

# PHYS 102 Experiment 1. Coulomb's Law with Two Charged Objects

## Introduction:

Coulomb's law states that the magnitude of the electric force between two point charges is directly proportional to the product of the charges, and inversely proportional to the square of the distance between them. Mathematically speaking, we write this as

$$F = k \frac{Q_A Q_B}{r^2}$$

where  $Q_A$  and  $Q_B$  are magnitudes of the two charges A and B,  $r$  is the distance between them, and  $k$  is a constant of proportionality whose numerical value depends on the unit system used. The force is attractive if the two charges have opposite sign and repulsive if the two charges have the same sign.

In this experiment Coulomb's law will be demonstrated using a computer simulation and the numerical value of the proportionality constant will be calculated in SI unit system.

## Online Experiment Link:

<https://ophysics.com/>

## Procedure:

1. Open the website given under the "Online Experiment Link". From the top menu choose the menu item "E&M", and from the appearing drop-down menu choose the experiment "Coulomb's Law with Two Charged Objects". Clear the two check boxes in the upper right hand corner named "Show ... Graph".
2. Read the description given at the bottom of the page.
3. For fixed values of the charges  $Q_A = Q_B = 1 \times 10^{-4} \text{ C}$  vary the distance between the charges, and complete the table below.

r (m) :	3	4	5	6	7	8	9	10
F (N) :								

4. Plot  $F$  (on the vertical axis) versus  $\frac{1}{r^2}$  (on the horizontal axis) on a graph paper. You should have a straight line.
5. Measure the slope of the straight line from the plot.
6. Using the numerical value of the slope you have found, calculate the proportionality constant  $k$ . Look up the value of this constant in your textbook and calculate the percentage error in your result.

7 For fixed values of  $Q_A = 10 \times 10^{-4} C$  and  $r = 10 m$  vary the charge  $Q_B$  and complete the table below.

$Q_B (10^{-4} C)$	2	3	4	5	6	7	8	9
F (N)								

8. Plot  $F$  (on the vertical axis) versus  $Q_B$  (on the horizontal axis) on a graph paper. You should have a straight line.

9. Measure the slope of the straight line from the plot.

10. Using the numerical value of the slope you have found, calculate the proportionality constant  $k$  and compare it with the previous result you have found.

11. Write a properly formatted report of your results, convert it into a PDF file and upload it to MOODLE. Deadline for submission is Monday, 13 July 2020 at 07:59 (am). Late submissions will result in deduction of 10 points for each day late.