

# 4

## RC-CIR Worksheet

Trevor Nichols, Lauren Lee, Shravani  
PHYS 122-119B  
Station 31  
Lab 4: RC-CIR (RC Circuits)  
2024-10-23T23:21:13-04:00

Department of Physics,  
Case Western Reserve University,  
Cleveland, Ohio,  
44106-7079

### 1

(Section E.2.) The nominal values of the resistance and capacitance are  $10\text{ k}\Omega$  and  $47\text{ }\mu\text{F}$ , respectively. What are your measured values?

✓ Answer ✓

$$R = 10.3 \pm 1\% \text{ k}\Omega$$

$$C = 43.5 \pm 2\% \text{ }\mu\text{F}$$

### 2

(Section E.2.) What is the value of the time constant based on the measured values and nominal (labeled) values?

✓ Answer

$$\tau_{\text{measured}} = 0.43 \text{ s}$$

$$\tau_{\text{labeled}} = 0.45 \pm 0.01 \text{ s}$$

### 3

(Section E.7.) What is the maximum amount of charge stored on the capacitor during charging?

Note that you have taken two pairs of data sets, two while charging the capacitor and two while discharging it. From those graphs, read off the voltage across the resistor and the voltage across the capacitor at the end of each run.

✓ **Answer**

$$Q = 60 \pm 1 \mu C$$

Charging

$$V_R = -1.411 \pm 0.001 V$$

$$V_C = 1.376 \pm 0.001 V$$

Discharging

$$V_R = 1.450 \pm 0.001 V$$

$$V_C = -1.445 \pm 0.001 V$$

## 4

(Section E.7.) What should the two pairs of voltages add up to? Do they? Why or why not?

✓ **Answer**

They should add up to zero because as they charge or discharge, the state should be cyclical and the voltage should return to its original state.

## 5

(Section G) What are the five values of the time constant?

Compare these five values of the time constant to each other and discuss whether or not they are in agreement, within estimated errors.

✓ **Answer**

$$\tau_{measured} = 0.45 \pm 0.01 s$$

$$\tau_{charging_C} = 0.474 \pm 0.0007 s$$

$$\tau_{discharging_C} = 0.4752 \pm 0.0006 s$$

$$\tau_{charging_R} = 0.4711 \pm 0.0007 s$$

$$\tau_{discharging_R} = 0.4722 \pm 0.0007 s$$

$$\tau_{mean} = 0.473 \pm 0.001 s$$

I think yes, it does correspond with each other as they are easily within two STD of each other.

## 6

(Section G) Does the residual plot indicate you had a good fit or a bad fit? Explain.

### ✓ Answer

Yes, it indicates we have an absolutely amazing fit, as the errors are statistically insignificant. Our  $r^2$  was also very high, with over 3 sigfigs of correlation at 0.99981.

## 7

(Section H) What are your measured values of the resistance and capacitance of the two capacitors?

### ✓ Answer

$$R = 10.3 \pm 1\% \text{ k}\Omega$$

$$C_1 = 43.5 \pm 2\% \text{ }\mu F$$

$$C_2 = 43.0 \pm 2\% \text{ }\mu F$$

## 8

(Section H) What is your calculated time constant for parallel capacitors? For series capacitors?

### ✓ Answer

$$\tau_{calc_{parallel}} = 0.89 \pm 0.02 \text{ s}$$

$$\tau_{calc_{series}} = 0.2 \pm 0.3 \text{ s}$$

## 9

(Section H) What is the time constant from the fit for parallel capacitors? For series capacitors?

### ✓ Answer

$$\tau_{fit_{parallel}} = 0.9083 \pm 0.0007 \text{ s}$$

$$\tau_{fit_{series}} = 0.2265 \pm 0.0007 \text{ s}$$

## 10

(Section I) What are your measured values of the resistance and capacitance? What is the theoretical time constant?

