Fields & Equipotentials Class: PHYS xxxxxx

xxxxxxxxxxxxxxx Lab Date: xxxxxx

Partners: xxxxxxxxxxxxxxxx Memo Date: xxxxxxxxx

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The purpose of this lab is to learn how electric fields are created and their effect on charges. An electric field is created by a charge and can be thought of as a region of electrical influence that a charge creates in all the space surrounding itself. In part 1 of this lab we map the electric field of a dipole and in part 2 we calculate electric field and force using a spreadsheet.

An electric field **E** is a vector field giving the force **F** per unit positive test-charge q0 at each point in space surrounding a charge Q: **E**=**F**/q0. This means that an electric field is the region of electrical influence created by charge Q that is characterized by the force per unit charge at each point in space around Q. The size of the electric field at any point is just the size of the force per unit charge at that point and the direction is the direction a positive test charge would move in response to the field. An electric field’s presence can be revealed by the force it exerts on charges placed in the field. The electric potential difference ΔV between two points in an electric field is defined to be the work W per unit test charge q0 required to move a charge between those points: ΔV=W/q0. An equipotential surface is a surface in space over which the electric potential difference between any two points on the surface is zero. Equipotential surfaces and electric fields are always mutually perpendicular.

In part 1, we used a battery and conducting paper to generate an electric field of a dipole. To do so, we mapped the field using a voltmeter to measure equipotential lines. We placed a pin on the positive end and another pin on the negative end of the dipole. We then placed another pin along that line between them to find the equipotential lines by finding where the voltmeter read 0 V potential difference giving us a point on that equipotential line for the pin at the place. We then found more points on that equipotential line and then found the potential of that curve. We repeated this moving the pin over one space each time. After completing the graph of equipotential lines we drew in the electric field lines at right angles to the equipotential lines.

In part 2, we created a spreadsheet to calculate electric field and force. We used the data from question 1 for the coordinates and charges. We then used Coulomb’s law to calculate the electric field, found the x and y components of the electric field and total electric field, found the magnitude and direction of the total electric field, and then finally calculated the magnitude and direction of force on Qp. The magnitude of force on Qp is -4.47E-03 N and the direction of force on Qp is 153.43. We then used the spreadsheet to find the size and positions of two charges that would exert a force of 1 N at an angle of 225o on a charge of 1 nC located at the origin. We came up with Q1=7.94E-02 C at (1,0) and Q2=7.94E-02 C at (0,1) giving us a magnitude of 1.01 N and a direction of -1350=225o. As the distance between charges increases, the electric field decreases.

In this lab, we learned how to find electric fields and equipotential lines using a voltmeter to measure and by using a spreadsheet to calculate using charges and points. Electric fields effect charges by exerting force onto the charge.