

Gas Laws

Gas Properties

Volume, V : This is the space occupied by the particles that make up the gas.

Volume is measured in metres cubed, m^3

Temperature, T : This is a measure of the internal energy of the gas and this is equal to the average kinetic energy of its particles.

Temperature is measured in Kelvin, K

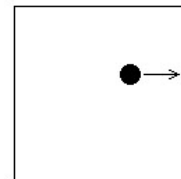
Pressure, p : When a gas particle collides with the walls of its container it causes a pressure. Pressure is given by the equation pressure = Force/Area or 'force per unit area'.

Pressure is measured in pascals, Pa

1 pascal is equal to a pressure of 1 newton per square metre.

Understanding the Gas Laws

We are about to look at the three different laws that all gases obey. To help us understand them let us apply each one to a simple model. Imagine one ball in a box; the pressure is a measure of how many collisions between the ball and the box happen in a certain time, the volume is the area of the box and the temperature is the average speed of the ball. To simply thing further let us assume it is only moving back and forth in the x direction.



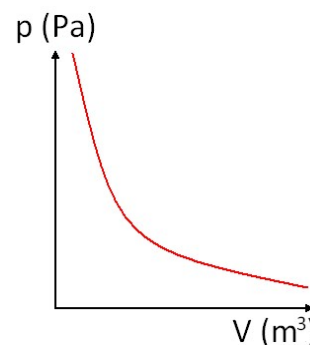
Boyle's Law

The pressure of a fixed mass of gas is inversely proportional to its volume when kept at a constant temperature.

$$p \propto \frac{1}{V} \text{ for constant } T$$

Explaining pressure and volume...

If temperature is constant, it means that the ball is travelling at a fixed, constant speed. If we increase the size of the box it makes fewer collisions in the same time, because it has to travel further before it collides with the side. If we make the box smaller the ball will collide with the box more often since it has less distance to travel.



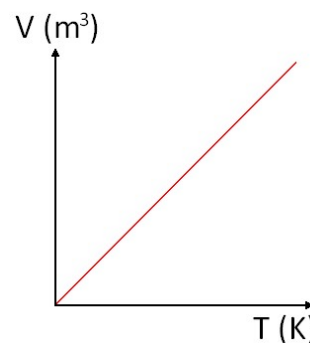
Charles' Law

All gases expand at the same rate when heated. The volume of a fixed mass of gas is proportional to its temperature when kept at a constant pressure.

$$V \propto T \text{ for constant } p$$

Explaining volume and temperature...

If pressure is constant, it means that the same number of collisions with the box are taking place. So, if the box was made bigger the ball would have to move faster to make sure there were the same amount of collisions per unit time. Increasing the temperature increases the speed of the ball.



The Pressure Law

The pressure of a fixed mass of gas is proportional to its temperature when kept at a constant volume.

$$p \propto T \text{ for constant } V$$

Explaining pressure and temperature...

If the volume is constant it means the box has a fixed size. If we increase the speed at which the ball is moving it will hit the sides of the box more often, which increases the pressure. If we slow the ball down it will hit the sides less often, decreasing pressure.

