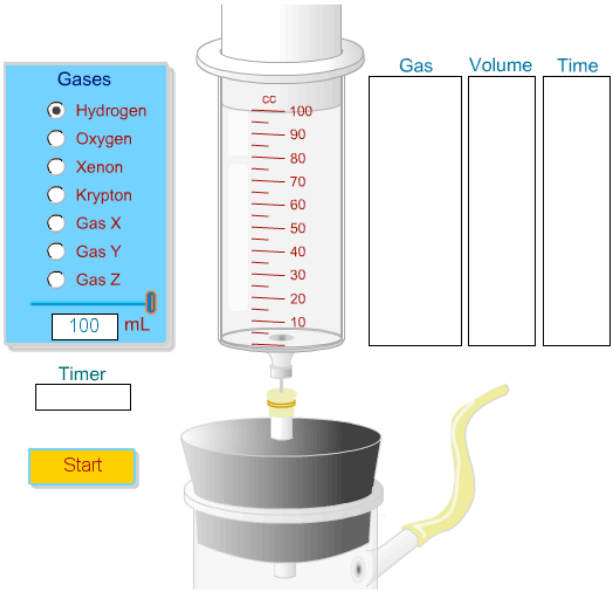
Effusion

Name_____ Lab Section_____

Problem Statement: How fast do gases escape from a container?

I. Data Collection:

A. Go to http://cheminfo.chem.ou.edu/~mra/home.html and open the Effusion Simulation. Your screen should look like the figure.



The apparatus represents a syringe that can be filled with different gases, including some unknown gases, to a volume that you can specify. The syringe is connected to a flask by a needle with a very small opening. The flask is connected to a vacuum pump that removes any gases that are in the system. The process of a gas escaping through a small hole into a vacuum is called effusion.

B. Use the button to pick hydrogen gas. Leave 100mL as the volume. Click on the start button and allow the gas to escape into the flask. Record what you observe happening.

C. Adjust the volume of hydrogen gas to 75 mL with the slider bar and repeat the experiment. Do the same for 50 mL and 25 mL of Hydrogen. Record the amount of time for the gas to escape from the syringe in the table below.

Gas	Volume	Time	Rate
Hydrogen	100 mL		
Hydrogen	75 mL		
Hydrogen	50 mL		
Hydrogen	25 mL		

The rate of a process is defined as the change of an amount per the elapsed time. For example the rate of speed of an automobile is the change of distance (miles) per unit time (hours). What is the rate (called the rate of effusion) that hydrogen gas escapes from the syringe in this experiment? Record these values in the table above.

II. Interpretation

A. What is the unit of the rate of effusion in this experiment?

B. Mental Modeling: At the level of atoms and molecules, explain how hydrogen molecules escape from the syringe? What factor(s) control how fast the molecules escape? How could you increase the rate of effusion in this experiment?

III. Data Collection:

Set the volume of the syringe at 100 mL and measure the rate of effusion for all of the gases. Record the data in the table below. Record the molecular masses of the gases in the table.

Gas	MM	Volume	Time	Rate
Hydrogen		100 mL		
Oxygen		100 mL		
Xenon		100 mL		
Krypton		100 mL		
Gas X		100 mL		
Gas Y		100 mL		
Gas Z		100 mL		

IV. Data Analysis and Interpretation:

A. Account for any differences in the rates of effusion for the different gases. Why do some gases effuse faster than others? Can you use the kinetic molecular theory to justify your answer?

B. Test to see if the rate of effusion is related to the molecular weight of the gases by plotting them on a graph and determining the equation of the line. Record you results below. Include the graph in your report. (If you have a straight line you can use the equation for a straight line ($y = mx + b$). If the line is a curved line you can test to see if the plot is a power function ($y = x^2$) or a logarithmic function ($y = \log x$). This can be made easier if you are using a graphing or data analysis program like Excel™. Your instructor can show you how to do this.)

C. From your graph determine the molecular weights of the unknown gases. Propose the possible identities of the unknown gases.

V. Conclusion:

Propose an equation that will relate the rates of effusion of two gasses. This equation could be used to determine the molecular weight of an unknown gas by comparing its rate of effusion with the rate of effusion of a known gas – ([rate unknown gas] / [rate known gas] = ?). How is this equation related to the kinetic molecular theory?