

Electrostatics WS 2: Coulomb's Law

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

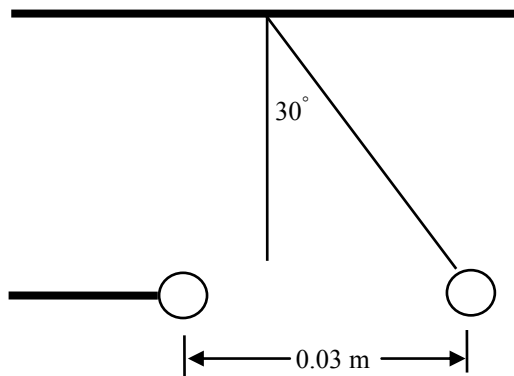
2. By how much does the electric force between a pair of charged bodies diminish when their separation is doubled? tripled?

3. The most common isotope of hydrogen contains a proton and an electron separated by about 5.0×10^{-11} m. The mass of a proton is approximately 1.7×10^{-27} kg. The mass of the electron is approximately 9.0×10^{-31} kg.
 - a) Use Newton's law of universal gravitation to calculate the gravitational force between the electron and proton in the hydrogen atom.

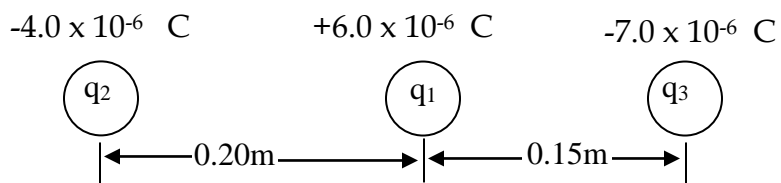
 - b) Use 1.6×10^{-19} C as the elementary unit of charge to determine the force of attraction between the two particles.

 - 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 $+3.0 \times 10^{-6} \text{ C}$, the other a $+6.0 \times 10^{-6} \text{ C}$ 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. A negative charge of $2.0 \times 10^{-4} \text{ C}$ and a positive charge of $8.0 \times 10^{-4} \text{ C}$ are separated by 0.30 m . What is the magnitude of the force between the charges? Is this force repulsive or attractive?
7. 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 ($r = 0.03 \text{ m}$). 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



8. 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 .



9. Three charges are placed as shown below. Determine the magnitude and direction of the net electrostatic force on charge q_1 . As part of the solution, include a force diagram.

