spectacle, and, no danger of pulling down the building or structure that the other end of the spheres is attached to.

4. RHK4 17.12

$$a = 8.55 \text{ km}$$

$$p = p_0 e^{-y/a} \qquad p_0 = 1.01 \cdot 10^5 \text{ Pa}$$

(a) $p = (1.01 \cdot 10^5) e^{-5/8.55}$

$$= 5.63 \cdot 10^4 \text{ Pa}$$

in atm $\boxed{p = \frac{5.63 \cdot 10^4}{1.01 \cdot 10^5} = 0.557 \text{ atm}}$

(b) $0.50 = \frac{\cancel{1.01 \cdot 10^5}}{\cancel{1.01 \cdot 10^5}} e^{-h/a}$

$$\boxed{h = a \ln 2 = 5.93 \text{ km}}$$

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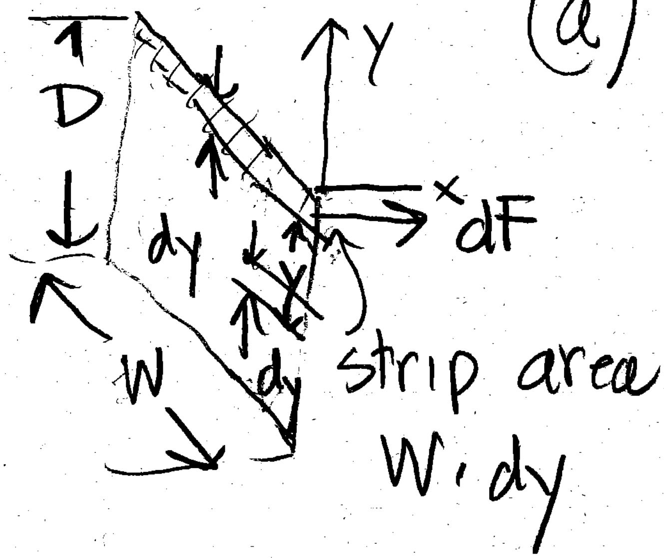
5 RHK4 14



(a) $h = -y$

$$P = P_0 + \rho g h$$

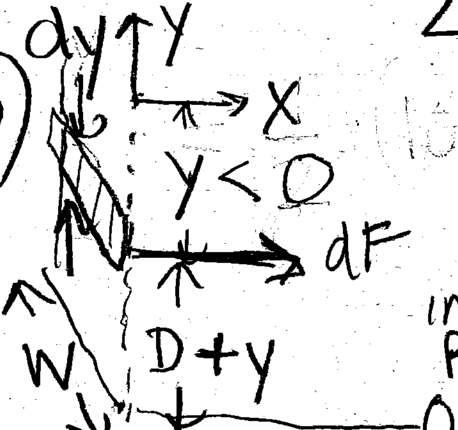
$$(P - P_0) = -\rho g y$$

$$dF = (P - P_0)\,W\,dy = -\rho g W\, y\,dy$$

$$F = -\rho g W \int_{y=-D}^{y=0} y\,dy = -\rho g W \left(\tfrac{1}{2} y^2 \Big|_{-D}^{0} \right)$$

$$F = \tfrac{1}{2} \rho g W D^2$$

(b)



$$d\tau = (D + y)(-\rho g W y\,dy)$$

into page

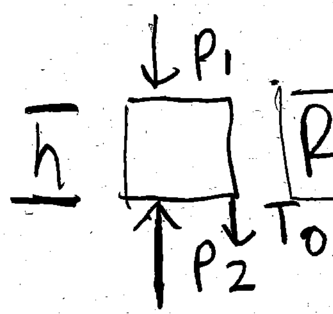
$$\tau = -\rho g W \int_{y=-D}^{y=0} y(D+y)\,dy = -\rho g W \left(\tfrac{1}{2} D y^2 + \tfrac{1}{3} y^3 \right)\Big|_{-D}^{0} = -\rho g W \left(\tfrac{-1}{2} D^3 + \tfrac{1}{3} D^3 \right)$$

(b) $\boxed{\tau = \frac{1}{6}\rho g W D^3}$

(c) The distance above O's elevation given by

$$\boxed{\frac{\tau}{F} = \frac{\frac{1}{6}\rho g W D^3}{\frac{1}{2}\rho g W D^2} = \frac{1}{3}D}$$

6 RHK4 17.28



Rest

$$p_2 A - p_1 A - T_0 = 0$$

$$T_0 = (p_2 - p_1)A$$

$$= \rho_L g h A$$

accelerating

refer to figure 2, p. 380

$$pA - (p + dp)A - \rho_L g A\,dy = \underbrace{(\rho_L A\,dy)\,a}_{\text{mass} \times \text{acc.}}$$

$$\frac{dp}{dy} = -(g+a)\rho_L$$

$$p_2 - p_1 = \rho_L (g+a) h$$

$$T = \rho_L (g+a) h A$$

$$\boxed{T = (\rho_L g h A)\left(1 + \frac{a}{g}\right) = T_0\left(1 + \frac{a}{g}\right)}$$

7. RHK4 17.31

31. (a) Still 35.6 kN.