✓ Answer

$$R = 0.97 \pm 1\% \text{ k}\Omega$$

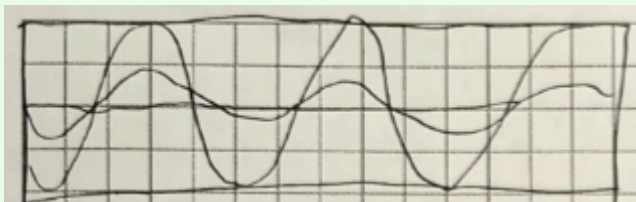
$$C = 0.446 \pm 2\% \text{ }\mu\text{F}$$

$$\tau = 0.43 \pm 0.01 \text{ ms}$$

## 11

(Section I-analog differentiator) Sketch the waveforms you see for the sine wave and its derivative.

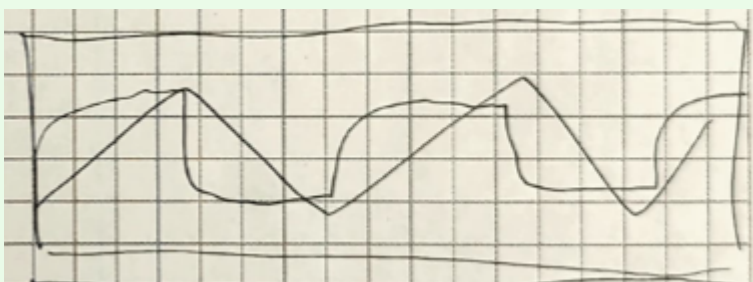
✓ Answer



## 12

(Section I-analog differentiator) Sketch the waveforms you see for the triangle wave and its derivative.

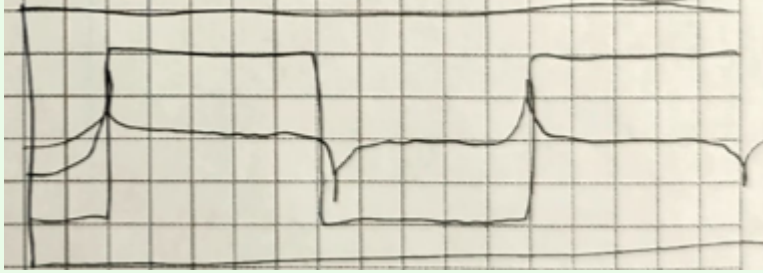
✓ Answer



## 13

(Section I-analog differentiator) Sketch the waveforms you see for the square wave and its derivative.

