

Graphs and Tables:

Tables

Tables should probably NOT be done in Excel. The spacing comes out weird and most people aren't willing to make the necessary adjustments. It's probably easier to make the table in Word and then copy and paste the data. The example below was done with tabs, however the table function can be appropriate if it meets the criteria.

Table Criteria:

Title:	Includes appropriate numbering (e.g., "Table 1. Absorbance of NiSO ₄ Solutions") Trials in vertical dimension
Columns:	Heading includes units in parenthesis Heading is not the unit Columns consist of all data that changes and results of relevant calculations
Entries:	Use significant figures as determined by measuring device or calculation Units are in column heading not in entry If data is the same for each entry, do not include as column, but elsewhere in table Table is on one page

Example:

Table 1. Speed and momentum of Object 5.

Mass of object 5 = 20.382 g

<u>Trial</u>	<u>distance (cm)</u>	<u>time (s)</u>	<u>speed (cm/s)</u>	<u>momentum (g·cm/s)</u>
1	5.00	10.0	0.500	10.2
2	25.21	51.2	0.492	10.0
3	40.72	79.1	0.515	10.5
4	63.55	129.3	0.4914	10.02

Graphs

Many great graphing programs exist. Excel is NOT one of them. However, it is something everyone has access to, so there is no reason not to learn to do basic graphs with this program. Regardless of which program is used, the graphing criteria below should be followed.

Graph Criteria:

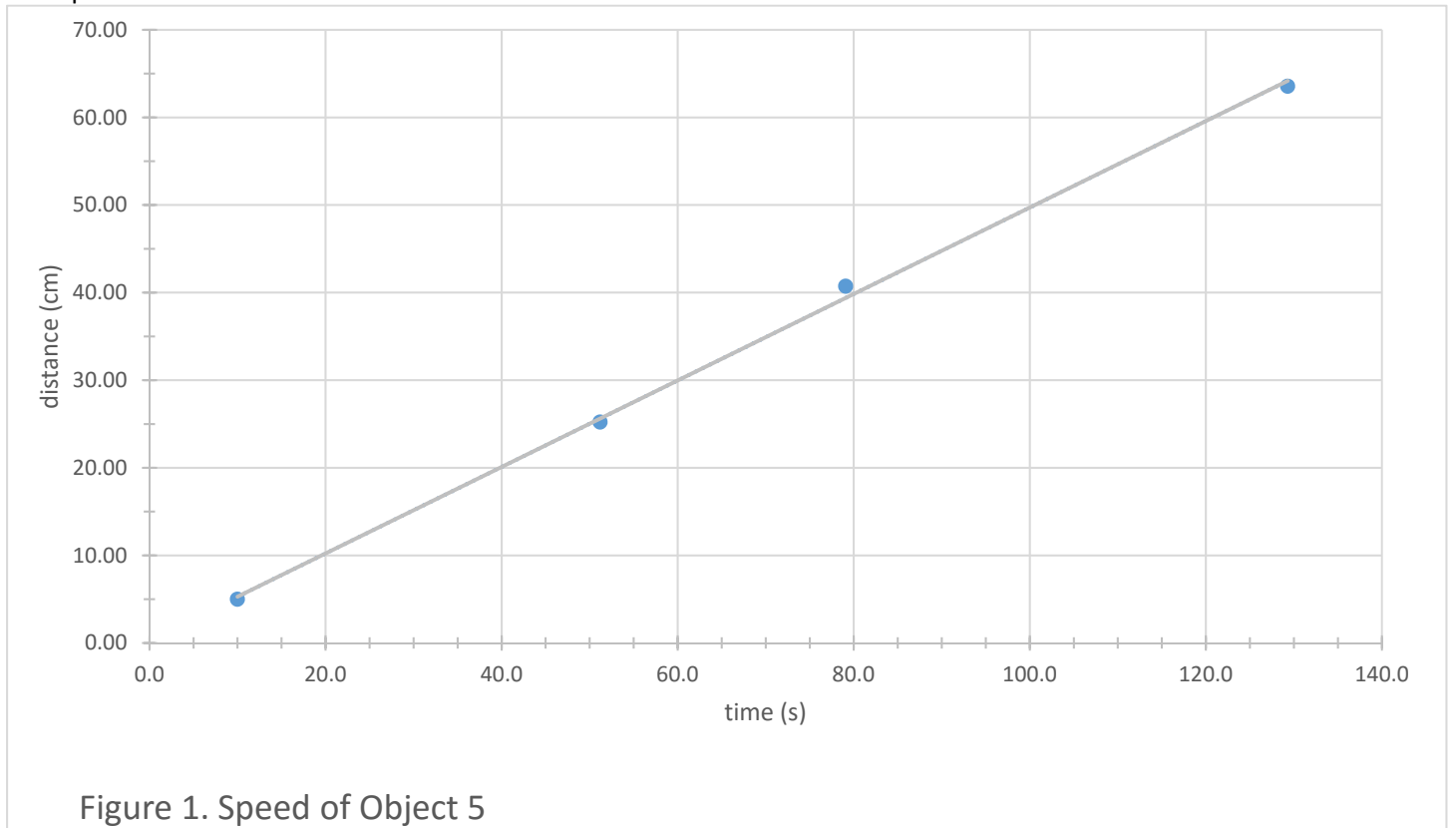
Use spacing effectively: The graph size should be more than ½ page.
Only show quadrants actually used or needed for context

