

RUTGERS UNIVERSITY

PHYSICS 2 LAB

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# ElectroStatics 2

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SIGNATURES

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July 19, 2013

## Part 1 - Amount of Charge

### procedure and goal

We applied varying voltage sources to a spherical capacitor. We then measured the charge on the spherical capacitor. Our goal was to find the relationship between the voltage applied and charge measured.

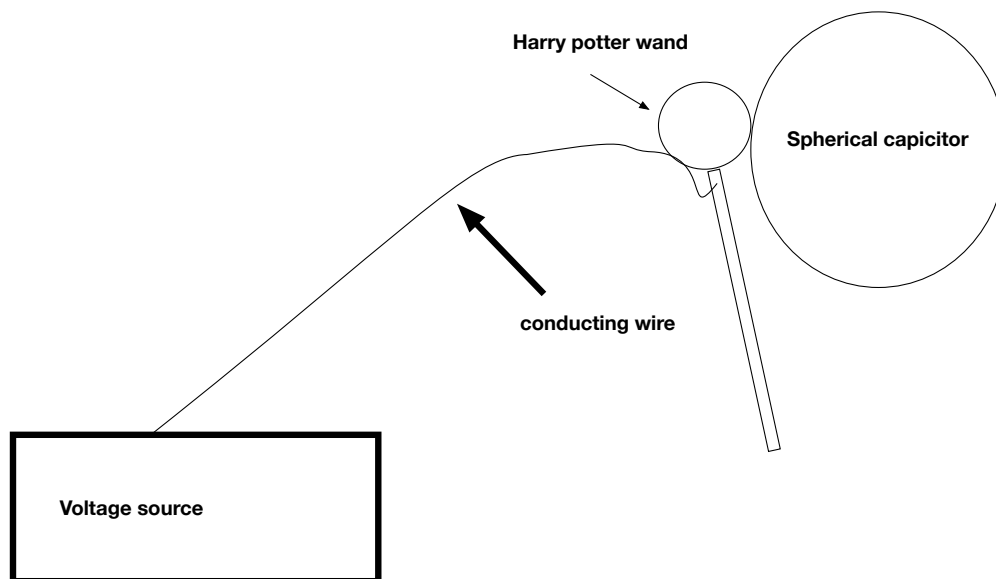


Figure 1: the setup to get current to the sphere

The Harry Potter wand is just there to transfer current to the sphere. It is not necessary but it is safer for students; we could have connected the voltage source straight to the sphere.

### Prediction

From our knowledge of physics we know that charge travels from high potential to low potential. The *voltage source* always has a fixed potential, while the Sphere has zero potential. But after the connection from the voltage source to the sphere is made, charge travels from the voltage source to the sphere until the sphere's potential equals the voltage source's. Because we know the capacitance and final potential of the sphere, we can calculate the

amount of charge on the sphere Using the the formula  $C = \frac{Q}{V}$

$$C = 4\pi\epsilon_0 R = 4\pi * 8.85 * 10^{-12} * .045 = 5 * 10^{-12} \quad (1)$$

$$Q = V * C = \mathbf{750} * 5 * 10^{-12} = 3.75 \text{ nC} \quad (2)$$

$$Q = V * C = \mathbf{1500} * 5 * 10^{-12} = 7.5 \text{ nC} \quad (3)$$

$$Q = V * C = \mathbf{3000} * 5 * 10^{-12} = 15 \text{ nC} \quad (4)$$

$$Q = V * C = \mathbf{6000} * 5 * 10^{-12} = 30 \text{ nC} \quad (5)$$

making a table we get

voltage(v)	charge(nC)
750	3.75
1500	7.5
3000	15
6000	30

## Results

Here are our results. The charge values here are the peak charged observed:

voltage(v)	charge-predicted(nC)	charge-observed(nC)
750	3.75	1.9
1500	7.5	2.9
3000	15	4.1
6000	30	5.8

## Analysis

The measured charge was a lot lower than the predicted. Here are possible explanations

1. We did not hold the connection from the battery to the sphere long enough. Capacitors take time to charge up. We held it for about 2 seconds. Not sure if that is long enough?
2. Charge was lost to the Air. Electrostatic studies are difficult in humid environments because objects discharge quickly through multiple paths
3. We did not calculate the capacitance correctly. We calculated the capacitance to be  $5 * 10^{-12}$  When we measured the radius the error was probably  $\pm .02 \text{ meters}$ , which is quite a lot in our experiment.

The predicted results are a perfect linear relationship, but the observed results seem to form a logarithmic relationship between voltage and charge. That is very interesting. Perhaps the air finds it easier to absorb high levels of charge? The only conclusion we can make is more voltage  $\rightarrow$  more charge.