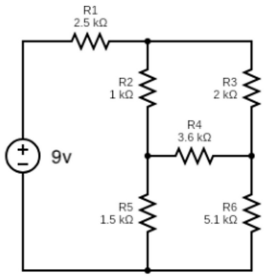
Lab Final Project

Thursday, November 19, 2020 9:57 AM

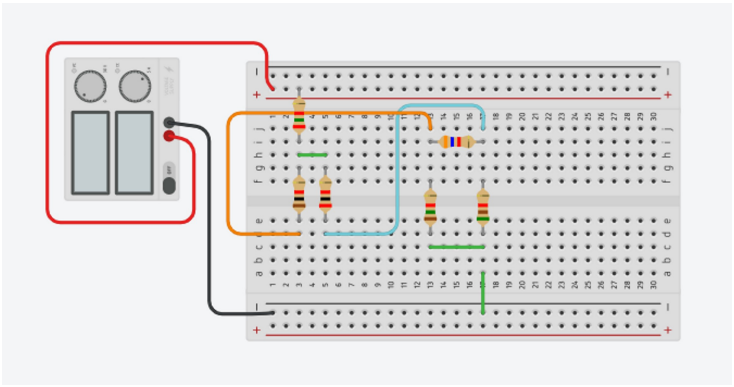
"I pledge my honor I have abided by the Stevens Honor system."

-Alex Gaskins

Problem One: Kirchoff's Law Circuit. Consider the circuit shown below and answer following questions.



a) Build the circuit on TinkerCad and show the figure for your circuit. **(1 points)**



b) Assume that the current though resistor R_n is I_n $(n = 1,\ldots,6)$, measure following currents by using the "multimeter" on Tinkercad. **(1 points)**

I_1: 2.07 mA.

I_2: 1.48 mA.

I_3: .595 mA.

I_4: (-.051) mA.

I_5: 1.56 mA.

I_6: .515 mA.

c) Assume that the voltage on resistor R_n is V_n $(n = 1,\ldots,6)$, measure following voltage by using "multimeter" on Tinkercad. **(1 points)**

V_1: 5.18 V.

V_2: 1.48 V.

V_3: 1.19 V.

V_4: .288 V.

V_5: 2.34 V.

V_6: 2.63 V.

d) Which of the following descriptions is correct by using KCL: **(1 points)**

i. I1 = I5 + I6 ✓

ii. I1 = I2 + I3 + I4 + I5 + I6 ✗

iii. I4 + I5 + I6 = 0 ✗

iv. I2 + I3 = I4 ✗

e) Which of the following descriptions is correct by using KVL: **(1 points)**

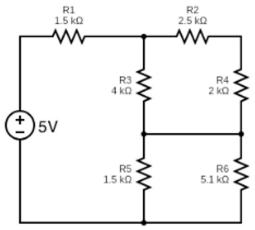
i. V1 = V2 + V3 ✗

ii. V4 + V5 – V6 = 0 ✓

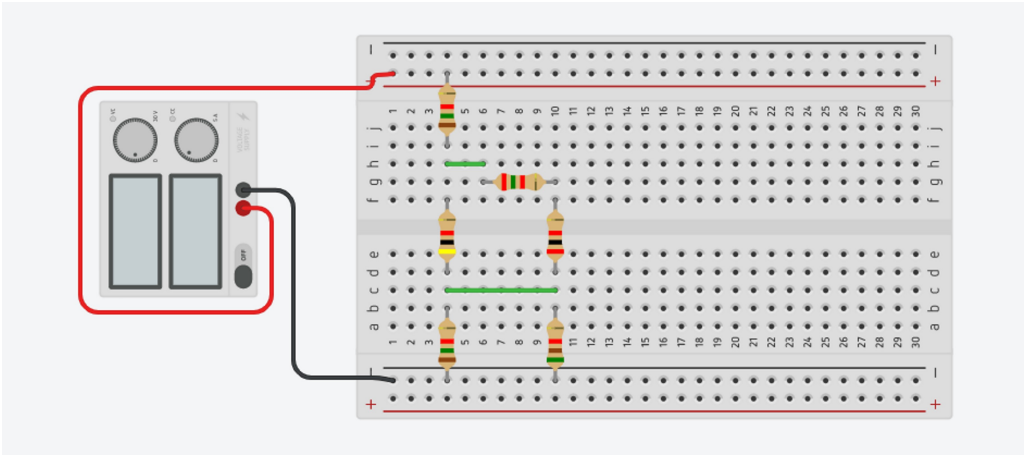
iii. V1 + V2 + V5 + V6= 9v ✗

iv. V1 = V3 + V6 ✗

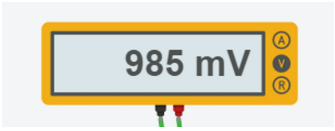
Problem Two: Thevenin Equivalent Circuits. Consider the circuit shown below and answer following questions.



a) Build the circuit on TinkerCad and show the figure for your circuit. **(1 points)**



b) What is the voltage of R4? **(1 points)**



V4 = .985 V.

c) We are going to find the Thevenin equivalent circuit for resistor R4. Please do following measurement. **(1 points)**

The open circuit voltage, V_{oc}: 3.00 V.

