Notes #35 **Kinetic Molecular Theory**

Ap Chemistry

I. Kinetic Molecular Theory of Gases:

a. What are the 4 *assumptions* made by this theory?

1. Volume:

2. Motion:

3. Attractive forces:

* 4. Kinetic Energy: The average KE of gas particles is proportional to the absolute temperature.

- ANY TWO GASES AT THE SAME TEMPERATURE WILL HAVE THE ____________ AVE. KE.

b. *Be able to explain each of the gas laws in terms of Kinetic Molecular Theory (refer to pages 181-182).*

II. Kinetic Energy: Let's look at equation for KE.

$KE = 1/2\ mv^2$........or (more accurately)......| ...KE = |

a. u = ______________________ - average of the square of the speeds of al the molecules.

** b. KE depends on both the ________________ and the ____________________________of particles.

1. Just because the average KE and speed of each molecule is the same at constant T, at any one instant, are all the molecules moving at that speed? Why or why not??

- We can use a Maxwell speed distribution curve to show the # of gas molecules moving at certain speeds.

** As T __________, molecular speed __________.

** As T __________, molecular speed becomes more variable. Why???

2. Let's say we are talking about TWO gases at the same temperature. Because they are at the same T, they should have the same ____________________________ but do their molecules travel at the same average speed?? Why or why not???

** Thinking back to the diffusion demo, which gas, NH_3 or HCl had molecules moving faster??? __________

III. Determining the speed of gas particles:

We can quantitatively estimate the speed of particles by calculating an average molecular speed or a ***root-mean-square (rms) speed (u_{rms})***.

a. How do we derive u_{rms}?? Equalize and manipulate the following two equations:

KE per molecule = $1/2\ mu^2$ KE per mole = $3/2\ RT$

$$u_{rms} = \frac{3RT}{M}$$

b. You want u_{rms} in m/s. In order to do this R has to be in units of **J/mol·K** and molar mass has to be in units of **kg/mol**. **R = 8.314 J/mol·K** (derivation in Appendix of book)

ex. Compare quantitatively the root-mean-square speeds (in m/s) of NH_3 and HCl gas molecules at 25 C.

IV. Gas Diffusion:

Refers to the gradual mixing of gas molecules. Diffusion always proceeds from a region of ___________ concentration to a region of ____________ concentration. Looking at the molecular speeds from above, one would *expect* molecules to mix quickly. However, this in NOT the case....why?

a. The relative rates of diffusion can be calculated by comparing u_{rms} values:

Rate of Diffusion for gas 1 — Simplify!

Rate of Diffusion for gas 2

b. This is called ____.

EX: The diffusion rate of an unknown gas is measured and found to be 31.50mL/min. Under identical experimental conditions, the diffusion rate of O_2 is found to be 30.50 mL/min. If the choices are CH_4, CO, NO, and CO_2, what is the identity of the unknown gas?

** With the diffusion, the above calculation is only a *prediction*. Because of all the collisions with air, the actual rates of diffusion are much more complex to determine.

V. Gas Effusion:

refers to the passage of a gas through a tiny hole in an evacuated chamber. The same relationship to molar mass applies as above.

** Unlike diffusion, determination of the rates of effusion are much more precise as this transfer of gas occurs in a vacuum where there are no air molecules to interfere.

EX: Calculate the ratio of the effusion rates of hydrogen gas and uranium hexafluoride (UF_6), a gas used in the enrichment process to produce fuel for nuclear reactors. (*M* of UF_6 is 352.02 g/mol)