Electric Field Lines and Equipotential Surfaces

Purpose: To plot the equipotential surfaces and electric field lines in two dimensions about several simple charge distributions.

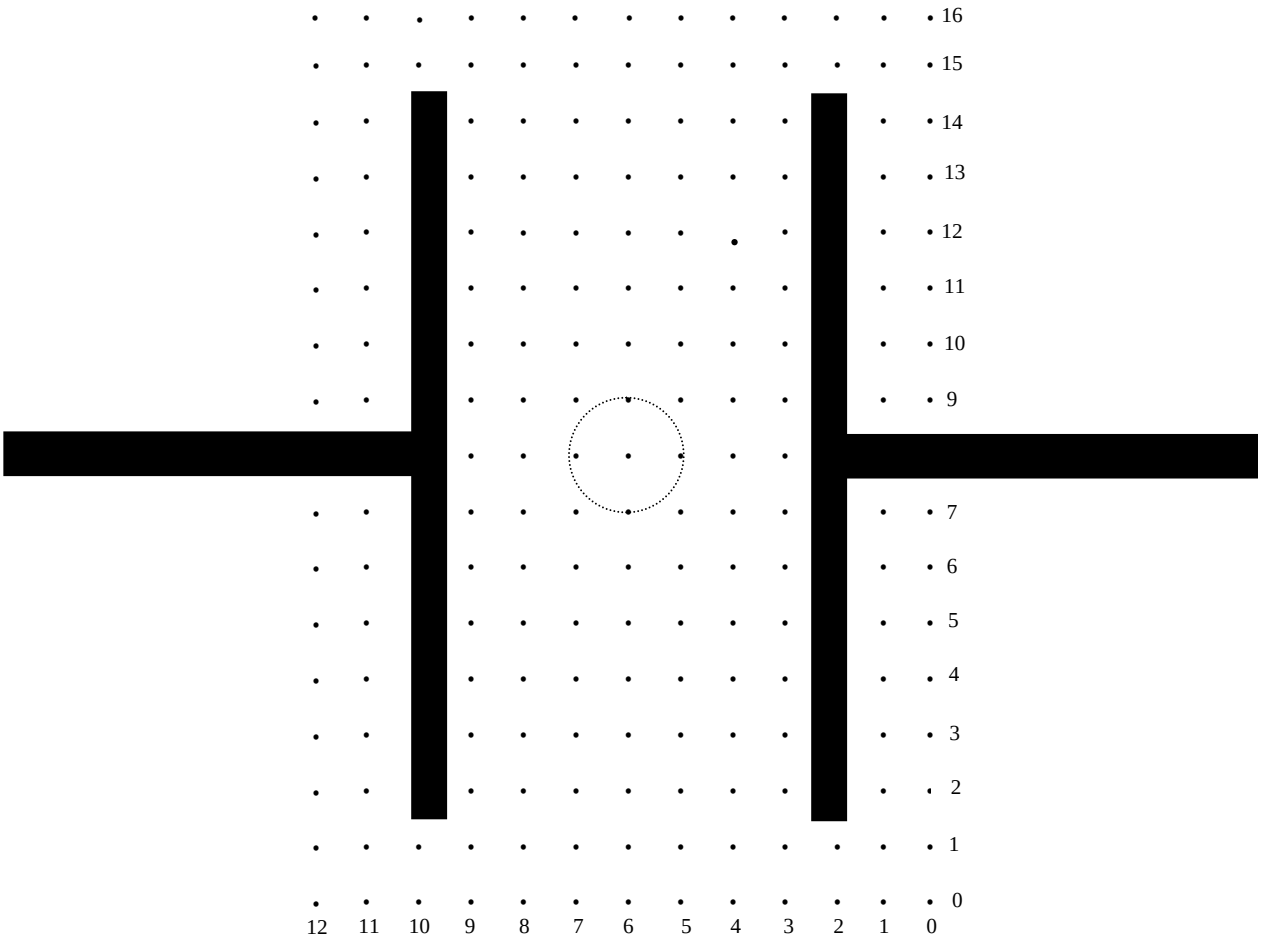
Equipment Needed: Mounting board, conducting paper (four different configurations), graph paper (with same four configurations), mounted probe, hand probe, galvanometer, 2 volt power supply, connecting wires.

Introduction:

As you know, an electric field exists in the space around any charged body. We can simulate this situation in two dimensions by using conducting paper with a uniformly high resistance. A conductor can be made on this paper by covering the desired region with silver (conducting) paint. Thus a region of space with a positively and negatively charged conductor can be represented by connecting the positive terminal of a power supply to one conductor and the negative terminal of the supply to the other conductor.

