* PRELAB 1: INTRODUCTION TO EXCEL

COMPLETE THIS EXERCISE BEFORE COMING TO THE FIRST LABORATORY AND SUBMIT BEFORE COMING TO LAB 1.

NOTE: Save your file in .xls format NOT .xlsx format! Assignments in .xlsx format may be returned ungraded.

This pre-lab should be done entirely on your own, without consulting your peers. If you have difficulty, see your instructor.

Learning Objectives:

- Working knowledge of basic features of Excel calculations
- Working knowledge of graphing in Excel
- Saving and Printing data in Excel

Even if you are already familiar with Excel, you may learn something. The assignment should not take longer than 60 minutes. If you have any trouble, feel free to get help from any of the instructors in the Dept. of Physics & Astronomy.

To begin:

Hop onto any computer that has Microsoft Excel on it and start up the program. These instructions were written for a PC running Windows, so things might look slightly different if you run on a Mac. These instructions were also written for the version of Excel in Office 2003, so there may be slight changes if you are using a newer version of Office.

A tour of the spreadsheet:

A spreadsheet consists of individual cells that are organized in columns (vertical) and rows (horizontal). The columns are identified by letters (**`A,B`**…), and the rows by numbers (**`1,2`**…). The coordinates of a cell are given as **`C3`** (column **`C`**, row **`3`**), and you will see the coordinates of any cell you select in the upper left corner of the spreadsheet. A block of cells is any (usually contiguous) group of cells, for example (**`C3...C8`**) meaning all cells from **`C3`** to **`C8`** inclusive, or (**`C3...D8`**) which means all cells from **`C3`** to **`C8`** and **`D3`** to **`D8`**.

You can enter information into any cell by first selecting the desired cell and then typing the information. To select a cell, you can use the mouse to point to the cell and then click the left button, or use the arrows (←↑↓→) to move the cell marker. The information will appear as you type it in the cell contents bar which is in (by default) the third row on top of the spreadsheet. To enter the information, press the **`Enter`** key or press any of the arrow keys (←↑↓→). The information can be a number, a sequence of text characters, or a formula.

At the top of the screen, you will see a row of dialog box buttons which, when pressed, open dialog boxes and allow you to select from within these boxes to perform operations. On the second row down from the top is a sequence of buttons that allows you to perform specific operations that are performed frequently. At the bottom of the screen are a series of tabs labeled **`Sheet1`**, **`Sheet2`**,…., which are markers to entirely

separate spreadsheet pages. It is sometimes handy to have information on multiple pages, especially if you are doing repeated calculations on data (i.e., different trials of a single laboratory exercise).

Help! Press the F1 key.

You can get online help in Excel on essentially any topic by pressing **F1** key. Type in a word for which you need more information and press the **Enter** key or click on **Search** with your mouse. Other ways to access help are to click on the **[?]** at the right end of the second row over the worksheet or click on the **Help** dialogue box button in the top row and pressing **Contents and Index**.

Mistake - now what? Press the ESC key.

If you have begun a sequence of operations and you don't want to continue that sequence (e.g., you selected **Edit**, then **Copy** and you don't want to copy something) you can return to the state immediately prior to the beginning of that sequence by pushing the **ESC** key. If you need to "undo" a series of operations you have already performed, you can click **Edit**, then **Undo**, as many times as necessary.

Scroll bar:

There is a vertical scroll bar on the right side of the spreadsheet and a horizontal scroll bar on the lower right part of the screen. Use the mouse to move the marker up/down, or left/right and watch what happens. You will also find the **PAGE UP, PAGE DOWN, HOME,** and **END** keys helpful when you need to move around in the spreadsheet.

Enter data:

Enter the following data into the first two columns (A and B) beginning with cell A1. [You need not label these as "A" and "B".]

1.2	3.4
2.2	4.1
3.7	5.2
4.9	5.7
6.1	6.6
7.0	7.3
8.3	8.3
9.8	9.2
10.8	9.7
12.2	10.5

You might notice at this point that the 6th entry in the column A (i.e., A6) appears as "7" rather than the 7.0 that you typed. To control the number of places after the decimal point that Excel displays, highlight (select) all the cells with numbers in them. Then click on FORMAT → CELLS. You'll see that the default "Category" selected is "General." Change this to "Number." You'll then be given the chance to change the number of "Decimal places." Change the number to "1." Now when you look at the cells on your spreadsheet, they'll all have one place after the decimal point.

Save Data:

Now save your spreadsheet to a file by selecting **File**, then **Save**. You will be prompted to enter a file name, but you first need to choose the directory into which you wish to save the file. Next, type in a name for the file and click **Save**. This week, name the file with your own name, with the first initial of

your first name and your whole last name followed by "_excel." For example, Gary Morris' file will be named "gmorris_excel." The suffix .xls will be added automatically on PCs to identify it as an Excel file. [NOTE: in newer versions of Excel the file suffix is .xlsx, but we would like you to save Excel files in the .xls format. This will require choosing **Save As** and then selecting the **Excel 97-2003** file format.] If you're working on a Mac, you'll need to add the suffix yourself.

