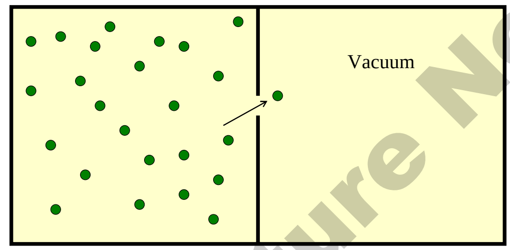
Gases 10.7

Effusion
Diffusion

Effusion

The movement of gas molecules through a very small hole into a vacuum



Rates of Effusion

- Gas particles that move faster will effuse at a faster rate.
- Gas particles with smaller molar masses have higher average velocities than do gases with larger molar masses, when at the same temperature.

Rates of Effusion

$$\frac{\text{rate}_1}{\text{rate}_2} = \sqrt{\frac{MM_2}{MM_1}}$$

rate_1 = effusion rate of gas_1
rate_2 = effusion rate of gas_2
MM_2 = molecular mass of gas_2
MM_1 = molecular mass of gas_1

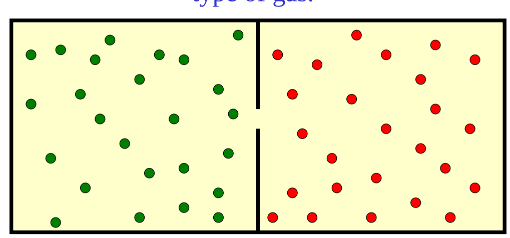
Ex) Effusion Rates

Ex) Find the ratio of effusion rates between He and Ne.

$$\frac{\text{rate}_{He}}{\text{rate}_{Ne}} = \sqrt{\frac{MM_{Ne}}{MM_{He}}}$$

Diffusion

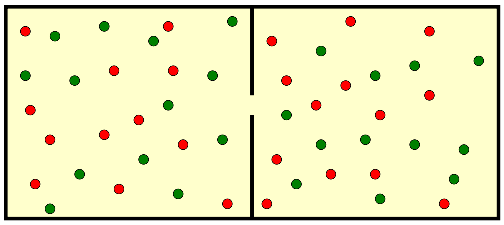
The movement of one type of gas into another type of gas.



Initial

Diffusion

The movement of one type of gas into another type of gas



Final

Ex1) Diffusion Rates

Ex1) A sample of an unknown gas diffuses three times faster than butane (C_4H_{10}). What is the molar mass of the unknown gas?

Enrichment of Uranium

^{235}U is used in nuclear reactors and bombs

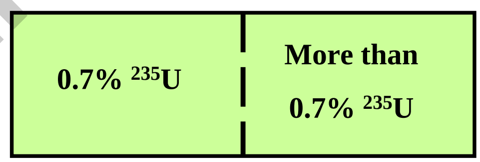
In nature we get 0.7% ^{235}U and 99.3% ^{238}U

Practical Requirements:

- Nuclear reactors ~ 4% ^{235}U
- Nuclear bombs ~ 90% ^{235}U

We must increase the concentration of ^{235}U

Enrichment of Uranium



$UF_{6(g)}$ with ^{235}U isotopes will diffuse faster than $UF_{6(g)}$ with ^{238}U isotopes.

Ex2) Diffusion Rates

Ex2) Find the ratio of effusion rates between $^{235}UF_6$ and $^{238}UF_6$.

$$\frac{\text{rate}_{^{235}UF_6}}{\text{rate}_{^{238}UF_6}} = \sqrt{\frac{MM_{^{238}UF_6}}{MM_{^{235}UF_6}}}$$