New HW - fluids (up soon)

EXAM 3

Rotational Motion — constant acceleration; conservation of Energy; 2nd Law

$\sum \vec{F} = ma$

$\sum \vec{\tau} = I\alpha$

Ch. 9, 10, 11

Ch. 12

Pressure, Fluids

Final Exam (Comprehensive)

1/2 on "new material" — Periodic Motion; Waves; Sound

Ch. 14, 15, 16

1/2 on "old material — already tested

Archimedes (~~~350~~ (?) B.C.) ~250 B.C.

IDEA: An object wholly or partly immersed in a fluid is bouyed up by a force (buoyant force) whose magnitude is equal to the weight of the fluid displaced.

"Touch" ds the fluid

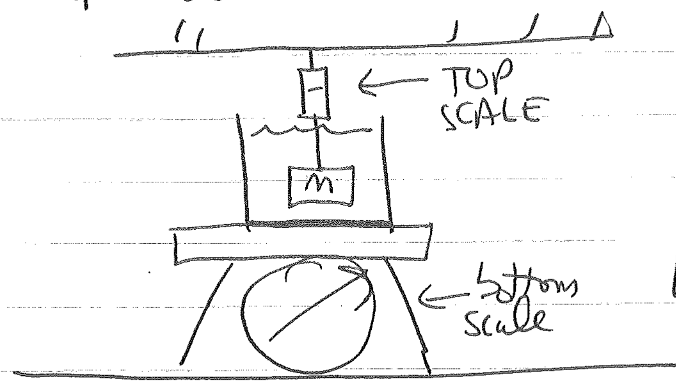
2^{nd} Law Problems, w/ $\vec{F}_{buoyant}$

Recall: $\rho = \dfrac{\text{Mass}}{\text{Volume}}$

Suppose that an object has a volume $\bar{V}$ immersed in a fluid, then that same volume of fluid has been displaced.

$$\begin{bmatrix}\text{Weight of fluid} \\ \text{displaced}\end{bmatrix} = M_{fluid}\, g = (\rho_{fluid} V)\, g$$

EX)



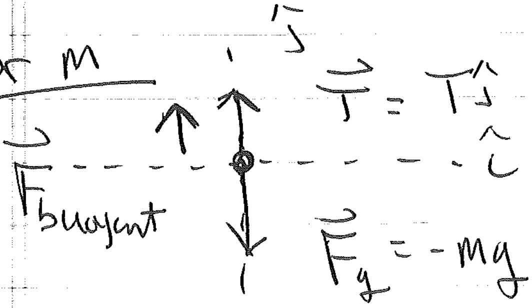
Mass 'm' w/ volume V

Let mass of (water + beaker) be M

fluid has density ρ.

Find the readings on each scale.

for m



$\vec{T} = T\hat{j}$

$\vec{F}_g = -mg\hat{j}$

$\vec{F}_{buoyant} = M_{fluid}\, g\, \hat{j}$

$= (\rho_{fluid} \bar{V}_{fluid})\, g\, \hat{j}$

$= \rho V g\, \hat{j}$

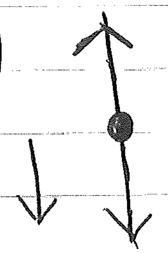
2^{nd} $\boxed{\hat{j}}$ $\sum F_y = m\cancel{a_y}^{\,0}$