Label Columns and Add Names:

You should always place labels over columns of data or calculated quantities. However, since you did not leave space for this, you will need to create a new row for this information. To do so, select cell **A1**, click on **Insert** on the top row, and click on **Rows**. You will see a blank row inserted. Now, type in headings for these data: column A: **Dist**, column B: **Time.** Repeat this procedure to add two more blank rows at the top of your spreadsheet. On the top line enter the name of the laboratory (**Introduction to Excel**). On the next line enter your name.

Physical Units:

Because these are measured data, they require two more pieces of information, namely the physical units for each, and the uncertainty or error for each. In this illustration, the physical units of each of the entries in a given column are the same so we can enter the units for the entire column in a cell above the data in each column. To enter the physical units, insert another row below the headings for these two columns and enter this information so it appears as follows:

Dist	Time
cm	sec
1.2	3.4
…	…

Measurement Uncertainty :

You can put the uncertainty for each value in A and B in a column immediately to the right of each of the present entries. But, since you did not leave room for a column to the right of A, you need to insert a blank column. To do so, position the cell marker at B1. Then, click on **Insert**, and then click on **Columns**. You should be left with a blank column labeled B and the data that was in B is now in C.

The units of the uncertainty in the distance measurements are also in cm, so, type **cm** in the appropriate row for column B, and a heading for column B such as **error-D** . Now, if the measurement error on each point is 0.02 cm, we want to place that in column B for each entry in column A. Here's the easy to do it --

Enter **0.02** to the right of the first measurement and press **Enter**. Then, position the cell marker on the 0.02 that you just typed and hold down the **control** key and press the **C** key. This accomplishes the same thing as clicking **Edit** and then **Copy**. You should see that the cell now has a dashed line around it. Position the cell marker on the next cell in the column into which you want to enter the 0.02, hold the button on the mouse down while you highlight the column all the way down to the last cell you want 0.02 to appear in, and release the mouse key. This should have highlighted the cells into which you want to copy the 0.02. If this is OK, hold down the **control** key and press the **V** key (same as clicking **Edit** and then **Paste**). The "0.02" now appears in all the appropriate cells.

Next, we shall suppose that the error on the first 5 measurements of the time is 0.1 seconds, and the error on the last 5 measurements is 0.2 seconds. Use the same enter/copy technique as above to place this information in column D. Don't forget to place a proper heading on the column and to enter the physical units.

Making a Graph:

Now, let's graph the data in column A (distance) versus the data in column C (time) where the distance will be along the *y*-axis, and the time will be along the *x*-axis. First, make sure that the cursor is in a cell that is empty and is not next to a cell containing text or data. Then, click on **Insert** on the top row and then click on **Chart**. Select **XY (Scatter)** as the chart type because it compares pairs of values (distance and time). By default, the first XY (scatter) sub-type will be selected. Since this is the type that you want, click **Next >** at the bottom of the window to continue. Click on the **Series** tab on the top of the window. Now, click **Add** to add your own series. There will automatically be "={1}" in the field "Y values." Highlight the "={1}." Then, go back to the spreadsheet and highlight all the cells with values (numbers) in the column labeled "Dist". Place the mouse over the field next to "X values" and click so that there is a blinking cursor in the field. Highlight all the values in the column labeled "Time." Click on **Next >** to go on. Under "Titles", enter the information

Chart Title: "Distance vs. Time"
Value (X) Axis: "Time (sec)"
Value (Y) Axis: "Distance (cm)".

Then click the **Legend** tab, and unselect the 'Show legend' box (because there is only one set of data shown, we don't need a legend. A legend is used to identify different data sets when more than one set of data or curve plotted on the same graph). Click on **Next >**. Select **As new sheet:**, enter the short graph label **D(t)**, and click on **Finish**. Your graph should now be displayed on the screen. The graph is saved on a separate sheet (as you can see from the highlighted tab at the bottom of the screen.

Now, move the cursor to any point in the gray background of your graph and double-click on it. In the dialog box that opens, select the white box under 'Area' (this will help save toner for the printer!). You can edit your graph further by selecting **Chart** and then **Chart Options**. Then select the aspects of your graph that you want to change.

You need to attach a *figure caption* for *every graph*. To do so, go to **View → Header/Footer.** This dialog box shows the present header or footer that will be printed with the graph. To add your figure caption select **Custom Footer** and in the center box enter your figure caption:

"Figure 1. This is a graph of distance vs. time for the glider on the air track tilted at 0 degrees. The plot appears to be a straight line indicating constant velocity."

Then, click **OK** and **OK** again on the Page Setup box. This will return you to the chart sheet but the figure caption will not appear. It does not show until the page is printed. (If you want to see that it is there – and see what the chart will look like if/when you print it, go to **File → Print Preview.** You should see the chart with all the titles and labels and with the figure caption. Close the print preview window.

Mathematical Operations:

Being able to do mathematical operations in a spreadsheet is one of its most powerful and useful features, especially for data analysis.

Let's begin by calculating the distance traveled over two time intervals. The equation for this would be

$\Delta d_j = d_{j+1} - d_{j-1}$ where j represents the midpoint of the interval $t_{j+1} - t_{j-1}$.

