LAD B3 (pg 1 of 2) Volume and Pressure of Gases

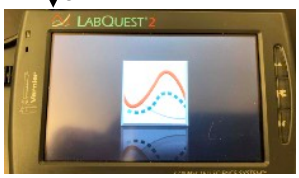
Name_____Per____

Introduction

In this lab we are going to investigate the relationship between the volume and pressure of a confined gas. The gas we use will be air, and it will be confined in a syringe connected to a Gas Pressure Sensor (see Figure 2). When the volume of the syringe is changed by moving the piston, a change occurs in the pressure exerted by the confined gas. This pressure change will be monitored using a Gas Pressure Sensor. It is assumed that temperature will be constant throughout the experiment. Pressure and volume data pairs will be collected during this experiment and then analyzed. From the data and graph, you should be able to determine what kind of mathematical relationship exists between the pressure and volume of the confined gas.

Procedure You MUST put on goggles whenever you are in the lab area.

Figure 1
On button is here.



A. One person in your group should collect the data on their computer right into the class data table, and then your lab mates can collect the data from the class shared table.

B. If not already turned on, start up the LabQuest by holding down the on button on the side for several seconds. (Figure 1) Sometimes it can take a while for the instrument to start up. This would be a good time for one partner to open the shared class data table and go to your class tab, then enter your names for the correct lab bench station.

C. The gas sensor is already connected to the LabQuest, but the syringe is not. First pull the syringe back to 10 ml and then twist the syringe gently on to the pressure sensor port. (Figure 2)

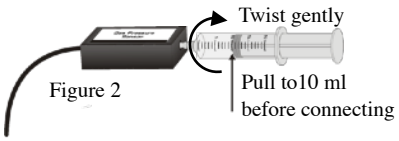


Figure 2

D. Change the units from kPa (kiloPascals) to mm Hg by using the pencil or your finger to touch the units. Go to change units and choose mm Hg. (Figure 3)

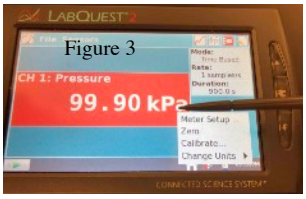


Figure 3

E. To obtain the best data possible, you will need to correct the volume readings from the syringe. Look carefully at the syringe; its scale reports its own internal volume. However, that volume is not the total volume of trapped air in your system since there is a little bit of space inside the pressure sensor.

F. To account for the extra volume in the system, you will need to add 0.8 mL to your syringe readings. For example, with a 10.0 mL syringe volume, the total volume would be 10.8 mL. It is this volume that you should record.

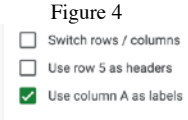
G. You are now ready to collect pressure and volume data. It is easiest if one person takes care of the gas syringe and another volume and pressure readings to the shared data table.

H. Squeeze AND pull back on the syringe to a particular volume, and tell your partner the volume (add 0.8 ml before recording in the table) and record the pressure at that volume. Repeat this process for 10 data points.

Processing the Data

1. Make a new tab in your own Google Lab sheet and title the Tab B3. Type a title in the Data Table. Go to the shared data and copy and paste your data into your lab sheet.
2. Make a scatter graph of pressure (y-axis) vs volume (x-axis).
   (a) Make sure that all your data is showing on the graph. You may need to check or uncheck some of the 3 boxes at the bottom of the set up menu. (Figure 4) Click until the graph looks correct.
   (b) Add your title and axes labels.
   (c) Set the minimum for the axes as zero.
   (d) Make a trendline, and choose the "power series" option for your trendline.

Figure 4



3. Set up a third column of data that is the the inverse of the volume data. You should put in an embedded formula to set up this column.
4. Make a scatter graph of pressure (y-axis) vs 1/volume (x-axis). You may find this easiest if you copy and past the pressure data into a fourth column so you can just highlight the 1/V data and pressure data. (Remember, the first column highlighted will pop up as the x-axis in the scatter graph.
   (a) Again, make sure that all your data is showing on the graph. You may need to check or uncheck some of the 3 boxes at the bottom of the set up menu. Click until the graph looks correct.
   (b) Add your title and axes labels.
   (c) Make a trendline, and choose the "linear" option for your trendline. Show the equation for the trendline.

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Post Lab Questions

1. Looking at your graph of pressure vs volume, would you conclude that the relationship between these two variables for a gas in a closed container at constant temperature is a direct relationship or inverse relationship? How can you tell?

2. Which mathematical relationship below is best to describe the relation ship between P and V? Explain why you made the choice that you did.

$$P \times V = constant \qquad \frac{P}{V} = constant$$

3. The second graph that you made linearizes the data. This tells us that we can make simple calculations to predict a pressure at a volume that you may not have measured.

   (a) Calculate what the pressure would have been in your syringe at 40 ml? Show your set-up.

   (b) Calculate what the pressure would have been in your syringe at 1.5 ml? Show your set-up.