

Pressure

Pressure: is the force per unit area. The SI Unit is Pa or kPa.

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

Pressure varies with force and area. If higher force applied on an object the pressure act on the object will be more. If the area of the object on which force applied is more, the pressure acting on the object is low and if the area of the object on which force applied is less the pressure acting on the object is more. E.g.

1. The area under the edge of the knife's blade is small. Beneath it, the pressure is high enough for the blade to push easily through the material.
2. The end of the pin is very sharp, it provides great pressure to the objects and so easy to put into objects.
3. Skis have a large area to reduce the pressure on the snow so that they do not sink in too far.
4. Tractors have wide tire to reduce the pressure act on the ground so that they do not sink too far in the ground.

The pressure at a surface produces a force in a direction at right angles to the surface.

Pressure in Liquids:

In a liquid such as water, pressure does not simply act down wards – it acts equally in all directions. This is because the molecules of the liquid move around in all directions, causing pressure on every surface they collide with. The pressure beneath the surface of a liquid changes with:

1. Depth of the liquid: The deeper the liquid, the higher pressure.
2. Density of the liquid: The more dense the liquid, the higher pressure at particular depth.

Pressure of the liquid does not depend shape of the container.

$$\begin{aligned}\text{Pressure} &= \text{density of the liquid} \times \text{gravitational field} \times \text{depth of the liquid} \\ &= \rho gh\end{aligned}$$

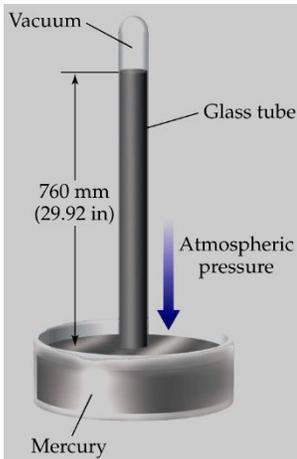
Hydraulic Systems:

In some machines, the forces are transmitted by liquids under pressure rather than by levers or cogs. Machines like this are called hydraulic machines. In hydraulic machine the following properties of the liquids is used:

- Liquids are virtually incompressible- they cannot be squashed.
- If a trapped liquid is put under pressure, the pressure is transmitted all parts of the liquids.

Hydraulic Jacks:

Pressure can be transmitted throughout a liquid in hydraulic presses and hydraulic brakes on vehicles. It may also be called a force multiplier.



The height of a liquid column in a liquid barometer may be used to determine the atmospheric pressure. Simple mercury barometer is used to measure the atmospheric pressure. The barometer contains liquid metal mercury. Atmospheric pressure has pushed mercury up the tube because the space at the top of the tube has no air in it. It is a vacuum. Normally the height of the mercury column found to be about 760 millimetres of mercury (760mmHg). Since the value of the mercury column reflects the value of the atmospheric pressure, atmospheric pressure can be express in terms of the height of the column of the mercury.

Standard atmospheric pressure:

The pressure that will support a column of mercury 760mm high is known as standard atmospheric pressure or 1 atmosphere (1atm). Its value in a pascals can be found by calculating the pressure due to a such column.

- Height of the mercury column (h) = 760mm that is 0.76m.
- Gravitational field strength (g) = 10N/kg
- Density of the mercury (ρ) = 13590kg/m³

So standard atmospheric pressure or 1atm = ρgh

Standard atmospheric pressure or 1atm = 13590 x 10 x 0.76 = 103,284 Pa, in calculators for simplicity, you can assume that 1atm = 100,000Pa or 100kPa

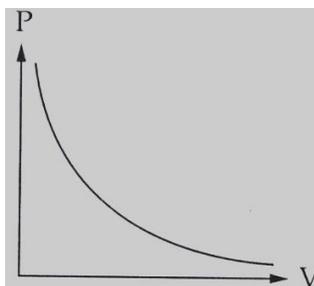
Pressure – volume relationship:

- Pressure is inversely proportional to volume.
 - When volume increases, pressure decreases. The pressure increases because the air molecules hit the wall of the syringe more frequently.
 - When volume decreases, pressure increases.

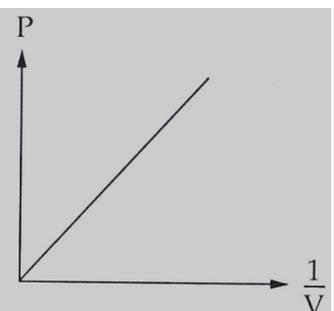
Boyle's law: For a fixed mass of a gas at a constant temperature, pressure of the gas is inversely proportional to the volume of the gas.

Which means if the temperature of the gas is constant, when the volume of the gas is decreased the pressure of the gas increases.

Initial pressure × initial volume = final pressure × final volume ($P_1V_1 = P_2V_2$)



Graph of P against V is a smooth curve



Graph of P against $\frac{1}{V}$ is a straight line