Boyle's Law: P vs V, DATA ANALYSIS

The experiment that you just did established an important relationship between pressure and volume;

$$P*V = constant;$$

This relationship, along with others, resulted in the ***Ideal Gas Law*** *(used in other activity)*.
- We can rearrange the above expression, P*V = constant, into the mathematical equation of a line (y=mx+b, where b=0, y=P, x=1/V, and m=slope=constant);

$$P = \text{constant} * \frac{1}{V}$$

EXCEL activity:
- Enter all data from table into Excel, include column headers.
- Make a new column "1/volume" and use Excel the "calculate" these values for you.
- Plot the **pressure** in atm (y-axis) vs the **1/volume** (x-axis) and fit a trendline to the data (show equation on graph).
- Record the equation of the line in your notebook, add axes labels/title, and print the graph to be turn in today (***remember each group member makes their own graph***).

- So, what is the significance of the numerical value of the slope? *Answer*: the constant was determined to be equal to:

$$\text{constant} = n*R*T,$$

where n = moles of gas, "R" is the "*gas constant*", and T is the temperature in Kelvin. Since you have determined a numerical value for the "constant" (= "slope" in your graph above), the temperature the data was collected was 298 K, and the number of moles gas in the syringe, when set to 10 ml, is approximately 4.09e-4 moles...you can calculate the "R" value. Do this now and record these calculations in your lab notebook.

The accepted value for R is 0.08206 (L•atm)/(mol•K); how close did you come? Calculate in your notebook the % difference from your value and the accepted value.

All analyses completed…MOVE TO NEXT STATION

Charles' Law: P vs T, DATA ANALYSIS

The experiment that you just did established an important relationship between pressure and temperature.

$$P/T = constant;$$

This relationship, along with others, resulted in the ***Ideal Gas Law*** *(used in other activity)*. The P/T data could be processed in order to determine the gas constant (R) (this was done in the Boyle's Law data analysis) but instead we are going to use the data to help define the "absolute temperature" scale called Kelvin.

EXCEL activity:
- Enter data from P/T table into Excel, include column headers. Use Excel to converted units of mmHg to atm.
- Plot the **pressure** in atm (y-axis) vs the **temperature** in °C (x-axis) and fit a trendline to the data (show equation on graph).
- Right-click on the trendline, choose "Format Trendline" then under the ***Trendline Options*** set the "forecast" - "backwards" to 350 units. This is done to visually note where the data crosses the temperature axis when the pressure is zero.

Record the equation of the line in your notebook, add axes labels/title, and print the graph to be turn in today (***remember each group member makes their own graph***).

The experiment that you just did was the origin of the Kelvin temperature scale. The conversion of degree Celsius (°C) to Kelvin (K) is done using the following equation: K = °C +273.15 The Kelvin scale is also referred to as the absolute temperature scale because it was proposed that at absolute zero temperature the pressure would also be zero.

Now write down the equation of your line in your notebook and then solve for the temperature when P=0. This temperature value should be near -273 °C. These calculations are to be done in your lab notebook.

All analyses completed…MOVE TO NEXT STATION