Gas Pressure and Volume Relationships

Name_____ Lab Section_____

CHECKOUT from the Storeroom: Plastic Tub containing Go!Link and Gas Pressure sensor

In this laboratory experience, you will be able to observe a classic chemistry concept from both the macroscopic and molecular point of view. It is important to be able to link the two different views when forming an understanding of chemistry.

Open the plastic tub and remove the Go!Link and gas pressure sensor and 20 mL syringe (Figure I).

Figure I.

Connect the gas pressure sensor to the Go!Link and then connect the Go!Link and gas pressure sensor assembly to the laptop through the USB port on the portable computer. Do not connect the syringe to the gas pressure sensor right away.

Log onto portable computer and open the Internet Explorer browser, and access the following web page:

http://introchem.chem.okstate.edu/jmol/GoIO1/

When the dialogbox appears click on the Trust button. This will load a particulate simulation that looks like Figure 1I.

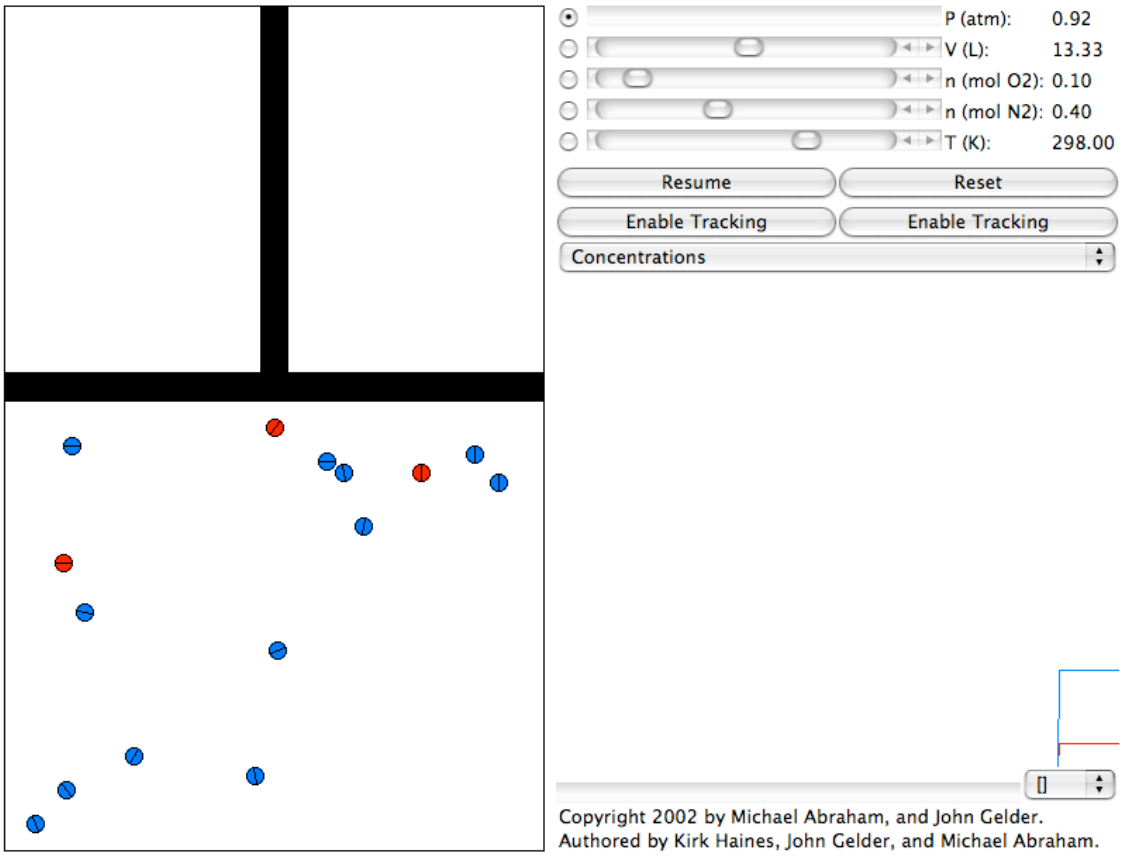


Figure II.

Once the simulation is running you may need to uncheck the Status Bar under the View option in the Menubar to see all of the simulation and control bar region.

Check the value of the volume in the upper right corner of the window on the computer screen. The volume should be read in units of mL (not L). For example in Figure II the volume of the syringe is 13.33 mLs NOT 13.33 L. Set the volume of your syringe to the volume shown in the display and attach the syringe to the gas pressure sensor. Click on the Volume radio button on the left of the volume horizontal scrollbar. If the particles are not already moving in the container shown on the left side of the display, click the Resume button.

Before getting started, familiarize yourself with the equipment and how it works.
Depress the syringe plunger and observe what happens in the simulation.
Pull the syringe plunger out and observe what happens in the simulation.
(NOTE: At this time do not change the number of moles of either gas in the container, or the temperature of the gas.)