✓ Answer

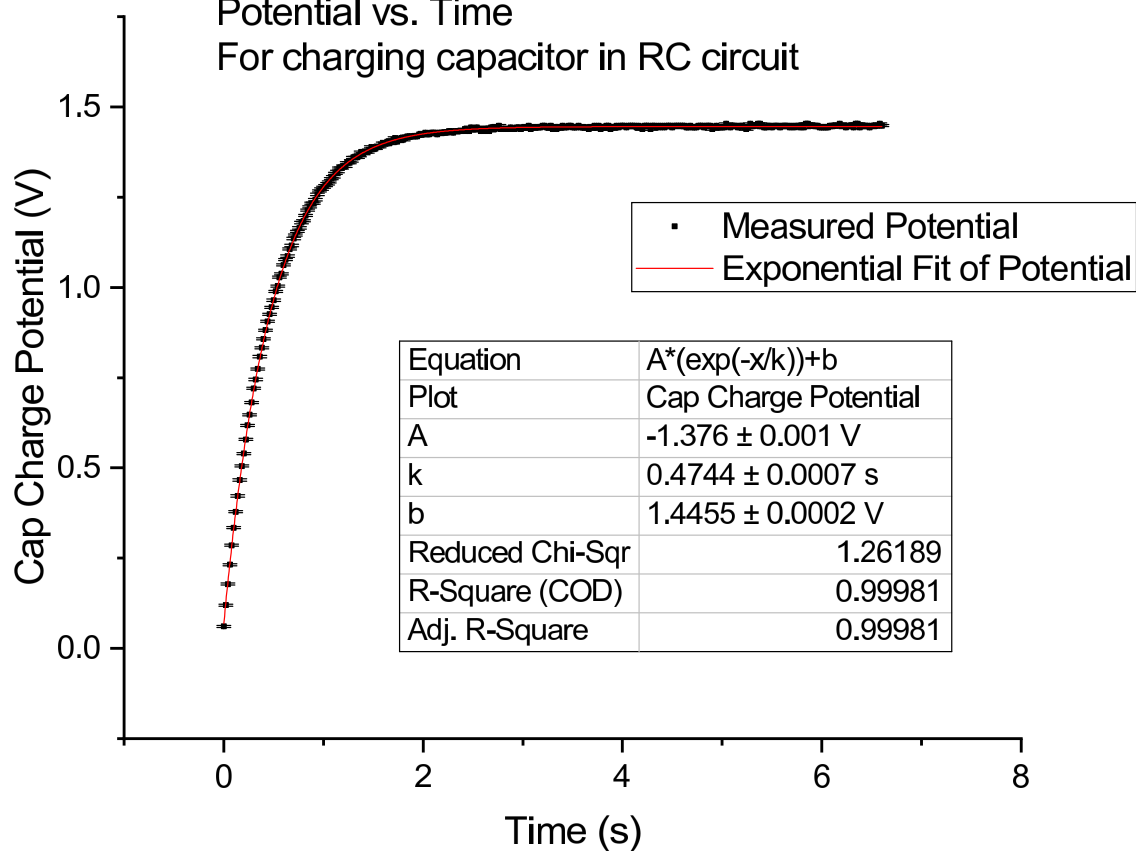


## Graphs

Trevor, Lauren, Shravani

