

# TechLab: Capacitor Variations

varying the parameters in an RC circuit

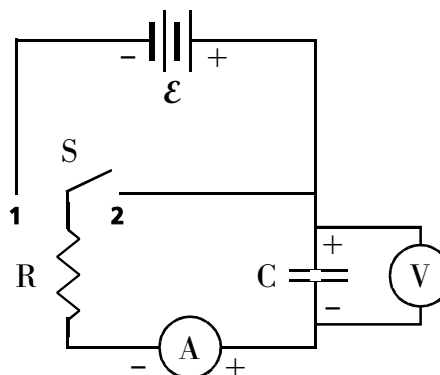
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## • Purpose •

In this activity, you will investigate the effects of varying the parameters of a resistor-capacitor ( $RC$ ) circuit.

## • Apparatus •

- \_\_\_ 2 1.0 F capacitors
- \_\_\_ 2 mini bulbs in sockets [6.3 V]
- \_\_\_ 2 C- or D-cell batteries
- \_\_\_ 2 more C- or D-cells or one 6 V battery
- \_\_\_ 3 battery connectors (optional)
- \_\_\_ single throw double pole switch
- \_\_\_ connecting wires
- \_\_\_ computer
- \_\_\_ data analysis software (DataStudio)
- \_\_\_ interface device (USB Link)
- \_\_\_ current/voltage sensor



## • Set Up •

1. Turn on the computer and set it aside.
2. Connect the circuit shown. Note: the switch is in an open (up) position during circuit construction.
3. Connect the current/voltage sensor so that it measures the current through the capacitor and the voltage across the capacitor.

**Pay attention to the polarity of the battery set. Connect the voltmeter leads so that the voltage will read positive when the switch is closed in position 1. Connect the ammeter leads so that the current will read positive when the switch is closed in position 1.**

4. Connect the current/voltage sensor to the interface device.
5. Connect the interface device to the computer.
6. When the computer detects the sensor and asks what you would like to do, select Open Activity: 2.07 Capacitor Variations.
8. Make certain the capacitor is discharged by touching opposite ends of a wire to both terminals of the capacitor for a few seconds.

• **Procedure** •

PART A. VARY THE POTENTIAL (VOLTAGE)

1. Observe the charging of the capacitor in the standard RC circuit while recording the current, voltage, and power.

a. Click the on-screen "start" button to activate data sampling. The software has been configured to start sampling once the current starts flowing.

b. Close the switch to position 1 and observe the charging of the capacitor for 100 seconds. The software has been configured to terminate data sampling after 100 seconds. If the sampling does not start when you close the switch, open the switch. Reverse the ammeter connections, then close the switch in position 2 to discharge the capacitor. Stop data sampling and repeat, starting from step a above.

c. Close the switch to position 2 to discharge the capacitor.

2. Double the potential of the battery by adding two more C- or D-cells in series or by replacing the two batteries with one 6 V battery. Observe the charging of the capacitor in the double-potential RC circuit while recording the current, voltage, and power.

a. Click the on-screen "start" button to activate data sampling. The software has been configured to start sampling once the current starts flowing.

b. Close the switch to position 1 and observe the charging of the capacitor for 100 seconds. The software has been configured to terminate data sampling after 100 seconds. If the sampling does not start when you close the switch, open the switch. Reverse the ammeter connections, then close the switch in position 2 to discharge the capacitor. Stop data sampling and repeat, starting from step a above.

c. Close the switch to position 2 to discharge the capacitor.

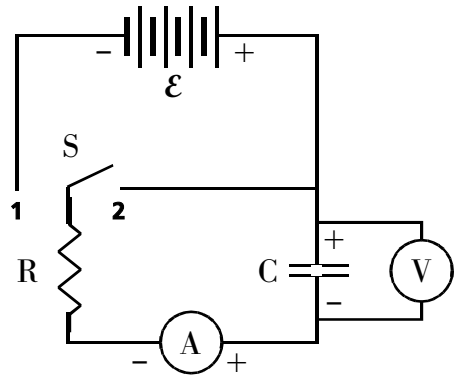
3. What differences—if any—are apparent when the charging potential is approximately doubled? Which measurements—if any—don't seem to be significantly different? Discuss each measurement with respect to time as well.

a. Voltage.

b. Current.

c. Charge.

d. Energy stored.



