1 Overview

1.1 Electric field

The electric field tells us the force that would be exerted on some positive test charge if it were placed at a given location in space. In principle, all you need to do is take an object with a known charge, place it somewhere, and measure the force it feels.

However, it is difficult to do this in practice. Instead of measuring the electric field directly, What we do is measure a quantity called the *electric potential*.

1.2 Electric potential

An electric field exerts force on a test charge that is placed in the field. If you release the test charge, the field will do work on the charge as it moves from one point to another. The change in electric potential is the work per unit charge done by the electric field. That is, if you know the potential difference between two points, you can determine the work that the field would do on an object with a known charge as it moves between those two points.

Change in electric potential is measured in volts. When you use a *voltmeter*, you are measuring the potential difference between the two probes. If you leave one probe in the same spot and move the other around, you will end up with a map of potentials for a given region of space. You can use this data to determine the electric field in that area.

(Note that if you move the reference probe to a different point, all your measured voltages will be different. This is because what you are measuring is a potential *difference* between two points. As long as you keep the reference probe in the same location, this is not a problem.)

1.3 Using potential to find field lines

If a charge is moved along a path that is perpendicular to the field lines, the field does zero work on the charge; there is no potential difference between those two points. You can look at your map of potentials, and draw lines connecting points with the same measured potential. These are called *equipotential lines*. Since these lines correspond to paths where the field does zero work, you know the field is perpendicular to the equipotential lines. This is what allows us to determine the E-field lines from measurements of potential.

2 Setup

In this lab, you will have lines drawn in conductive ink on conductive paper. You will connect the lines drawn in conductive ink to a power supply, and set it to somewhere between 12 V and 15 V—this means the potential difference between the two lines is 12 V to 15 V. (You can check this using your voltmeter.) What you have done here is separate positive an negative charges so that one line has a net negative charge and the other has a neg positive charge. This produces an electric field.

You will have three separate charge configurations: two point sources, two line sources, and one point source with one line source.

3 Task

Use a voltmeter to find the potential at a variety of points on the paper. (Be sure to report measurement uncertainty of your voltmeter.) Make a scaled drawing that shows equipotential lines and electric field lines for each charge configuration. Label which electrode is positive, and which is negative.