Chapter 5: The Basics of Kinetic-Molecular Theory

Goal: Understand (on a microscopic level) the variables in *PV=nRT* (especially temperature)

Assumptions (how a physicist would describe an ideal gas…):

(1) A gas consists of particles (that is, atoms or molecules) of negligible size.

(2) These particles move at a variety of speeds in all directions: this gives rise to the volume a gas is said to occupy.

(3) These particles exert no forces on each other, except during collisions.

(4) Particles exert pressure by colliding with the walls of its container.

Then sit back as brilliant 19th century physicists (like James Clerk Maxwell and Ludwig Boltzmann) do lots of math….

Result: Temperature determines the average kinetic energy (*KE*) of a gas

$$\boxed{KE = \frac{3}{2}nRT}$$

From physics, we know that

$$KE = \frac{1}{2}mu^2 = \frac{1}{2}nMu^2$$

where *u* is the average speed of the gas, and *M* is the molar mass. So

$$\frac{1}{2}nMu^2 = \frac{3}{2}nRT$$

$$Mu^2 = 3RT$$

$$\boxed{u \approx \sqrt{\frac{3RT}{M}}}$$