Graphing

Purpose: To graph density lab data and to determine if density is an intensive or extensive property

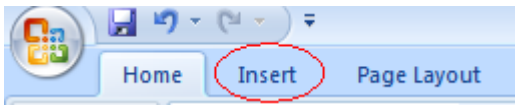
Directions for Graphing by Hand:

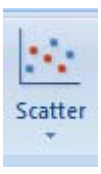
1. Use Graph Paper. (Graph paper has gridlines. Your student lab notebook will work.)
2. Draw the x axis.
    a. Use the x-axis for the independent variable (the variable that the experimenter controlled; also known as the manipulated variable).
    b. Decide on the limits of the axis (maximum and minimum values). The axis does not have to start at zero unless you have data in this region. You may round down from your minimum, but must round up for your maximum. Round to a "nice" number.
    c. Select divisions on the axes which are easy to read. Hence one square may equal 1, 2, 5, 10, or 10, 20, 50, 100, but never 3.75 or some other "odd" number.
    d. For greatest accuracy, select scales so that the graph nearly fills the page. (At least 2/3 of the page.)
    e. Label the axis with numbers at appropriate intervals.
    f. Label the axis with the variable name and the units. For example: "Pressure (torr)"
3. Draw the y-axis.
    a. Use the y-axis for the dependent variable (the variable that the experimenter observed, whose values depended on the independent variable; also known as the responding variable).
    b. Decide on the limits of the axis (maximum and minimum values). The axis does not have to start at zero unless you have data in this region. You may round down from your minimum, but must round up for your maximum. Round to a "nice" number.
    c. Select divisions on the axes which are easy to read. Hence one square may equal 1, 2, 5, 10, or 10, 20, 50,100, but never 3.75 or some other "odd" number.
    d. For greatest accuracy, select scales so that the graph nearly fills the page. (At least 2/3 of the page.)
    e. Label the axis with numbers at appropriate intervals.
    f. Label the axis with the variable name and the units.
4. Mark the data points with a small dot. (Pencil may be used before being inked for permanency.) Draw a small circle around the point or darken to make more visible.
5. Title the graph in a descriptive manner. For example: "Steve's Pressure vs. Volume"
6. Using a ruler, draw a straight line that is as close to the data points as possible. The line **does not** have to start at the origin. A straight line follows the equation y=mx+b
7. Find two points on the line (not specific data points) that exactly cross an intersection point on the graph paper grid. Write down their x, y coordinates. Ideally, these are very far apart on the line.
8. The slope is $(y_2-y_1)/(x_2-x_1)$ and is m in our equation. The intercept, b, is value of y where it crosses the y axis.
9. Write down the equation on the graph, substituting variable names (or symbols) for the math symbols, x and y. For example, in a graph of mass versus volume, the equation might read: Mass = 2.5 Volume +.002

Directions for Graphing by Computer *(instructions given for Excel 2007, use full screen mode)*:

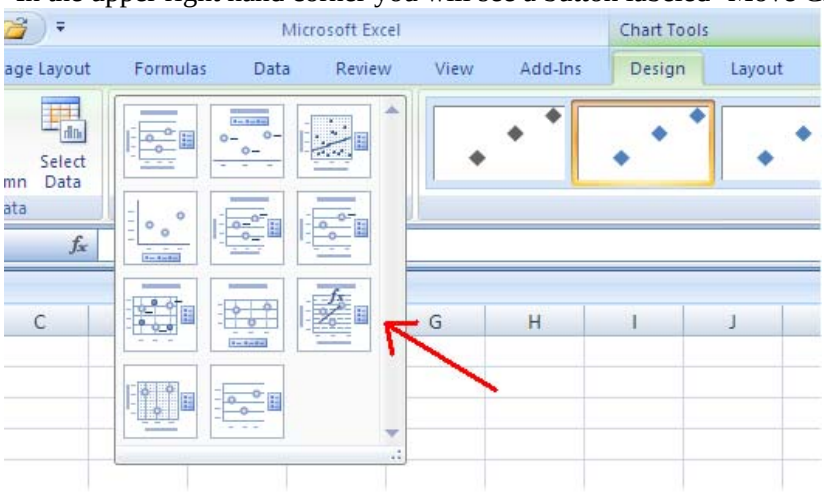
1. Type your data into Excel with x values in the left column and y values in the right column.

2. Select your data and click on the Insert tab.





3. Select scatter graph, and then select the one with the points not connected.
4. In the upper right hand corner you will see a button labeled 'Move Chart'. Click that button. Choose to put the chart as a new sheet.



5. Under the *Design* tab, click on the *Layouts* button. Use the scrolling arrow at the right side to display all 11 layout options. Note that we will choose option 9 because it has all of the essential chart features. Now, edit the title and also the axis labels Be sure to label your x and y axes with units. (Example: "Pressure (torr)")
6. Print the chart.

Note: Instructions for an older version of Excel are provided on the last page of this lab.

Prelab Questions:

1. Define intensive property.
2. What is the mass in kilograms of 200.0 mL of mercury? Mercury has a density of 13.6g/mL.
3. What is the mass in kilograms of 400.0 mL of mercury?
4. What happens to the mass when you double the volume?

Is Density an intensive property of a substance?

We will use the following three graphs to evaluate this question.

Part 1: Graphing by hand

Graph by hand, the mass/volume information from part b of the density lab. You should have three data points. Make sure that you determine a slope and an intercept. Write the equation for the line on the graph. Compare your slope to your average density.