Potential vs. Time

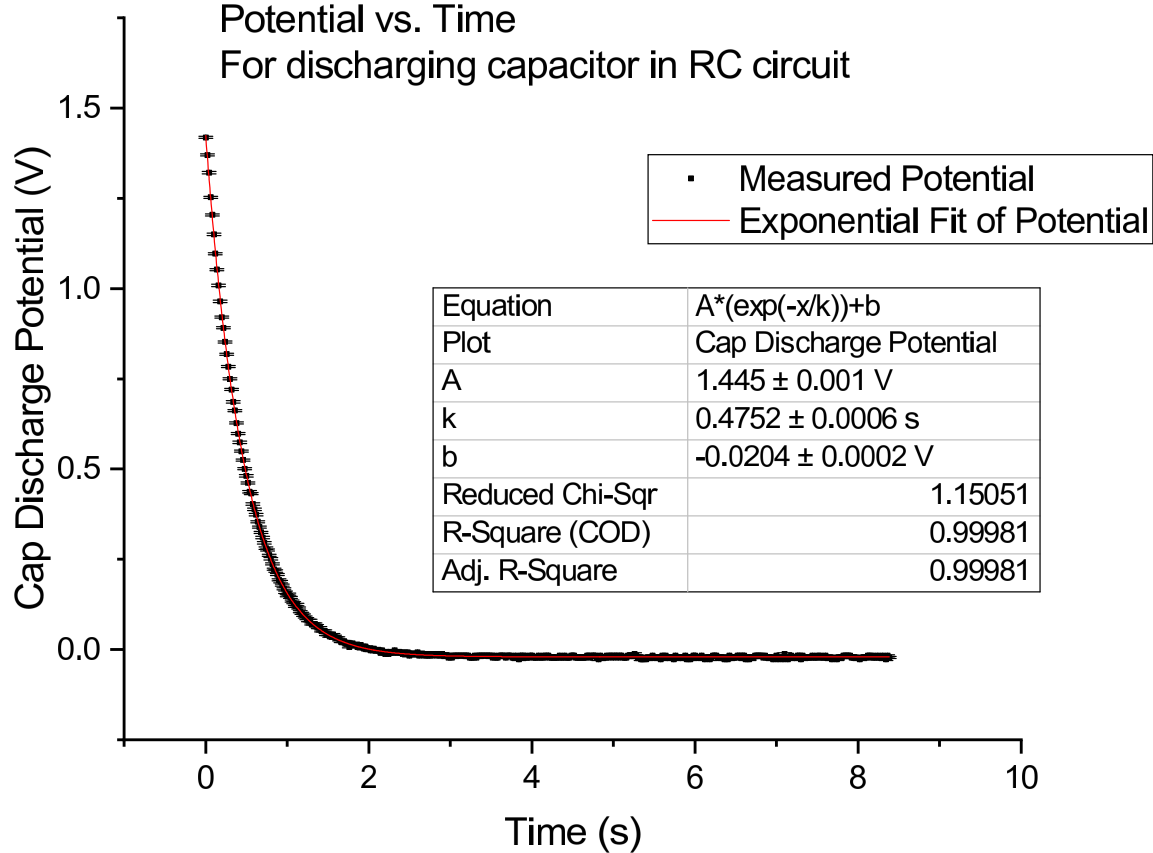
For charging capacitor in