Procedure:

1. Select one of the sheets of conducting paper having imprinted electrodes and place it on the mounting board with the spring mounted contacts touching the silver electrodes. Connect the two terminals of the power supply to the two electrodes. Set the voltage at no more than two volts.
2. Connect the two probes to either side of a galvanometer. Place the mounted probe at some point near the edge of the conducting paper. Watching the galvanometer, move the hand probe over the surface of the conducting paper until the galvanometer show a null reading (zero current). What is the potential difference between the two probe tips now? Why?
3. Mark the corresponding point on your graph paper and locate enough other points (all the way across the graph paper) at this same potential so that a smooth curve can be drawn connecting them. This represents a line of equal potential. In a similar fashion construct other equipotential lines across the paper. Choose a reasonable and consistent spacing between the lines.
4. Remembering that electric field lines are perpendicular to equipotential surfaces (why?), draw in enough field lines to give a reasonable picture of the electric field. Use dashed lines for the electric field lines and clearly show their direction.
5. Repeat for three other electrode configurations.
6. Open the **Physics Apps** folder, start the program **EM Fields** (located in the **Electricity and Magnetism** folder) and select **Display/Show grid**. Recreate each charge configuration used above by moving various charges to the appropriate locations on the screen (Select **Sources/3D point charges**). Draw in both the equipotential lines and the electric field lines (Select **Field and Potential**) by clicking at various symmetrical locations. Print out your results by doing the following: Select **File/Save picture of screen** and click on the 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**.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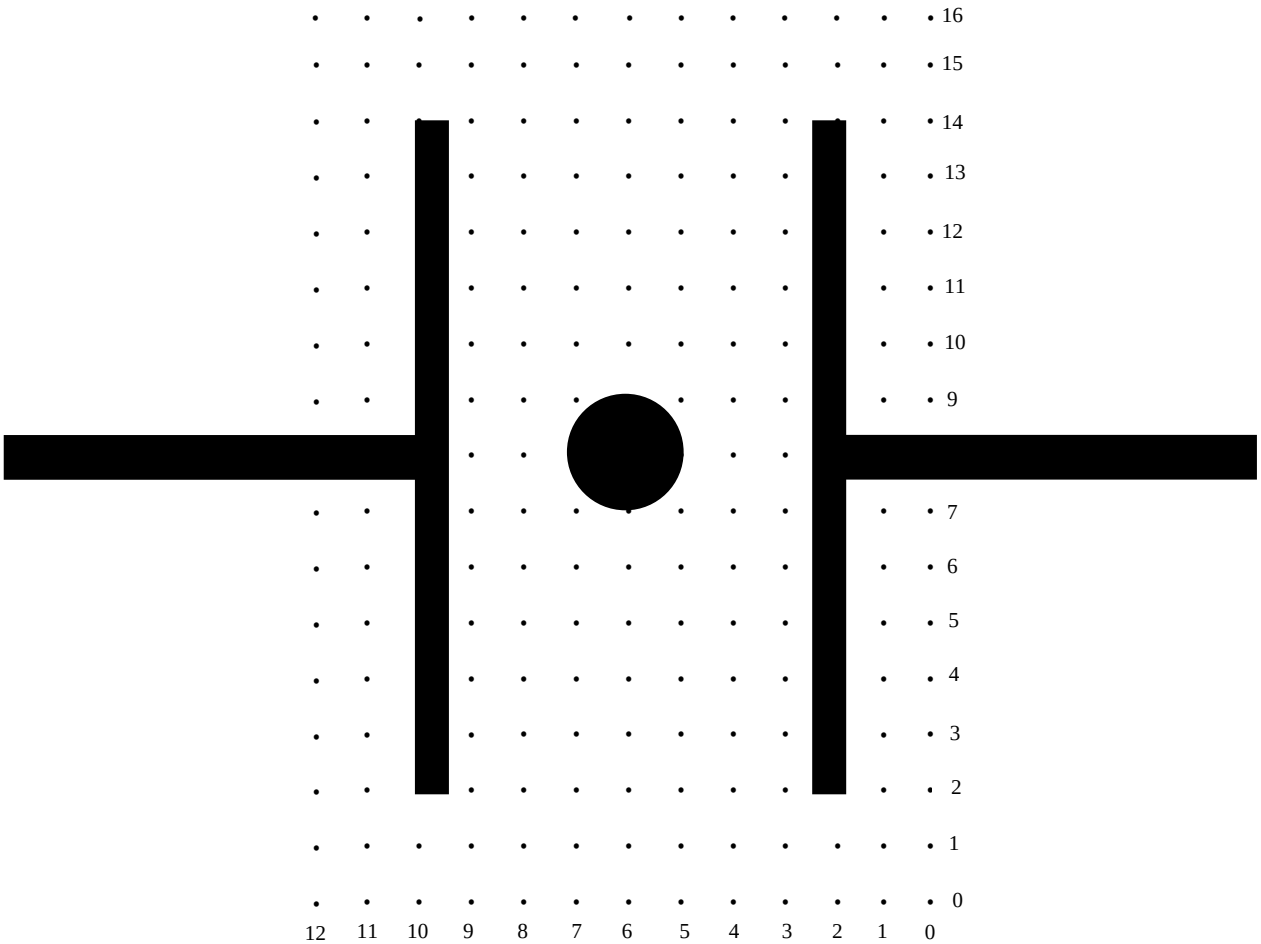
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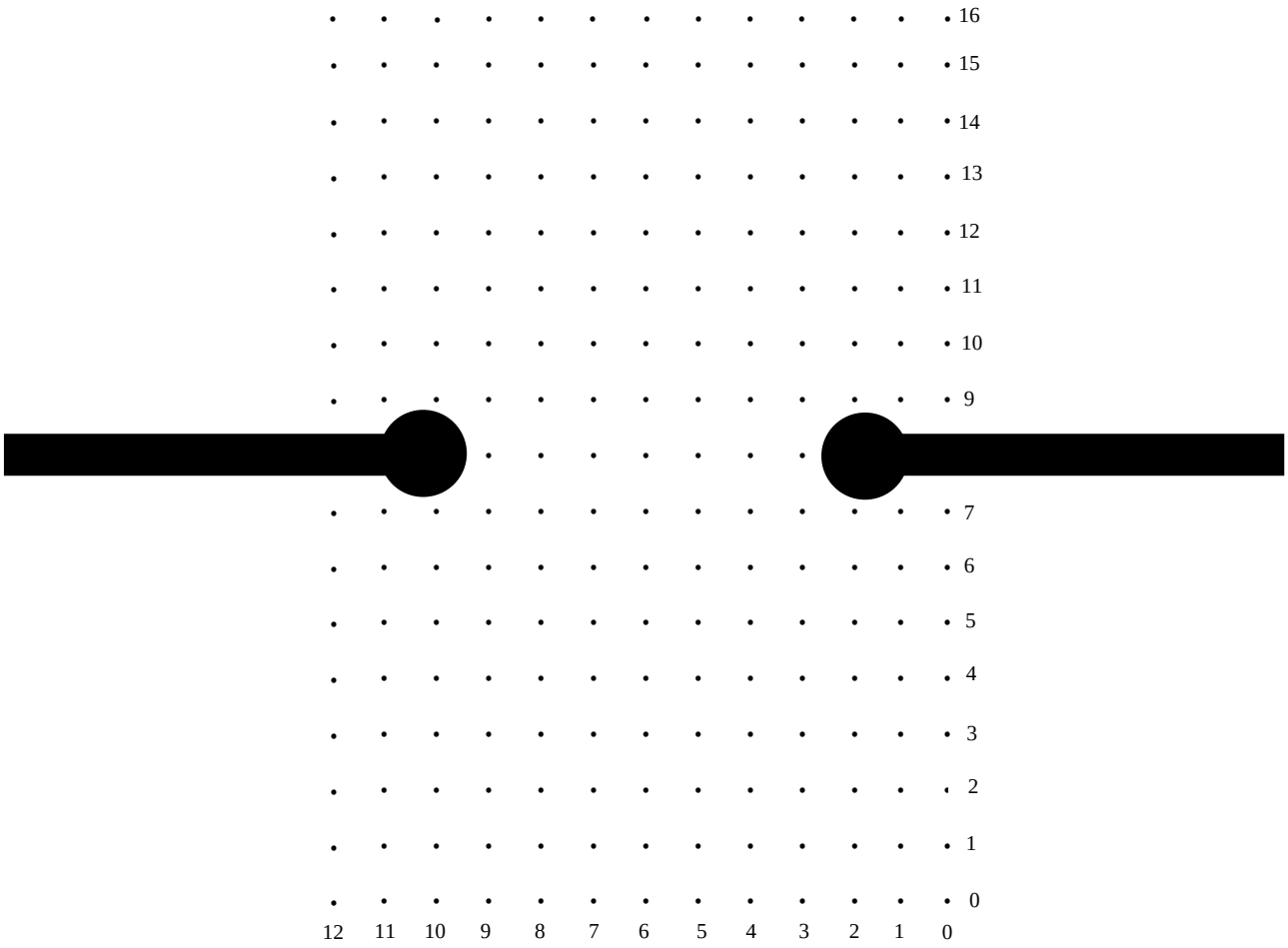
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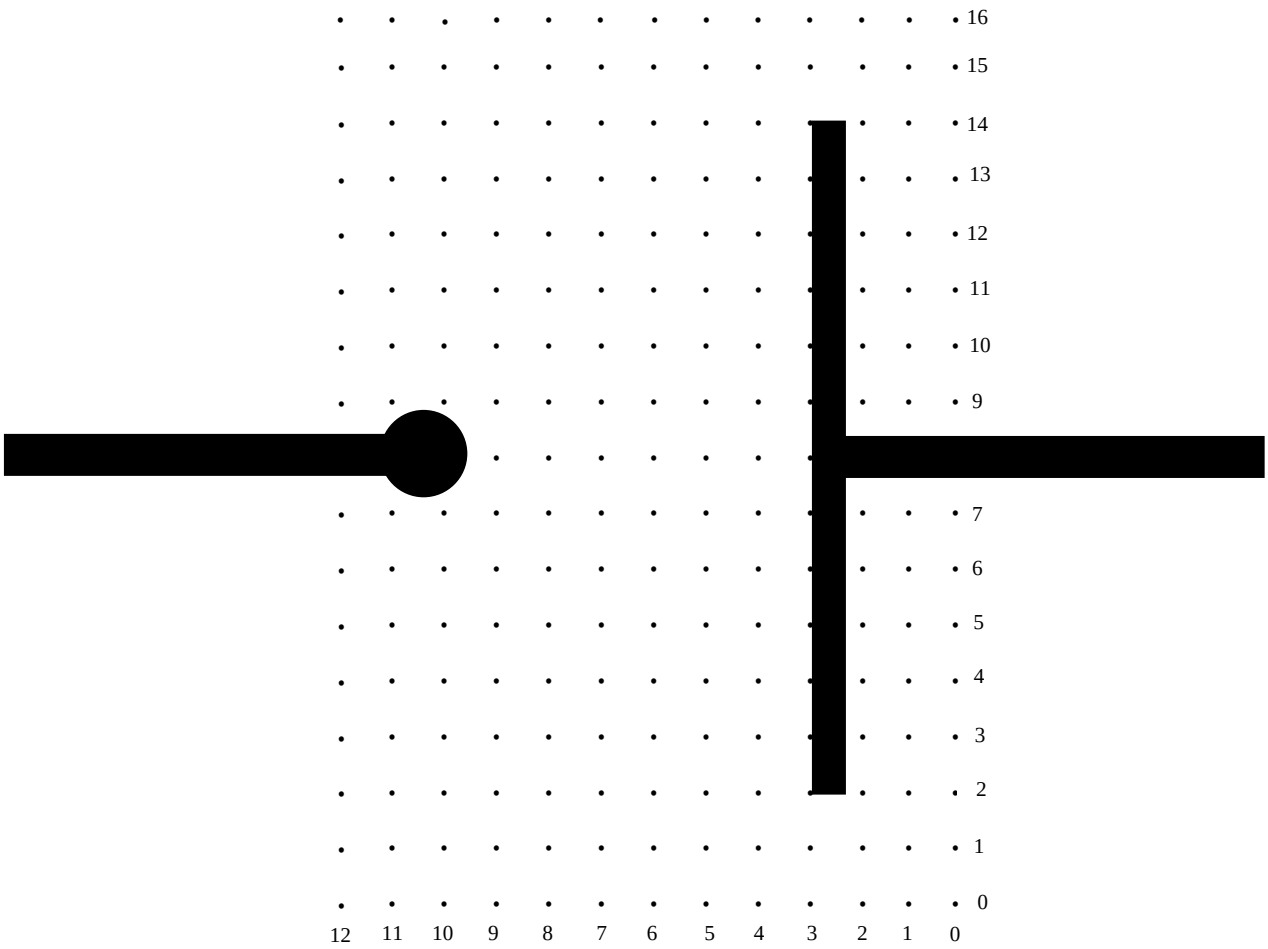
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