Gases 10.1

Pressure
Kinetic Molecular Theory
Boyle's Law
Charles' Law
The Combined Gas Law

Properties of Gases

- Expand to fill the volume of the container they occupy
- Form homogeneous mixtures
- Low density
- Highly compressible
- Exert a pressure

Pressure

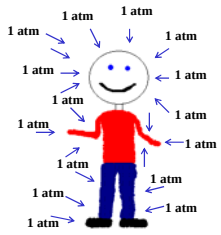
$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

Pa ← Pressure → N / m^2

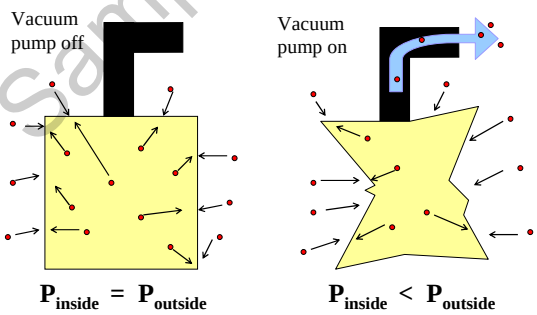
Gases exert pressure by bouncing off surfaces

- Gas particles are evenly distributed in a container.
- The same number smash off every cm^2 per unit of time.
  - Each collision exerts a force.
- The pressure is constant at constant temperatures.

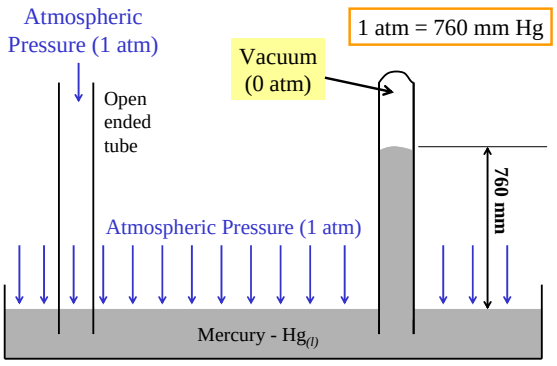
Gases Exert Pressures in all Directions



Sucking gas particles out of a can



Barometers Measure Gas Pressure



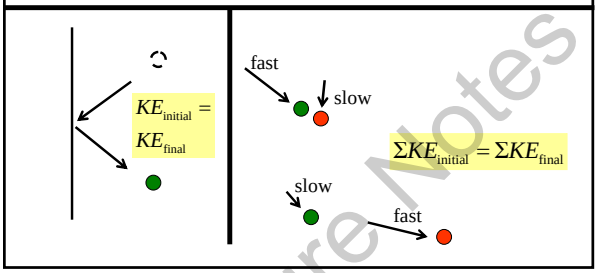
Kinetic Energy of Gas Molecules

- Translational Energy
  – gas molecules move through space in straight lines.
- Rotational Energy
- Vibrational Energy

Most of a gas particle's KE is related to its translational velocity

Notes on Kinetic Molecular Theory

- Collisions experienced by gas particles are elastic.
  - Kinetic Energy is conserved.



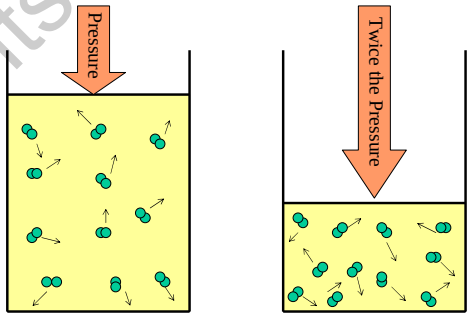
Boyle's Law

Relationship between
Pressure and Volume

$$V_1P_1 = V_2P_2$$

Volume is inversely proportional to pressure.

Pressure – Volume Relationship



Charles' Law

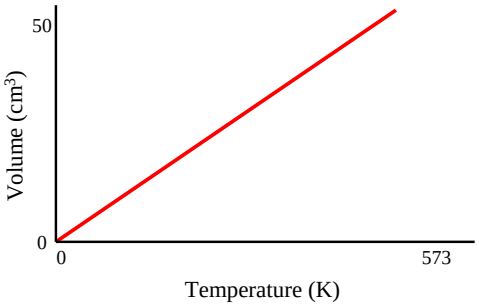
Relationship between
Temperature and Volume

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

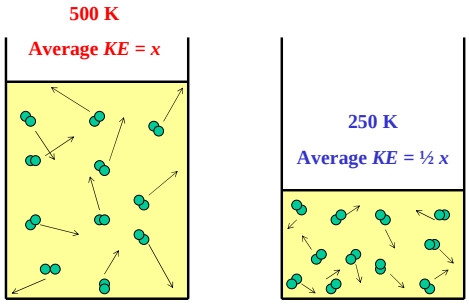
Volume is proportional to temperature.

You must use absolute temperature (K)!

Relating Volume and Temperature



Temperature – Volume Relationship



The Combined Gas Law

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

You must use absolute temperature (K)!

Ex1) Combined Gas Law

Ex1) A cylinder of gas is kept at a constant volume, as the temperature increases from 24.1°C to 326.4°C.

If the initial pressure was 1.10 atm, what is the final pressure in mm Hg?

Ex1) Combined Gas Law (cont.)

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

Ex2) Combined Gas Law

Ex2) A cylinder of gas is kept at a constant pressure, as the volume decreases from 1.150 L to 0.860 L.

If the initial temperature was 21.8°C, what is the final temperature?

Ex2) Combined Gas Law (cont.)

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