Name _____ Date _____

SI Physics Lab #27 (20 pts)

Period _____ Mrs. Nadworny

Partners: Due Date: _____

Behavior of Gases

NO Lab Write-Up Required

Purpose

To determine the relationship between

- pressure and volume
- pressure and number of moles
- pressure and temperature

Materials

- ChromeBook with Graphical Analysis
- LabQuest Mini
- Two 250 mL beakers
- Beaker Tongs
- Temperature Probe
- Erlenmeyer flask
- Hot water
- Gas Pressure Sensor
- 400 mL beaker
- Ice

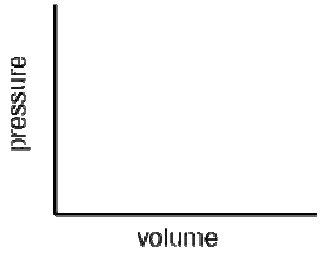
*Start the hot plate so you have hot water for Part 3.

Pre-Lab Questions – Part 1 (3 pts)

1. Predict what would happen to the pressure of a gas in a sealed container if you were to increase the volume.

2. What variables would you need to keep constant in order to see only the relationship between pressure and volume?

3. Sketch the line or curve you would expect if you were to graph the pressure-volume data.



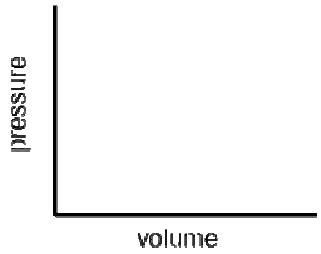
Procedure – Part 1

1. Start the Vernier Graphical Analysis app on the computer. Plug the Pressure Sensor into the LabQuest Mini interface ($_{CH1}$) and then plug this into the USB port of the computer. Graphical Analysis should auto-detect the senor.

2. In the lower left hand corner, click to change the data collection mode to Events with Entry. Enter Volume as the name and mL as the units.
3. Obtain the syringe that came with the sensor. Have one person manipulate the syringe while the other person works the ChromeBook.
4. With the syringe disconnected from the sensor, position the piston in the syringe so that the front edge of the inside black ring is at the 5.0 mL line.
5. Connect the syringe to the pressure sensor by screwing it on the the white nozzle (do NOT use the tubing) and press the green COLLECT button. Click KEEP and enter 5 in the volume field.
   - Do NOT disconnect the syringe.
6. Slowly pull on the piston until the volume is increased to 7.0 mL. When the pressure reading stabilizes, click KEEP and enter the volume.
7. Repeat step 6, increasing the volume by 2 mL each time, until you have at least six data points.
8. Click STOP to end data collection and remove the syringe from the sensor.

Data Analysis – Part 1 (6 pts)

1. From the graph options in the lower left corner, choose Analyze, Curve Fit, and then change the drop down menu from Linear to Inverse.
2. Sketch the line or curve represented by your data.



3. What is the relationship between Pressure and Volume?

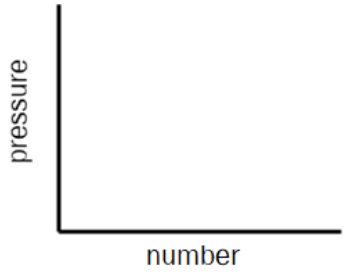
Claim:	
Evidence:	Reasoning:

Pre-Lab Questions – Part 2 (3 pts)

1. Predict what would happen to the pressure of a gas in a sealed container if you were to increase the amount of gas inside the container.

2. What variables would you need to keep constant in order to see only the relationship between pressure and number of particles?

3. Sketch the line or curve you would expect if you were to graph the pressure-number data.



Procedure – Part 2

1. Start the Vernier Graphical Analysis app on the computer. Plug the Pressure Sensor into the LabQuest Mini interface (CH1) and then plug this into the USB port of the computer. Graphical Analysis should auto-detect the senor.

2. In the lower left hand corner, click to change the data collection mode to Events with Entry. Enter Number as the name and "puffs" as the units.

3. With the syringe disconnected from the sensor, position the piston so that the syringe contains one "puff" (3 mL) of air.

4. Press the green COLLECT button. Connect the syringe to the pressure sensor (do NOT use the tubing) and pull back on the piston until the volume reads 10 mL and when the pressure reading stabilizes click KEEP and enter 1 as the number of puffs of air in the syringe.

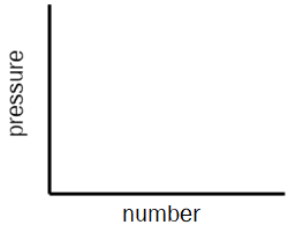
5. Disconnect the syringe from the sensor and move the piston so that it now contains two "puffs" (6 mL) of air. Re-connect the syringe to the sensor and move the piston until the volume again reads 10 mL. When the pressure stabilizes, click KEEP and enter 2 as the number of puffs of air in the syringe.

