

Scaling a Graph

Math Lab Instructor Notes

- Course Level/Topic: Beginning Algebra/Graphing
- Purpose: To introduce students to real world graphs which contain very small and/or very large numbers
- Learning Goals:
 - Determine the appropriate scale to use when dealing with very large and/or very small values
 - Graph functions using variable other than x and y .
- Pre-requisite knowledge:
 - Graphing points on the Cartesian coordinate system
 - Ordering of very small decimal values
 - Determine the scale for simple graphs
- Materials: Graph paper, scientific calculator
- Time Required: 30 – 45 minutes
- Description: In science, students often start their graphs at an origin other than $(0, 0)$. Also the scales are often very large or very small and variables, other than x and y , are used. The students will need to use breaks in the graph to accommodate the values. For example with the first problem they will want to start the vertical axis at 350, and the horizontal at 0.1000.
- General Notes:
 - In the answer key a graph created in Excel gives a general view of the data, however it is not possible to insert the necessary break to indicate that the intersection of the axis is not $(0, 0)$.
- Implementation: The directions for determining the scale need to be explained and further examples given prior to the students working on this lab.
- Follow Up/ Discussion Questions:
 - How does the break in the graph affect the ability to determine the y -intercept from the graph?

Scaling a Graph

Name(s): KEY

When creating graphs of functions in mathematics, we usually use the standard Cartesian coordinate system with an origin at (0, 0) and all four quadrants. In science, however, there is often a need to scale the axis so as to graph very large or very small values. In addition, the positive quadrant is often the only one of interest.

To Graph This Type of Data:

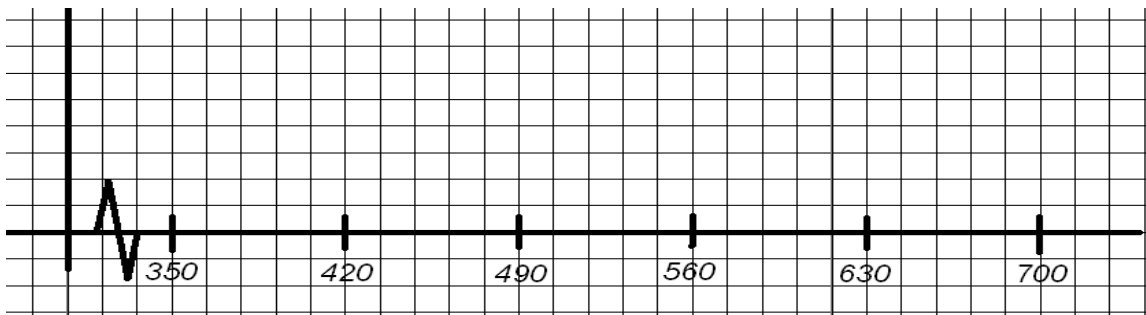
- choose an appropriate starting and ending point for each axis
- determine the appropriate scale for each axis by subtracting the starting point from the ending point and dividing by the number of squares you have on the graph paper – remember that the scale on the horizontal need not be the same as that for the vertical
- place a \backslash in between the origin (0,0) and the initial value

For Example: Consider the data to the right and let's look at how to scale the x-axis.

- The minimum value for Temperature is 356 and the maximum value is 698. So 350 would be a good starting point and 700 would be an appropriate ending point.
- Suppose the graph paper is about 25 units wide. The scale would be determined by finding the range $700 - 350 = 350$ and then dividing by 25, $350/25 = 14$

Temperature (Kelvin)	Pressure (torr)
356	0.24
406	0.97
590	1.78
698	4.98

Hence your graph would start at 350 with the \backslash between 0 and 350, then the scale would increase by 14 until it reached 700.



The following data was provided to the Math Department by the Mesa College Chemistry Department as examples of data students have to graph in their classes.

- The sugar content of a soft drink can be determined by measuring its density. The following data represent a series of density measurements on aqueous sugar solutions. Using this data, plot the density as a function of % sugar.

% Sugar by mass	Density (g/mL)
0.0	.998
2.0	1.045
4.0	1.063
6.0	1.100
8.0	1.145
10.0	1.202
12.0	1.211
14.0	1.312
16.0	1.322
18.0	1.365
20.0	1.430

 % sugar Which variable will you represent on the horizontal (x) axis?

 0.0% What value will you use as the starting point for the horizontal axis?

1 square = 1% What scale will you use on the horizontal axis?