For example, if j = 2 (i.e., the second data entry), then j-1 = 1, and j+1 = 3. In our illustration, this would mean

$\Delta d_2 = d_3 - d_1$ where 3-1 = 2 time intervals, and we will associate this distance with the midpoint of the time interval, i.e., at time measurement 2.

How do we write this in spreadsheet notation? We will put the calculated quantities in the next column, which is column E. So, position the cell marker in the cell corresponding to the row for the second time measurement. If you have followed the suggested format, this would be E6. This is where the result of the calculation will be placed, i.e., the left-hand side of the equation above. Now, you enter the above mathematical operation using the following spreadsheet notation:

`=A7-A5` and then press **`Enter`**.

The interpretation of this formula is as follows: The leading "=" sign indicates a formula is to follow. The notation says to take the contents of the A7 cell and subtract the contents of the A5 cell. Since you typed this in the E6 cell, the result should appear in E6. Check it out, and if it looks OK, proceed on. If not, check your typing, or get help. (While this is a very simple example, you might want to see what the **`F1`** help facility has to offer by selecting **`Formulas`** from the **`F1`** help page and examining what follows...)

Now comes the really neat part! It would be a real nuisance to have to type this formula for each data point. As it turns out, we don't have to. We simply copy it into all the other proper locations. Position the cell marker on the cell with the formula you just entered (E6) and hold down the **`control`** key and press the **`C`** key (same as selecting **`Edit`** and then **`Copy`**). Then highlight the cells into which you want the formula copied, hold down the **`control`** key and press **`V`** (same as selecting **`Edit`** and then **`Paste`**). The results of the calculation should appear in all the cells you selected. You can position the cell marker on any of these cells and see from the contents of the cell that the spreadsheet program automatically incremented all of the row numbers properly. Be careful when performing such calculations: it doesn't make sense to execute such a formula in some of the cells of column E. Which ones? Why not?

Cell Comments:

It may be very useful for you to attach comments to specific cells in your spreadsheet. If, for example, a datum point is not useable because during data collection you bumped the table, a notation to that effect should be made. It can be made in your lab notebook by noting the datum point in question and including a comment. Another way is to "attach" a comment to the cell. To practice this, go to the cell with the distance value **`12.2`** by moving the curser to this cell and clicking on it. Then, click on **Insert → Comment**. A small yellow box will open and you can enter a comment such as: "This is the last data point." (You can change the shape of the yellow box to suit your needs or preferences. You can also move the yellow box on the page and an arrow will point back from the yellow box to the cell.) Now, move the cursor to any other cell and click on it. The yellow box will disappear but a small red triangle will appear in the upper right corner of the cell in which the comment was made. This will remind you that this cell has an attached comment. To see the comment for that cell, simply move the cursor to that cell and the comment will immediately appear. You can view all comments at once by clicking on **View → Comments**.

Printing:

Often it is helpful to print a copy of your spreadsheet to include in your three-ring binder and/or to submit with your report. *Never, never press the `PRINT SCREEN` button!* Instead, select **`File`** from the top row of the spreadsheet, and then select **`Page Setup`**. In the box that opens, select **`Fit to 1 page wide by 1 tall`**, then click OK. Now select **`File → Print Preview`** to be sure that the file is formatted properly for printing. If you were in the lab, you would next select **`File`** and then **`Print`**. The default printer when working in the laboratory is **\MERCURY\LASERJET 135**, which is located through the back door of the lab. If you wanted a copy of the graph to turn in with your laboratory report, you

would do the same as the above while you were on the page of your graph. It is not necessary to print your graph this week (save trees!)

If you should need to print the Cell Comments from your sheet, you can do so by going to **File → Page Setup → Sheet → Comments.** Note that the default is **"None".** Select either **"at end of sheet"** or **"as displayed on sheet".** The former may cause less confusion because unless you work at it, the comments will obscure other cells when printed. Then click **OK** on the **Page Setup** dialog box.

Saving and Exiting:

The last step is to save your changes and exit the program. First select **`File`** from the top row of the spreadsheet, and then select **`Save`**. *NOTE: Be sure your file is saved in .xls format NOT .xlsx format! Assignments in .xlsx format may be returned ungraded.* Then select **`File`**, followed by **`Exit.`** That's all!

Congratulations!

If you have completed all of the above steps, you are well on your way to efficient use of the spreadsheet as a tool to organize data, analyze data, make graphs, and more. You will discover faster and even more convenient ways of doing some things as the semester progresses. Remember: the spreadsheet is only a tool to understand the experimental physics. The better your skills, the less you will have to focus on the spreadsheet, and the more you can focus on what you can learn from its use.

Turn It In:

When you're done, attach your excel spreadsheet to an email message addressed to the instructor for your lab period. In the subject line, type "Excel Primer – Lab Section X" replacing the "X" with the letter of your lab section (i.e., "A," "B," "C," etc.). Include a brief message with your name, then send your email off and you're all done! To receive credit, your email must be received by the start of your first scheduled lab session. *ONE MORE TIME: Be sure your file is saved in .xls format NOT .xlsx format! Assignments in .xlsx format may be returned ungraded.*