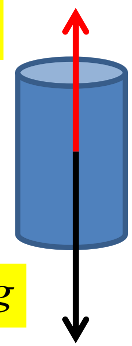
Density and Buoyancy

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

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

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



$$F_{buoyancy} = m_{fluid} g = \rho_{fluid} V g$$

$$\text{Weight of the body} = m_{body} g$$

here V is the volume of the body, $g = 9.8 m/s^2$.

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

- Units of Volume and Density:

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

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

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

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

Units of Pressure:

$1Pa = 1\frac{N}{m^2}$ (standard SI unit called Pascal)

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

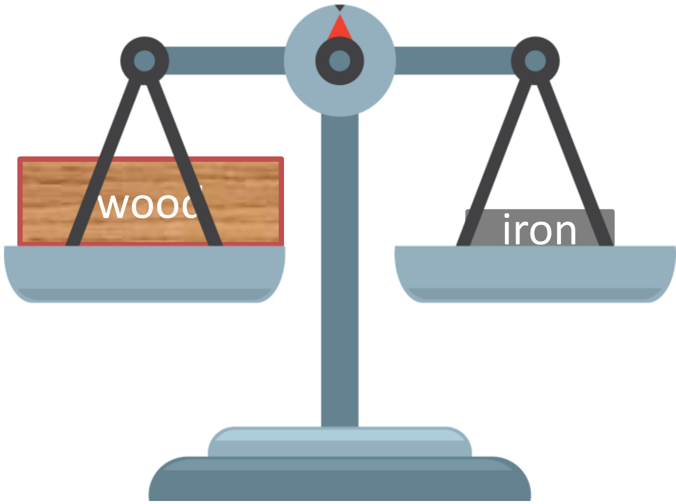
Atmospheric Pessure is very close to 1 Bar:

$1atm \approx 1.01bar$

Homework

Problem 1

Imagine that you have extremely sensitive balance scales. You balance them with a piece of iron on the right, and a piece of wood on the left, in the presence of regular Earth gravity but **in vacuum** (see figure). Will the balance change if you now expose these scales with both objects, to air? If yes, how and why?



Problem 2

a) A boat is floating in a pool. A person sitting in the boat takes a big rock (which is originally in the boat as well), and drops it to the bottom of the pool. Will the water level in the pool drop/rise or stay the same? Why?

b) Now the person jumps from the boat into the pool, and starts swimming. Will the water level in the pool drop/rise or stay the same? Why?

Problem 3

a) Estimate the pressure under your feet when you are walking.

b) Estimate the pressure applied to paper by a staple when you are stapling it.