Lab: Coulomb's Law

Objective: The student will determine the amount of charge on a pith ball by measuring some very simple geometric data as two pith balls mutually repel one another.

Apparatus: ring stand with wooden dowel, two pith balls, string, fur, charging rod, protractor, electronic balance, metric ruler.

Background Information:

Coulomb's law describes electrostatic forces. Electrostatic forces are directly proportional to the amount of charge present, and inversely proportional to the distance of separation of the charges involved.

Furthermore, electrostatic force is an important force because it is the force that keeps molecules together. Remember *ionic* and *covalent bonds* from chemistry? These bonds are formed by the application of electrostatic forces between charged molecules and atoms.

The first verification of the law of electrostatic forces was made by the French engineer Charles Augustus Coulomb (1736-1806). Using hairs and wires, he constructed a torsion balance similar in design to Lord Cavendish's experiment that measured the gravitational force. The amount of torsion (or twist) required to bring a charged pith ball within various distances of another pith ball allowed for the calculation of k, the electrostatic (or Coulomb) constant. We will use it to confirm the amount of charge a pith ball contains.

Procedure:

1. Obtain an **average mass** for the two pith balls and measure the **length** (**L**) of the string to the center of the pith ball.

2. Suspend the two pith balls from the wooden dowel attached to the ring stand such that their strings have a common point of origin.

3. Using the fur, charge the rubber rod negative and transfer the charge to the two pith balls.

4. Measure the angle (which is 2θ) that the two strings make at the point of origin.

Analysis Questions: (type your questions and answers in Microsoft Word)

1. Sketch a **free body diagram** for each pith ball showing all the forces acting on each while suspended by the electrostatic force.

2. Using the value of the Coulomb constant ($k = 9.0 \times 10^9\ Nm^2/C^2$) and the equation we solved in class, determine the **charge q** on each pith ball.

3. Using your answer from **Analysis question 2**, calculate the **number of excess electrons** on each pith ball while they were suspended.

4. Why were equal sized pith balls used?

5. If an ampere is defined as the flow of charged particles in Coulomb/second (C/s), how many amps would each pith ball generate if its electrons flowed in a wire in 1 second?

6. Compare your answer in **Analysis question 6** to the current consumed by a television set. Use the internet to find this value.

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