## PART B. VARY THE RESISTANCE

1. Double the resistance by adding a second bulb in series with the original. Observe the charging of the capacitor in the double-resistance RC circuit while recording the current, voltage, and power.

a. Click the on-screen "start" button to activate data sampling. The software has been configured to start sampling once the current starts flowing.

b. Close the switch to position 1 and observe the charging of the capacitor for 100 seconds. The software has been configured to terminate data sampling after 100 seconds.

c. Close the switch to position 2 to discharge the capacitor.

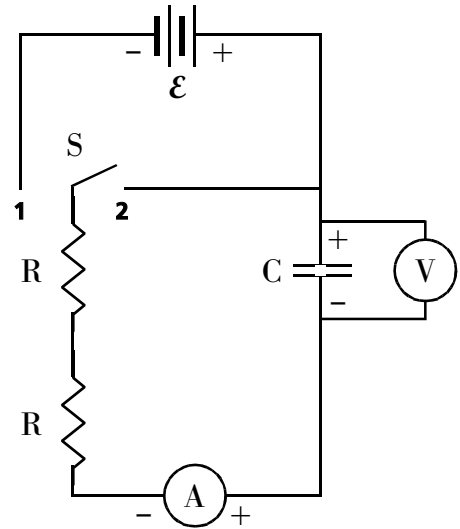
2. What differences—if any—are apparent when the resistance is approximately doubled? Remember you're comparing this circuit to the original RC circuit in part A.1. Which measurements—if any—don't seem to be significantly different? Discuss each measurement with respect to time as well.

a. Voltage.

b. Current.

c. Charge.

d. Energy stored.



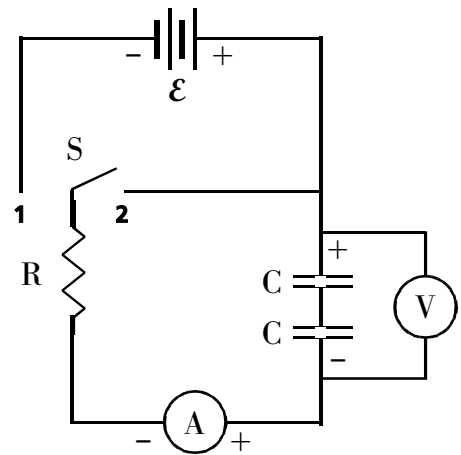
### PART C. VARY THE CAPACITANCE

1. Two capacitors in series. Connect two capacitors in series. Measure the voltage across the entire combination. Observe the charging of the capacitor in the series capacitor RC circuit while recording the current, voltage, and power.

- Click the on-screen "start" button to activate data sampling.
- Close the switch to position 1 and observe the charging of the capacitor for 100 seconds.
- Close the switch to position 2 to discharge the capacitor.

2. What differences—if any—are apparent when a single capacitor is replaced by two capacitors connected in series? Which measurements—if any—don't seem to be significantly different? Discuss each measurement with respect to time as well.

- Voltage.
- Current.
- Charge.
- Energy stored.



3. Two capacitors in parallel. Connect two capacitors in parallel. Observe the charging of the capacitor in the parallel capacitor RC circuit while recording the current, voltage, and power.

- Click the on-screen "start" button to activate data sampling.
- Close the switch to position 1 and observe the charging of the capacitor for 100 seconds.
- Close the switch to position 2 to discharge the capacitor.

4. What differences—if any—are apparent when a single capacitor is replaced by two capacitors connected in parallel? Which measurements—if any—don't seem to be significantly different? Discuss each measurement with respect to time as well.

- Voltage.
- Current.
- Charge.
- Energy stored.

