Using Excel for Physics graphs

1 Introduction

You will often be asked to graph data you take in physics lab. The purpose of this introduction is to give you a sense of what needs to be included with a graph for it to be considered "complete", why that information is important and how to do so using Excel.

On rare occasions, you may be graphing data you don't expect to follow a linear relationship. More often than not in a physics class, you will plot data in a manner such that you expect the plotted points to follow a linear relationship
\[
y = mx + b
\]  
where "y" is the quantity plotted on the vertical axis, "x" is the quantity plotted on the horizontal axis, \(m\) is the slope of the line and \(b\) is the y-intercept. One reason for plotting data in such a way is that you can perform a Linear Regression Calculation to determine the slope and y-intercept of the Best Fit Line to your data; the line that comes closest to going through all of your data points on the graph. You will usually have theoretically expected values (derived from a theoretical relationship involving the plotted quantities) for the slope and y-intercept of this line. By comparing your experimentally determined slope and y-intercept of the best fit line values with those expected from theory, you can test the theoretical relationship for agreement with real world data.

Each graph you turn in with a lab report should be on a separate page with all the expected analysis included on that same page. Each graph should have a title and both axis should be labeled describing the quantities plotted on those axis and the units for those quantities. Points should be plotted on the graph representing your actual data. If the graph was expected to be linear, you will perform a Linear Regression Calculation and include the Regression Coefficients (with uncertainties) on the page with the graph. You will also have the Best Fit Line put on your graph so one can see just how close the data points are to the line. Under the Regression Coefficients, you will include 4-line summaries for both the slope and y-intercept of the best fit line, comparing your experimental results with theoretically expected values. You will also include an explanation of how those theoretically expected values were determined from a theoretical relationship. All of this information, on one page, is expected for graphs you make to turn in for physics lab reports.

2 Enter data, get the “chart” to appear, etc

1. After starting Excel, enter your data in columns \((x,y)\). You can do rows, but we’re going to stick with columns.

2. Highlight the data with the mouse. There is a selection of charts along the top. Pick the one that looks like points. A window should appear with options for scatter plots. The first one (no lines) is what you want.

3. After this, the “chart” appears. Click on said “chart” to select it, and notice that a Chart Tools tab appears at the top.

4. Click on Design. The stuff along the top changes depending on which tab is active. The upper right of the array of options is Change Chart Type. Click on this, and in the window that appears click on Templates. The only option that appears (Physics standard) is what you want. Click OK.
5. The template has some pre-set values for the graph in it, like axis labels, title, and the like.

6. Since you want the graph on its own page, in the Design tab, click on the Move Chart menu choice. A pop-up window will appear and you can select sheet 2 (or any other available sheet) to put the graph on. Place the graph in the top left corner of the worksheet. If additional sheets are needed, they may be added by clicking on the Insert Worksheet tab at the bottom of the workbook.

7. You will need to add appropriate axis labels, units, and a title to the graph.

3 The line on the graph

Click on the chart. Up along the top should be a Chart Tools tab. In this is a Design tab, and what appears under this is Add Chart Element. Clicking this allows you to select Trendline, and of the many you want to choose Linear. The line should appear on the graph.

4 Regression analysis

The fit parameters (or Regression Coefficients) corresponding to the trendline need to be obtained, along with their errors. Here’s how to do this.

1. Click on the Data tab. Way over on the right is Data Analysis. Click on this, and you will get a window appearing.

2. Scroll down in this window and click on Regression, and then click on OK.

3. Use the mouse to highlight the columns in your spreadsheet corresponding to the y and x data input ranges.

4. Click the small box next to Confidence Level 95%.

5. Click OK. A new spreadsheet will appear. Just over half way down is a table with Intercept and X-variable at the left side of rows. These are what you want.

6. Change Standard Error to SE, X-variable to Slope and tStat to AE. Now, the two cells below the AE column header need to show the result of taking the value just to the left of it (standard error) multiplied by 1.96. This is the Associated Error (AE), the error associated with the mean. Click and drag over these 12 cells (4 columns by 3 rows) and Copy them.

7. Return to the worksheet with your graph and click on cell C30 then Paste the 12 copied cells starting there. While they are all highlighted, change the font size to 16. Adjust the widths of those 4 columns so your values appear such that they are easy to read. You can now re-size the graph so that it fills the space above the copied regression coefficients.

8. You can now do your four line summaries for the slope and intercept below this, of course using correct units. We suggest you do the following. Click on the Insert tab, and then the textbox icon. You can use the mouse to re-size this box. You can put your four line summary information in this box.

We advise that you check how things look before you print. It is easy with spreadsheets to have the graph not fit on the page. So, click on File and then select Print. It should show a preview of what will be printed. If things look bad, click on the Home tab and move things and check with Print until it will print what should be printed.