Title/Caption:

Includes appropriate numbering
Labeled as "Figure" not "graph" or whatever
Does not repeat axes (Ask instructor if you do not know the name of the graph type)
Include the identity of what you are measuring
Put title (more appropriately called a figure caption) at bottom of table
Figure caption should not overlap other components of graph
Some common graph types: calibration curve, Beer's Law Plot, Spectrum

- Axes:** The x-axis is used for the independent variable
 The y-axis is used for the dependent variable
 Do not include axes or axes sections where it is not used to graph data (or show context)
 Labeled (label is not unit, but includes unit)
 Include dimension (unit) in parenthesis
 Have visible tick marks
 Spacing between tick marks reasonable for reading
 Normally 1, 2 or 5 divisions
 Tick labels have correct significant figures (consistent decimal places)
- Data points:** Visible but not inappropriately large
 Data points reflect actual data
 All the data!
 Include outliers on graph even if they were ignored when drawing trend line.
- Trend:** If more than one data set is on the same graph, use different marker styles
 Show data trend using line or curve as appropriate
 If more than one data set is used, use a different style line for each and include a legend.
 Do NOT include a legend if only one data set is used.
 If trend is linear, determine equation of the line

Example:



Introduction

For most homework and all lab reports, you will need to produce a graph using Excel. This graph must meet the scientific standards of an informative graph. Being able to use Excel in this manner will also be a valuable skill. The criteria for an appropriate graph is detailed above. The following are detailed instructions for a practice graph that touches on nearly all the skills you will want for making your own graphs.

Step 1. Input your data

Typically “X” data is in column A and “Y” data is in column B

You may use the first row for a heading

Input the following data:

Table 1. Electrochemical Calibration of PO_4^{3-}

trial	$[\text{PO}_4^{3-}]$ (M)	potential (mV)
1	0.1000	67.5
2	0.0500	55.1
3	0.0100	38.1
4	0.0050	30.0
5	0.0010	18.0

To add superscripts or subscripts...

Go to the “home” tab

In the lower right corner of the font section there is a little box with an arrow

Click on the little box to bring up a pop up

In the pop-up click on the appropriate box, then “ok”

Now you add the superscript or subscript

Uncheck the box to stop using a super or subscript



Step 2. Make a graph

a. Highlight the entire data set (numbers not column headings; trial number is not part of your data)

b. Choose “insert” tab

c. Under “insert charts” choose the scatter chart (Other name: “xy”)

It’s the icon that looks like a bunch of dots.

WARNING! Do not choose “line graph” it is wrong and will not allow you to fix it.

Clicking on the arrow will give you a bunch of scatter plot choices

Normally choose the one with dots only (first choice)

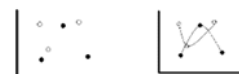
For complex graphs (like titration curves) choose the one with the dots and curve through them.

d. The chart will pop up on the spreadsheet. This is normally inconvenient and hard to see so let’s move it.

Choose “move chart” from the chart tools/design menu bar

Click “New sheet”

You may want to name it...how about “Figure 1”?



Step 3. Make it pretty

a. Add gridlines

Click on the plus sign on the right side of the chart

Click on the little triangle/arrow to the right of “gridlines”

Check “major gridlines” for both horizontal and vertical axes

Optional: You can also check minor gridlines if you do so for BOTH axes



b. Fix axes

i. Insert the axes titles

Click on the plus sign next to the chart

Click to check “axes titles”

A box should appear at each axis

Click in the box and type in the appropriate title

This title should exactly match the column heading of your data table

To add superscripts or subscripts...