The short circuit current, I_{sc}: .733 mA.

Calculate the Thevenin resistance $R_{th} = ?$

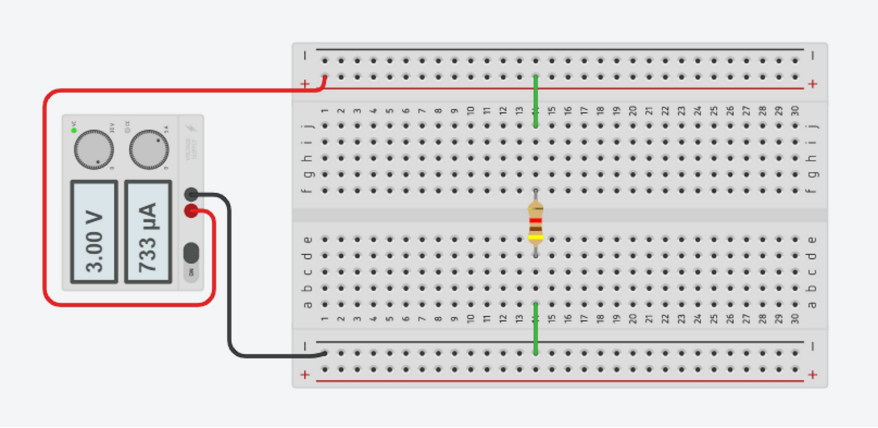
$$R_{th} = \frac{V_{oc}}{I_{sc}}$$

$$R_{th} = \frac{3}{(.733 \times 10^{-3})}$$

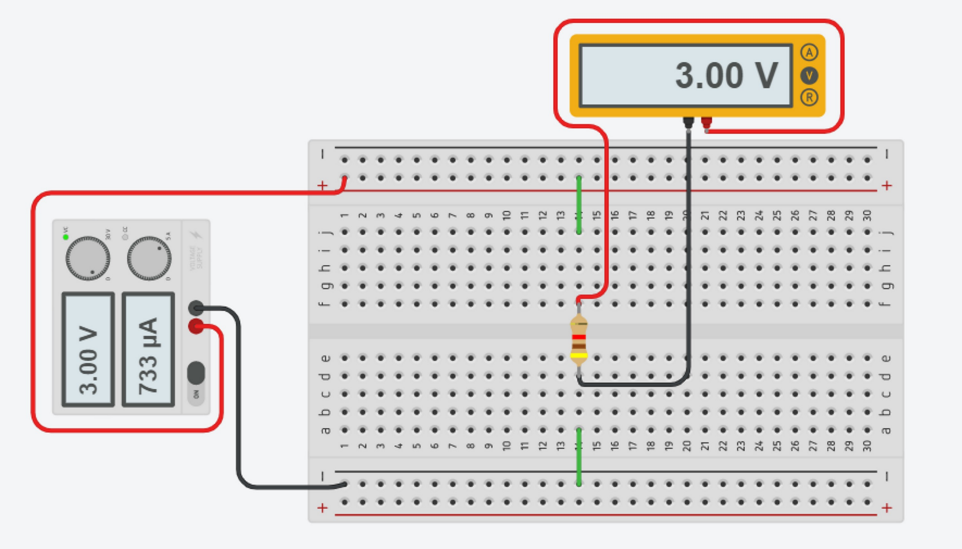
$$R_{th} = 4092.77\ \Omega.$$

$$\boxed{R_{th} \approx 4.093\ k\Omega.}$$

d) Build the circuit on TinkerCad for your Thevenin circuit. **(1 points)**

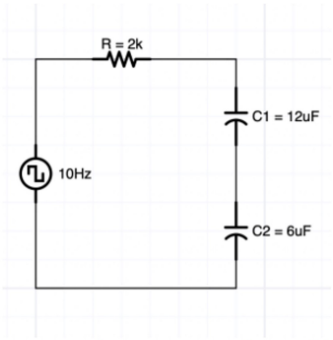


e) What is the voltage of R4 in the Thevenin circuit? **(1 points)**



3.00 V.

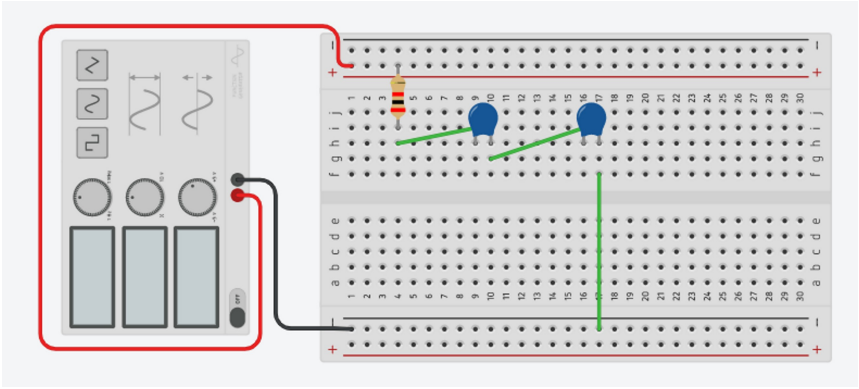
Problem Three: Exponential waveform. Consider a RC circuit shown below and answer following questions.



