

Extra Coulomb's law problems – in class

Key

Memorize these: n, μ , m, k, M, G (know c for centi too)

1. How much force do two charges 50 cm apart experience if one charge is +5.0 C and the other is -6.0 C?

$$F = k \frac{Q_1 Q_2}{d^2} = \frac{9e9 (5)(-6)}{.5^2} = \underline{-1.08 \times 10^{12} \text{ N}}$$

2. Two protons are 3 nm apart. What is the force between them?

$$F = k \frac{Q_1 Q_2}{d^2} = 9e9 \frac{(1.6e-19)(1.6e-19)}{(3e-9)^2} = \underline{2.56 \times 10^{-11} \text{ N}}$$

3. I estimate that the attractive force between the balloon in class and my hair might be about 10 mN. How many electrons did I strip off if the balloon is 5 mm from the hair?

- a. How much net charge in C is on the balloon's surface?

$$F = k \frac{Q_1 Q_2}{d^2} \Rightarrow |Q_1| = |Q_2| \rightarrow F = \frac{kQ^2}{d^2} \rightarrow Fd^2 = kQ^2 \rightarrow Q^2 = \frac{Fd^2}{k}$$

$$Q^2 = \frac{10^{-2} (5 \times 10^{-3})^2}{9 \times 10^9} = 2.78 \times 10^{-17} \text{ C}^2$$

$$Q = \sqrt{2.78 \times 10^{-17}} = \underline{5.27 \times 10^{-9} \text{ C}}$$

- b. How many electrons make that amount of charge?

$$5.27 \times 10^{-9} \text{ C} \left(\frac{1 \text{ electron}}{1.6 \times 10^{-19} \text{ C}} \right) = \underline{3.29 \times 10^{10} \text{ electrons}}$$

4. If the foil electroscope requires $50 \mu\text{N}$ to keep the foils in place, and they are 4 cm apart, how many electrons were stripped off?

a. How much net charge in C is on a foil leaf?

$$Q^2 = \frac{Fd^2}{k} = \frac{(50 \times 10^{-6})(.04)^2}{9e9} = 8.89 \times 10^{-18} \text{ C}^2$$

prev.
Problem

$$Q = \underline{2.98 \times 10^{-9} \text{ C}}$$

b. How many electrons make that amount of charge?

1 electron has $-1.6 \times 10^{-19} \text{ C}$
of charge

$$2.98 \times 10^{-9} \text{ C} \left(\frac{1 \text{ electron}}{1.6 \times 10^{-19} \text{ C}} \right) = \underline{1.86 \times 10^{10} \text{ electrons}}$$