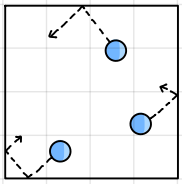
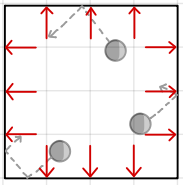
Pressure and volume

The pressure exerted by a gas is due to the collisions of the particles with the walls of the container.

The collisions by the particles exert a force at right angles to the wall of the gas container.

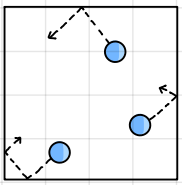


particles collide with the wall to exert pressure

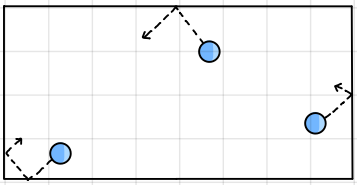


the force (→) is exerted at right angles to the container

Effect of volume on pressure



If we take the same gas and increase the volume of the container (at a constant temperature) then the pressure will decrease.



The gas pressure is inversely proportional to the volume of the gas at a constant temperature. If the volume of the gas increases by a factor of 10 the pressure of the gas will be reduced by a factor of 10.

The equation to calculate the energy required for a change of state is:

pressure x volume = constant or $pV = constant$

pascals (Pa) metres cubed (m^3)

You DO NOT need to learn this equation for the exam

The equation only holds true if the temperature is constant.

Calculating the constant

Because p x V is a constant, if we double the pressure, the volume is halved. If we halve the pressure, we double the volume (inversely proportional).

Using this principal, we do not need to calculate the value of the constant (though you can), but instead we use the principal of inverse proportionality.

Pressure and volume...

Example calculation

A gas has a volume of $3m^3$ and a pressure of 900 000 Pa. The volume is increased to $9m^3$. Calculate the pressure.

Calculate the the change in volume: 9/3 = 3
The volume has increased x3.

Now calculate the change in pressure. If the volume has increased by 3 times the pressure must have reduced by 3 times
Pressure = 900 000 / 3 = 300 000 Pa

Practice question #1

A gas has a volume of $10m^3$ and a pressure of 60 000 Pa. If the volume of the gas is increased to $50m^3$. Calculate the pressure of the gas.

Practice question #2

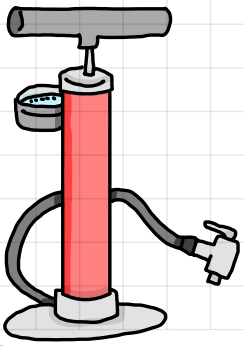
A gas has a volume of $200m^3$ and a pressure of 5000 Pa. The the gas is compressed to a volume of $10m^3$. Calculate the pressure of the gas.

Work done by gases.

Work is done when energy is transferred. When a bicycle pump is used, the piston pushes down and compresses the gas particles causing a transfer of energy. Because energy has been transferred we can say that work has been done.

The kinetic energy of the gas particles is increased. Temperature is related to the average kinetic energy of the particles so the temperature of the gas will rise.

Over prolonged use a bicycle pump will become warm because the pump is doing work which will increase the internal energy of the particles.



watch video