

From Griffiths, READ section 3.1 (3.1.3 applies specifically to this assignment). Also, read ahead sections 3.2 & 3.4.

AQ1: The Relaxation Method for solving LaPlace's Equation

Refer to the readings from Hayt that were emailed to you. Read the stuff on "Curvilinear Squares" and "The Iteration Method." At the end of the packet are the problems. **Do problems 9, 11, and 14(c), BUT work to the nearest 0.001 Volt.** Further, try using this method for modeling the fringing field of a parallel-plate capacitor. You'll likely want to use a large number of grid points for this. For these problems, I would like you to use Microsoft Excel, which has a feature made just for doing iterative calculations, called "Recalculation." Try this procedure:

In Excel 2010 or later:

Start Excel. click on the **File** tab in the upper left hand corner. Near the bottom of the window click **Options**. In the new window, click on **Formulas** in the choices along the left hand column. In the option window, under *Calculation options*, check the **Manual** box for calculation options and the **Enable Iterative Calculation** box. Set the **Maximum Iterations** (iterate by hitting the F9 key) to whatever you desire (one, for now, is good). Click **OK** to leave this menu. This setup will put Excel in a mode in which it does not automatically calculate the contents of each cell. You have to press the **F9** key to get the spreadsheet to do a calculation. Every time you hit the **F9** key, the spreadsheet will do **Maximum Iterations** rounds of calculations.

Now set up your grid of points and the potential boundaries in the spreadsheet by letting each cell represent the intersection of grid lines (grid points). The "boundaries" are just set to the given potentials; the inner cells contain formula 4 from the readings (Use COPY to enter it once and copy to the other grid points).

Once it's all set up, hit F9 once and notice the change in the inner values. Every time you hit F9, the spreadsheet recalculates (iterates) once more. You can keep hitting F9 until you get however many decimal places you want! It's great!

Be sure to print out the values of your map (Print/Format) "As Displayed", in addition to the cell contents, "Cell-Formulas". Also, you should create a "3 D" plot or "topographic" plot of your potential map by using the charting features of the software (see the **Insert** tab and look under **Charts** for *Surface* charts). Play around with it and see what it can do! I'd be happy to work with you on this, if you need help.

The best part about using spreadsheets is that it's really easy to increase the mesh size (# of grid points) to get a better feel for what the potential is doing. I encourage you to try this with these problems (extra credit!)

Put all of these problems in one spreadsheet, each problem under a different tab. Name each tab by the problem number in Hayt (e.g, Hayt 9, Hayt 11). Name the spreadsheet *PHYS301HW15AQ1.xyz.xlsx* where xyz = your initials and email me the file by 11:59 pm on the due date.