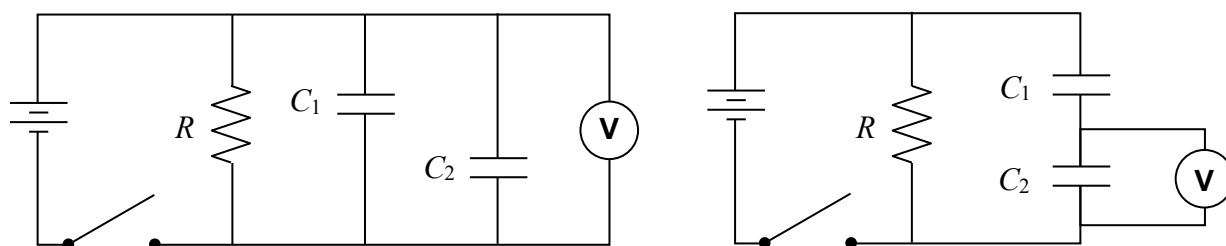


RC Circuits Lab – Discharge of Capacitor Combinations

Goals: Confirm the relationships of capacitor combinations and the exponential behavior in an RC circuit.

Procedure:

The following circuits can be set up using the Vernier circuit board and two additional “loose” capacitors. Connect the voltmeter to measure the voltage of C_2 in each case.



Two capacitors will be charged and discharged: $C_1 = 1000 \mu\text{F}$ and $C_2 = 680 \mu\text{F}$. Three trials will be done – capacitors in parallel with $R = 22 \text{ k}\Omega$, capacitors in series with $R = 22 \text{ k}\Omega$, and capacitors in series with $R = 47 \text{ k}\Omega$. Use a stopwatch (such as found on most cell phones) to collect data of voltage versus time of discharge for C_2 in all three trials. Note: the time $t = 0$ is arbitrary and it can (at your choice) occur *after* the switch is thrown. For example you could pick a convenient voltage as a “starting point” (like say 3.00 V) and then measure the time to drop to other convenient values of voltage. Do what makes the most sense to you, but collect at least seven data points per trial. Make a neat, well labeled data table that clearly shows the details and data of each trial. Include an “extra column” in your table(s) – see below for details.

Analysis:

1. Create a single graph of voltage versus time with all three sets of data and include appropriate curve fits.
2. Add a calculated column to each data table such that it will produce a linear result (a curve-straightening graph). One way to do this is to calculate the natural logarithm of a quantity based on the variables. (You figure it out!) Produce a single graph based on this and include linear fits.

Questions:

1. For each trial calculate the equivalent capacitance of the two-capacitor combination based on the capacitors' ratings (labels). Show work
2. Using a coefficient from a curve fit, determine the effective capacitance of the two-capacitor combination during the discharge. Show all work. Repeat this determination for each of the three trials.
3. Evaluate the results of the experiment: (a) Does the voltage versus time data illustrate the expected behavior of an RC circuit? (b) Does the capacitance based on the behavior during discharge agree with the expected amounts based on ratings and type of connection? Explain both answers and be specific.
4. Discuss error.

What to turn in:

Data Tables

Graphs

Questions