RC Kinetics Activity

Purpose

Observe the voltage changes from charging and discharging capacitors through resistors.

Relate the characteristics of charging and discharging kinetics to capacitance and resistance.

Introduction

Capacitors store opposite charges on their plates, maintaining a voltage between the plates. Conductors allow current to flow in response to a voltage. Resistors are conductors that restrict the flow of charge: their tendency to inhibit the transfer of charge is their resistance.

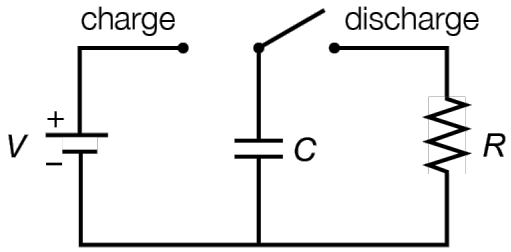
How does a capacitor push current across a resistor? How does a resistor influence the build-up or depletion of charge on a capacitor?

Materials

Capacitors, resistors, breadboard, voltage source, single-pole single-throw switch, single-pole double-throw switch, wires, voltmeter, timer, or Logger Pro with voltage sensor

Discharging capacitors

1. Set up the circuit illustrated to the right. This circuit makes it easy to bring the capacitor up to charge, to isolate the capacitor by opening the switch, and to discharge the capacitor by completing the circuit including the resistor. If the capacitor is poled, make sure to match its terminals to the correct terminals of the voltage source.

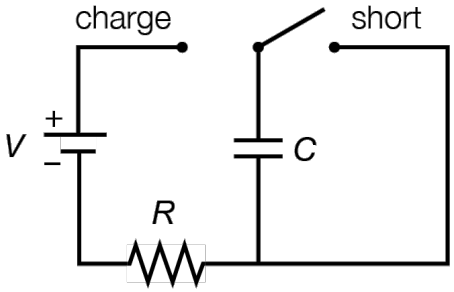


2. Charge the capacitor.
3. Open the switch. Measure the voltage across the capacitor. Check if it drifts or self-discharges.
4. Close the switch to discharge the capacitor through the resistor and simultaneously start the timer. Observe the capacitor's voltage change.
5. Experiment with different combinations of capacitors and resistors to find systems whose voltage changes fast enough to notice but gradually enough to measure.
6. Record measurements of voltage at regular time intervals.

Questions

1. How does voltage change with time? Does it appear to follow a recognizable mathematical function?
2. How do capacitance and resistance affect the rate of voltage change?
3. Should you measure the voltage across the capacitor, or across the resistor? Is there a difference?

Charging Capacitors



1. Set up the circuit illustrated to the right. This circuit makes it easy to discharge (neutralize) the capacitor before taking measurements. If the capacitor is poled, make sure to match its terminals to the correct terminals of the voltage source.
2. Short the capacitor.
3. Connect the voltmeter to measure the voltage across the capacitor or across the resistor.
4. Flip the switch to connect the capacitor to the voltage source and resistor and simultaneously start the timer. Observe the voltage change across the resistor or capacitor. Or both, if you have two voltmeters.
5. Experiment with different combinations of capacitors and resistors to find systems whose voltage changes fast enough to notice but gradually enough to measure.
6. Record measurements of voltage at regular time intervals.

Questions

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2. How do capacitance and resistance affect the rate of voltage change?
3. Should you measure the voltage across the capacitor, or across the resistor? Is there a difference?