النظرية الجزيئية الحركية وقوانين الغازات
The Kinetic Molecular Theory of Gases

$KE = \frac{1}{2} mv^2$

$\langle KE \rangle = \frac{1}{2} m\langle v^2 \rangle$

In addition, it can be shown that -

$\langle KE \rangle = CT$ where C = constant

$\Rightarrow \quad \frac{1}{2} m\langle v^2 \rangle = CT$

النظرية الجزيئية الحركية وقوانين الغازات

1. جزيئات الغاز في حالة حركة عشوائية دائمة

و الجزيئات تعمل بشكل منفرد وذلك لعدم وجود تجاذب بينها

2. الحجم الجزيئات نفسها مهمل مقارنة بحجم الغاز الكلي ومعظم الحجم فراغ.

٣. الجزيئات تتصادم مع بعضها البعض كذلك مع جدران الوعاء

ولكن من دون ان تتغير الطاقة الكلية .

4. متوسط الطاقة الحركية لجزيئات الغاز تتناسب طرديا مع درجة الحرارة المطلقة

استخدام نظرية حركة الجزيئات لتفسير قوانين الغازات

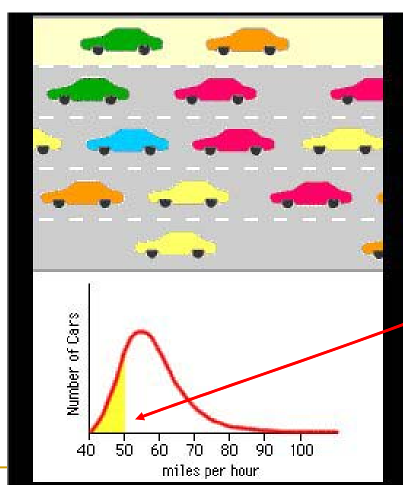
1. Boyle's Law (P α 1/V)

2. Charles' Law (V α T)

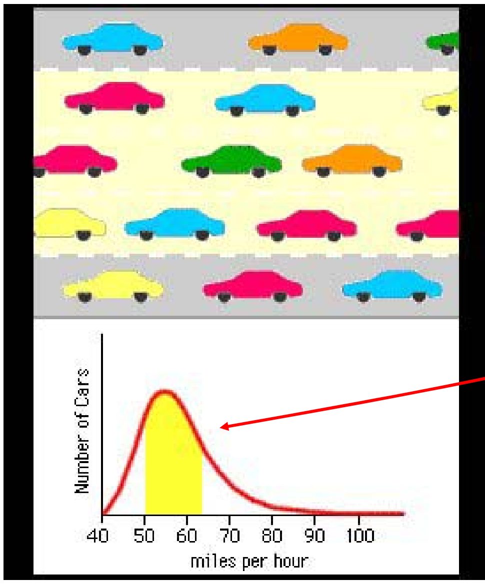
3. Avogadro's Law (V α n)

توزيع سرعة الجزيئات

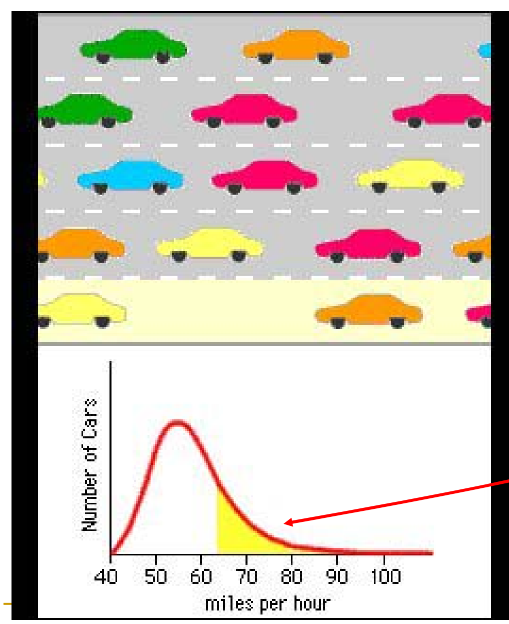
السيارات في الصورة مثل مجموعة من الجزيئات لها معدلات مختلفة بالسرعة



