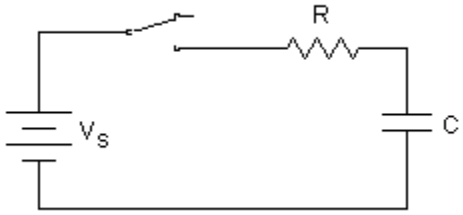
Name: David Gutierrez | Group Members:

AP PHYSICS II

*Lab 7: RC Circuits*

**Purpose**

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



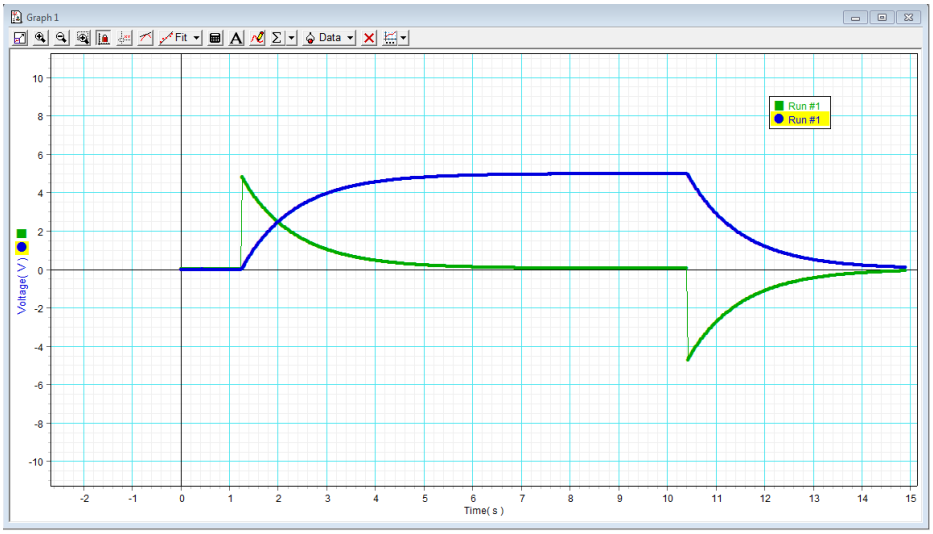

**Setup Procedure**

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 $20\ \Omega$ resistance (each resistor is $10\Omega$).
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)? $\tau = RC =$ __1_____.
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 Different vs. Time for the capacitor setup and resistor setup.

Capacitor *V* vs. *t (blue)* (green) Resistor *V* vs. *t*

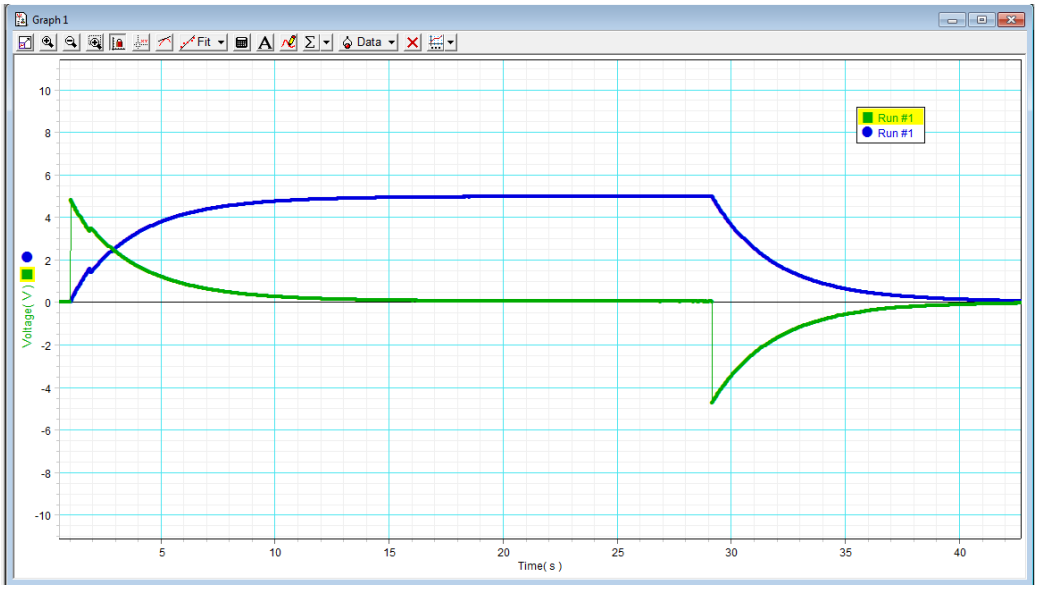



5. Repeat the experiment with a capacitance of $75{,}000\ \mu F$ and paste your resulting graphs.

6. What is the new RC time constant? $\tau = RC =$ __1.5_____

Capacitor $V$ vs. $t$ (Blue)

Green is Resistor $V$ vs. $t$




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

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| The capacitor's voltage and time relationship during charging is direct and exponential, but the discharging phase has an inverse relationship. The resistor's relationships are opposite |

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, $\tau$?

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| It reaches near maximum capacity after 15 seconds or 10 time constant intervals. |

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

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| It will always sum up to 5 volts. This is because the voltage between the positive and ground of the power source is 5 volts. |