Note: You are free to use (e.g. copy verbatim) any text in black. All text in red indicates areas where you need to insert your own work.

Experiment #2: Electric circus

Reading for this lab:
Chapter 20 in Essential University Physics (3rd Edition) by Wolfson.

Introduction:

While gravity is important at the large scales, being responsible for the development of structures the size of the earth and larger, it is a weak force compared to the electric field. That is, a small number of electric charges could, in principle, be distributed to levitate a frog by counteracting the force of gravity that is generated by the entire mass of Earth. An important distinction between gravity and electric fields is that there is only one "flavor" of mass that is always attractive to itself, whereas charges comes in either positive or negative units and in like combinations create repulsive forces and in unlike combinations create attractive forces. Life owes its existence to the electric field for allowing molecular complexity to develop, and to gravity for bringing sufficient matter together to allow this happen. This lab presents a series of experiments that illustrate aspects of the electric force and charge distributions.

Experiments:

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Instructions:
In this lab you conducted experiments at four stations. You were asked to create a series of experiments to test how these devices/phenomena behave. Write one subsection for each station, describing the apparatus and what experiments you conducted. Note that the order in which you actually conducted the experiments need not be the same as the order in which you present the data, so present your information in the best **logical** order. When describing the physical apparatus, do your best to explain what it is that it is, either with model numbers or some specific description of material properties, so that someone unfamiliar with the experiment would have a good understanding of what you have done. Following the description of the apparatus, describe how you used the device and what you observed.

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Data and Analysis:

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Instructions:
There is no data analysis for this lab, per se. However you should present a clearly organized description of each experiment and a list of your major observations, organized in a way that allows you to deduce properties of these systems.

Below are a few questions that you might consider answering for each station.

Station 1: Van de Graaf generator

1. Why did it seem that the hanging aluminum can was initially attracted to the metal dome of the device, then repelled after it arced?

2. Why did the aluminum pie pans fly off the dome and a piece of paper stuck to the dome?

3. Why does the frequency of arcing increase as you get your hand or the grounding wand closer to the dome?

4. Why does an arc form at all?

5. Why does a small piece of Styrofoam get initially attracted to the dome then bounce off of it?

6. What happens when you place your hand on the dome and then near stream of water?

Station 2: metal and plastic tubes

1. What happens when you drop different objects down each of the tubes (magnet, chalk, screws)?

2. What happens when you connect the voltage source to each of the objects? Does this affect the rate of fall of the objects?

3. How would you characterize the tube materials in terms of their electric and magnetic properties?

Station 3: Arduino LED dimmer

1. What happens to the LED when you change the number in the computer code?

2. What happens to the plot on the oscilloscope when you change the number in the computer code?

3. You were told to use only number between 0 and 255. Why is that? Why this strange limit?

Station 4: Tesla coil

1. To what materials does the Tesla coil want to arc?

a. Rank the following: water, wood, metal, plastic, glass, ceramic (maybe others?)

2. Can you prevent the Tesla coil from arcing to metal by placing some material between it and the metal surface? If so, how effective or not effective is this?

3. How does the frequency of arcing depend on distance from the surface?

4. What shape do the arcs have? Does the arc form the same way every time or is each arc shape unique?

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Conclusion:

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Instructions:

Write a few concluding paragraphs that summarize your observations. Your goal here is to organize your observations into a kind of coherent system that attempts to explain everything. Do you have sufficient knowledge to do this? Are there things that cannot yet be explained with what you know? You could also comment on additional experiments that could have been conducted to resolve ambiguity, or comment on how you might possibly make quantitative measurements of these experiments.

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