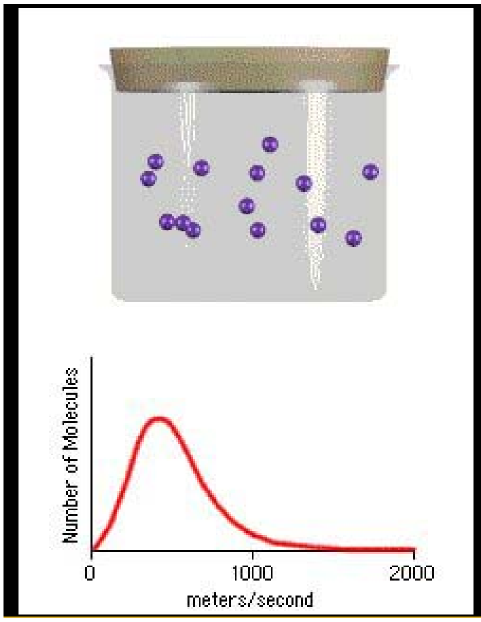
Slow lane



medium lanes



fast lane



A collection of molecules in the gas phase will also have a distribution of velocities.

توزيع سرعات الجزيئات

متوسط السرعة

$$\langle v^2 \rangle = \frac{3RT}{M}$$

$$\mu = \sqrt{\langle v^2 \rangle}$$

$$\mu = \sqrt{\langle v^2 \rangle} = \sqrt{\frac{3RT}{M}}$$

Maxwell's Equation

$$\mu = \sqrt{<v^2>} = \sqrt{\frac{3RT}{M}}$$

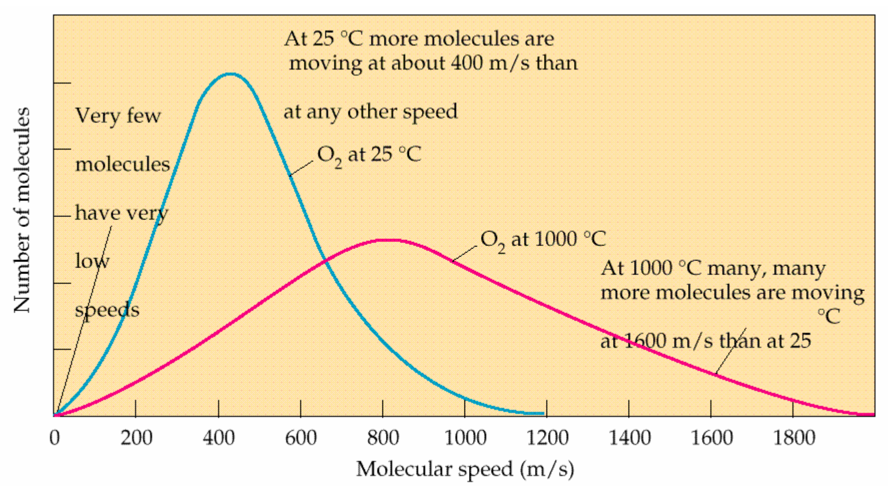
From this equation it can be deduced that -

