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. Sketch the electric field at the location of each sensor.

2. Calculate the Electric field at the location of the sensors, and compare it 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. Sketch 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 sensor's location 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 electric field results 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 sensor's location.

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.

1 Questions

1. Considering the **Square's** analysis, what would be the electric field at the center of the square if the charge at the upper-left corner is removed?
   Do not use the simulation to produce the answer; show your calculations.

2. Use equation (1) from the lab Manual to verify the equivalence between Newtons per Coulomb and Volts per meter.

3. Based on your observations on discrete charges, what would you say is the direction of the Electric field around an infinite line with a uniform distribution of positive charge? Explain your response using a sketch.
   Hint: think of this continuous charge distribution as made up of very small discrete charges.