# Pressure of a gas

Gas molecules are constantly in motion and due to that they exert a pressure on the surface they come in contact with.   There is also a pressure exerted on our body by the atmosphere but we are not aware of it as our body is well adjusted to that pressure. The pressure is defined as a *force exerted on a unit area* that is written in an equation form as

$$pressure = \frac{force}{area}$$

Pressure Units

Pressure can be measured in a number of different units, the common unit being **millimeter of mercury (mm Hg).**   The pressure is measured with a device known as a barometer invented by the Italian physicist Evangelista Torricelli (1608 – 1647)(the picture is taken from http://en.wikipedia.org/wiki/Evangelista_Torricelli)   It is a very simple device consists of evacuated glass tube inverted into the open try filled with mercury.
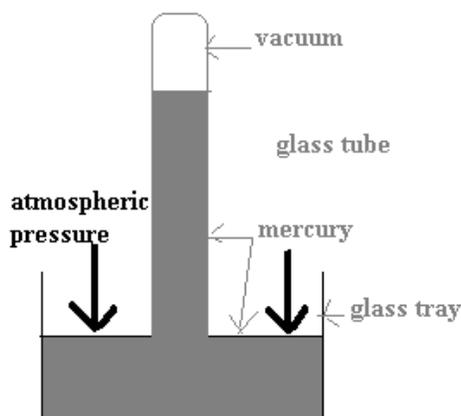
The height of the mercury column in the tube is directly related to the atmospheric pressure exerted on the open surface of the mercury in the tray; if the atmospheric pressure increases, the mercury column in the tube arises and if the pressure decreases, the mercury column decreases. It happens that at sea level and at 0^0C, the column of the mercury stands up 76 cm Hg (760 mm Hg). This is labeled as the **standard atmospheric pressure** and set equal to 1 atm. Therefore,

> 1 atm = 76 cm Hg
> = 760 mm Hg

There is another unit known as torr to honor the Torricelli, who invented the barometer; one torr equal to 1 mm Hg.

1 torr = 1 mm Hg

Then   1 atm = 760 torr

Other common units of pressure include the inches of mercury (in Hg) and pounds per square inch (psi).

1 atm = 14.7 psi

The modern unit of pressure is pascal (Pa) defined within the frame work of SI unit that is based on the force of 1 newton (N) acting on the surface area of 1 meter square. That is,

$1\ Pa = 1\ N\ /\ m^2$

The relation between the atmosphere and pascal (Pa) and also kilopascal (kPa) is

1 atm = 101,325 Pa = 101.325 kPa

Example

If today's atmospheric pressure is 77.5 cm Hg, what is this pressure in mm Hg, torr, atm, and kPa?

Answer

The needed conversion factors are:

1 cm Hg = 10 mm Hg
1 atm = 76 cm Hg = 760 mm Hg = 760 torr

Therefore,

mm Hg = 77.5 cm Hg x (10 mm Hg / 1 cm Hg) = 775 mm Hg

torr = 775 mm Hg x (1 torr / 1 mm Hg) = 775 torr

atm = 77.5 cm Hg x (1 atm / 76 cm Hg) = 1.018 atm

kPa = 1.018 atm x (101.325 kPa / 1 atm) = 103.191 kPa

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Hands on Practice on Pressure Conversion