Problem Statement: How are the pressure and volume of a gas sample related?

When you have the simulation running in the browser window (the gas particles are moving in the gas sample region), and the simulation is responding to the gas pressure sensor you are ready to begin Data Collection.

I. Data Collection

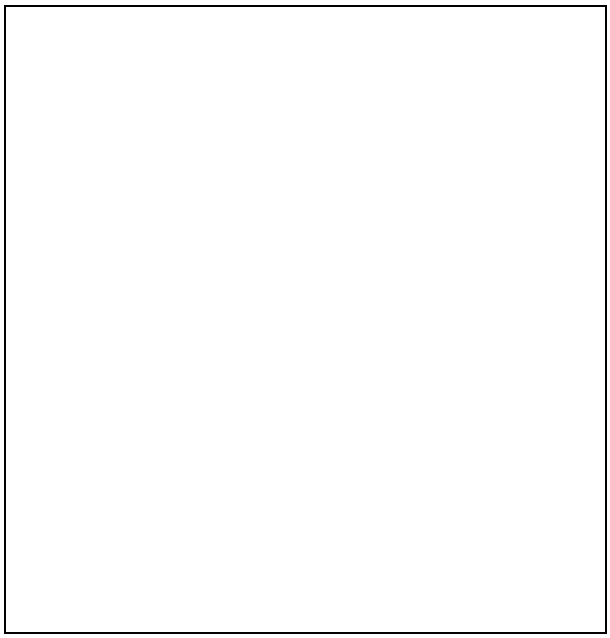
A. What are the names, formulas and relative proportion of the major gaseous components of air?

B. Based on your responses in Part I.A., identify the gas particles in gas sample region of the simulation.

C. Are the particles in the gas sample region of the simulation monoatomic or diatomic? How can you tell?

D. Observe the gas sample in the gas sample region on the computer screen. Describe what is happening on the molecular level. Consider using some or all of the following words in your description: particles, atoms, molecules, collisions, speed, energy, force.

E. Enable one of the tracking buttons to track the path of a gas particle. In the space below trace the path of the particle from one side of the container to the other. Explain any changes in speed or direction of the particle that you observe.



Explanation:

F. Record the values for pressure, volume (remember the unit is mL), and temperature that appear on the computer screen. What is the pressure of the trapped air in your syringe?

F. Check to be sure the volume of air in your syringe compares closely to the volume of air displayed in the simulation. Does gas volume describe the space that individual molecules occupy or does volume describe the space that the individual molecules occupy and the space between molecules?

G. Depress the plunger of the syringe and describe the changes that occur in the system. Is the pressure of the trapped air greater or less than atmospheric pressure? Explain.

H. Take pressure and volume data for a total of seven data sets such that you capture data over the full range of the syringe. NOTE: The minimum volume the simulation can measure is around 5 mLs, so be careful collecting data at the low end of the volume reading. Record the pressure and volume data in the provided table.

Pressure(atm)	Volume (mL)	Pressure(atm)	Volume (mL)
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

I. Click on the dropdown button below the two tracking buttons and select the Velocities option. Look at the velocity bar graph. Click on the Pause button and sketch and label the graph below.

J. Click on the Resume button and observe the changes in the velocity bar graph to what you see with the behavior of the particles in the gas sample window. What can you say about the speeds of the gas particles? Are they all the same? Are they different? Does the velocity of a particle remain constant?

II. Data Analysis

A. What patterns do you find from the data collected in I.H.? How are pressure and volume related? Try to come up with an algebraic relationship to express the pattern you found. (Hint: the variables are pressure and volume; try graphing the pressure and volume data in Excel. Print out the graph and include it here.)

III. Data Interpretation

A. How are the pressure and volume of a gas related?

B. Mental Model—Draw a picture(s) that explains how the pressure and volume of a gas sample are related at the level of atoms and molecules and that illustrates the observations you made in the experiment. In words, explain how your picture(s) illustrates this relationship.

C. Based on your data (I.H. and II.A), predict the pressure of a gas sample at a volume of 100 mL. Show how you made your prediction.

POST LAB QUESTIONS

1. What is the difference between the density of a gas and the mass of a gas?

2. What is the difference between the volume of a sample of gas and the volume of the same sample in the condensed liquid phase?

3. What is the difference between the mass of a sample of gas and the mass of the same gas sample in the condensed liquid phase?

4. Generate a hypothesis regarding the relationship between temperature and either volume or pressure. Briefly design and carry out an experiment in which you determine a) the relationship between pressure and temperature or b) the relationship between volume and temperature.

NOTE: To test your hypothesis open the following page in a new browser window. You will not need the syringe and gas pressure sensor for this activity.

http://cheminfo.chem.ou.edu/~mra/CCLI2004/GLHeNeAr.htm

Hypothesis:

Independent Variable:

Dependent Variable:

Describe the experiment you performed to collect the data below:

Data Collection:

Independent Variable	Dependent Variable

Was your hypothesis supported or refuted? Explain.