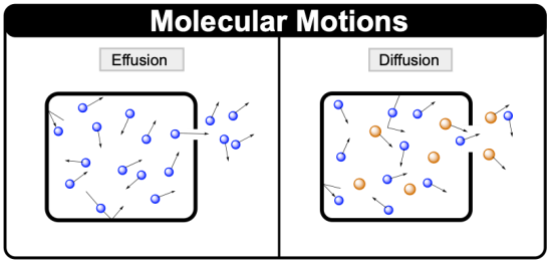
CONCEPT: EFFUSION

- Gases consist of a collection of molecules or atoms that are in constant linear motion.
  - **Mean Free Path:** The average distance traveled by gas molecules between collisions.
  - **Effusion:** The escape of gas molecules or atoms through a pinhole.
  - **Diffusion:** The motion of a gas mixture from a _____ to _____ concentration.



Rate of Effusion

- States that the rate of a gas is _____ proportional to the square root of their mass.
  - In simple terms, ⇧ the molar mass of a gas then the _____ its speed and the _____ its rate.

Rate of Effusion

$$\text{Rate}_{Gas} = \frac{\quad}{\quad}$$

EXAMPLE: Rank the following in order of increasing rate of effusion:

O_2 PF_5 CO_2 Xe

Graham's Law of Effusion

- Used when comparing the rate of two different non-reacting gases.
  - The *effusion rate* of a gas and its **time** to travel are _____ proportional.
  - The *effusion rate* of a gas and its **molar mass** are _____ proportional.

Graham's Law

$$\frac{\text{Rate}_{Gas}\_\_}{\text{Rate}_{Gas}\_\_} = \frac{\text{time}\_\_}{\text{time}\_\_} = \frac{\sqrt{M\_\_}}{\sqrt{M\_\_}}$$

EXAMPLE: Calculate the ratio of the effusion rates of helium to methane (CH_4).

CONCEPT: EFFUSION

PRACTICE: If H_2 has an effusion rate that is 3.72 times faster than a gas, what is the identity of the unknown gas?

a) Cl_2 b) CO_2 c) N_2O_4 d) N_2 e) O_2

PRACTICE: How many times faster will H_2 gas pass through a pinhole into an area of vacuum than O_2 gas?

a) 32 b) 2 c) 2.5 d) 4 e) 8

PRACTICE: It takes 6.3 minutes for 2.3 L argon to effuse through a semipermeable membrane. How long would it take for 2.3 L of chlorine gas to effuse under similar conditions?