

I plan to skip Solids ... stress, strain for now

Fluid Mechanics

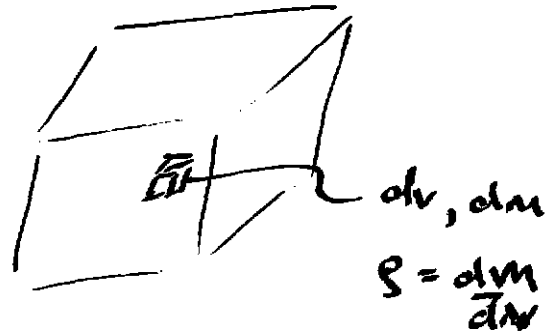
Hydrostatics

Average
Volume density = $\frac{M}{V} \equiv \rho \text{ kg/m}^3$



We will see

Area densities
line densities
in P114



Specific gravity = $\frac{\rho_{\text{material}}}{\rho_{\text{water}}}$

$dm = \rho dv$

unitless

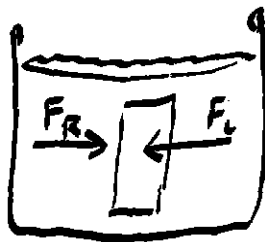
$\rho_{\text{H}_2\text{O at } 4^\circ\text{C}} = 1000 \text{ kg/m}^3 = 1 \text{ g/cm}^3$

This has nothing to do w/ gravity really

if specific gravity > 1 object will sink in water at 4°C

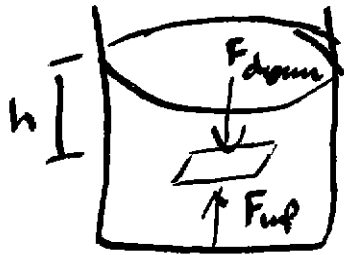
< 1 " " float " " "

Consider a bucket of water with a (Surrounding) plastic wrap divider
w/ fluid at rest



Total force of the fluid on the plastic wrap is 0 or it would accelerate

$\therefore \vec{F}_L = \vec{F}_R$



Same if plastic wrap oriented this way
 what is F_{down} ?



Mass of fluid = $\rho_{fluid}(\text{Volume})$

$$\therefore F_{down} = F_0 + \rho V g$$

$$\frac{F_{down}}{Area} = \frac{F_0}{Area} + \frac{\rho(Area)(height)g}{(Area)}$$

define $F/Area = \text{Pressure}$ $N/m^2 \equiv \text{Pascal}$

in this case the F is constant over area
 in some cases it may NOT be \rightarrow go to differential limit

$$\text{Pressure} = \frac{dF_{\perp}}{dA}$$

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

$$\begin{aligned} 1 \text{ atm} &= 1.013 \times 10^5 \text{ Pa} \\ &= 1013 \text{ millibar} \\ &= 14.70 \text{ lb/in}^2 \end{aligned}$$

Also $F_{up} = F_{down} \therefore P_{up} = P_0 + \rho g h$ as well!

IF we change F_0 on top of fluid w/ a piston



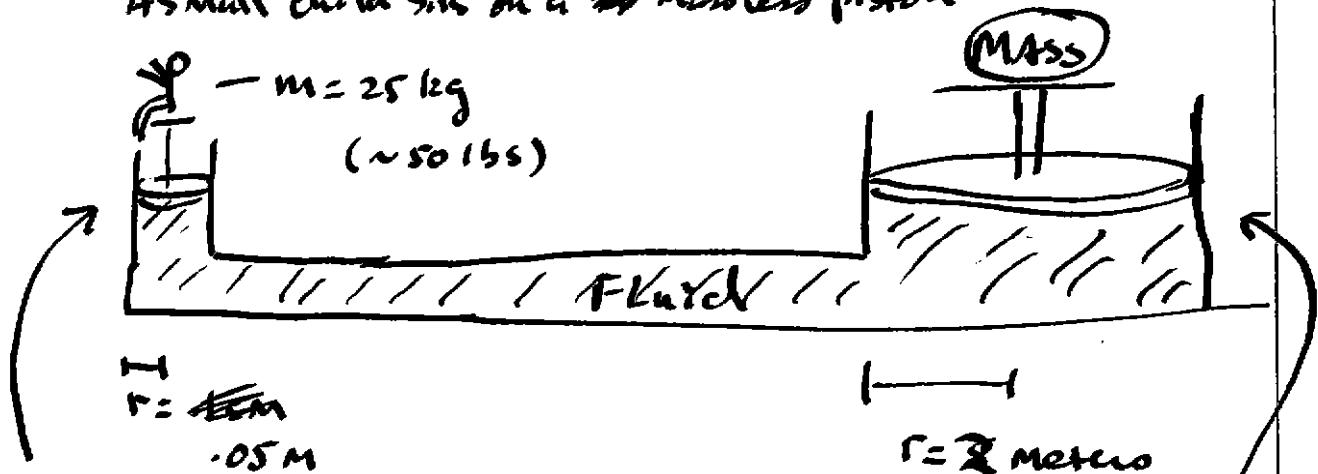
P on top and bottom of plastic
 wrap change ~~to~~ in response!

Pascal's Law:

Pressure applied to an enclosed fluid is transmitted ~~is~~ undiminished to every point in the fluid and to the walls of the containing vessel.

Example hydraulics

A small child sits on a ~~the~~ massless piston



$$P = \frac{F}{A} = \frac{(25)(9.8)}{\pi (0.05)^2}$$

"

~~31,194~~ Pa

31,194

$$= P = \frac{(\text{Mass})g}{\pi (2)^2}$$

equality from
Pascal's law

$$\therefore 31,194 \text{ Pa} = \frac{\text{Mass } 9.8}{\pi (2)^2}$$

$$\text{Mass} = 40,000 \text{ kg}$$

$\sim 80,000 \text{ lbs}$

\Rightarrow A baby can lift
a loaded truck!

Example

Mercury barometer



Turn over



$$P = P_0 + \rho gh$$

define $h=0$

$$P_0 = P_{\text{atmosphere}}$$

$$\therefore P = P_{\text{atm}}$$

$$P = P_0 + \rho gh$$

$$= 0$$

$$P = \rho gh$$

there must be the same by

Pascal's law

\therefore

$$P_{\text{atm}} = \rho gh$$

\nearrow height of column of Mercury

This is why one hears of pressure in inches of mercury!

$$1 \text{ mm Hg} = \text{pressure of } 1 \text{ Torr}$$

$$1 \text{ atmosphere} \approx 760 \text{ mm} = .76 \text{ m Hg}$$

$$760 \text{ Torr}$$

Archimede's principle

When a body is completely or partially submerged in a fluid, the fluid exerts an upward force on the body equal to the weight of the displaced fluid.

buoyancy buoyant force