$$\mu \,\alpha\, T$$

$$\mu \,\alpha\, \frac{1}{M}$$

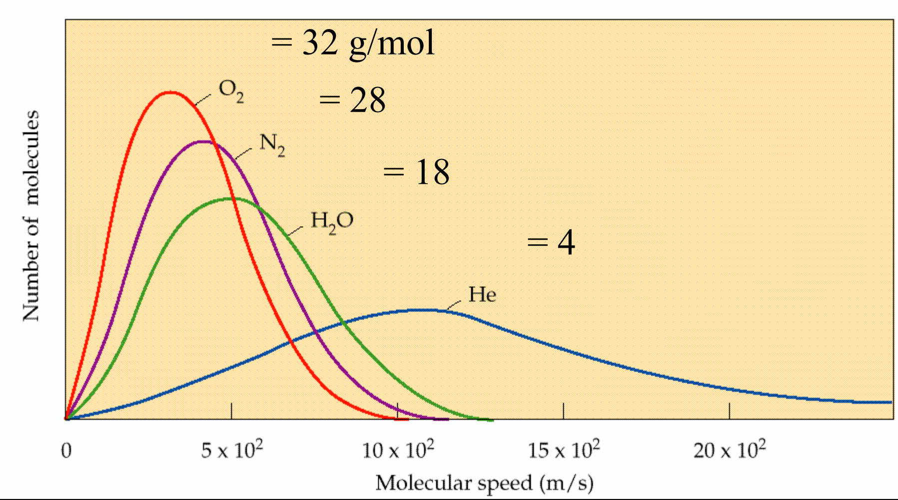
Maxwell-Boltmann Curves

$$\mu \,\alpha\, T$$



Maxwell-Boltmann Curves

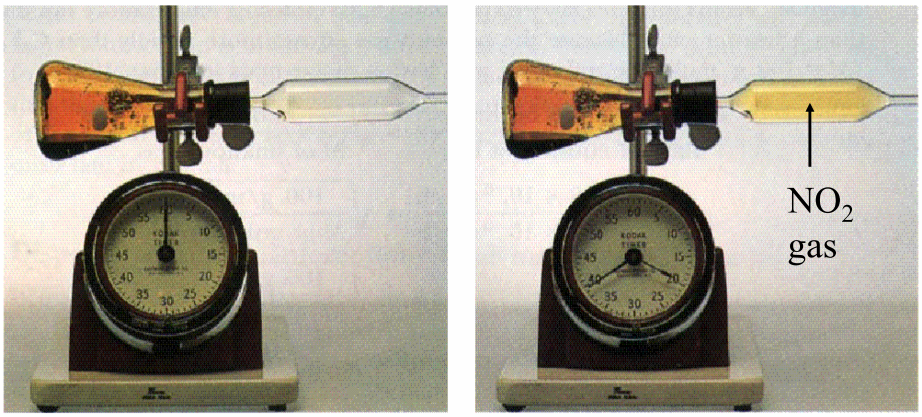
$$\mu \ \alpha \ \frac{1}{M}$$

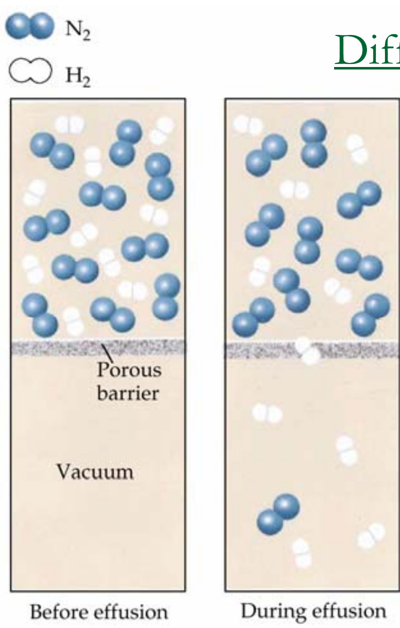


Example 12.13 - Calculate the μ speed of oxygen molecules at 25 ^{o}C

Diffusion and Effusion

Diffusion is the mixing of two or more gases due to random molecular motions





Diffusion and Effusion

Effusion is similar to diffusion except molecules move through a tiny hole (or pore) into another container at lower pressure. Lighter molecules will effuse faster than heavier ones.

Graham's Law of Effusion

The relative rate of effusion of two gases depends on their molecular speeds (rms), and their speeds are given by Maxwell's equation -

$$\frac{\text{Rate of effusion of gas 1}}{\text{Rate of effusion of gas 2}} = \frac{\sqrt{\langle v_1{}^2 \rangle}}{\sqrt{\langle v_2{}^2 \rangle}}$$

$$\frac{\text{Rate of effusion of gas 1}}{\text{Rate of effusion of gas 2}} = \frac{\sqrt{\dfrac{\cancel{3RT}}{M_1}}}{\sqrt{\dfrac{\cancel{3RT}}{M_2}}}$$

Graham's Law of Effusion

$$\boxed{\frac{\text{Rate of effusion of gas 1}}{\text{Rate of effusion of gas 2}} = \sqrt{\frac{M_2}{M_1}}}$$

KNOW!

Example 12.14 - C_2F_4 effuses through a barrier at a rate of 4.6 X 10^{-6} mol/hr. An unknown gas, consisting of only boron and hydrogen, effuses at 5.8 X 10^{-6} mol/hr under the same conditions. What is the molar mass of the unknown gas?