



Discharging a capacitor

Teacher Notes

PHYSICS
Electric fields

Driving Question:

How do capacitance and resistance values determine the time of discharging?

Applied Technology: Data-logging

Student Level: High School Level (14-18)

Duration: 1 lesson period

Recommended Settings: Student Investigations

Learning Objectives

- To measure the potential across a capacitor during the discharging of the capacitor
- To find an experimental time constant of the circuit
- To compare the experimental constant with the theoretical value predicted from R and C values
- To investigate how capacitance and resistance values influence the time of charging

Didactical Approach

In this activity students use the voltage sensor to measure the potential across a capacitor as the capacitor discharges. They determine the time constant of the circuit. They investigate the effect of changing the capacitance of the capacitor and changing the resistance of the resistor on the time of discharging.

Concepts learnt in this activity:

- Potential across a capacitor, charging and discharging of a capacitor, capacitance, time constant of the circuit.

Materials

- Data-logger e.g. VinciLab or CoachLab II⁺,
- Voltage sensor or 4-mm leads (when working with CoachLab II⁺),
- Capacitors (e.g. 10 μF , 100 μF and 1000 μF),
- Resistors (e.g. 10 $\text{k}\Omega$, 22 $\text{k}\Omega$, 33 $\text{k}\Omega$),
- External 5 V DC power supply.

Procedure

- Help students to set up the electrical circuit.
- Connect the voltage sensor to input 1 of your interface or connect 4-mm wires directly

to a 4-mm input of CoachLab II+

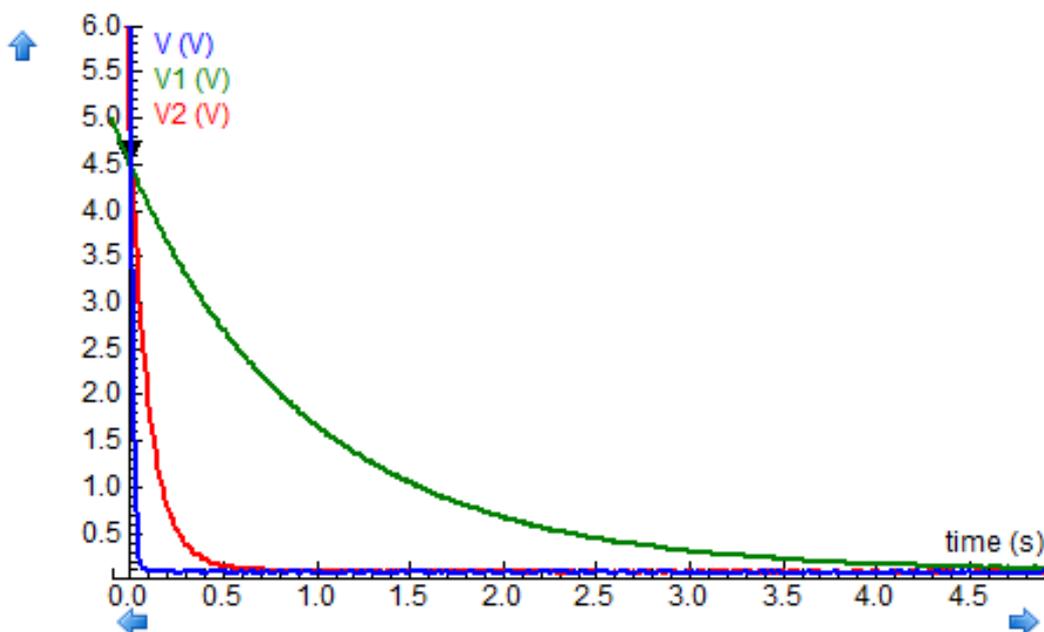
- Open Coach Activity 'Discharging a capacitor'.
- Make students aware that the measurement uses triggering. Discuss the trigger conditions.
- In the first part of experiment the students record the potential difference across the capacitor during its discharging. Discuss the resulting graph.
- The second part of the experiment compares the discharging graphs for a range of values of C and R. Before the experiment, ask your students how the graphs will be affected when the value of R increases (C remains constant) and when the value of C increases (R remains constant).

Questions and Assignments

- How the discharging capacitor through a resistor affects the voltage in the circuit?
- What is the experimental value of the RC-time of the circuit?
- What is the theoretical value the RC-time of circuit?
- Is your experimental value close to the theoretical value?
- Note that resistors and capacitors are marked with approximate values with a tolerance. How can this influence your data?
- What is the effect of changing the capacitance of the capacitor on the discharging time?
- What is the effect of changing the resistance?

Data Analysis

The diagram below shows typical data recorded during the discharging of a capacitor.



R= 1k Ω , Green graph: C = 1000 μ F, Red graph C= 100 μ F, Blue graph C = 10 μ F.

Decreasing the value of capacitance causes the capacitor to discharge quicker.
Decreasing the value of resistance causes the capacitor to discharge quicker.

Resources

Coach Activity: Discharging a capacitor.cma7

Coach Activity: Discharging a capacitor (with CoachLab II+).cma7

Coach Result: Discharging a capacitor.cmr7

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