(b) Yes, from $\dfrac{35{,}600\text{ N}}{1000 \cdot 9.8 \frac{N}{m^3}}$

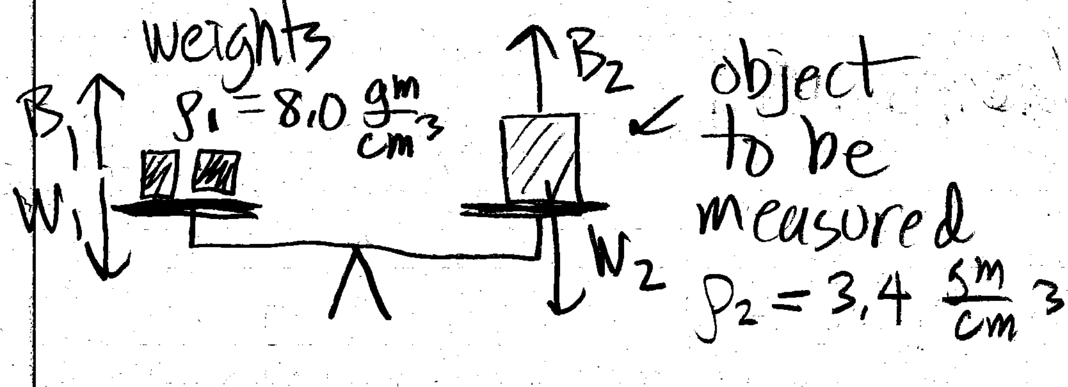
$= 3.63 \text{ m}^3$

to $\dfrac{35{,}600 \text{ N}}{1024 \cdot 9.8} = 3.55 \text{ m}^3$

$\Delta V = 3.63 - 3.55 = 0.085 \text{ m}^3$

$\dfrac{\Delta V}{V_0} = 2.34\%$

8. RHK4 17.35



$W_1 - B_1 = W_2 - B_2$

$= W_2 = W_1 + \underbrace{B_2 - B_1}_{\text{error}}$ want fractional error

$$\frac{B_2 - B_1}{W_2} = \frac{\rho_A V_2 - \rho_A V_1}{\rho_2 V_2} = \frac{\rho_A}{\rho_2}\left(1 - \frac{V_1}{V_2}\right)$$

but (approximately) $\rho_2 V_2 = \rho_1 V_1$

$$\frac{V_1}{V_2} \simeq \frac{\rho_2}{\rho_1}$$

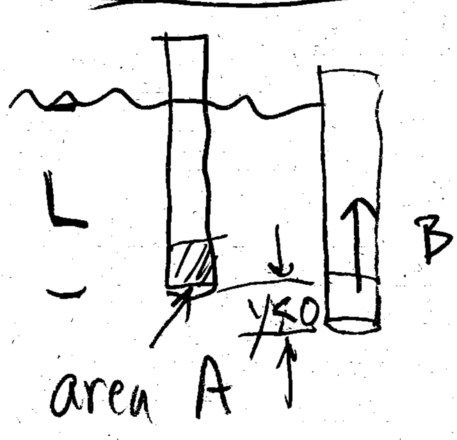
so fractional error is...

$$\boxed{\frac{B_2 - B_1}{W_2} = \frac{\rho_A}{\rho_2}\left(1 - \frac{\rho_2}{\rho_1}\right)}$$

$$= \frac{1.2 \cdot 10^{-3}\ \mathrm{gm/cm^3}}{3.4\ \mathrm{gm/cm^3}} \cdot \left(1 - \frac{3.4\ \mathrm{gm/cm^3}}{8.1\ \mathrm{gm/cm^3}}\right)$$

$$\boxed{\begin{aligned}\frac{B_2 - B_1}{W_2} &= 0.00020 \\ &= 0.02\%\end{aligned}}$$

9. RHK4 17.46 (a)



push down distance y, extra water with:

$V = -\rho A y$ displaced

B (buoyant force) = weight displaced water

$$B = \underline{-\rho_w A y g} \quad \underline{\propto -y} \quad \text{SHO}$$

(b) $M\ddot{y} = -(\rho_w A g)\, y$

↳ determine from L; $M = \rho_w A L$

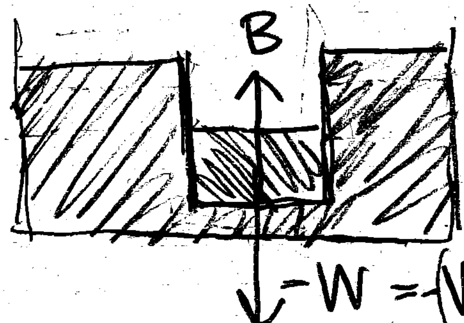
so $\cancel{\rho_w A} L \ddot{y} = -\cancel{\rho_w A} g y$

$$\ddot{y} = -\frac{g}{L} y$$

$$\omega = \sqrt{\frac{g}{L}} \quad \boxed{T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{L}{g}}}$$

10, RHK4 17.48 (ρ_w = density of water
V_{Bi} = Volume inside beaker = 500 gm
V_B = beaker volume cm

Beaker: $M_{beaker} = 390\,g$



$$B = (\rho_w V_{Bi} + \rho_w V_B)\, g$$

$$-W = -(W_b + W_w) = -(M_B g + \tfrac{1}{2}\rho_w V_{Bi} g)$$

$$B - W = 0 \Rightarrow B = W$$

$$(\rho_W V_{Bi} + \rho_W V_B)\cancel{g} = M_B \cancel{g} + \frac{1}{2}\rho_W V_{Bi} \cancel{g}$$

$$V_{Bi} + V_B = \frac{M_B}{\rho_W} + \frac{1}{2} V_{Bi}$$

$$V_B = \frac{M_B}{\rho_W} - \frac{1}{2} V_{Bi}$$

$$\boxed{\rho_B = \frac{M_B}{V_B} = \frac{M_B}{\frac{M_B}{\rho_W} - \frac{1}{2} V_{Bi}}}$$

$$\rho_B = \frac{390\ g}{\frac{390\ g}{1\ g/cm^3} - \frac{1}{2} \cdot 500} = \frac{390\ g}{140\ cm^3}$$

$$\boxed{\rho_B = 2.78\ gm/cm^3}$$