RC circuit



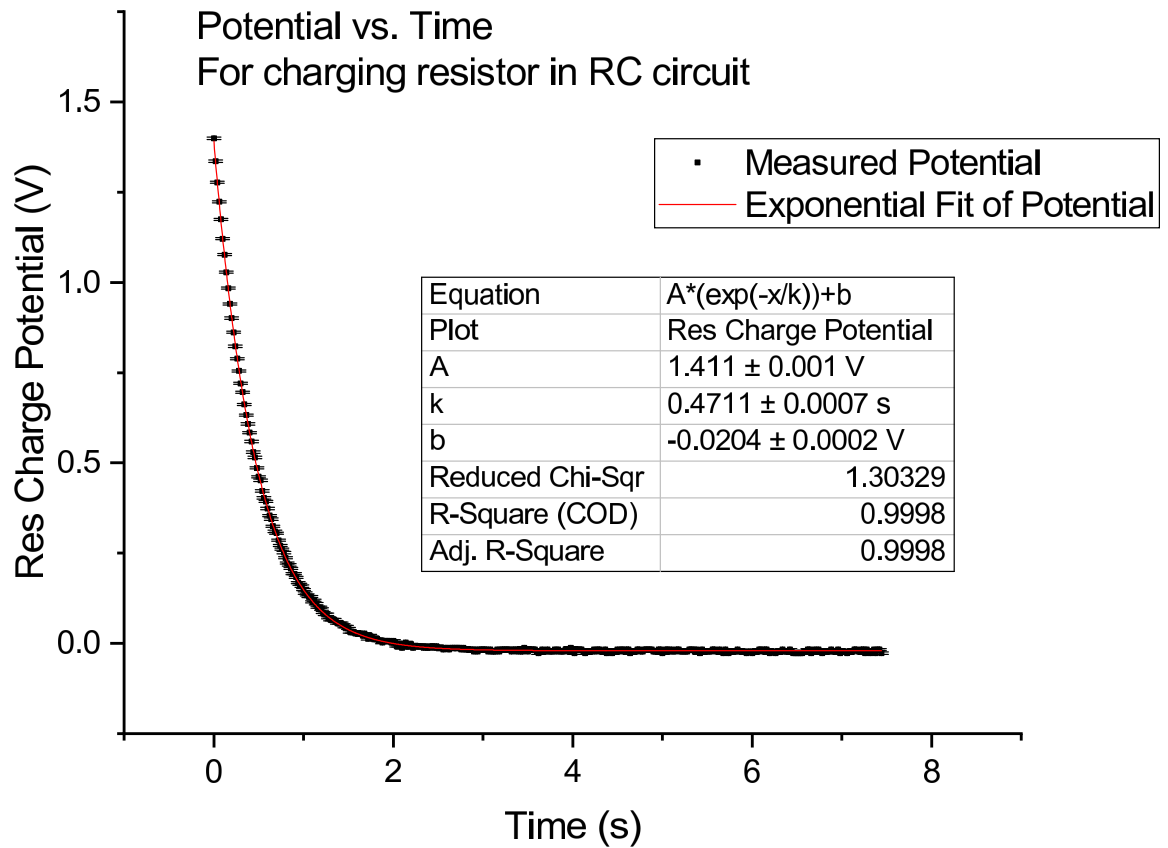
Trevor, Lauren, Shravani

