Capacitors

As you work through the steps in the lab procedure, record your experimental values and the results on this worksheet. Use the exact values you record for your data to make later calculations.

Procedure A: Lighting an LED

How long did the LED remain lit when the capacitors were connected in series?

How long did the LED remain lit when the capacitors were connected in parallel?

How long did the LED remain lit when connected to the 1000 μF capacitor?

Which configuration held the most energy, series or parallel?

Which configuration should theoretically store more energy, and why?

CHECKPOINT 1: Ask your TA to check your work before proceeding.

Procedure B: Capacitors in Parallel

Complete the table below. Here C_1 refers to the capacitor with the larger value and C_2 refers to the capacitor with the smaller value.

Data Table 1

	C_1	σ_{C_1}	C_2	σ_{C_2}	C_p	σ_{C_p}
C_{meas} (μF)						
ΔV_{meas} (V)						
Q_{calc} (μC)						
E_{calc} (μJ)						

Calculate the theoretical equivalent capacitance for the two capacitors in parallel.

What is the percent difference between your measured equivalent capacitance and the theoretical value of the equivalent capacitance?

Do the theoretical and experimental values agree within the range of your experimental uncertainty? (Consider your capacitances and their uncertainties exactly as you have entered them.)

Calculate the theoretical total charge. (Use the charges and their uncertainties you calculated above for each capacitor.)

What is the percent difference between the theoretical total charge and the value calculated in the Data Table 1?

Do the theoretical and experimental values agree within the range of your experimental uncertainty? (Consider your charges and their uncertainties exactly as you have entered them.)

CHECKPOINT 2: Ask your TA to check your table and calculations.

Procedure C: Capacitors in Series

Complete the table below. Here C_1 refers to the capacitor with the larger value and C_2 refers to the capacitor with the smaller value.

Data Table 2

	C_1	σ_{C_1}	C_2	σ_{C_2}	C_s	σ_{C_s}
C_{meas} (μF)						
ΔV_{meas} (V)						
Q_{calc} (μC)						
E_{calc} (μJ)						

Calculate the theoretical equivalent capacitance for the two capacitors in series.

What is the percent difference between your measured equivalent capacitance and the theoretical value of the equivalent capacitance?

Calculate the theoretical value of total voltage. (Use the voltages and their uncertainties you calculated above for each capacitor.)

What is the percent difference between the theoretical value and the calculated value from Data Table 2?

Do the theoretical and experimental values agree within the range of your experimental uncertainty? (Consider your voltages and their uncertainties exactly as you have entered them.)

Do the charges on the individual capacitors and the series arrangement conform to the theoretical prediction of Eq. (9)? (Calculate the percent difference for Q_{C_1} and $Q_{C\mathrm{s}}$, and the percent difference for Q_{C_2} and $Q_{C\mathrm{s}}$.)

Which circuit configuration held the most energy?

CHECKPOINT 3: Ask your TA to check your table and calculations.