FLINN SCIENTIFIC

Name________________________________

Boyle's Law in a Bottle

Data and Results Table

Barometric Pressure							
Trial 1				Trial 2			
Gauge Pressure	Volume of Air in Syringe	Total Pressure*	1/V†	Gauge Pressure	Volume of Air in Syringe	Total Pressure*	1/V†

*See Post-Lab Question #2. †See Post-Lab Question #5.

Post-Lab Questions

1. Convert the local barometric pressure to psi units and enter the value to the nearest psi in the Data and Results Table. Some appropriate conversion factors are shown below.

$$1 \text{ atm} = 760 \text{ mm Hg} = 29.92 \text{ in Hg} = 14.7 \text{ psi}$$

2. The pressure gauge measures the relative pressure in psi above atmospheric pressure. For each pressure reading in the Data and Results Table, add the local barometric pressure to the gauge pressure to determine the total pressure of air inside the pressure bottle. Enter the total pressure to the nearest psi in the table.
3. Plot a graph of volume on the y-axis versus total pressure on the x-axis. *Note:* The origin of the graph should be (0,0). Choose a suitable scale for each axis so that the data points fill the graph as completely as possible. Remember to label each axis and give the graph a title.

4. Describe the shape of the graph. Draw a best-fit straight or curved line, whichever seems appropriate, to illustrate how the volume of a gas changes as the pressure changes.

5. The relationship between pressure and volume is called an "inverse" relationship—as the pressure increases the volume of air trapped in the syringe decreases. This inverse relationship may be expressed mathematically as $P \propto 1/V$. Calculate the value of $1/V$ for each volume measurement and enter the results in the Data and Results Table.

6. Plot a graph of pressure on the y-axis versus $1/V$ on the x-axis and draw a best-fit straight line through the data. *Note:* The origin of the graph should be (0,0). Choose a suitable scale for each axis so that the data points fill the graph as completely as possible.

7. Another way of expressing an inverse relationship between two variables ($P \propto 1/V$) is to say that the product of the two variables is a constant ($P \times V = \text{constant}$). Multiply the total pressure (P) times the volume (V) for each set of data points. Construct a Results Table to summarize the $P \times V$ values.

8. Calculate the average value of the $P \times V$ "constant" and the average deviation. What is the relative percent error (uncertainty) in this constant?

Relative percent error = (Average deviation/Average value) × 100%

9. At constant temperature, the pressure of a gas is proportional to the concentration of gas particles in the container. When some of the pressure was released from the bottle, the syringe plunger moved up. Why did this happen? Use diagrams and explain in words what happens to the gas particles moving around both inside and outside the syringe before and after the pressure is released.

10. *(Optional)* Research the properties of PETE on the Internet. What characteristics of PETE make it an ideal plastic for use in soda bottles?