Name: Key

Notes – 18.3 Coulomb's Law

1. Write the equation for Coulomb's Law.

$$F = \frac{k q_1 q_2}{r^2}$$

2. $k = 8.99 \times 10^9 \frac{N m^2}{C^2}$

3. The electrostatic force is a vector quantity and is expressed in units of newtons. What direction is this force? radial – along the line between the two charges

4. Compare the electrostatic force between an electron and proton separated by 0.530×10^{-10} m with the gravitational force between them. This distance is their average separation in a hydrogen atom.

   A. Electric Force – Show your work

$$F_E = \frac{\left(8.99 \times 10^9 \frac{N m^2}{C^2}\right)\left(1.60 \times 10^{-19} C\right)\left(1.60 \times 10^{-19} C\right)}{\left(0.530 \times 10^{-10} m\right)^2} = 8.19 \times 10^{-8} N$$

   B. Gravitational Force – Show your work

$$F_G = \frac{\left(6.67 \times 10^{-11} \frac{N m^2}{kg^2}\right)\left(9.11 \times 10^{-31} kg\right)\left(1.67 \times 10^{-27} kg\right)}{\left(0.530 \times 10^{-10} m\right)^2} = 3.61 \times 10^{-47} N$$

   C. Comparison

$$F_E / F_G = 2.27 \times 10^{39}$$

5. As the example above implies, gravitational force is completely negligible on a small scale, where the interactions of individual charged particles are important. On a large scale, such as between the Earth and a person, the reverse is true. Most objects are nearly charge neutral, and so attractive and repulsive Coulomb forces nearly cancel. Gravitational force on a large scale dominates interactions between large objects because it is always attractive, while Coulomb forces tend to cancel.