

Boyle's Law: Pressure-Volume Relationship in Gases

INTRODUCTION

When a gas held at constant temperature undergoes a change in volume, the pressure should change in inverse proportion to the volume change. Historically, this relationship was first established by Robert Boyle in 1662 and has since been known as Boyle's law.

PURPOSE

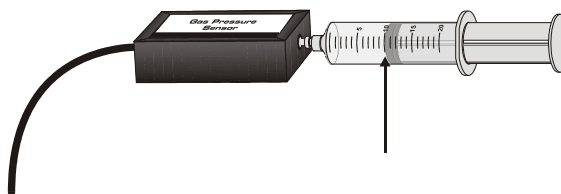
The purpose of the lab is to determine the relationship between the pressure and volume of a confined gas.

MATERIALS

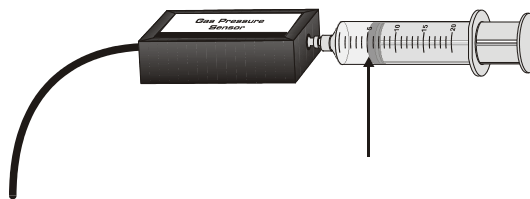
LabQuest interface
20-mL gas syringe
Vernier Gas Pressure Sensor or Pressure Sensor

PROCEDURE

1. Prepare the Pressure Sensor and an air sample for data collection.
 - a. Plug in the LabQuest interface using the power adapter provided to you. Turn on the LabQuest interface; it will take a couple of minutes to get up and running.
 - b. Plug the Pressure Sensor into Channel 1 of the LabQuest. DO NOT attach the syringe yet!
 - c. The LabQuest should recognize the pressure probe and immediately measure pressure in kPa (kiloPascals). It should read a pressure of near atmospheric pressure (101.3 kPa). If the reading is drastically different, inform your instructor.
 - d. With the 20-mL syringe **disconnected** from the Pressure Sensor, move the piston of the syringe until the front edge of the inside black ring is positioned at the 10.0 mL mark.
 - e. Attach the 20-mL syringe to the valve of the Pressure. Vernier Gas Pressure Sensors have a white stem protruding from the end of the sensor box—attach the syringe directly to the white stem with a gentle half-turn.
2. We are not particular about Data Collection mode since we are going to use the sensor as a continuous measuring device and record our data on paper as we go.
3. You are now ready to collect pressure and volume data. It is best for one person to take care of the gas syringe and for another to operate the LabQuest.



- a. Move the piston so the front edge of the inside black ring is positioned at the 5.0-mL line on the syringe. Hold the piston firmly in this position until the pressure value displayed on the calculator screen stabilizes. Record the pressure in your data table.
CAUTION: Handle the syringe carefully – the tip breaks quite easily. Do not compress the pressure probe and syringe together.
- b. Record the pressure on your lab paper.
- c. To collect another data pair, move the syringe to 7.5 mL. When the pressure reading stabilizes, record the pressure on your lab paper.
- d. Continue with this procedure using volumes of 10.0, 12.5, 15.0, 17.5, and 20.0 mL.



4. Shut down the LabQuest interface.

When you are done collecting data, you can press on the "Home" icon to go to the home screen. From there, open the System folder and choose "Shut down". Return the LabQuest and the Pressure probe.

RESULTS

Volume (mL)	Pressure (kPa)
5	
7.5	
10.0	
12.5	
15.0	
17.5	
20.0	

Using graph paper, make a graph of volume vs. pressure.

1. Prepare the graph paper
 - a. Use a straight edge to draw the axes.
 - b. Label the "x" axis as "Volume, mL).
 - c. Label the "y" axis as Pressure, kPa
 - d. Provide an appropriate scale for both axes. The graph should take up at least half of a piece of graph paper
2. Graph your data
 - a. Plot the points on your graph for the seven (Volume, Pressure) data pairs you recorded from the lab.
 - b. Draw a "curve of best fit" through your data points, but NOT extending beyond the first and last points on the graph. If you are not sure what is meant by a "curve of best fit", then ask your instructor for an explanation. Hint: Curve of best fit DOES NOT mean to draw straight lines from data point to data point. It means to draw a smooth curve that passes, if possible, through all of the data points.