$+T + \rho V g - mg = 0$

$\therefore\ T = Mg - \rho V g$ Reading of Top Scale. ☺

for the (water + beaker), M

$N\hat{j} = \vec{N}$ $+\hat{j}$



$-\rho V g\,\hat{j} = \vec{F}_{buoyant}$ $\vec{F}_g = -Mg\,\hat{j}$

2^{nd} $\boxed{\hat{j}}$ $\sum F_y = M\cancel{a_y}^{\,0}$

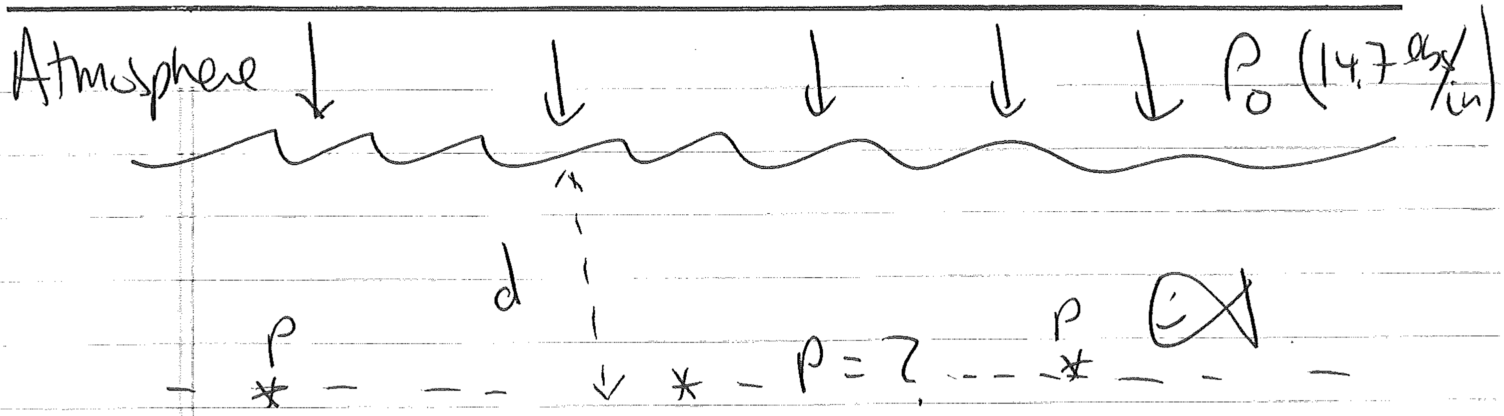
$+N - \rho V g - Mg = 0$

$N = Mg + \rho V g$ Reading of bottom Scale

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

SI: pascal (Pa)
torr
lbs/in.
mm Hg

- Force is $\perp$ to area
- Transferred to every point in a fluid. (Pascal's principle)



@REST

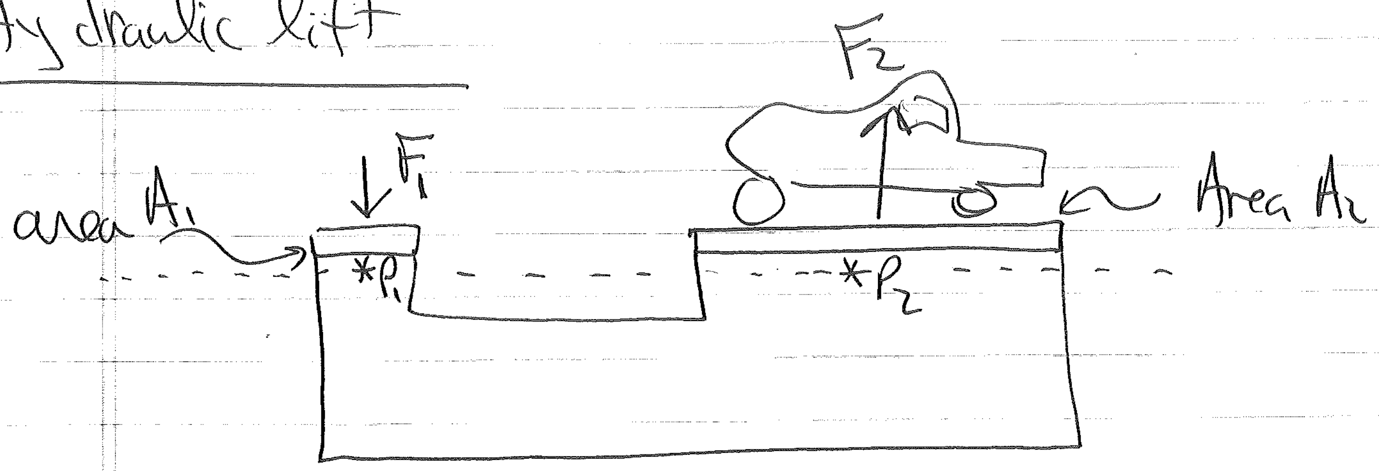
$$P = P_0 + \rho g d$$

does not depend on size of the container

Ex. 12.4 Pg(375)
Prob. 12.59

Pressure same along horizontal

Hydraulic lift



$$P_1 = F_1/A_1 \qquad P_2 = F_2/A_2$$

$$P_1 = P_2$$

$$\therefore \frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$$F_1 = \frac{A_1}{A_2} F_2$$

large

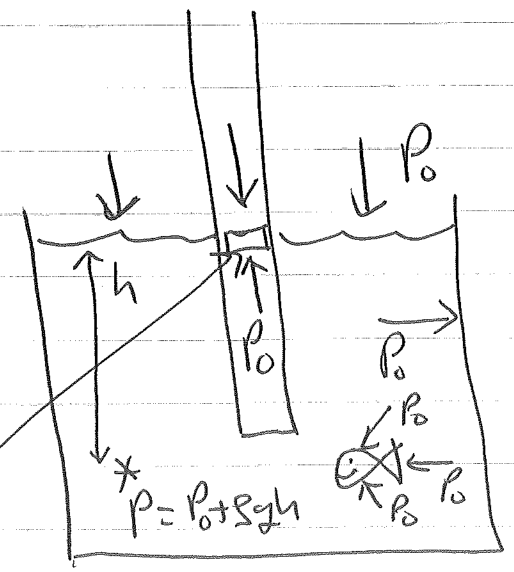
small

so long as $A_2 >> A_1$

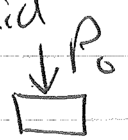
Bar Bet:

