

GRAHAM'S LAW OF DIFFUSION

DIFFUSION: is the spontaneous spreading out of a gas leading to a uniform distribution of gas particles throughout the container.

Thomas Graham in 1829 found that lighter gases diffuse more rapidly than heavier gases.

WHY?

The average kinetic energy is the same for all gases at the same temperature and pressure.

$$E_K = \frac{1}{2} m v^2 \quad \begin{array}{l} m - \text{mass of the particle} \\ v - \text{velocity of the particle} \end{array}$$

if we have two gases, Gas A and Gas B, their kinetic energies are equal when both gases are at the same temperature and pressure.

$$E_K(A) = E_K(B)$$

$$\frac{1}{2} m_A v_A^2 = \frac{1}{2} m_B v_B^2$$

$$m_A v_A^2 = m_B v_B^2$$

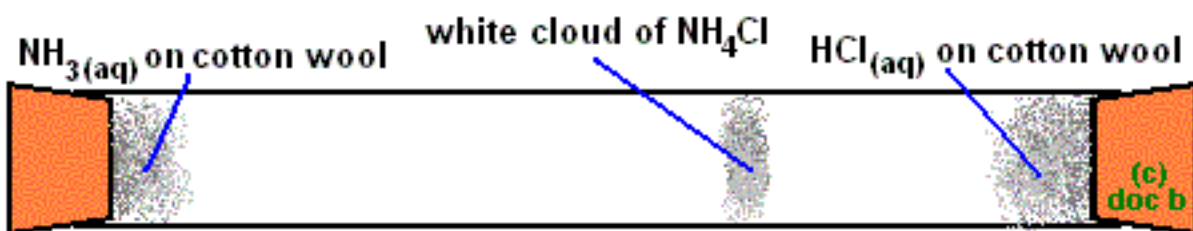
$$\frac{v_A^2}{v_B^2} = \frac{m_B}{m_A}$$

$$\frac{v_A}{v_B} = \frac{\sqrt{m_B}}{\sqrt{m_A}}$$

★ m is the molar mass of gas!

This leads to Graham's Law of Diffusion

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



From this image, which gas diffused faster? _____

Practice

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|--|-------|
| 1. Under the same conditions of temperature and pressure, how many times faster will hydrogen effuse compared to carbon dioxide? | _____ |
| 2. If the carbon dioxide in Problem 1 takes 32 sec to effuse, how long will the hydrogen take? | _____ |
| 3. What is the relative rate of diffusion of NH_3 compared to He? Does NH_3 effuse faster or slower than He? | _____ |
| 4. If the He in Problem 3 takes 20 sec to effuse, how long will NH_3 take? | _____ |
| 5. An unknown gas diffuses 0.25 times as fast as He. What is the molecular mass of the unknown gas? | |