**PHYS 202L** RC circuit Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Introduction:** Watch this video <https://www.youtube.com/watch?v=OIpHPsnLlNU> and answer the questions that follow:

1. A 9-V battery, 18-Ω resistance, 6-μF capacitor, and an open switch are connected in series. The capacitor is not charged initially. Draw a circuit diagram for this RC circuit below.
2. Now the switch is connected,   
   a. What will be the (calculate) current in the circuit as soon as the switch is connected?

b. What will be the (calculate) charge in the capacitor after a long time?

c. Sketch the following curves as a function of time:

1. Voltage across Capacitor, VC vs. Time 2. Voltage across Resistance, VR vs. Time

d. Time constant, τ is given by: , *R* = resistance, *C* = capacitance.   
1. In one time constant how much (percentage) charge is stored in the capacitor?

2. In one time constant how much (percentage) of the voltage across the resistance decreases?

**Purpose:** Use a simulation to investigate the discharge characteristics of a RC circuit and determine its time constant.

**Theory:** The capacitance (C) of a capacitor is given by, where Q is the charge stored and V is the potential difference.   
  Time constant =

The SI unit for capacitance is the Farad (F). Farad = Coulomb/Volt.

Consider a charged capacitor (C) and its discharge through a resistor, R. Time constant, is used to indicate how fast the charge is discharged. The unit of RC is second. Time constant is the time required to discharge a capacitor to 36.8% of the initial charge or its voltage to reduce to 36.8% of the initial voltage.

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Procedure:

1. Open the following simulation, and click begin.

<http://www.thephysicsaviary.com/Physics/Programs/Labs/RCCircuitLab/index.html>



1. The multimeter on the left measures the voltage across the resistor and the one on the right measures the current in the circuit. Click on them to see their readings. Clicking again on them will take back to the circuit.
2. Click on the capacitor to reveal its value and record it in the data table below.
3. Click on the resistor and use the color code below to figure out the value of the resistance, and record it in the data table below.



1. Click on the "Charge Cap" Button to charge capacitor.
2. Click on the multimeters to read the voltage or the current. (Meters can only be read when the simulation is paused). Record these values for Time = 0 s.
3. Calculate the time constant (), total time of data collection (5), and

time interval for data collection , and enter them in the data table below. Data will be collected during this time interval. Time values doesn’t have to exactly match the time interval for data collection, they could be anything close to it. Just record those times and the voltage and current values at those times.

1. Resume simulation and collect voltage and current data for every time interval above by pausing the simulation, and record the voltage and current values as shown below in Excel.

DATA:

Capacitance = C = \_\_\_\_\_\_\_\_\_\_ Resistance = R = \_\_\_\_\_\_\_\_\_\_

Time constant = = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Total time for data collection = 5 =\_\_\_\_\_\_\_\_\_\_\_\_\_

Time interval for data collection = = \_\_\_\_\_\_\_\_\_\_\_\_

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| Time (s) | Voltage (V) | Current (μA) |
| 0 |  |  |
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1. What happens to the voltage across the resistance and the current through the circuit as time passes?
2. Plot Current versus time, add an appropriate trendline, and insert your graph below.
3. Determine the time constant from your graph, and compare it to the time constant calculated form the resistance and capacitance set at the beginning of the simulation.
4. Write a conclusion for the purpose.