PHY131 - Class 22 - Wed. Nov. 30, 2011

"Fluid" is something that flows, ie:

liquid ← density does not depend on pressure (incompressible)

or gas ← density is directly related to pressure by ideal gas law.

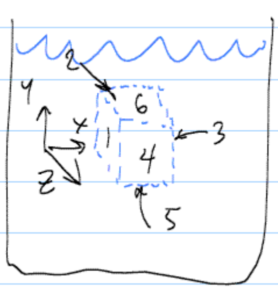
"Pressure" is a scalar quantity → it doesn't have direction.

← At any point in a fluid, a tiny piston in the beaker will be compressed. ← This is same no matter what orientation of beaker

- "Pressure" exists everywhere in the fluid.

- Pressure tends to increase with depth in a fluid → "hydrostatic equilibrium"

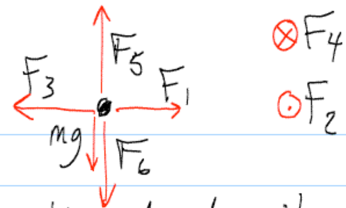
- Consider a tiny cube of liquid in a Container:



1, 2, 3, 4 are sides of cube
5 = bottom of cube
6 = top of cube.

Pressure force presses inward on all 6 surfaces. → if cube is not accelerating, the $\vec{F}_{Net} = 0$.

f.b.d. of cube:



$\odot$ $+z$

$m = \rho V$, ρ = liquid density.

$(F_{Net})_x = 0 = F_1 - F_3 \Rightarrow F_1 = F_3$

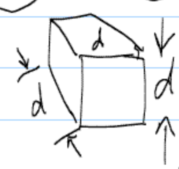
$(F_{Net})_z = 0 = F_2 - F_4 \Rightarrow F_2 = F_4$

$(F_{Net})_y = 0 = F_5 - F_6 - mg \Rightarrow F_5 = F_6 + mg$

$P = F/A$

$\Rightarrow F = PA$

$$P_5 A = P_6 A + \rho V g$$



$$P_5 = P_6 + \frac{\rho V g}{A}$$

$A = d^2$

$V = d^3$

$\frac{V}{A} = \frac{d^3}{d^2} = d$

Hydrostatic Pressure Equation. $\rightarrow$ $\boxed{P_{bottom} = P_{top} + \rho g d}$ $\longleftrightarrow$ Pressure increases with depth.

Pressure in a room is $\sim 10^5$ Pa

P_{atm}

- We define "gauge pressure" to be the difference between actual pressure and P_{atm}.
- Pressure is always positive, or zero for a perfect vacuum.
- Gauge pressure can be negative $\rightarrow$ "partial vacuum"