

Coulomb's Law

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.

Open this PHET simulation and select "Macro Scale"

https://phet.colorado.edu/sims/html/coulombs-law/latest/coulombs-law_en.html

Electric Force and Distance

In this experiment, we control the distance between charges and observe the force between them. The objective is to determine the Coulomb's constant and from there obtain an estimate for the permittivity of free space, ϵ_0 .

Data

Place a $1 \mu\text{C}$ positive charge at the 10-centimeter mark of the meter scale, and another $1 \mu\text{C}$ positive charge at the eight-centimeter mark. Make sure that the force values are displayed. Record the force on q_1 in Newtons and the distance between the two charges in meters. Next, move q_1 successively to the 7, 6, 5, 4, 3, 2, 1, and zero cm marks and record the force on q_1 and the distance between the charges for each position of q_1 . Make a table with the separation between the charges on the first column and the force on q_1 on the second column.

Analysis

1. Use graph paper to Plot the force on q_1 as a function of its separation distance from q_2 . Call this Figure 1 and included it as an appendix to this document.
 2. Add a third column to your data table to record the inverse square of the separation distance. Call this variable x ; x should have units of m^{-2} .
 3. Make another graph of the force, but this time as a function of the x variable. Call this Figure 2, and also include it as an appendix.
 4. If the data on Figure 2 look like a straight line, use a straight edge to determine the line that best fit your data; draw this best-fit line on top of your data in Figure 2.
 5. Determine the best-fit line slope, which is a good estimate for the Coulomb's constant –see equation (1) of your lab manual.
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6. Estimate the free space's permittivity from the value of the Coulomb's constant determined in this section.

Electric Force and Charge

In this experiment, We are keeping the charge separation fix as we change the amount of electric charge on the spheres, and observe the force between them. The objective is still to determine the Coulomb's constant and from there obtain another estimate for the permittivity of free space, ϵ_0 .

Data

Place a $1 \mu\text{C}$ positive charge at the 0-centimeter mark of the meter scale, and another $1 \mu\text{C}$ positive charge at the second-centimeter mark. Record the force on q_1 in Newtons and the amount of charge on each sphere in Coulombs (use scientific notation). Next, increase the charge on each sphere by the same amount; make the increases successively to 2, 3, 4, 5, 6, 7, and 8 microcoulombs. Make a table with the charge on each sphere on the first column and q_1 on the second column. Include a third column on your data table to include the product of the charges q_1 and q_2 , call this variable x .

Analysis

1. Use graph paper to Plot the force on q_1 as a function of x . Call it Figure 3 and included it as an appendix to this document.
2. If the data on Figure 3 look like a straight line, use a straight edge to determine the line that best fit your data; draw the best-fit line on top of your data in Figure 3.
3. Determine the slope of the best fit line.

4. Estimate the permittivity of free space from the value of the Coulomb's constant determined in this section.





