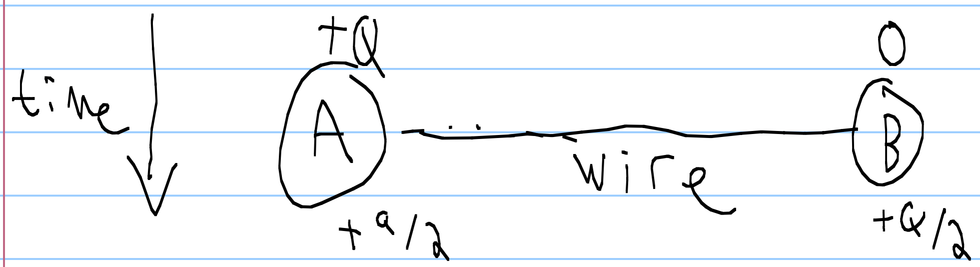
HW 2, Phys221

Note Title 9/4/2008

1

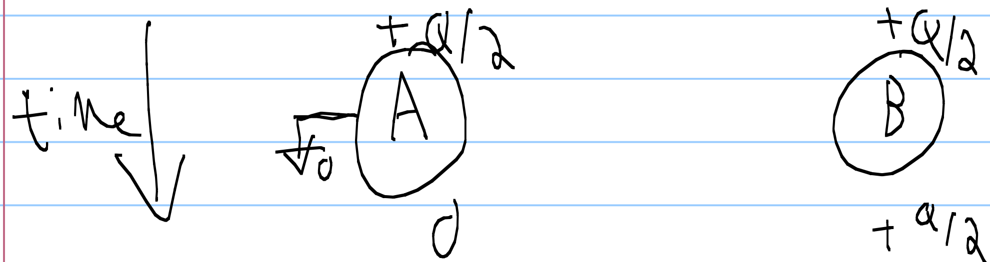


Initially, sphere A has charge +Q and sphere B has charge 0. When the spheres are connected by a conducting wire, electrons are free to move between the spheres. Electrons from the neutral sphere are attracted to the positively charged sphere A until sphere A and sphere B have equal charge at which point no more charge will move between the spheres. That's all well and good, you say, but how long does this process take? In fact, it is almost instantaneous. So connecting the two spheres with a conducting wire, even momentarily, results in the identical spheres having identical charge. Due to charge conservation, that means each sphere must have charge +Q/2. We can now plug this into Coulomb's Law.

$$F = \frac{qQ}{4\pi\varepsilon_0 r^2} = \frac{\left(\frac{1}{2}Q\right)\left(\frac{1}{2}Q\right)}{4\pi\varepsilon_0 a^2} = \frac{Q^2}{16\pi\varepsilon_0 a^2}$$

And the sign convention for Coulomb's Law tells us that the force is repulsive.

2



"...connect the far side to the ground with a wire, electrons will flow from the ground, attracted by the positive charge, which they neutralize." (page 711, course textbook) In other words, when you connect a positively charged object to ground, the ground provides electrons to the object, leaving it electrically neutral.

Thus, when we connect sphere A to ground, it becomes electrically neutral, and it follows automatically that the electric force between the two spheres is **zero**.

Note that some students chose to begin this problem with a "reset" version of problem 1, meaning that sphere A started with charge +Q and sphere B started with charge 0. In fact, it makes no difference the magnitude of A's charge since it will become electrically neutral, and it makes no difference the charge on B since its electrical interaction with an electrically neutral object will always be zero.