Electric Field and Superposition

Name:_____ Date: _____

Instructor: _____

Teammates

1.- _____ 2.- _____

3.- _____ 4.- _____

Instructions: Follow the steps on this worksheet, using your lab manual as a guide, unless directed to do otherwise by your lab instructor. Show at least one sample calculation for each step. Box final mathematical results. Do not forget the units.

Analysis

Single Charge

Take a 1 nC charge of either sign out of the bin and drop it in the middle of the screen. Call this point (0,0). Put sensors at (0.5, 0), (-1, 0), (0, 1.5) and (0, -2) and record the Electric field at each point.

1. Make a sketch of the electric field at the location of each sensor.

2. Calculate the Electric field at the location of the sensors, and compare with your measurements.

Superposition Principle

Dipole

Pick a point near the center of the screen, and define it as the origin of coordinates (0,0); take a +1 nC charge and put it at (0, +0.5 m); take a -1 nC charge and put it at (0, -0.5 m).
Place a sensor at the location given by your instructor _____.

1. Make a sketch of the electric field due to the dipole at the location of the sensor and note its magnitude and direction.

2. Return the negative charge to the box. Sketch the Electric field due only to the positive charge at the location of the sensor and note its magnitude and direction.

3. Restore the negative charge and return the positive charge to the box.
   Sketch the Electric field due only to the negative charge at the location of the sensor and note its magnitude and direction.

4. Use the superposition principle to combine the results of the Electric field from the negative and positive charges, and compare to the case when both charges were present.

5. Sketch the fields due to the individual charges and their superposition at the location of the sensor.

Square

Arrange four equal charges in a square of 2 meters side and place a sensor at the center of the square.

1) Sketch the net Electric field at the middle of the square and measure its magnitude and direction.

2)Write down the x and y components of the net electric field vector.

3)Leave the electric field sensor in its place, but return all charges to their bin except for the one on the upper left corner of the square. Make a sketch and note the magnitude and direction of the Electric field due to only this charge.

4)Write down the x and y components of the electric field vector.

5) Do the same for the other charges. Make a table including the magnitude and direction of the Electric field, as well as the x and y components of the Electric field vector for each charge.

6) Superimpose the results from the individual charges and compare to the result when all four charges were present.

7) Sketch the fields due to the individual charges and their superposition.

Triangle

Put a negative charge and a positive charge at the base of the triangle with a one-meter separation. Put a negative charge at the top of the triangle at a one-meter height; place a sensor aligned with the top negative charge, one meter above it.

1. Sketch the Electric field at the location of the sensor and measure its magnitude and direction.

2. Write down the x and y components of the net Electric field vector.

3. Proceed similarly to the Square section, and measure the Electric field of each individual charge at the location of the sensor.
   Make a table including the magnitude and direction of the electric field, as well as the x and y components of the Electric field vector for each charge.

4. Superimpose the results from the individual charges and compare to the result when all three charges were present.

5. Sketch the fields due to the individual charges and their superposition.

1 Questions

1. Based on your observations, what would be the direction of the Electric field around an infinite line, that has a uniform distribution of positive charge. Explain your response using a sketch.