6. Repeat step 5, increasing the volume by one "puff" (3 mL) each time, until you have at least six data points.
   - When you get to 12 mL and higher, push in to get to 10 mL.

7. Click STOP to end data collection and remove the syringe from the sensor.

Data Analysis – Part 2 (6 pts)

1. From the graph options in the lower left corner, choose Analyze, Curve Fit, and then choose the best fit line for your data.
2. Sketch the line or curve represented by your data.



3. What is the relationship between Pressure and Number of air molecules?

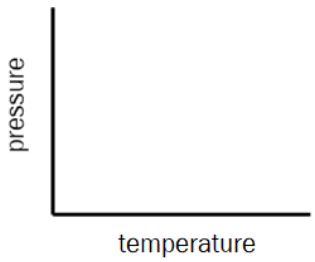
Claim:	
Evidence:	Reasoning:

Pre-Lab Questions – Part 3 (3 pts)

1. Predict what would happen to the pressure of a gas in a sealed container if you were to increase the temperature.

2. What variables would you need to keep constant in order to see only the relationship between pressure and temperature?

3. Sketch the line or curve you would expect if you were to graph the pressure-temperature data.



Procedure – Part 3

1. Start the Vernier Graphical Analysis app on the computer. Plug the Pressure Sensor into the LabQuest Mini interface (CH1) and then plug this into the USB port of the computer. Plug the Temperature Probe into the LabQuest Mini interface (CH2). Graphical Analysis should auto-detect the sensors.

2. In the lower left hand corner, click to change the data collection mode to Event Based. Do NOT name it!

3. Instead of a syringe, you will use an Erlenmeyer flask as your container. Using the lock connectors, attach one end of the plastic tubing that accompanies the sensor to the white stopper and attach the other end to the gas pressure sensor. Place the stopper firmly in the flask. Check that the valve on the other stopper opening is closed (horizontal).

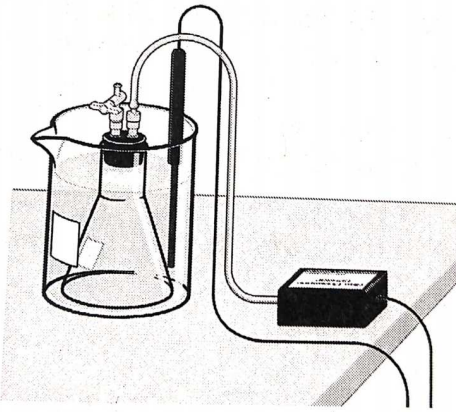


Figure 1

4. Obtain approximately 200 mL of hot water in the 400 mL beaker. Obtain approximately 200 mL of tap water a 250 mL beaker.

5. Put the 200mL of hot water into your 400 mL beaker, then carefully lower the Erlenmeyer flask into the hot water bath. Hold it under water.
   - Note that the temperature probe is placed in the water bath rather than directly in the gas itself; this means the system must be allowed to equilibrate for several seconds before recording the pressure and temperature.
   - Make sure the temperature probe is NOT touching the beaker walls or Erlenmeyer flask.

6. Press the green COLLECT button.When the temperature and pressure readings stabilize, click KEEP. The program will save the pressure-temperature data for each trial.

7. Take the flask and thermometer out of the beaker while changing the water temperature. Carefully pour out some of the hot water into the empty 250 mL beaker and replace it with some tap water. The temperature should be 10 – 15 ^{o}C below your initial value. When the temperature and pressure readings stabilize, click KEEP.

8. Repeat step 7 three more times, reducing the temperature by about 10 – 15 ^{o}C for each subsequent trial.

9. Finally, add a handful of ice cubes to the water bath. When the temperature and pressure readings stabilize, click KEEP.

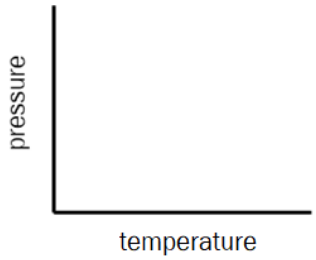
10. Click STOP to end data collection. Separate and clean up all supplies.

Data Analysis – Part 3 (6 pts)

1. On the x-axis, click the blank box and select Temperature.

2. From the graph options in the lower left corner, choose Analyze, Curve Fit, and then choose the best fit line for your data.

3. Sketch the line or curve represented by your data.



4. What is the relationship between Pressure and Temperature?

Claim:	
Evidence:	Reasoning:

Conclusions (2 pts)

1. What is the proportional relationship involving P, V, n, and T.

2. What equation from Chemistry does this remind you of?