Capacitor Investigation Lab

Capacitor as devices that hold charge that is deposited by a presence of a voltage. The relationship between the amount of charge a capacitor can hold and the voltage required to place that charge can be shown with the equation:

or

This is the definition of Capacitance. Measured in Farads, where 1 Farad = 1 Coulomb/Volt

**Part A:** Stored Energy

If capacitors stored electric charge, then they must also store potential energy. We can get an idea of how much energy is stored in a capacitor by using a hand crank generator.

1. Grab a variable voltage supply, a 1 F capacitor, a hand crank generator and some wires.
2. hook it up to the capacitor to the voltage supply (MAKE SURE THE BLACK GROUND LINE GOES TO THE TINE WITH THE BLACK BAR)
3. Starting with the lowest voltage setting, turn on the supply and let it charge for about a minute.
4. Turn off the supply, disconnect the supply and connect the hand crank generator.
5. Count how many revolutions the handle turns. (this amount of rotations is proportional to the amount of energy stored in the capacitor.)
6. Record data, turn up voltage, and repeat.

|  |  |
| --- | --- |
| Voltage (V) | # of Rotations |
| 1.5 |  |
| 3 |  |
| 4.5 |  |
| 6 |  |
| 9 |  |
| 12 |  |

|  |  |
| --- | --- |
| Ratio of Voltage  compared to 1.5 V | Ratio of Rotations  compared to 1st setting |
| 2 |  |
| 3 |  |
| 4 |  |
| 6 |  |
| 8 |  |

Comparing the ratios to the first setting:

What do you notice about how the amount of energy changes when you change the voltage? What type of relationship is this?

CALCULUS TIME: The electric potential is defined as and if Q = CV, derive an equation for the energy stored in a capacitor in terms of C and V.

For a parallel plate capacitor (2 conducting surfaces separated by an insulating material), the equation for the capacitance is:

**Part B:** Finding dielectric of Styrofoam through changing the Area.

I have created a set of large parallel plate capacitors out of Styrofoam and aluminum conducting tape. Your goal is to measure the dimensions of the different Styrofoam capacitors and the resulting capacitance using a capacitance measure.

Thickness of the Styrofoam: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| Length (cm) | Width (cm) | Capacitance (F) |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

The known value for the dielectric constant (κ) for Styrofoam is 1.03. Using the data above, calculate your value of κ for Styrofoam and compare your results to the known value.

**Part C:** Finding dielectric of Styrofoam through changing the thickness.

Grab a pair of Aluminum tape strips, a capacitance meter, and a textbook. Place one strip at **page 100.** Starting at **page 300** (therefore 100 pages of paper between each strip), vary the amount of paper (thus the value d) record the resulting capacitance of the set up.

|  |  |
| --- | --- |
| Page number | Resulting Capacitance (F) |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

Width of Al strip: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Length of textbook paper: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The thickness of a single page of textbook paper is about 55 μm.

The known value for the dielectric constant (κ) for paper is 3.7. Using the data, calculate your value of κ for paper and compare your results to the known value.

Your formal lab report for this unit is to walk me through your process for parts **B and C**. NO GRAPH NEEDED FOR THIS LAB REPORT. Your lab report is due **10/7.**