Go to the “home” tab

In the lower right corner of the font section there is a little box with an arrow 

Click to check the box and it will let you add the superscript or subscript

Uncheck the box to stop using a super or subscript

ii. Make sure the axes have the correct number of significant figures

Double click on one of the axes (or choose “more options” from the axes list of the plus sign)

A “format axis” box should pop up on the right hand side

Choose “axes options” and the bar chart (at top right under title)

Choose the “number” category (almost at bottom, scroll down)

Go to “category” then choose “number”

Input the number of decimal places appropriate to your measuring device/data
(if your values are in scientific notation, choose “scientific”)



iii. **OPTIONAL** under the “format axes” menu

You can add “tick marks” (not required if you have gridlines, essential if you do not)

You can change the spacing of your gridlines under “units”

(best choices are divisions of 1, 2 or 5)

You can change the maximum and minimum values under “bounds”

iv. Repeat parts ii and iii above for the other axis

v. **IF YOUR AXIS IS IN THE WRONG SPOT**

click on double-click on the other axis

that’s right, the axis you don’t want to move—so to move the y-axis

click on “format x-axis”

choose “axis options” (bar chart as above)

Toward the end of that section, you will see “vertical axis crosses at”

Choose “axis value” and input the leftmost number from your x-axis

When moving the x-axis, format the y-axis and tell the horizontal axis to cross at your lowest number.

c. Figure Caption

Click on the plus sign next to the chart

Click to check the box “chart title”

Fill in the appropriate information. It should look a lot like your Table title but it is a “Figure” not a table.

Hover your mouse near a corner to the move icon with four arrows.



Move the title to the bottom of the graph window and left justify it.

Move (possibly resize) other graph elements so that everything is readable.

You may also want to resize the graph title so it looks good to you.

Step 4. Add a Trendline

- a. Look at your data. Is the trend a line or a curve or something else?

Hint: The data given is NOT a line.

- b. click on the plus sign to the right of the chart

Click on the arrow that pops up when you hover over "trendline"

Do not click on the "trendline" box! I will insert the line you don't want!

Click on "more options"

In the format trendline box that pops up, click on the type of curve that looks most like your data

Click in the box that says "display equation on chart"

Move equation to a visible location.

Step 5. Print the graph

Go to the "file" tab then choose print

Using Excel to do calculations

We prefer linear graphs, so let's practice using Excel to do calculations

To make this example graph linear, we need to graph the log of the concentration instead of concentration. However, we still want to graph potential NOT the log of the potential.

In addition, it is easier to create two new adjacent columns with "x" on the left and "y" on the right than to tell Excel where you have put your data. So do this:

Choose another column (probably on the same sheet)

If you are going to do a formula in Excel, it must start with an equal sign.

Note the cell location of your first concentration value (mine was A2..sub in your value below)

Also note your first potential value (Mine was B2...sub in your value below)

In another cell type "=log(a2)"

It does not matter whether or not you capitalize the A

Do not type the quotes, type what is inside them

Remember to use the reference of the cell you want to change not my example

In the next cell to the right type "=b2"

Here you are just moving the number without changing it.

Copy and Paste these two cells so that you have the same number of data points.

If you have the talent you can also do a copy and drag, but I never figured that out

If you did too many cells it will show up as zeros. You can delete or ignore those.

FYI: To multiply in Excel, you use the * symbol; to divide use the /. You can write formulas with these terms based on the principles shown above. For example, to use the dilution equation. If the amount of 25.00 ppm stock solution was in cell b3, and the total volume was 75.00 mL, to get the diluted concentration, write the formula

=b3*25/75

Like other calculating devices, Excel doesn't understand significant figures.

To determine the equation of a line, with error, in Excel

First determine your equation with error.

Highlight 6 blank cells in a 2 column by 3 row grid

Click in the function (fx) line and type

=linest(

Then highlight your y data and type a comma

Highlight your x data and type a comma

Finish typing with: true, true)

The overall function line should look something like: =LINEST(B3:B10,A3:A10,TRUE,TRUE)

Then for PC press CONTROL+SHIFT+ENTER

Or for Mac press "COMMAND+RETURN"

Your highlighted cells will get values that represent:

m	b
u_m	u_b
R^2	s_y

On the ribbon at the top, go to "insert" then choose the text box icon at the top.

Draw the text box where you want to put in the equation and (using the numbers from before) type:

$$y = (m \pm u_m)x + (b \pm u_b)$$

Or you can put this information in the figure caption.

Sneaky trick: You can make a + by underlining a "+" sign! Otherwise you can find it in the "insert→symbol" section.