Density: $\rho = \dfrac{Mass}{Volume}$

Example: density of water $\mathbf{1000\,\frac{kg}{m^3} = 1\,\frac{kg}{l} = 1\,\frac{g}{cm^3} = 1\,\frac{g}{ml}}$

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

Units of Pressure:

$1Pa = 1\frac{N}{m^3}$ (standard SI unit called Pascal)

$1\ bar\ = 100\ kPa = 10^5 Pa$

Atmospheric Pressure $1\ atm = 101\ kPa,$ it is very close to 1 bar.

Pressure in fluids

- **Pascal's Principle:**

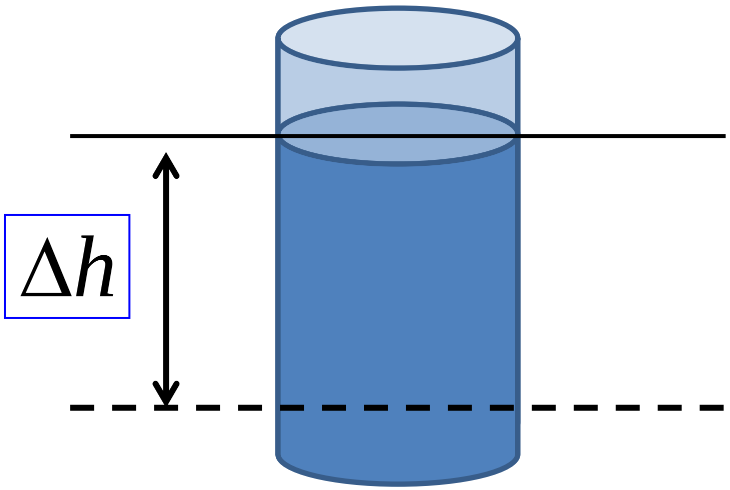
"Pressure in static fluid is transmitted uniformly in all directions"

P = *const*

(static fluid, no gravity)

- **Hydrostatic Pressure.** Due to gravity, the pressure increases as you go deeper in fluid:

$$\Delta P = \rho g \Delta h$$



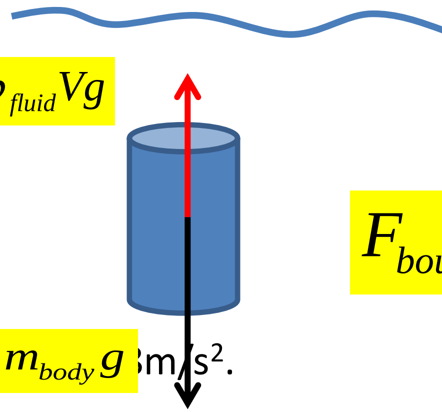
$$P = P_{atm}$$

$$P = P_{atm} + \rho g \Delta h$$

Buoyancy

•Archimedes Principle : ***"Buoyancy force = weight of displaced fluid"***

$$\text{Bouyancy Force} = \rho_{fluid} V g$$



$$F_{bouyancy} = m_{fluid}\, g = \rho_{fluid} V g$$

here $\text{Weight of the body} = m_{body}\, g$ m/s².

• Buoyancy also acts on objects in gases (think of balloons in air).

• Units of Volume and Density:

$$1m^3 = 10^3 l = 10^6 cm^3$$

$$1cm^3 = 1ml = 10^{-3} l = 10^{-6} m^3$$

$$\rho_{H_2 0} = 1\frac{g}{ml} = 1000\frac{kg}{m^3}$$

Homework

Problem 1

Imagine that you have extremely accurate digital scales that were calibrated in vacuum (in the presence of regular Earth gravity). How much will they show (in grams) if you weight m=1kg of Aluminum, in the presence of atmosphere? Density of Aluminum is ρ_{Al}=2.800 kg/m^3, density of air is ρ_{air}=1.2 kg/m^3.

Problem 2.

Two U-shaped pipes are used to measure pressure in a sealed tank containing some gas. The first pipe contains water, and it shows a level difference h_1=10cm. What is the density of the liquid in the other pipe, if the level difference in that pipe is h_2=15cm? The open ends of both pipes are exposed to the atmosphere.