Part 2: Graphing by computer

Using Excel, graph the mass/volume information from part b of the density lab. You should have three data points. Make sure that the program has added a slope and an intercept. Compare your slope to your average density.

Part 3: Graphing by computer

Your instructor has facilitated a way for all the groups to share data. Graph on excel, the mass/volume information from the density lab from <u>all</u> the groups. You should have a maximum of 36 data points. Make sure that Excel has added a slope and an intercept. Compare your slope to your average density.

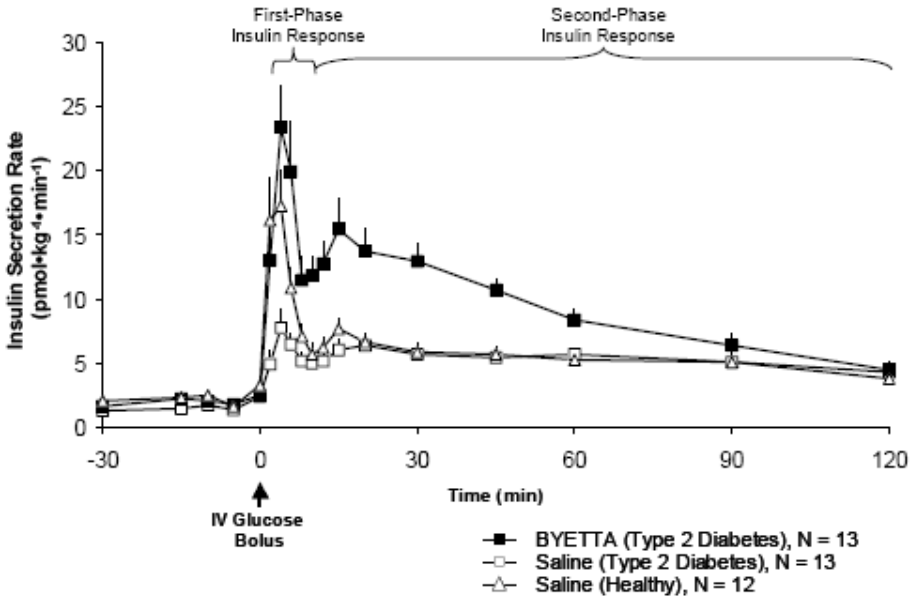
Post Lab Questions (Answer in complete sentences and show all work .)

1. Why did we name volume the independent variable and plot it along the x axis?
2. What is the definition of a dependent variable and explain how mass meets this definition in this experiment.
3. Slope is $\frac{\Delta y}{\Delta x}$. Rewrite this equation using the variables plotted (mass and volume). What do scientist call the ratio of mass to volume?
4. Compare the slopes from graphs 1, 2 & 3 with your average density. In your opinion, is the difference in each case: zero, very small, fairly big, completely off? Copy the table below into your lab report to summarize your opinion.

	Difference
Slope from graph 1 vs. average density	
Slope from graph 2 vs. average density	
Slope from graph 3 vs. average density	

   Write a sentence commenting on these results.
5. At 25°C, the unknown solution has a density of 0.997 g/mL.
   a. What is the % error of the density from the slope of just your data (part2)?
   b. What is the % error of the density from the slope of just the class data (part3)?
6. Identify any data points *(x, y)* in the Part 3 data that are clearly not consistent with the other data points. What should we conclude about density from these data points?
7. This question involves the Insulin Secretion Rate versus Time graph, given below:

Figure 1: Mean (+SEM) Insulin Secretion Rate During Infusion of BYETTA or Saline in Patients With Type 2 Diabetes and During Infusion of Saline in Healthy Subjects



   a. Estimate the first phase peak insulin secretion rate for healthy individuals.
   b. Estimate the first phase peak insulin secretion rate for Type 2 diabetes patients after administration of the BYETTA Bolus.

c. Estimate the length of time needed for the first phase peak insulin secretion rate for Type 2 diabetes patients after administration of the BYETTA Bolus.
d. What does the word bolus mean in the usage above?

Concluding Questions: Must be done individually without the assistance of anyone. You may not discuss this with any instructor, tutor, or classmate. Please answer these questions on a separate sheet of paper.

1. What is the problem or purpose to be solved in this lab?
2. How was the problem solved? *(Answer this by answering the questions below.)*
    a. What is the hypothesis that was tested?
    b. What are the variables that were used? (Also consider what variables were controlled or held constant in the experiment.)
3. Based on your answer to the previous questions, how was the hypothesis tested?
4. Based on the experimental result, what sources of error exist?
5. What can you conclude about the density based on the results?

Older version of Excel Graphing Directions

1. Type your data into Excel with x values in the left column and y values in the right column.
2. Select your data and hit the chart wizard button. 
3. Select XY (scatter) graph, and then click the *next* button.
4. Click the *next* button. Input your title, label your axis (example: "Pressure (torr)")
5. Click Gridlines and select major gridlines for both x and y axis.
6. Click legend and unselect "Show legend". Click the *next* button.
7. Select "As new sheet:" Click the *finish* button.
8. Click somewhere on the graph and, select “Chart” from the menu at the top. Select “Add Trendline.” Select “Linear” as the type of line, and select “Options”. Select “display equation on chart”. Edit the chart to make it aesthetically pleasing.
9. Print the chart.