Capacitors and Dielectrics

Name:_____ Date: _____

Instructor: _____

Teammates

1.- _____ 2.- _____

3.- _____ 4.- _____

Instructions: Follow the steps on this worksheet, using your lab manual as a guide, unless directed to do otherwise by your lab instructor. Show at least one sample calculation for each step. Box final mathematical results. Do not forget the units.

1 Data

1.1 Effective Capacitance

1. Select two different fixed value capacitors that vary in capacitance by less than a factor of ten. Measure and record their individual capacitances using the digital capacitance meter.

2. Connect the two capacitors in series, then measure and record their effective capacitance.

3. Connect the two capacitors in parallel, then measure and record their effective capacitance.

1.2 Parallel Plate Capacitor

1. Insert an acrylic sheet between the movable plates of the parallel plate capacitor and close the plates. Measure and record the capacitance. **Carefully**, remove the acrylic without changing the distance between the two cylindrical plates. Measure and record the capacitance with only air in between the two plates.

2. Repeat the last procedure 4 times, inserting an additional acrylic sheet each time. On your last trial, you should have 5 acrylic sheets stacked between the parallel plates. Make a table of your data.

1.3 Cylindrical Capacitor

1. Measure and record the inner diameter of the capacitor, the outer diameter of the capacitor, and the length of the capacitor.

2. Measure and record the capacitance of the cylindrical capacitor.

2 Analysis

2.1 Effective Capacitance

1. Calculate and record your theoretical effective series capacitance and the theoretical effective parallel capacitance for the capacitors used.

2. Compare your experimental values to your theoretical values and obtain the percentage difference between both.

2.2 Parallel Plate Capacitor

For our analysis, we will experimentally determine the dielectric constant of the acrylic used in this lab.

1. Plot the capacitance of acrylic, $C_{acrylic}$, versus the capacitance of air, C_{air}.

2. Use this plot and Equation 4 to determine the dielectric constant, κ, for acrylic. (Try to figure it out yourself first, then ask your instructor as needed.) Be sure to explain your work.

2.3 Cylindrical Capacitor

1. Find the theoretical value for the capacitance of the cylindrical capacitor.

2. Compare the theoretical and experimental values of capacitance for the cylindrical capacitor using percent error.

3. Use Gauss's Law to outline the derivation of the concentric cylinder capacitor without dielectric –eq(5).