LAD B4 (pg 1 of 2) Temp and Pressure of Gases

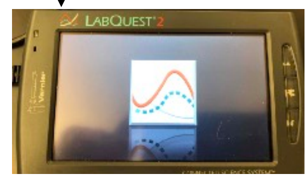
Name____________________________Per____

Introduction

In this lab we are going to investigate the relationship between the temperature and pressure of a confined gas. The gas we use will be air, and it will be confined in a flask connected to a Gas Pressure Sensor (see Figure 2). When the temperature of the syringe is changed by submerging the flask in water at different temperatures, 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 volume will be constant throughout the experiment. Temperature and pressure 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 temperature and pressure of the confined gas. Your lab group will have only one assigned temperature, and we will share all the class data points.

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

Figure 1
On button is here.

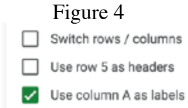


A. Get your water bath started doing what you need to do to hit your approximate target temperature.
B. One person in your group should collect the data on their computer right into the class data table, and then all of your lab mates can collect the data from the class shared table.
C. The gas sensor and temperature probe should already be connected to the LabQuest.
D. If not already turned on, start up the LabQuest by holding down the on button on the top 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.
E. Change the units from kPa (kiloPascals) to mmHg by using the pencil or your finger to touch the units. Go to change units and choose mm Hg. (Figure 3)
F. You are now ready to collect temperature and pressure data. It is easiest if one person takes care of the flask and thermometer and another person makes the pressure readings and types them into the shared data table.

Processing the Data

1. Make a new tab in your own Google Lab sheet and title the Tab B4. Type a proper title into your Data Table (include your name & partner's name(s). Go to the shared data table and copy and paste the class data into your lab sheet.
2. Make a scatter graph of pressure (y-axis) vs temperature (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 a title and axes labels.
   (c) Set the minimum for the x-axis as to negative 300ºC.
   (d) Make a trendline, and choose the "linear" option for your trendline.

Figure 4



3. Repeat the graph for the sample data. Include all the same specifications as above.

Post Lab Questions

1. Looking at your graph of pressure vs temperature, 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.

$P \times \mathrm{T} = constant$ $\qquad$ $\frac{P}{T} = constant$

3. Let's consider the meaning of this graph., and why is this cooler gas causing less pre
   (a) What happens to the speed of molecules as the temperature goes down?

   (b) What happens to the pressure as the molecules get cooler? Why?

   (c) As you continue to cool molecules even colder, what happens to the molecules speed? and the pressure?

   (d) At some really cold temperature, the molecules would actually stop moving. What pressure would the molecules cause at this really cold temperature?

   (e) Look at your graph and determine the temperature at the moment that the molecules stop moving. (Perhaps the sample data will give you the best number.) This temperature is called absolute zero.

   (f) Thinking about the speed of the molecules as we were imagining the temperature cooling down, and explain why there is NO temperature colder than the temperature that you reported in part (e)?

4. We can make simple calculations to predict a pressure at a temperature that you may not have measured.
   (a) Calculate what the pressure would have been in your flask at 60.ºC? Show your set-up.

   (b) Calculate what the pressure would have been in your flask at 120.ºC? Show your set-up.

   (c) Calculate what the pressure would have been in your flask at 393ºC? Show your set-up.

   (d) Compared to the pressure in part (a) at what temperature was that pressure doubled?