Name______________________________Pd________

Coulomb's Starting To Push It!

Coulomb's Law is named after French mathematician and physicist Charles Augustin de **Coulomb** (1736-1806). Coulomb's early studies in electrostatics allowed him to determine the relationship between the attraction or repulsion of two electrical charges in nature. We know already that **like charges repel** one another while **opposite charges attract**. Repulsions will push charges apart, while attractions will pull charges together. If you have two such charges, the following equation (Coulomb's Law) explains mathematically what would occur.

$$F_E = k\frac{q_1 q_2}{d^2}$$

Where
- F_E = Electrical Force in Newtons (N)
- k = Coulomb's Constant ($9\cdot10^9$ $N\cdot m^2/C^2$)
- q_1 = Charge of 1st object in Coulombs (C)
- q_2 = Charge of 2nd object in Coulombs (C)
- d = Distance between the charged objects in meters (m)

NOTE: The d^2 is in the denominator of the equation, thus Coulomb's Law is known as an INVERSE SQUARE LAW, since the square of the distance between two charges inversely affects the amount of force between them!

Alright, now that the ground work is laid out, let's start some questions!

1. You are holding one piece of Pyrex glass that's charged with +2 C in your left hand, while sitting firmly in your right hand's grasp is a water glass with a charge of +1.5 C. Your two hands are separated by 50 cm.

The objects in your each of your hands are (REPELLED FROM) ATTRACTED TO one another… (Circle one)

What is the electrical force between the two objects in your hands?

$F_E = 9\cdot10^9(2)(1.5)/(0.5)^2$

$F_E = 1.08\cdot10^{11}$ N

Whoa! Look at that force! If you actually had such a force between two objects in your hands what would happen to them if you held on tightly?

Your hands would no longer be a part of you.

This means charges on the order of 1 C are uncommonly large. We'll be doing lots of charge conversions to the micro scale ($\mu = 10^{-6}$) or to the nano scale ($n = 10^{-9}$) which are more realistic charge amounts.

2. At your little brother's birthday party you have one –3.5 μC red balloon that is located 75 cm away from a white balloon that has a –460 nC charge. What is the electrical force between the two balloons?

$F_E = 9\cdot10^9(3.5\cdot10^{-6})(460\cdot10^{-9})/(0.75)^2$

$F_E = 0.02576$ N

The two balloons are (REPELLED FROM) ATTRACTED TO one another… (Circle one)

3. At a family BBQ, the electrical force between one of the plastic plates and a plastic tablecloth on a nearby picnic table is attractive and is 0.4 N in magnitude. The distance between the two objects is 4 m and the tablecloth's charge is +1.6 μC. What is the net charge on the plate?

$0.4 = 9\cdot10^9(1.6\cdot10^{-6})(Q_2)/(4)^2$

$Q_2 = -4.4\cdot10^{-4}$ C

The plate must be negatively charged because the two objects are attracted

4. Two empty pie tins at the party have exactly the same positive charge and are 3 m away from each other. They are repelled from one another with an electrical force of 0.9 N. What is the charge of one of the two pie tins? Would your answer change if the two pie tins were negatively charged?

$0.9 = 9{\cdot}10^9(Q)^2/(3)^2$ (Q is squared since the charges are the same)

$Q = 3{\cdot}10^{-5}$ C

The numerical answer would be the same, except negative, and the tins would repel.

5. One chunk of styrofoam is charged with +60 nC while another is charged with –9 μC. The attraction between the two opposite charges causes 0.012 N of electrical force between them. What is the distance between the two pieces of styrofoam?

$0.012 = 9{\cdot}10^9(60{\cdot}10^{-9})(9{\cdot}10^{-6})/d^2$

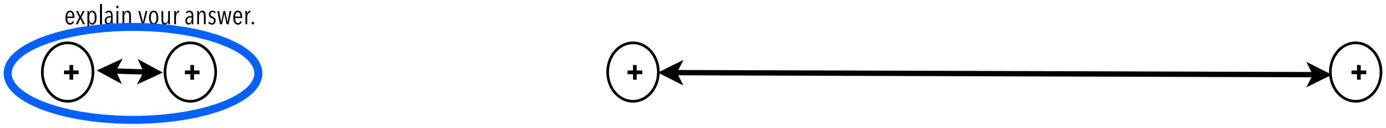
$d = 0.636$ m

6. One electron ($q = -1.6 \times 10^{-19}$ C) is positioned 0.05 nm away from one proton, which has the opposite charge of the electron. What is the electric force between the two atomic particles?

$F_E = 9{\cdot}10^9(1.6{\cdot}10^{-19})(1.6{\cdot}10^{-19})/(.05{\cdot}10^{-9})^2$

$F_E = 9.22{\cdot}10^{-8}$ N

7. In the two situations below, circle the one that would provide the greatest electrical force between the two identical positive charges and explain your answer.



Electrical force is proportional to the amount of charge for each object (same in each situation) and inversely as the square of the distance between the charges. Since the first situation has charges that are closer together, the force is greater.

Would your answer change if instead of two identical positive charges, you had one positive charge and an doubly large negative charge? If so, what would change?

The answer would be the same because of the smaller distance, but the force would increase and it would be attractive instead of repulsive.

True or **False** time:

T (F) The electrical force depends on the mass of the two charged objects.

T (F) The value for ***k*** will change whenever you change the distance between the two charged objects.

(T) F A neutral object will be attracted to a positively charged object.

T (F) According to Coulomb's Law a neutral object will be attracted to a positively charged object.

T (F) If two charged objects are moved 3 times further from each other, the force between them will be 3 times less.