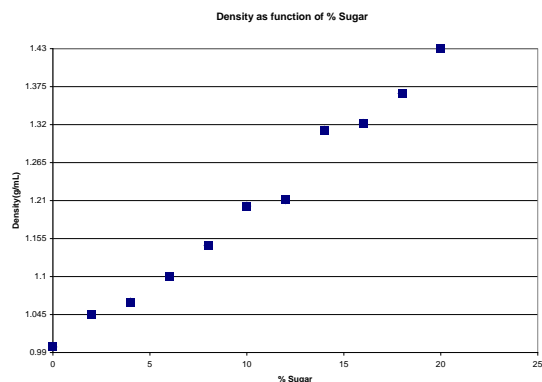
Density Which variable will you represent on the vertical (y) axis?

0.990g/mL What value will you use as the starting point for the vertical axis?

0.011g/mL What scale will you use on the vertical axis?

Using the maximum area on the graph paper, graph the values given in the chart.

Graphs may vary but this is what it looks like in Excel. Note that the break in the graph can not be illustrated using Excel.



2. The following data values represent the temperature in degrees Kelvin and the vapor pressure in torr. Graph the vapor pressure as a function of the temperature.

Temperature (°K)	Vapor Pressure (torr)
352	0.1003
372	0.3081
392	0.8419
412	2.083
432	4.729

Temperature (°K) Which variable will you represent on the horizontal axis?

350°K What value will you use as the starting point for the horizontal axis?

3°K What scale will you use on the horizontal axis?

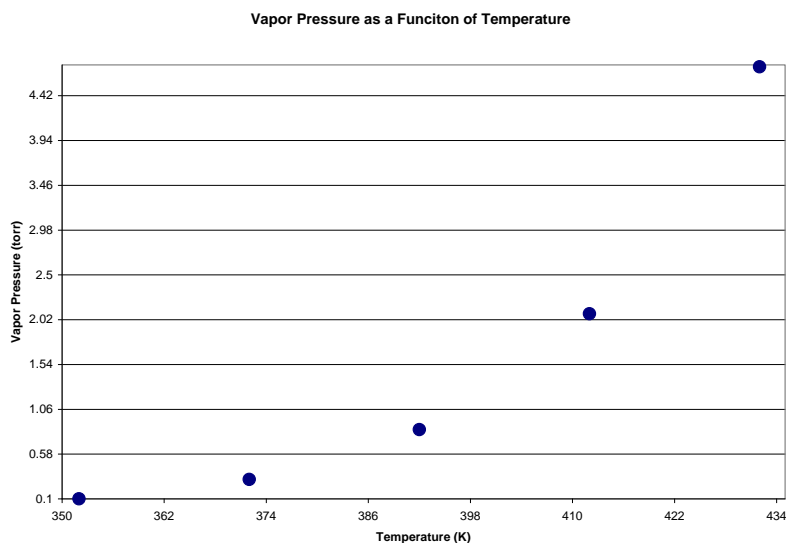
Vapor Pressure (torr) Which variable will you represent on the vertical axis?

0.1 torr What value will you use as the starting point for the vertical axis?

0.12 torr What scale will you use on the vertical axis?

Using the maximum area on the graph paper, graph the values given in the chart.

Graphs may vary but this is what it looks like in Excel. Note that the break in the graph can not be illustrated using Excel.



3. In general, equilibrium constants are only constant when the temperature is fixed. To investigate the temperature dependence of K_a (the equilibrium constant) plot the data below where the equilibrium constant is a function of the temperature.

Temperature ($^{\circ}\text{C}$)	K_a
4.0	2.055×10^{-5}
9.0	2.099×10^{-5}
14.0	2.127×10^{-5}
19.0	2.147×10^{-5}
24.0	2.166×10^{-5}
29.0	2.180×10^{-5}
34.0	2.175×10^{-5}

Temperature ($^{\circ}\text{C}$) Which variable will you represent on the horizontal axis?

4 $^{\circ}\text{C}$ At what value will you start the scale?

1 $^{\circ}\text{C}$ What value will each square on the grid represent?

Equilibrium Constant (K_a) Which variable will you represent on the vertical axis?

2.055×10^{-5} At what value will you start the scale?

0.003×10^{-5} What value will each square on the grid represent?

Using the maximum area on the graph paper, graph the values given in the chart.

Graphs may vary but this is what it looks like in Excel. Note that the break in the graph can not be illustrated using Excel.

