Electric Fields Forever

Mapping an electric field

Objective: Students will analyze qualitatively and quantitatively an electric field created by two point charges. Specifically, students will…

- Determine how the strength of an electric field relates to proximity to a point charge.
- Determine, based on the voltage at numerous positions in an electric field, where the positive point charge and negative point charge are located.
- Predict the path a positive test charge would travel if dropped into the field at any location.

Safety:

- Take care not to touch the water pan once the point charges are hooked up to it, even if you think your power source is not turned on.
- Do not turn on the power source until your teacher has approved your set up.
- Turn off your power source immediately upon completion of data collection.
- Dry your materials completely when finished with the experiment.

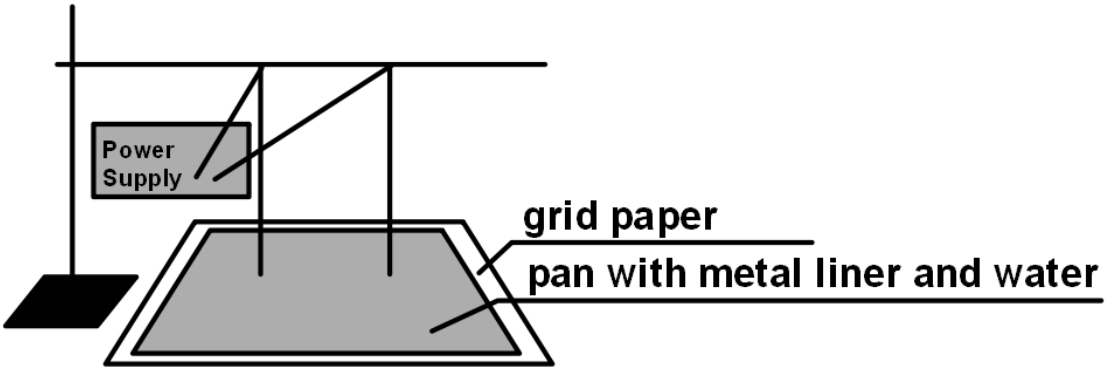
Materials:

- Power supply
- Ring stand with support rod and clamp
- PASCO voltmeter
- Electric leads
- Plastic tray with metal liner
- Grid paper

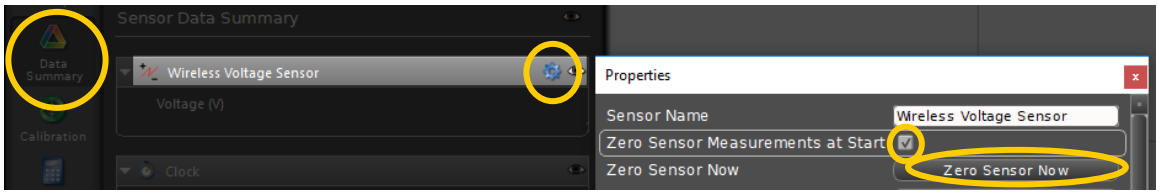
Procedure:

1. Fill your pan with just enough water that the bottom of the pan is entirely covered in water.

2. Set up your materials according to the following diagram. The leads from the power supply should be taped to the ring stand so that only the very tips of the leads touch the top of the water in the pan. **DO NOT TURN ON THE POWER SUPPLY UNTIL TOLD TO DO SO.**



4. **It is essential that you note in your data section exactly where the positive and negative hanging leads are. (For example, "Positive: Box D5 and Negative: Box G6")**
5. Open Capstone and connect your voltmeter. Drag a "Digits" box onto your screen and set the measurement to "Voltage."
6. Clip the red and black alligator clips that are coming from your voltmeter together and set them down on the table so that nothing else is touching them. Then on the left of the screen click "Data Summary." Next to "Wireless Voltage Sensor" click the blue gear icon. Check the box that says "Zero Sensor Measurements at Start" and *also* click "Zero Sensor Now." Then click OK at the bottom of that window.



7. Unclip the two alligator clips and attach the black one to the metal pan liner.
8. Take a moment to re-read the safety instructions for this lab.
9. Call your teacher over to check your set up and to help you turn on your power supply. She will turn your power supply on for you with approximately 10 V of voltage.
10. Use the red lead of the voltage sensor to measure the voltage in each square of the grid. Have a group member record these on a separate piece of grid paper. If a cell contains a hanging lead, hold the red probe lead in the water near the hanging lead without touching the hanging lead. **DO NOT BUMP THE HANGING LEADS, OR YOU WILL HAVE TO START OVER. THAT WOULD BE A TOTAL BUMMER!**

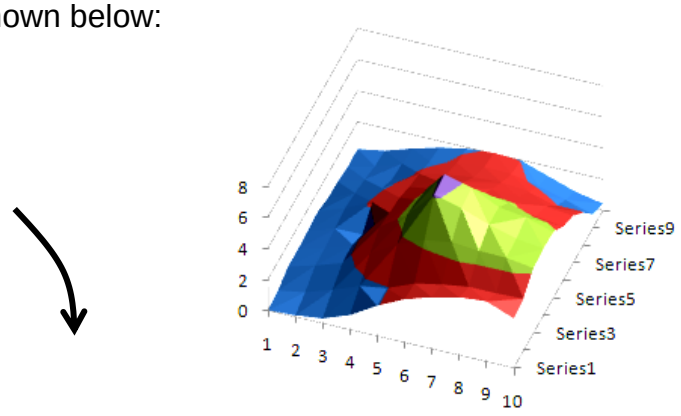
11. Turn off the power source immediately when you've finished collecting your data.
12. Dry all of your materials completely and put them where your teacher directs you to put them.
13. Close the PASCO program software.
14. Open an Excel spreadsheet.
15. Enter the data from your grid into corresponding boxes in the spreadsheet. Be sure to save a version of this as you type in the folder designated by your teacher.
16. When finished, highlight your data.
17. Click the "Insert" tab at the top of the screen.
18. Click "Other Charts."
19. Select "3-D Surface."
20. Right click along the right side of your graph so that a window appears.
21. Select "3-D Rotation" and call your teacher over to help you rotate your chart.

Data Tables & Graphs: Include:

- The spreadsheet grid containing all of the values of voltage for the electric field
- A statement of where the positive and negative leads were actually hanging (i.e., which boxes they were in)
- The 3-D surface graph

Data Analysis:

- On the grid that contains the voltage values, circle the box that corresponds with the part of the pan where the positive lead must have been and write a + sign. Then circle the box that corresponds with the part of the pan where the negative lead must have been and write a – sign. These should be clearly marked on your diagram, so you may need to use colored pen or marker.
- Draw at least six arrows in colored pen or marker on the surface graph to show where a marble would roll if it were dropped onto an actual surface shaped like this surface graph. Be sure your lines show which way the marble would go if it were dropped onto any region of your graph. An example of one arrow is shown below:



One more page…

Conclusion: Write a conclusion that uses the data from this lab and to draw conclusions relating to each of the objectives of this lab.