

# Electric Fields

**Purpose:** To become more familiar with electric fields by plotting electric field lines using the program EM Fields

**Procedure:**

1. Turn on the computer and double click on the **Physics Apps** icon to open the physics window (if it is not already open). Double click on the **Electricity and Magnetism** folder and open the **EM Fields** file. Double click on that icon to start the program.
2. Familiarize yourself with the program by examining the various selections available on the menu bar. Now select **Sources/3D Point Charges** from the menu bar and also select **Display/Show Grid**.

**Note:** For the next three exercises (parts 3-5), make neat sketches of your results in your lab book. **Do not obtain computer printouts.**

3. Use the mouse to drag a positive and negative charge of equal magnitude onto the screen to form an electric dipole. Space the charges a reasonable distance apart so that a significant portion of the screen will be used. Put one charge vertically above the other. Select **Field & Potential/Field Lines**. Click on the screen at various symmetrical locations to form a pattern of electric field lines showing the appearance of the field around a dipole.
4. Repeat step 3 for a configuration of two equal sized positive charges.
5. Repeat step 3 for a positive charge and a negative charge whose magnitude is three times that of the positive charge.
6. Repeat for one other configuration of charges of your own design. This time, instead of drawing the field by hand you can print out the results by doing the following: Select **File/Save picture of screen** and click on c:\EMFIELD\ box, delete EMFIELD\ and enter a name for the file, then click on the **create** button (file will be saved to the c drive). Close **EM Fields** program by selecting **Options/Quit**. Double click on the file you saved to the c drive. Obtain a print out of your graph. **Be sure to add arrows to the electric field lines.**
7. Open **EM Fields** file and select **Options/Challenge game** from the menu bar to start your electric field challenge. Choose three hidden charges and then attempt to locate these charges by probing the electric field at various locations by clicking with your mouse. (Note the scale showing the magnitude of the electric field for a unit ( $Q = 1$ ) charge at the bottom of the screen.) Once you have determined the location of a charge, mark that location by dragging a marker (at the bottom of the screen) to that spot. By noting the magnitude and direction of the electric field near the vicinity of your charge, estimate the sign and magnitude of each unknown charge by selecting **Challenge/Estimate amount of charge**, clicking on the desired charge and entering the information. You can check your results by selecting **Challenge/Judge**. Continue until you have successfully located all three charges.
8. Record the location and magnitude of the three charges found in part 7 and construct the electric field lines in the space around these charges as you did in parts 3-6 above. Print out your results by following the procedure outlined in part 6 above.
9. Now try out the **Electric Hockey** program. Its icon is also located in the electricity and magnetism folder. Show the electric field vectors on one of your successful "shots" and observe the non-linear ( $1/r^2$ ) behavior of the force on the charged puck as the distance varies between the puck and the other charges. Print out your results by following the procedure outlined in part 6 above.