**Name**_____

**Date**_____ **Pd**____

# Unit I - Worksheet 3: Coulomb's Law

1. Given the mathematical representation of Coulomb's Law, $F = k\frac{q_1 q_2}{r^2}$, where $k = 9.0 \times 10^9\ {Nm^2}/{C^2}$, describe in words the relationship among electric force, charge, and distance.

2. By how much does the electric force between a pair of charged bodies diminish when their separation is doubled? tripled?

3. The most common isotope of hydrogen contains a proton and an electron separated by about $5.0 \times 10^{-11}$ m. The mass of a proton is approximately $1.7 \times 10^{-27}$ kg. The mass of the electron is approximately $9.0 \times 10^{-31}$ kg.

   a) Use Newton's law of universal gravitation to calculate the gravitational force between the electron and proton in the hydrogen atom.
   b) Use $1.6 \times 10^{-19}$ C as the elementary unit of charge to determine the force of attraction between the two particles.
   c) How many orders of magnitude greater is the electric force between the two particles than the gravitational force between the two particles? How important are gravitational force effects in this case?

4. Two charged spheres are on a friction-less horizontal surface. One has a charge of $+3.0 \times 10^{-6}$ C, the other a $+6.0 \times 10^{-6}$ C charge. Sketch the two spheres, showing all forces on them. Make the length of your force arrows proportional to the strength of the forces.

5. Two positive charges of $6.0 \times 10^{-6}$ C are separated by 0.50 m. Draw a force diagram for each of the charges, considering only electrostatic forces. What is the magnitude of the force between the charges? Is this force repulsive or attractive?

6. A negative charge of $2.0 \times 10^{-4}$ C and a positive charge of $8.0 \times 10^{-4}$ C are separated by 0.30 m. What is the magnitude of the force between the charges? Is this force repulsive or attractive?

7. A young man accumulates a charge $q_1$ of $+2.0 \times 10^{-5}$ C while sliding out of the front seat of a car. His girlfriend, who had been waiting in the wind, has picked up some extra electrons and now has a charge $q_2$ of $-8.0 \times 10^{-5}$ C.

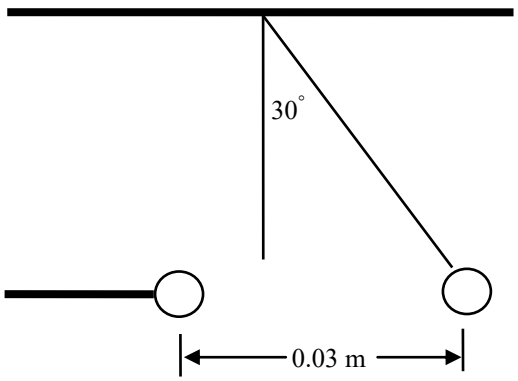
   Draw a sketch of the situation. Estimate the magnitude of the electrical force that each person exerts on the other when separated by a distance of 6.0 m. Is the force attractive or repulsive?

8. Suppose the two people in the previous problem move toward each other. Calculate the magnitude of the electrical force of one on the other when their separation is reduced by a factor of 10.

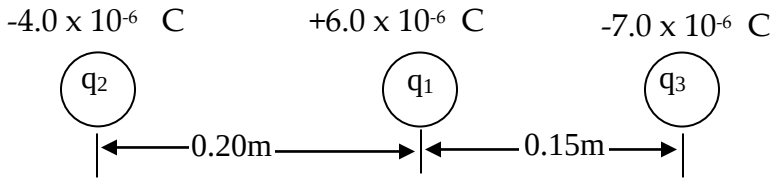
9. Two pith balls shown in the diagram below have a mass of 1.0 g each and have equal charges. One pith ball is suspended by an insulating thread. The other charge is brought to within 3.0 cm. of the suspended ball (r = 0.03 m). The suspended pith ball is deflected from its rest position until the thread forms an angle of 30˚ with the vertical. At this angle, the ball is in equilibrium.

   a) Draw a force diagram depicting the forces acting on the suspended ball.

   Calculate (b) mg (c) $F_e$ (d) the charge on the pith balls



10. The figure below shows three point charges that lie along the x axis. Determine the magnitude and direction of the net electrostatic force on charge $q_1$.




11. Three charges are placed as shown below. Determine the magnitude and direction of the net electrostatic force on charge q1. As part of the solution, include a force diagram.