Set up the function generator as the square waveform with:
- Frequency: 10 Hz
- Amplitude: $V_{pp} = 10V$
- DC Offset: 0 V

The value for resistors and capacitors:
R1 = 2 KΩ, C1 = 12 µF, C2 = 6 µF

a) Build the circuit on TinkerCad and show the figure for your circuit. **(1 points)**



b) Measure the following values from the oscilloscope: **(3 points)**
   a. Maximum voltage = 5 V.
   b. Minimum voltage = -5 V.
   c. The time for capacitor gets fully discharged/charged: $5\tau =$ 40 ms.

c) Calculate the capacitance by using values from the last measurement (c = ?), please show the calculation steps: **(1 points)**

$\tau = RC$

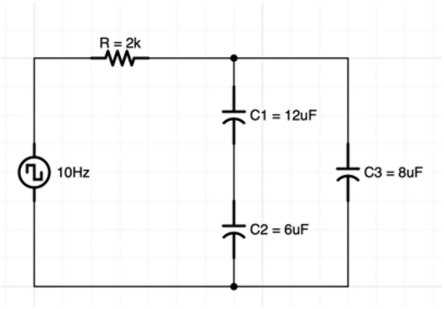
$\frac{.04}{5} = 2000C$

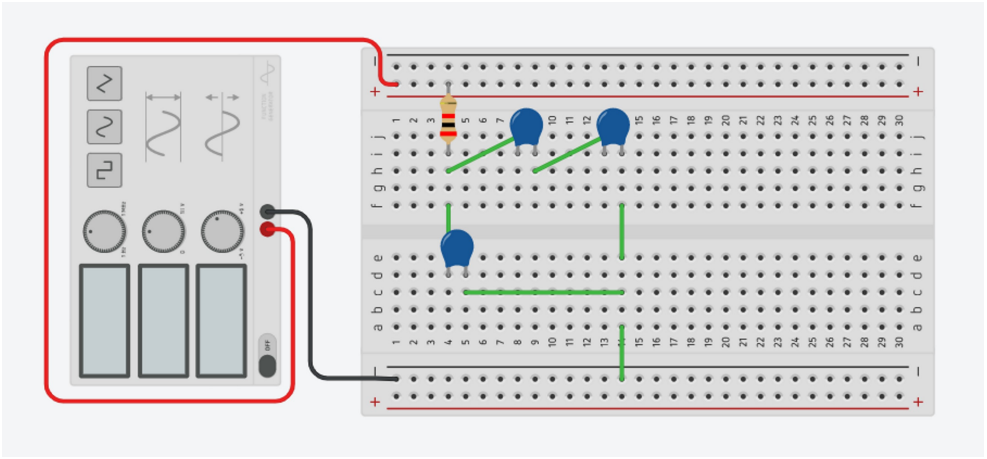
$C = 4\,\mu F$

$C_{eq} = \frac{12(6)}{18}$

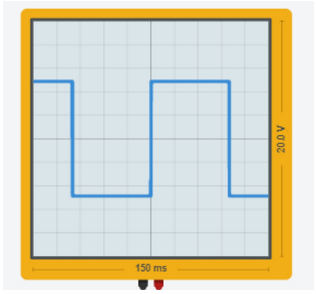
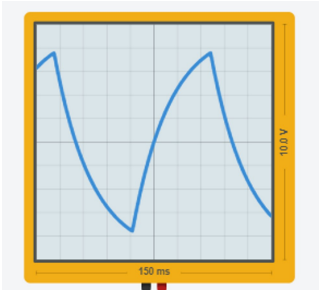
$C_{eq} = 4\,\mu F$

d) Now, parallel a new capacitor with $8\mu F$, show the new circuit on TinkerCad follow the given diagram: **(1 points)**





e) Show the waveform for function generator and the waveform for capacitors: **(2 points)**

waveform for function generator	waveform for capacitors
	

f) Describe the shape of the waveform for capacitors and explain or try to find the reason why the shape looks unusual. (Hint: the waveform for capacitors cannot reach the maximum voltage) **(2 points)**

The waveform represents the capacitor charging to V_C and discharging according to the input voltage. V_C approaches the maximum voltage asymptotically, but never reaches it, which is why it looks flatter as it charges closer to the maximum voltage.

as it charges closer to the maximum voltage.

5RC is used to estimate this flat area on the graph.

5τ

* In this case, the max voltage across each capacitor is smaller than the voltage source, as there are three different capacitors sharing the same input voltage (It's being split).

In brief, the capacitor is not a perfect storage. It peaks and then immediately discharges, and this cycle becomes continuous.