Potential vs. Time

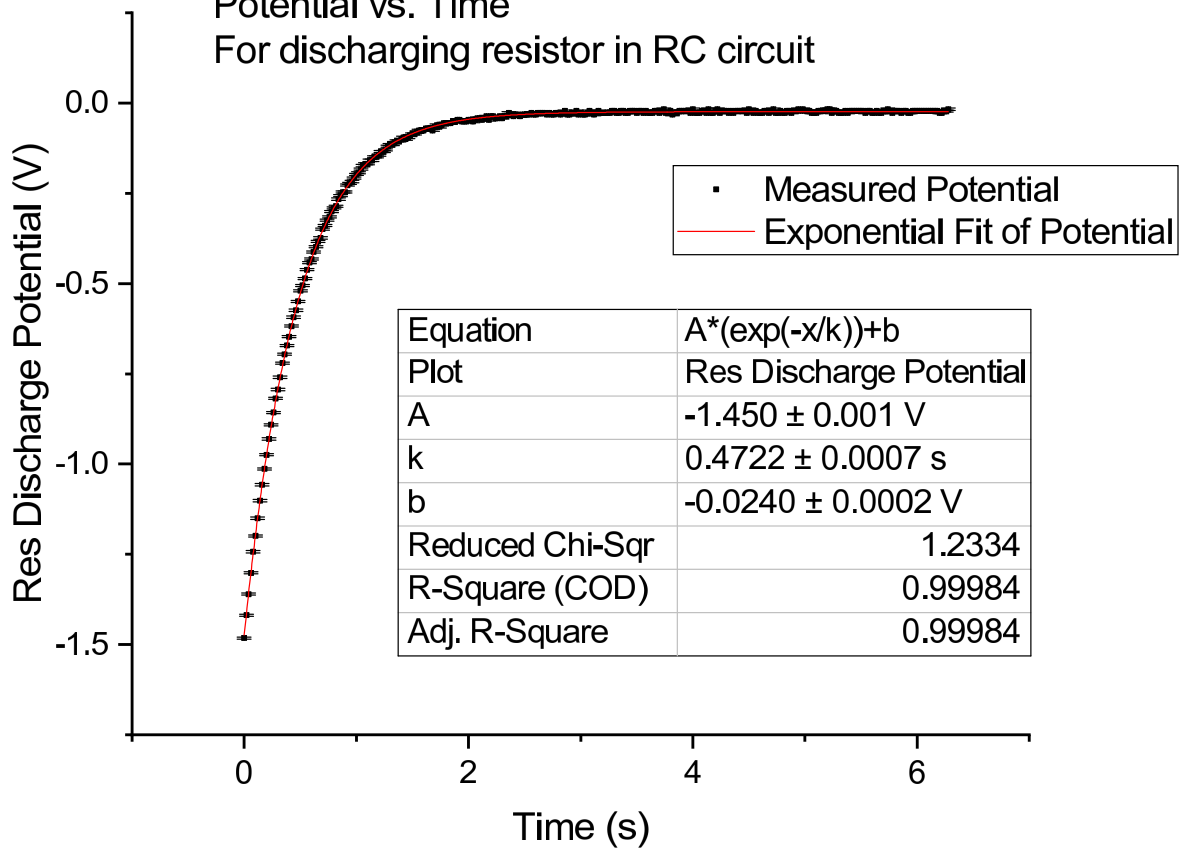
For discharging capacitor in RC circuit

