

Graphing Scientific Data Lab

Discussion: If data points lie roughly along a straight line, the x and y variables have a **linear relationship** or are **directly proportional**. This means as one variable increases, the other does too, in a constant proportion - as x doubles, y doubles; as x triples, y triples; etc. Directly proportional quantities, x and y, relate to one another through mathematical equations of the form $y = mx + b$, where m is a constant and b is zero. The equation for the directly proportional linear relationship is $y = kx$. Here $m=k$ and $b=0$. For an **indirect relationship**, one variable increases while the other decreases at a constant rate. The mathematical expression for an indirect relationship is $y = -kx$.

If data points lie along a curve that drops from left to right, then the quantities have an **inverse relationship** or are inversely proportional. In an inverse relationship, one quantity increases as the other decreases. The mathematical relationship that expresses an inverse relationship is $y = 1/x$. The expression relating gas pressure and volume follows the expression $PV=k$. Note that an inverse relationship is nonlinear because the increase of one variable is not accompanied by a constant rate of decrease in the other variable.

Purpose: To determine the relationship between mass and volume of aluminum; to determine the relationship between the pressure and volume of a gas.

Hypothesis: (Predict the relationship between the variables.)

Procedure: Use any graphing program or the excel program to enter and analyze the data.

You will find the instructions on how to create the line graph, a trend line, and equations for the graph on page 4 of the following graphing module:

<https://students.ga.desire2learn.com/d2l/lor/viewer/view.d2l?ou=1798&loc=0&isPopUp=false&searchType=2&lidentId=4227>

Data:

1. When the program opens, Enter "Volume" for the x axis title and "cubic centimeters" for the units.
2. Enter "Mass" for the y axis title and "grams" for the units.
3. Enter the data from the data table below for the mass and volume of aluminum samples.

Volume (cm ³)	Mass (g)
5.3	14.1
7.5	20.5
10.8	29.0

15.0	39.6
18.4	51.3
20.2	53.7
23.1	64.8

- After you have entered all the values, click on the graph to select
- Enter a title on the graph "Volume vs. Mass".
- Close, but save, the previous graph and open a new graph and data table.
- Enter the values for the pressure and volume of a gas as given below and create labels and units for the axes as well as a title for the graph.

Pressure (atm)	Volume (L)
0.100	245
0.200	122
0.400	61.0
0.800	30.4
2.00	12.2
4.00	5.98
8.00	2.92

Follow the instructions in the tutorial to create a trend line and the equations for each graph.

- Save a copy of each graph to submit.

Questions:

- What is the slope for the first graph?
- What type of relationship is indicated in Graph 1?
- Write the equation for the line in the $y=mx + b$ format, substituting the slope for m and zero for b .
- If the mass of the aluminum sample was 17 g, what volume would this correspond to? Read

this from the graph. This is called **interpolating data**. Finding a data point outside the data range is called **extrapolating data**.

5. Using the equation from question 3, solve for the volume (x) when the mass (y) is 17 g. Does this answer agree with what you read from the graph? If it does not, recheck your math or the graph.
6. For Graph #2, what type of relationship is indicated?
7. Multiply each P and V point together to get a number. Average these values to get a constant "k".
8. If the equation for Graph 2 is $PV=k$, rearrange this equation for V.
9. Substitute the k value calculated in Question 7 into the formula from Question 8. This is the equation for the graph.
10. Using the equation from Question 9, calculate the volume for a pressure of 1.0 atm.
11. Using the graph, estimate the volume for a pressure of 1.0 atm. Do the values from Questions 10 and 11 agree? If not, recheck your math or check the graph again.

Graded Assignment:

Write a formal lab report using the lab report format and rubric in this unit. You must include all parts of the lab to receive full credit. Please copy and paste your data and graphs in the word document with your report. You can printscreen the graphs and paste them into your report.

Please follow your teacher's instructions for submitting your work.