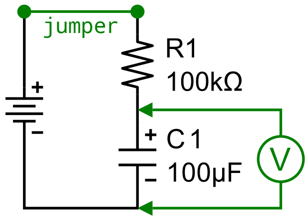
English Name: ____________________

Activity: Capacitor Voltage and Current

For this activity, we will be discussing and experimenting with the voltage across a capacitor and current flow into (and out of) a capacitor.



Required Components

Power Supply: 5V
Resistor: 100kΩ
Capacitor: 100µF
Voltmeter
A stopwatch, or other timer with resolution to one second (or better).

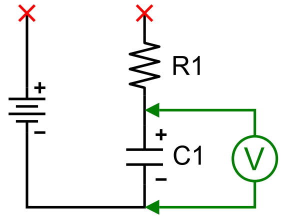
Safety Precautions

1. Electrolytic capacitors have a polarity. Always ensure the negative lead of the capacitor is connected to a lower voltage than the positive lead.
2. In the step where you discharge the capacitor, ensure the power supply is disconnected from either the positive or negative side of the circuit (or both).

Procedure 1: Charging the Capacitor

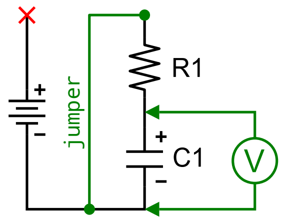
1. Assemble the circuitry shown in the figure above right. Later in the discharge procedure, you will need to disconnect the connection labeled “jumper”, and connect it elsewhere, so it is suggested you don’t use a short wire for this connection.
2. Prepare to measure and record the voltage across the capacitor ***every five seconds for at least 90 seconds*** after the circuit is turned on, and record each measurement in the appropriate space in the table on the next page. The initial voltage at time zero is expected to be zero volts. Decide which team member will:
   - watch the timer and call out the five second intervals
   - read the measurement on the volt meter
   - record the voltage measurements in the table.
3. Turn on the power supply and record the measurements in the table.

Procedure 2: Open-Circuit Voltage

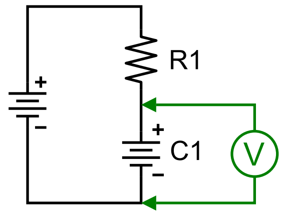


1. While the capacitor is still charged from completion of Procedure 1, disconnect the jumper, as shown in the diagram to the right, and observe the voltage across the capacitor. (Do NOT simply turn off the power supply, the power supply must be disconnected!)
2. In the space on the worksheet, describe how the voltage changes when the capacitor is in an open circuit.

Procedure 3: Discharging the Capacitor



1. Reconnect the power supply as in the first diagram at the top of the page to again charge the capacitor to within about 10% of the supply voltage.
2. For this procedure, you will measure the voltage across the capacitor ***every five seconds for at least 90 seconds*** while the capacitor discharges. Again, assign the same tasks, as you did in Procedure 1, to team members.
3. Disconnect the jumper from the power supply and connect it to the negative lead of the capacitor, as shown in the diagram to the right of the text for this procedure. As soon as this connection is made, start the counter and record the starting voltage in the table for time zero.
4. Continue recording the measured voltage across the capacitor until recordings are complete.



Analysis

1. Plot the points from your table to produce graphs for:
   - Capacitor Voltage Versus Time (Charging)
   - Circuit Current Versus Time (Charging)
   - Capacitor Voltage Versus Time (Discharging)
   - Circuit Current Versus Time (Discharging)
2. As shown in the diagram (above right), the capacitor acts similarly to a small battery. Study the graphs you made while reading and considering the following:

   When discharged, the capacitor is like a battery with no charge at all. When a voltage is applied to the capacitor, it charges – quickly at first, then slowly as the voltage difference between the supply and the capacitor becomes smaller. Note the shape of the charging curve.

   When the capacitor is open-circuit, it holds the charge, but loses it slowly. The rate at which is loses charge is much faster than a battery; however, a large capacitor may hold a charge for hours. This makes circuits that contain large capacitors (such as AC to DC converters) dangerous, even when the power is turned off.

   When a capacitor is charged and connected to a circuit that draws power, the capacitor will discharge quickly at first, and more slowly as the charge and voltage of the capacitor becomes low. Note the shape of the discharging curve.