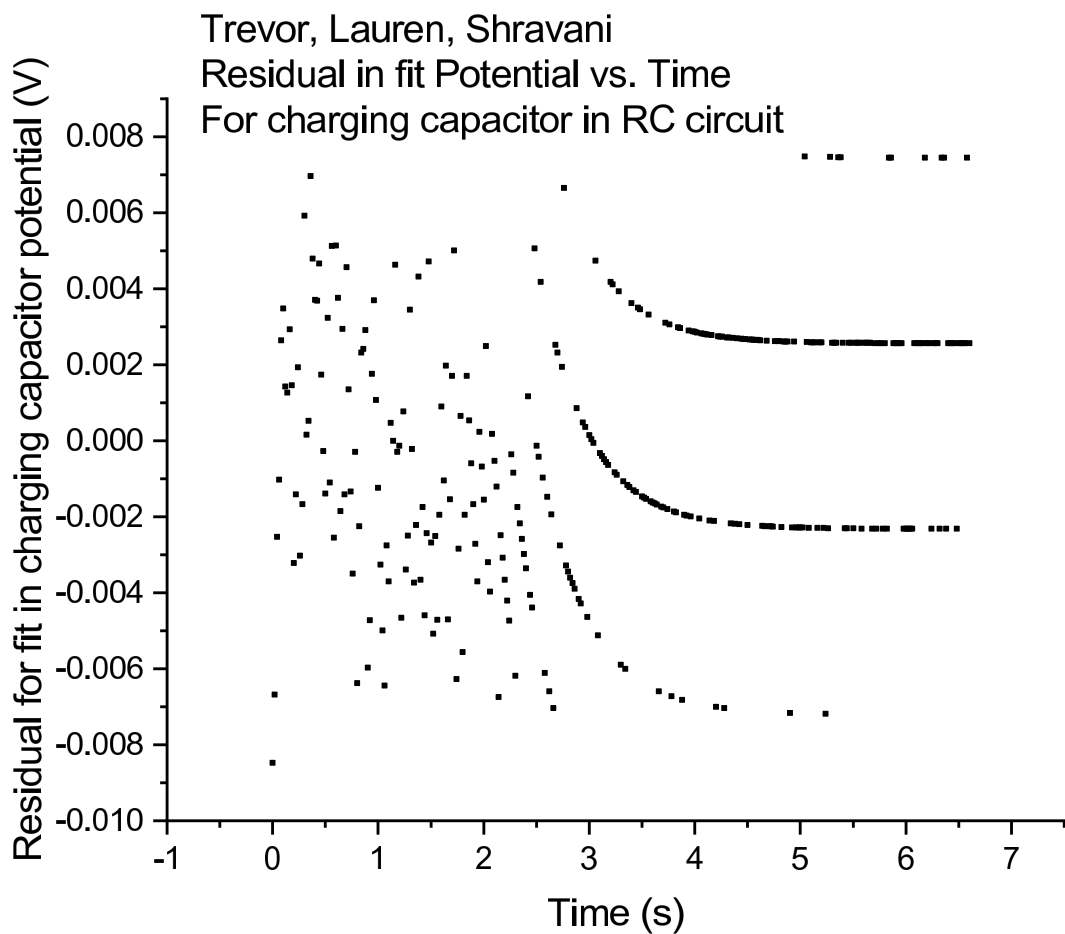
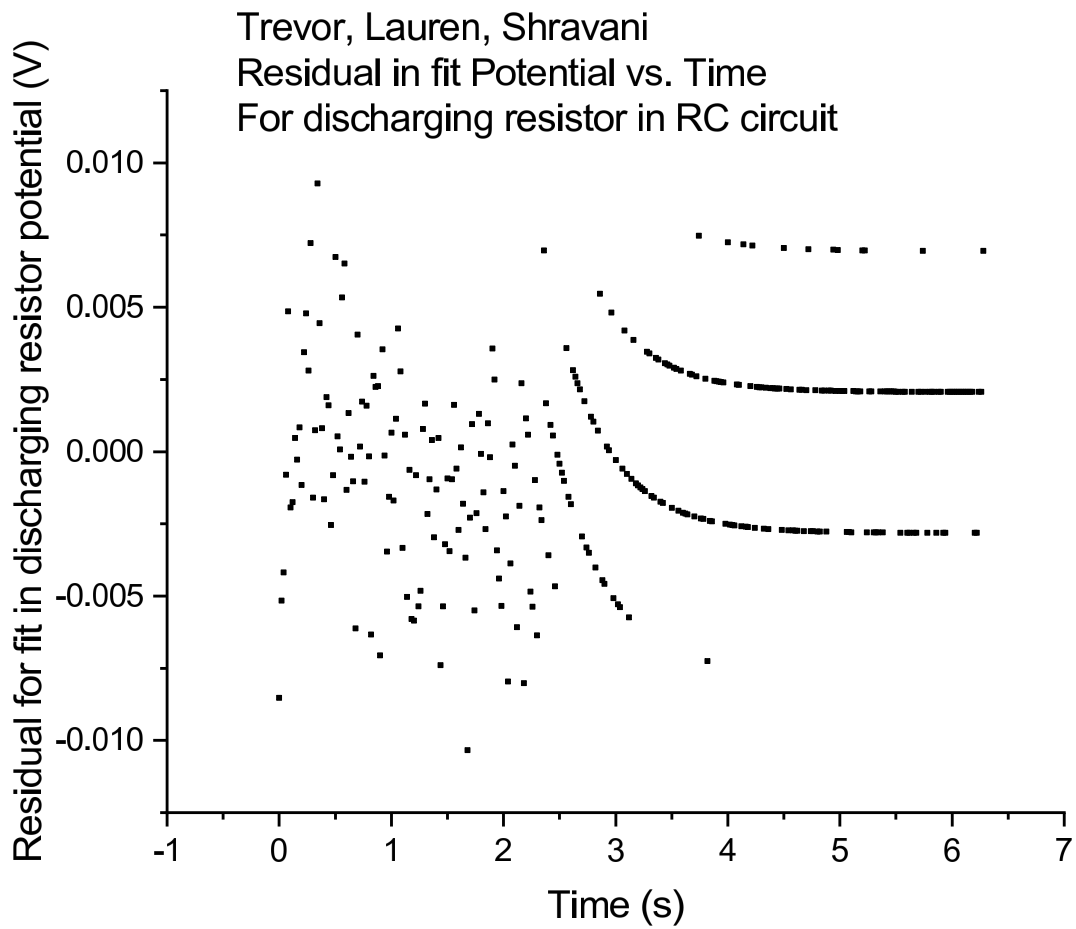


