Lab 2
Electric Field Mapping

Introduction

In this lab, you will investigate the electric potential between different configurations of charges. You will do this by using a voltmeter to find so-called "equipotential lines": curves where the electric potential is constant ($\Delta V = 0$). Figure 1 shows field lines and equipotential lines for a point charge. In this case, an equipotential line is just the set of points equidistant from the charge, forming concentric circles.

Since $\Delta V = -\vec{E} \cdot \vec{\Delta r}$, curves of constant V are necessarily perpendicular to $\vec{E}$. We can therefore use equipotential lines to sketch the direction of the electric field $\vec{E}$. This is the goal of today's lab.

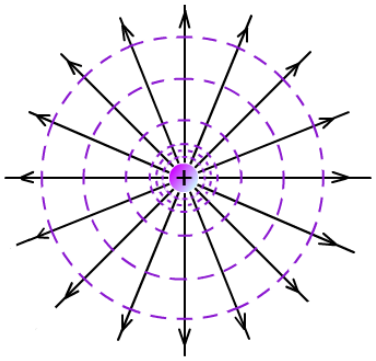

Figure 1: Schematic of a point charge. The solid black lines are the electric field lines. The purple dashed lines are the equipotential lines.

Procedure

In today's lab, you will use the electric field mapping board to map lines of equipotential, which you will then use to draw the electric field.

n this lab, we'll be mapping out the equipotential lines for several configurations.

1. Choose a configuration board (see Figure 2). This board may be in the front or back of the classroom.
2. Copy the schematic onto a separate sheet of paper. Your instructor should teach you how to do this accurately.
3. Turn the mapping board over (see Figure 3). Screw the configuration board into the bottom of the mapping board.
4. Turn the mapping board right-side-up.
5. Using either tape or the legs of the mapping board, fix the schematic onto the top of the mapping board.
6. In your notes, sketch a prediction of what both the electric field lines and equipotential lines will look like.
7. Use the probe to measure the voltage on the mapping board. Your instructor should teach you how to operate the multimeter and the probe if you do not know how.
8. Select a voltage (around 3 V is a good start). Mark the spot where you measured the voltage with a pencil, like in Figure 4. Keep probing for this voltage and marking the spot until you have enough points to form a curve (at least five points).
9. Once you have at least five points on your equipotential curve, connect the points. Remember to write down what voltage you measured next to the curve.
10. Repeat steps 8–9 until you have at least three different equipotential curves.
11. Repeat the entire process for one additional configuration.

Figure 2: An example of a configuration board.

Figure 3: The a mapping board.

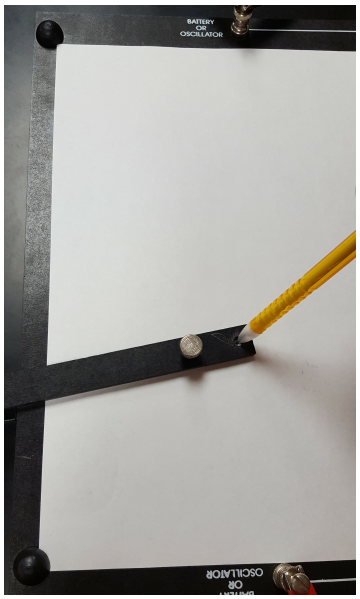

Figure 4: How to mark on the paper with a pencil. Note that the pencil is in the hole.

Analysis Questions

1. Explain any discrepancies between your predicted and measured results equipotential/field lines.
2. For each configuration, pick three points and approximate the magnitude of the electric field at that point (*Hint: measure the distance between two nearby equipotential curves, then you have* Δr *and* ΔV*, so you can find* $\vec{E}$)
3. Explain why equipotential lines and electric field lines must be perpendicular.
4. Is it ever possible for two different equipotential lines to cross one another?