# ATMOSPHERIC PRESSURE

MARCH 24, 2024

Let us to understand why a gas exerts pressure on the walls of its container. It is quite easy to understand from the microscopic picture of a gas. Remember that a gas consists of molecules flying around randomly and colliding with each other and the walls of the container. When a molecule hits a wall, its' momentum is changed which means the wall acted on it with some force. By Newton's third law it means that the molecule acted on the wall with some force. There is an enormous amount of molecules hitting the wall every second so the average force is very close to a constant and depends just on the area of the wall we are considering. Therefore, gas is characterized by its' pressure. The force with which the gas presses the wall is always directed perpendicularly to this wall and outwards from the container.

One example of pressure in a gas is atmospheric pressure. Our atmosphere acts upon every object with a pressure. At sea level it is normally about 100 kPa - so, on every square meter it acts with 100000 Newtons.

## Homework

**1.** Calculate the force with which atmosphere pushes down on the top surface of a desk of a rectangular shape, 1 meter by 2 meters. How does this force compare to the weight of an elephant? Mass of the elephant is 5000 kg.

**2.** You are designing a submarine and you want it to have a round window for observations. Radius of the window is 10 $cm^2$. You can make the window withstand a force up to 50000 N. What is the maximal depth you can take the submarine to? Density of ocean water is 1030 $kg/m^3$.

***3.** Estimate the mass of Earth's atmosphere. You are given atmospheric pressure $p_0 = 100000$ Pa and radius of the Earth $R = 6400$ km. *Hint: surface area of a sphere of radius $R$ is $4\pi R^2$.*