Lab 2: Electric Potential & Electric Fields Student Handout

The Project: Electric Potential & Electric Field

Company X desires the ability to measure and map the equipotential surfaces due to charging for some of its electronics components. Charges may build up a variety of conductive surfaces, including sharp points, linear planes, and curved surfaces. Company X requires an automated algorithm to measure and map the equipotential surfaces of the electric potential, as well as a map of the electric field.

You and your team have been hired to prove that the voltage probe and software are capable of accurately measuring the voltage and electric field.

You should consult your instructor for additional safety instructions before starting on ***ANY*** lab. *You should cap the current output of your power supply at* ***.1 A (100 mA).***

WARNING: *The aluminum shapes provided can be sharp. Please use caution while handling the shapes.*

Equipment:

- CNC
- DC Power Supply
- CNC mounted probe voltage probe
- Conductive paper
- Push Pin Magnets
- Various conductive pieces to simulate different charge distributions
- Pasco CI- 6512 RLC Circuit Board
- Data Acquisition (DAQ) Unit
- Magnetic Alligator wires
- Banana to Banana cables

Pre-Lab Organizational Questions:

1. The voltage probe measures the voltage at a point relative to ground. How can you use the measurement data to find the electric field your system?
2. You must define a ground for your system. What can you do to set the ground on the conductive paper?
3. How can you orient the shapes to simulate a closed conductor (faraday cage)? A sharp point? A parallel plate capacitor? What should the field look like in these shapes?
4. How can you calculate the value of the resistances used for your circuits from the parameters you derived earlier in the experiment?

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The Requirements:

Company X requires that this algorithm be able to measure and map the electric potential and electric field for at least the following types of systems:

1. A point-point charge configuration
2. A point-plate charge configuration
3. A plate-plate charge configuration (similar to a parallel-plate capacitor)
4. A spherical conductor
5. A sharp point

Presentation of the solution:

Your team must prepare a presentation that will be given to a member of Company X on the approach that your team is using to complete the project. The presentation may be given by the whole team as a group or by a single member of the team chosen by a member of the Company X team. The presentation must include:

- A description of the basic physics principles used in your project, including the definition of an equipotential surface, and the method used to determine the electric field from your measurements. Describe any significant differences in the results surfaces from the four arrangements.
- Plots of the electric potential for each of these shapes. Be sure to indicate where you placed and electric field for each configuration measured. You should include drawings of your experimental setup.
- Plot the electric field for each measurement of the electric potential
- Include a discussion of any deviations that your results might have from experimental results.