Gases and Gas Laws **Name**_____

P and V Gas Law – Boyle's Gas Law

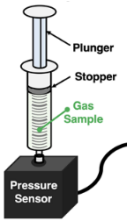
Read from **Lesson 2c:** Pressure and Volume in **Gas Laws** in the **Chemistry Tutorial Section, Chapter 10** of **The Physics Classroom**.

Irish chemist Robert Boyle determined that for a sample of gas with a constant temperature and constant number of moles, the pressure of the gas is inversely proportional to its volume.

This proportionality statement is often written in equation form as $\mathbf{P \propto \frac{1}{V}}$ **or** $\mathbf{P * V = k}$

where **P** is the pressure measured in atmospheres (atm), kiloPascals (kPa), millimeters mercury (mmHg), and torr, and V is volume measured in milliliters (mL) and Liters (L).

Part 1: Boyle's Law Lab



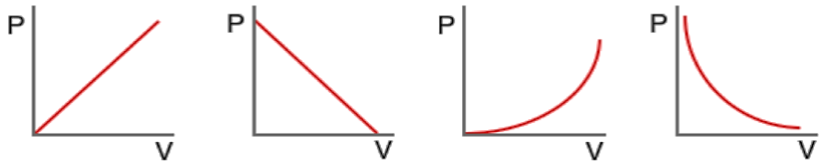
Flo and Clo Wrene (identical twin chemistry students) are studying gas laws in the lab. They use a sample of air in a syringe. When the volume of the syringe is changed by moving the piston, a change occurs in the pressure exerted by the air. Pressure is measured with a pressure sensor. The temperature of the air sample and the number of molecules it contains are kept constant. Flo and Clo are trying to determine what kind of mathematical relationship exists between the pressure and volume of a gas.

1. a. Fill in the missing data in their data table. How do you determine the constant for this lab?
   P ×V = constant or *P/ V = constant?*

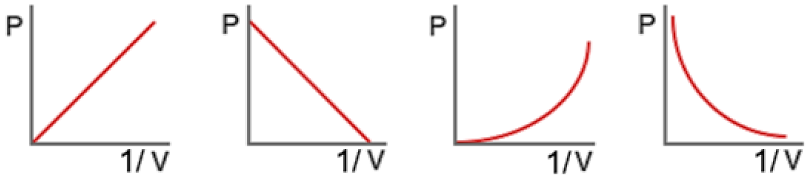
Volume (mL)	Pressure (kPa)	Constant
5.9	154	
7.5	121	
	91.0	910
12.5	72.8	
15.0		
17.5	52.0	
19.5	46.6	

b. Graph pressure (kPa) vs volume (mL). Use your calculator or graphing app.

c. Circle the graph that represents the relationship between pressure and volume from this lab?



d. Circle the graph that represents the relationship between pressure and 1/volume from this lab?



e. Calculate what the pressure would have been in the syringe at 30 ml? Show your work.

f. Calculate what the pressure would have been in your syringe at 2.5 ml? Show your work.

g. Using Boyle's Law, explain why bubbles exhaled by scuba divers (at lower depths) get larger as the bubbles reach the surface of the ocean?

Part 2: Boyle's Law Problems Show all work as you solve these problems.

Example: A gas has a volume of 65 mL and a pressure of 0.25 atm. If the temperature is held constant, what is the new pressure when the volume is decreased to 45 mL?

First, assign values to the variables in the equation

$P_1 = 0.25$ atm

$V_1 = 65$ mL

$P_2 = ?$

$V_2 = 45$ mL

$$P_1 * V_1 = P_2 * V_2$$

$$(0.25)(65) = P_2 * (45)$$

$$P_2 = 0.36 \text{ atm}$$

1. The pressure inside of a flexible bicycle tire is measured 6.68 atm when the air inside of the tire has a volume of 365 mL. After an extended ride, the pressure rises to 7.25 atm. Determine the volume of air in the tire after the ride, assuming no temperature change.

$P_1 =$

$V_1 =$

$P_2 =$

$V_2 =$

2. A gas has a volume of 117 mL at standard pressure. If there is no change in temperature, what is the pressure of the gas when the volume is 89.2 mL?

$P_1 =$

$V_1 =$

$P_2 =$

$V_2 =$

3. A sample of carbon dioxide gas exerts a pressure of 5.40 atm. What is the pressure when the volume of the gas is reduced to one-fourth of the original value at the same temperature?

$P_1 =$

$V_1 =$

$P_2 =$

$V_2 =$