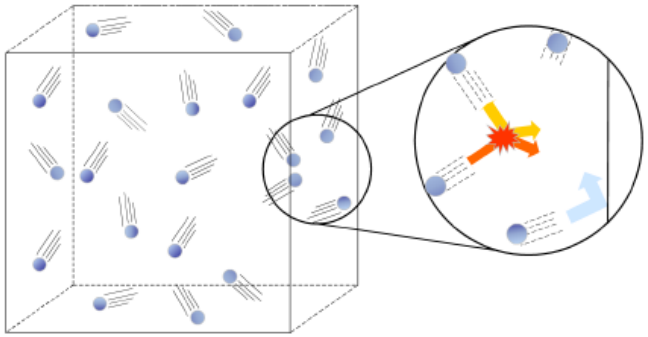
1. Gas Pressure

- A gas consists of very small particles, which are all very far apart and which all move randomly at high speeds.
- These particles collide with one another and with anything else they come in contact with.
- Each time a particle collides with a wall of the container, it exerts a force on the wall.
- Thus with particle continuously bombarding the container walls, the gas exerts a pressure on the container.



Temperature, energy and the kinetic model

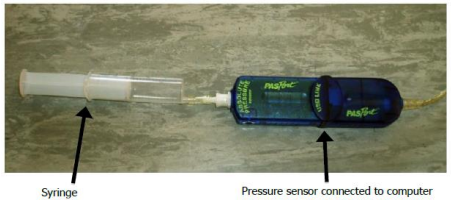
- To convert between Kelvin and Celsius :-
  Temperature in K = Temperature in ^{o}C + 273
- To convert between Celsius and Kelvin :-
  Temperature in ^{o}C = Temperature in K – 273

10. GAS LAWS

N5 Past Papers HW
2014 MC Q5,6,7
2015 MC Q5,6
2016 MC Q5,6,7

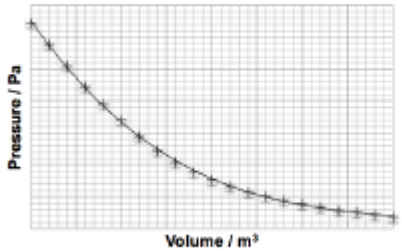
2. Pressure and Volume (Boyle's Law)

Using the apparatus below, the volume of a gas can be changed and any corresponding change in Pressure measured. The mass and temperature of the gas are fixed.

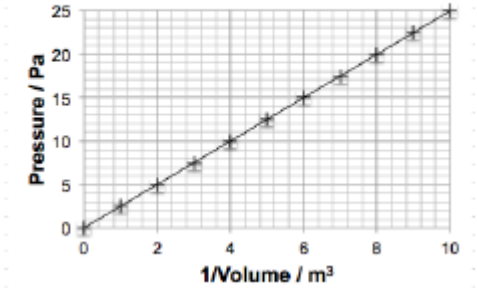


As the syringe is pushed, the volume decreases, so the pressure increases. We can explain this in terms of the kinetic model. We have seen how the pressure exerted by the gas on its container arises from the collisions of molecules with the container walls. If we have the same number of molecules in a smaller container, they will hit the walls more frequently.

Graph of P versus V



Graph of P versus 1/V



We can state for a fixed mass of gas at constant temperature:

$$P \propto \frac{1}{V}$$

$$PV = constant$$

$$P_1V_1 = P_2V_2$$

4. Temperature and Pressure

- According to the kinetic theory, the average speed of the gas particles increases with increasing temperature.
- The hotter the gas, the faster the gas particles are moving.
- The faster the gas particles are moving, the greater the pressure exerted by the gas on the walls of the container.

For a fixed mass of gas at fixed volume,

$$P \propto T$$

$$\frac{P}{T} = constant$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

5. Volume and Temperature (Charle's Law)

- Consider a fixed mass of gas trapped in a cylinder with a frictionless piston. If the gas is heated, the average speed of the gas particles increases.
- This means the force exerted on the piston when gas particles collide with it increases.
- The number of collisions per second will increase.
- The increased force and rate of collisions act to push out the piston, increasing the volume inside the cylinder and hence the volume of the gas.
- Once the piston has been pushed out, the rate of collisions will decrease, as particles now have further to travel between collisions with the piston or the walls. Thus the pressure remains the same. The overall effect is that heating a gas causes it to expand, and the relationship between volume and temperature is,

$$V \propto T$$

$$\frac{V}{T} = constant$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

6. The General Gas Equation

$$PV = \text{constant}$$

$$\frac{V}{T} = \text{constant}$$

$$\frac{P}{T} = \text{constant}$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

7. Pressure

Pressure is the force exerted on a unit area.

$$P = \frac{F}{A}$$

Symbol	Name	Unit	Unit Symbol
P	Pressure	Pascal	Pa
F	Force	Newton	N
A	Area	Square Metre	m^2

Pressure in everyday situations

1. A knife has a very small surface area creating a large pressure. This allows food to be cut more easily.

2. An elephant has a large total foot surface area, preventing it from sinking into the Earth's surface.