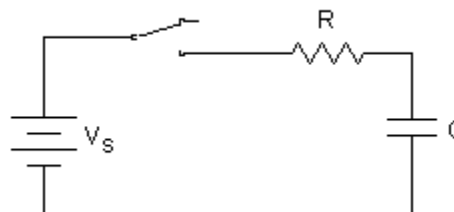


AP PHYSICS II
Lab 7: RC Circuits

Purpose

The purpose of this lab is to observe the behavior of electric potential change across a capacitor during its charging and discharging phases.



Setup Procedure

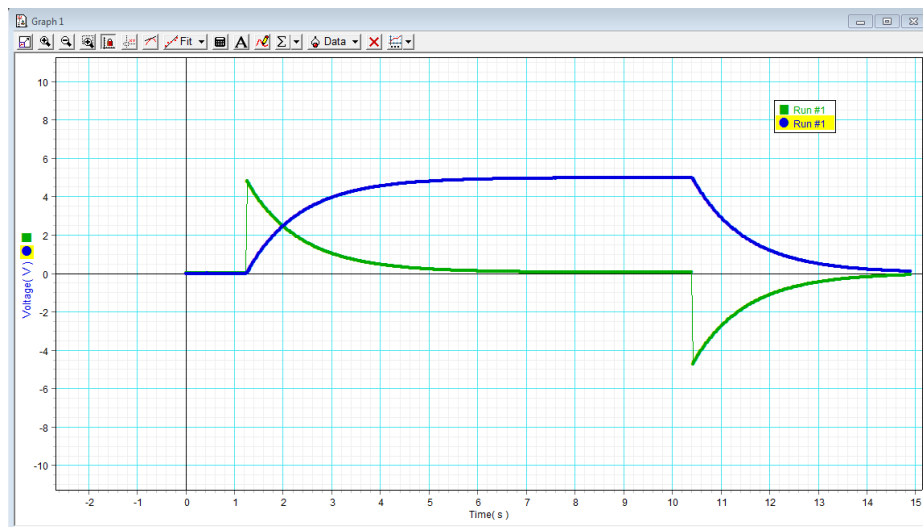
1. Open DataStudio.
2. Activate “Voltage Sensors” on channel A and channel B.
3. Activate the power output and set it to “5V DC”
 - a. Select the “auto function” to where you can control when to turn the voltage source on and off.
4. Find some circuit combination which yields a capacitance of $50,000 \mu F$ in series with a 20Ω resistance (each resistor is 10Ω).
5. Place 1 voltage probe across the resistor setup. This will read the potential difference across R as a function of time.
6. Place 1 voltage probe across the capacitor setup. This will read the potential difference across C as a function of time.
 - a. Increase the sampling rate of each sensor to 250 Hz
7. You are ready to start!

Data

1. What is the RC time constant (resistance x capacitance)? $\tau = RC = \underline{\quad 1 \quad}$.
2. Press the “Start” button to begin recording data. After a small amount of time has passed, turn the voltage supply on by clicking “On.”
3. Once the capacitor has been fully charged, turn off the supply by clicking “Off” and observe the potentials during the discharging phase.
4. In the space below, paste a screenshot the 2 graphs of Potential Difference vs. Time for the capacitor setup and resistor setup.

Capacitor V vs. t (blue)

(green) Resistor V vs. t

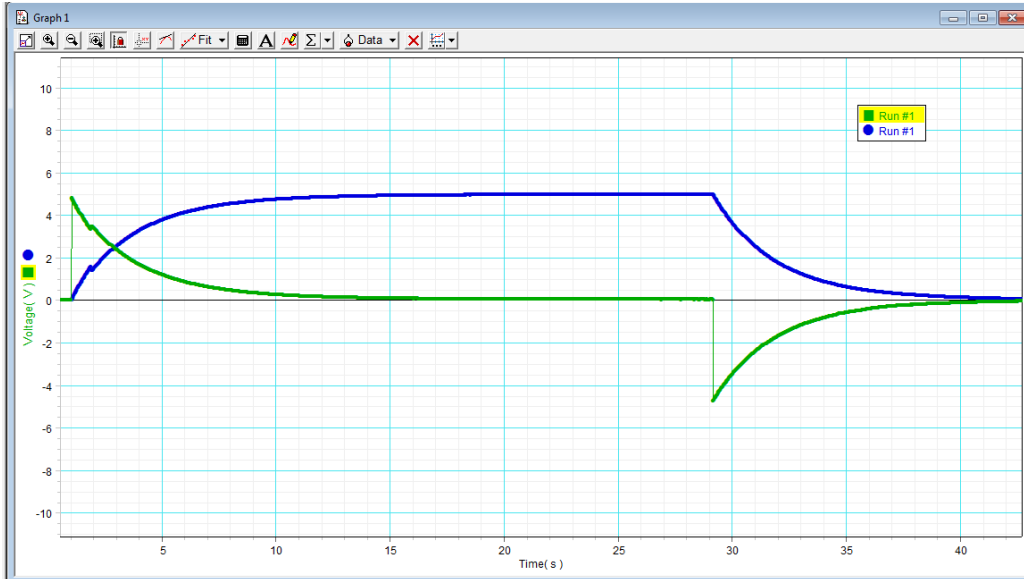


5. Repeat the experiment with a capacitance of $75,000 \mu F$ and paste your resulting graphs.

6. What is the new RC time constant? $\tau = RC = \underline{\underline{1.5}}$

Capacitor V vs. t (Blue)

Green is
Resistor V
vs. t



7. What kind of relationship exists between potential difference and time during this charging phase for the resistor setup? For the capacitor setup?

For the capacitor, the relationship is direct, in the charging phase and inverse in the discharging phase. The resistor voltage is opposite, being inverse during the charging phase and direct during the discharging phase.

8. Taking a look at your data, how much time does it take for your capacitor to fully charge? How does this number compare to your RC time constant, τ ?

However, it would reach practically maximum capacity after 5 time constant intervals.

9. Taking a look at the potential differences across the resistors and the capacitors, if the potential difference across the capacitor, ΔV_C , and the potential difference across the resistors ΔV_R , what would be the resultant of $\Delta V_R + \Delta V_C$ be at $t = \tau$? At $t = 2\tau$?

It will always sum up to 5 volts, independent of the time elapsed. This is because the potential difference between the positive and ground of the power source is 5 volts, and voltage adds linearly in series.