# 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.

## Data

Place a 1 $\mu$C positive charge at the 10 centimeter mark of the meter scale. Place another 1 $\mu$C positive charge at the eight centimeter mark of the meter scale. 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 $\mathrm{m}^{-2}$.

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 slope of the best fit line.

6. What is the relationship between the slope of your best fit line and Coulomb's Law.

7. From your results, estimate the permeability of free space.

## Electric Force and Charge

In this experiment, we control the amount of electric charge and observe the force between them.

## Data

Place a 1 $\mu$C positive charge at the 0 centimeter mark of the meter scale. Place another 1 $\mu$C positive charge at the second centimeter mark of the meter scale. Record the force on $q_1$ in Newtons and the charge on each charge in Coulombs (use scientific notation). Next, increase the amount of charge on each sphere successively to the 2, 3, 4, and zero cm marks and record the force Make a table with the charge on each charge 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 the product of the charges on $q_1$ and $q_2$. Call this 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 ruler 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. what is the relationship between the slope of this best fit line and Coulomb's Law;
5. From the results of this section, estimate the permeability of free space.

## 1 Questions

1. How your estimates for the permeability of free space, compare with its accepted value.