Trevor, Lauren, Shravani  
 Potential vs. Time  
 For charging resistor in RC circuit

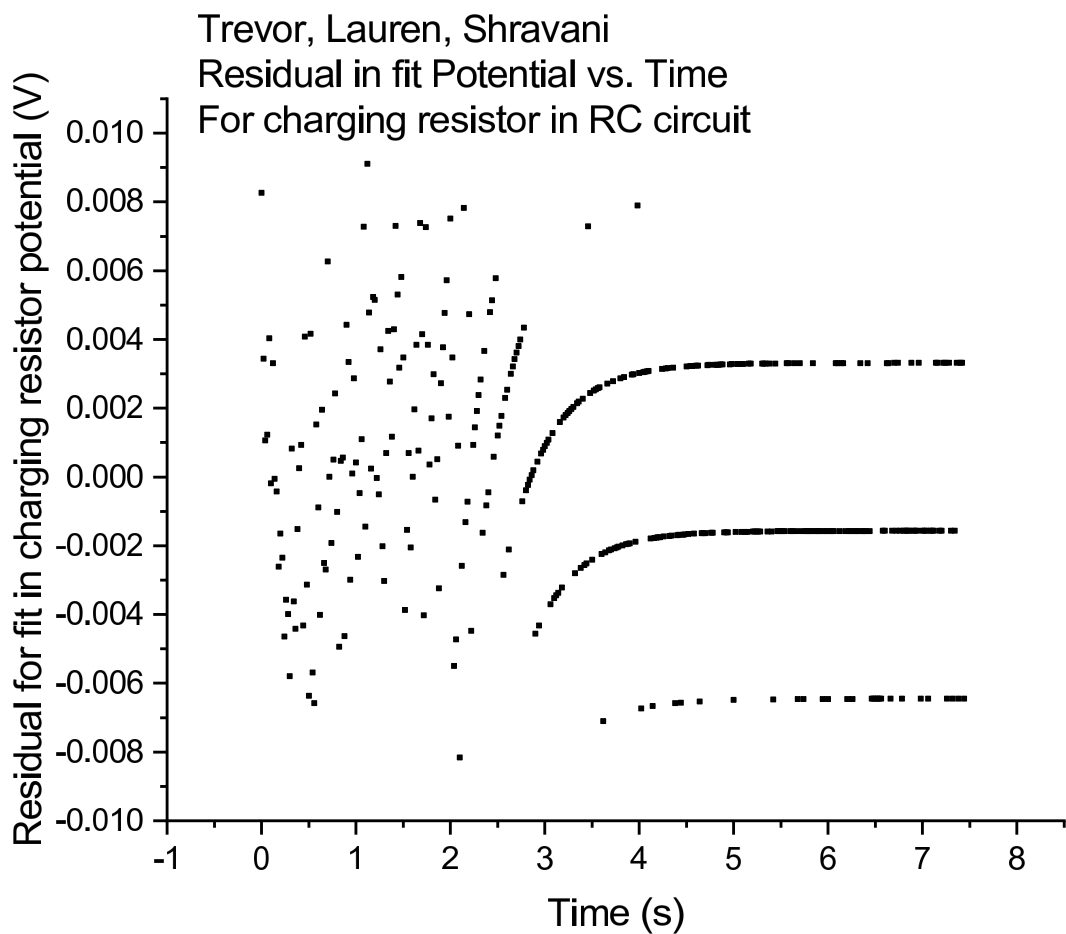
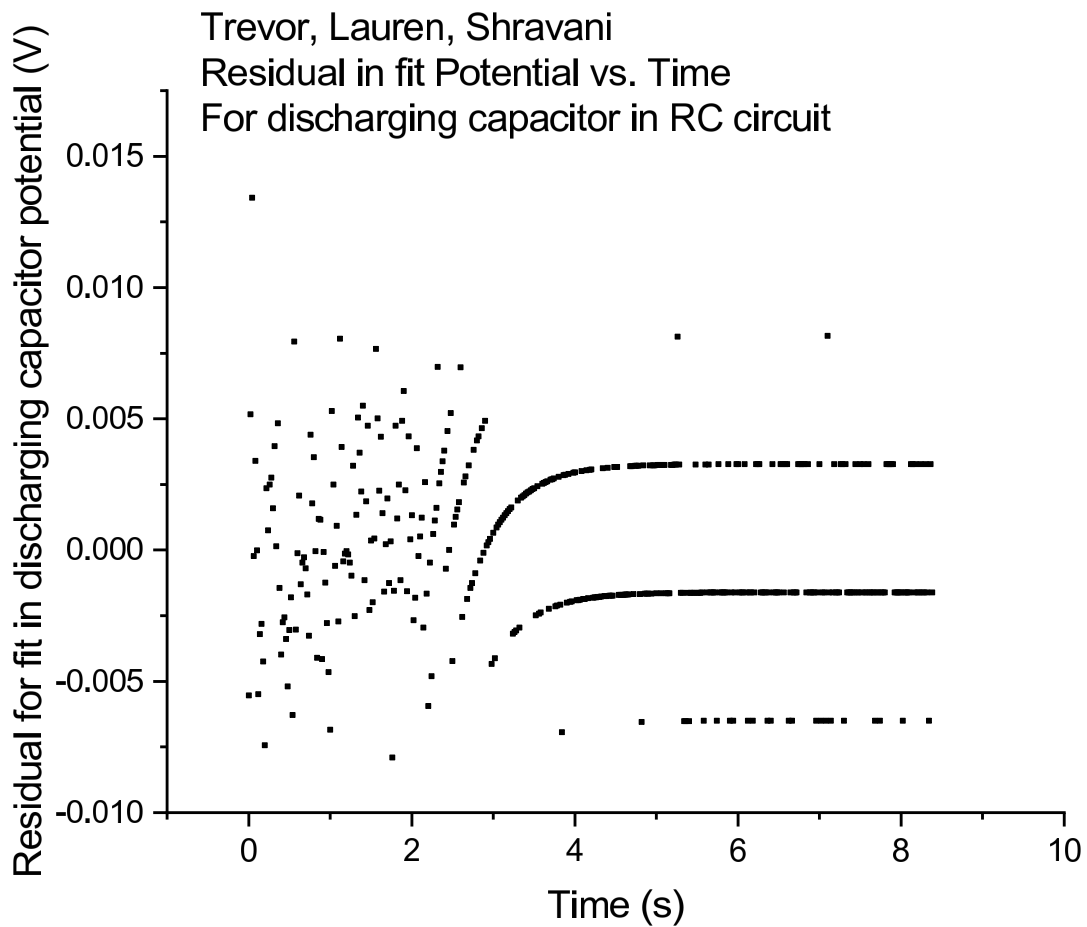


Trevor, Lauren, Shravani  
 Potential vs. Time  
 For discharging resistor in RC circuit









Trevor, Lauren, Shravani

Log-Log Graph of Vpp vs. Frequency

For low-pass filter sine wave in RC circuit

