Name: _____ Date: _____ CHEM 1A

Monday/Tuesday November 4 & 5, 2019 - Kinetic Model of Gases & Effusion and Diffusion (Chapter 5 Pt 2)

I. Recall & Warm-Up

1. What is the difference between **scientific theory** and **scientific law**?

2. Which gas is most dense at 1 atm and 25°C?
   (A) hydrogen cyanide
   (B) hydrogen sulfide
   (C) nitrogen monoxide
   (D) carbon monoxide
   (E) nitrogen dioxide

3. Which of the following will have the greatest average kinetic energy?
   (a) 2.4-L of He at 1 atm and 25°C
   (b). 5.9-L of Ne at 2 atm and 20°C

Assumptions Needed for the Kinetic Theory of Gases

II. The Kinetic Model of Gases

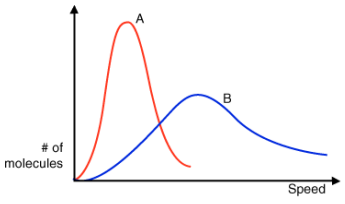
4. The kinetic-molecular theory of gases does *not* assume that
   (A) gases are made up of tiny particles in constant chaotic motion.
   (B) gas particles are very small compared to the average distance between the particles.
   (C) gas particles collide with the walls of their container in elastic collisions.
   (D) the average velocity of gas particles is directly proportional to the absolute temperature.
   (E) All of these are correct.

Most Probable Velocity (u_mp)

Average Velocity (u_ave)

Root Mean Square Velocity (u_rms)

5. The plots on the right represent the speed distribution for 1.0 L of oxygen at 300 K and 1000 K. Identify which temperature goes with each plot.



6. Now the plots on the right represent the speed distribution for 1.0 L of He gas at 300 K and 1.0 L of Ar gas at 300 K. Identify which gas goes with each plot.

7. Calculate the average kinetic energy of CH_4 molecules at 0.°C. Report answer in J/mol.

8. Calculate the temperature at which the average velocity of Ar (g) equals the average velocity of Ne (g) at 25°C.

9. A plot of the Maxwell distribution against speed for different molecules shows that
   A) heavy molecules have a higher average speed.
   B) light molecules have a very narrow range of speeds.
   C) heavy molecules have a wide range of speeds.
   D) light molecules have a lower average speed.
   E) heavy molecules travel with speeds close to their average values.

Diffusion – The spreading of one substance through another substance.

Effusion – The escape of a substance (particularly a gas) through a small hole.

Graham's Law of Effusion

If the numbers of particles are the same then**

III. Effusion and Diffusion

10. It takes 12 seconds for 8 mL of hydrogen gas to effuse through a porous barrier at STP. How long will it take for the same volume of carbon dioxide to effuse at STP?

11. The effusion rate of H_2 gas is 6.45 times faster than that of a certain noble gas (both gases are at the same temperature). What is the noble gas?

12. The following experiment was carried out using a newly synthesized chlorofluorocarbon. Exactly 50 mL of the gas effused through a porous barrier in 157 s. The same volume of argon effused in 76 s under the same conditions. Which compound is the chlorofluorocarbon?
   (A) $C_2Cl_4F_2$ (B) C_2ClF_5 (C) $C_2Cl_2F_4$ (D) C_2Cl_5F (E) $C_2Cl_3F_3$

13. Order the following according to increasing rate of effusion: F_2, Cl_2, NO, NO_2, CH_4

14. Determine if each of the following statements are true or false:

a. Gases tend to behave more ideally at high temperatures and pressures

b. CO_2 and N_2O_4 gas have the same average kinetic energy at STP

c. The distance between gas particles is much larger than the size of the gas particles is one of the assumptions of kinetic molecular theory

d. 1 mol of CO at 1 atm and 25 °C has a greater collision frequency than 1 mol of N_2 at 0.9 atm and 25 °C.

e. In the van der Waals equation the *b* value increases as the forces between the gas particles gets stronger.