Effusion Encyclopedia Article

Effusion

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Effusion

Effusion is the movement of gas molecules through a small opening into an area of lower pressure.**Thomas Graham**, a Scottish chemist studied effusion and **diffusion** of **gases** and found that lighter gases move faster than denser gases. Based on his experiments with **density** he formulated Graham's law of effusion or diffusion which states that the rate of effusion or diffusion of gases at the same **temperature** and pressure are inversely proportional to their densities. Since density of a gas is proportional to its molar **mass** the law can also be written as the rate of effusion of gases at the same temperature are inversely proportional to their molar masses.

To mathematically explain his experiments the following facts can be used, one, the average kinetic energies of the molecules of two different gases at the same temperature and pressure are equal, two, the **velocity** of a gas varies inversely with its mass, and three, the kinetic **energy** is equal to one-half the mass times the velocity squared. The kinetic energies of two different gases can therefore, be set equal to each other. By substituting the rate of effusion for velocity the final formula supports Graham's law.

William Aston, a physicist used Graham's law to separate isotopes of **neon**.**Uranium** and other radioactive substances are also separated and used in medicine, **chemistry**, and nuclear energy. Another application of Graham's law is the ability to calculate the molar mass of an unknown gas if the mass of one gas is known and the rate of effusion has been determined. For example, If **hydrogen** effuses 5.65 times faster than an unknown gas the molar mass of the unknown gas can be determined. The square root of the molar mass of the unknown gas divided by the square root of the molar mass of hydrogen is equal to 5.65. The molar mass of the unknown gas is 64 gram per **mole**.

To compare the rate of effusion of two different gases such as **methane** and **sulfur** dioxide you must first calculate the molar mass of each gas. The molar mass of methane is 16 grams and the molar mass of sulfur dioxide is 64 grams. The square root of the heavier gas divided the square root of the lighter gas is two. Therefore, methane travels twice as fast as sulfur dioxide.