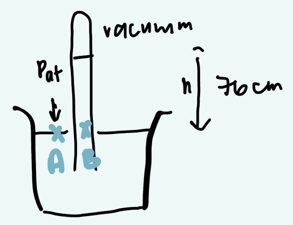
(w mercury) Measuring pressure

Barometer

pressure ↑ height ^

• measures atm pressure

$P_{atm} = hpg$



$P_A = P_B$

• pressure at same level are equal

• only measure atmospheric pressure

h = surface to top

vacuum = no pressure

h does not change even if tube is slanted

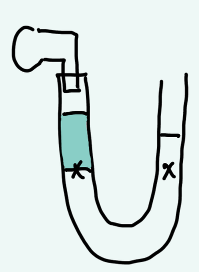
$P = hpg$

$= (h \text{ in mm})(\text{density})(9.81)$

check if there is a vacuum by tilting tube & seeing if h remains the same

$phg = mmHg$

$1mmHg \approx 133.3Pa$



The change in heights of the liquids are directly proportional

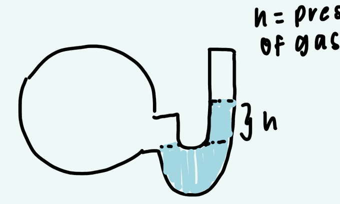
$P_A h_A \cancel{g} = P_B h_B \cancel{g}$

$\frac{\Delta h_A}{\Delta h_B} = \frac{P_B}{P}$ } proportional to liquid density

Manometer

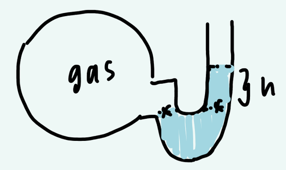
utilize $P = phg$ concept

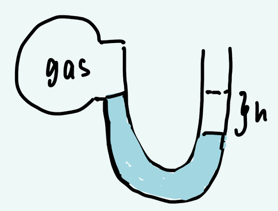
1) closed end manometer



2) open end manometer

$P_{gas} = P_{atm} + phg$





$P_{gas} = P_{atm} - phg$

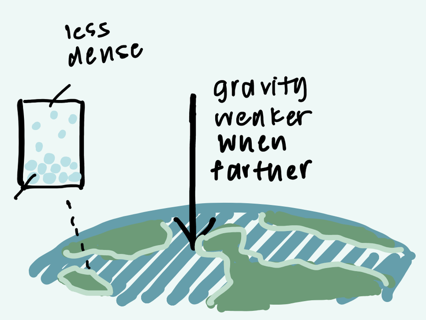
→ pressure ←

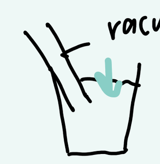
When there is a pressure difference, a force acts in a direction of higher pressure to lower pressure.

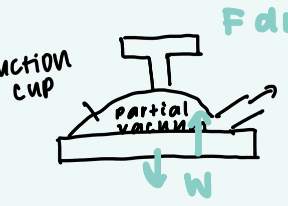
Atmospheric pressure

• air all around you
• acts in all directions
• At sea level: 1.01×10^5 Pa

$P_{at} - P_{air} = \frac{F}{A}$



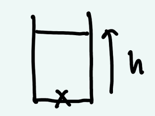




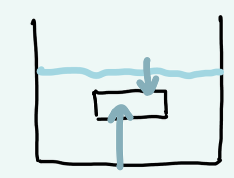
↳ removing more air inside
↳ increase cup area
⇓
hold heavier

Liquid pressure

$P = pgh$



• not affected by container shape
• acts in all directions at the same depth



more pressure is exerted on the bottom of an object hence the fluid exerts an upwards net force.

stronger water force due to higher pressure (from h)

Hydraulic systems

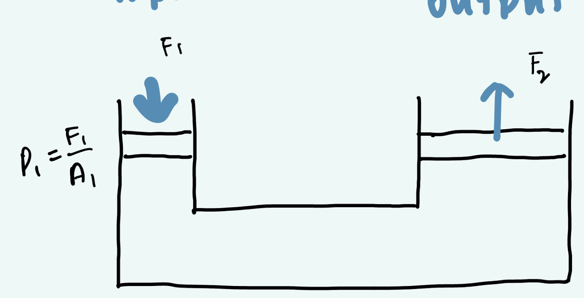
$P = \frac{F}{A}$

- Perpendicular force acting per unit area
- Pressure acts in a direction that is perpendicular to the surface

Ex: cars hydraulic breaks ✓ application of pressure ✓

liquid used

1) incompressible
2) pressure acts in all directions at the same level
3) change in P pressure is transmitted undiminished to the whole system



$P_2 = \frac{F_2}{A_2}$

larger area → greater output force

pressure is constant $\boxed{P}\ \frac{F_1}{A_1} = \frac{F_2}{A_2}$ → if amplified by 10x height will go up by 1/10 x decrease by 10x

$V = A_1 d_1 = A_2 d_2$

$Wd = F_1 d_1 = F_2 d_2$

Pascal's principle

• any change in pressure is transmitted undiminished to all other parts of an enclosed incompressible fluid → no air bubbles

Application

Why do your eardrums feel uncomfortable when the airplane is taking off?
[P] Ear contains a pocked of trapped air
[R] It Is at atmospheric pressure before the plane takes off.
At higher altitude, cabin pressure is lowered to match lower atmospheric pressure outside
[O] As P ear > P outside, the change in pressure exerts a force on the eardrum

[P] A force applied on the master cylinder with a smaller surface area exerts a pressure on the oil in the system.
[R] According to Pascal's Principle, a change in pressure is transmitted undiminished to all parts of an enclosed incompressible fluid.
[O] Thus pressure by oil on the wheel cylinder pistons is the same but due to the larger area, force applied to the wheel will be larger, thus producing a larger breaking force at the wheel cylinder.

<u>Why is using air inferior to oil in a hydraulic system?</u>
[P] Air is compressible, thus the pressure at the wheel cylinder will be smaller than the increase in the pressure at the master cylinder. So the force acting on the wheel cylinder will be smaller.

<u>Is the conservation of energy still valid?</u>
Some air is transferred to the air to increase the energy in the internal store of the air.