Set up:

Straw in a cup

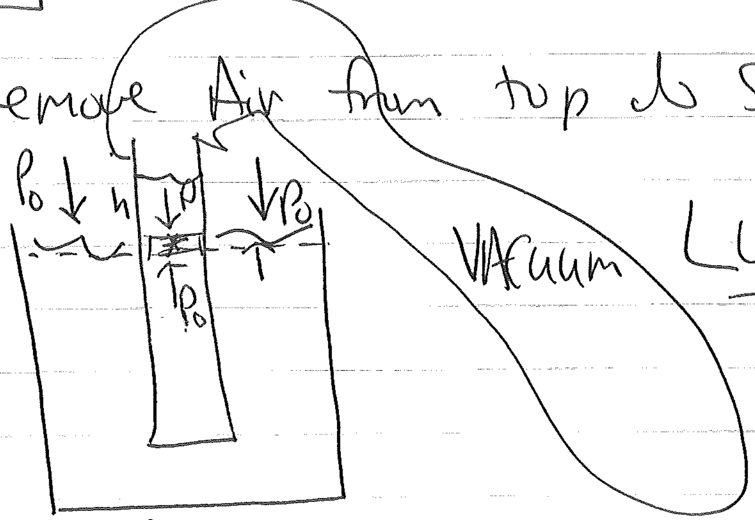


for this piece of fluid



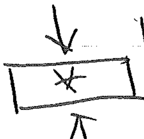
"Now remove Air from top of Straw"

No "sucking"



LUNG

NEWTON SAYS!



$P = \rho g h$ ← height of water column

"Equilibrium" $\Rightarrow P_0 = \rho g h$

$\therefore h = \frac{P_0}{\rho g} = 10.3$ meters @ 14.7 lbs/in

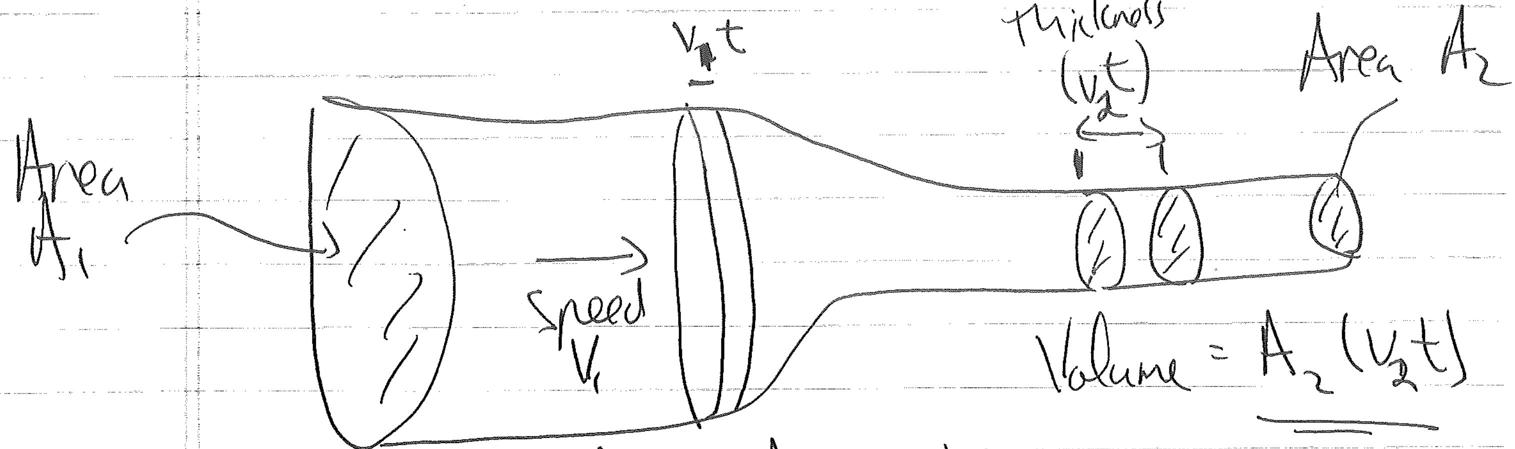
WATER

Absolute Pressure (Includes atmospheric)

* Gauge Pressure (does not include atmospheric)

Moving fluids

Eqtn. of Continuity (what goes in, comes out) *



Volume $= A_1(v_1 t)$

* $$\boxed{A_1 v_1 = A_2 v_2}$$

Bernoulli: Pressure is lowered in a moving fluid