RC Circuits Prelab

by

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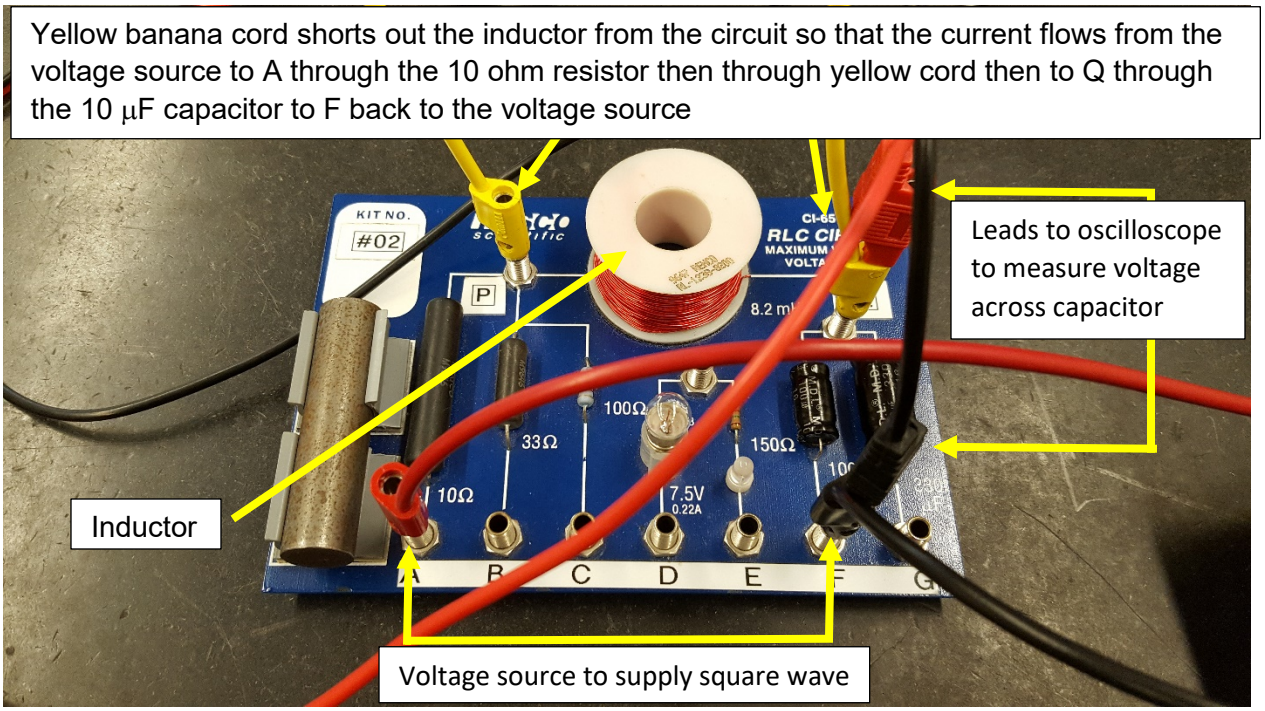
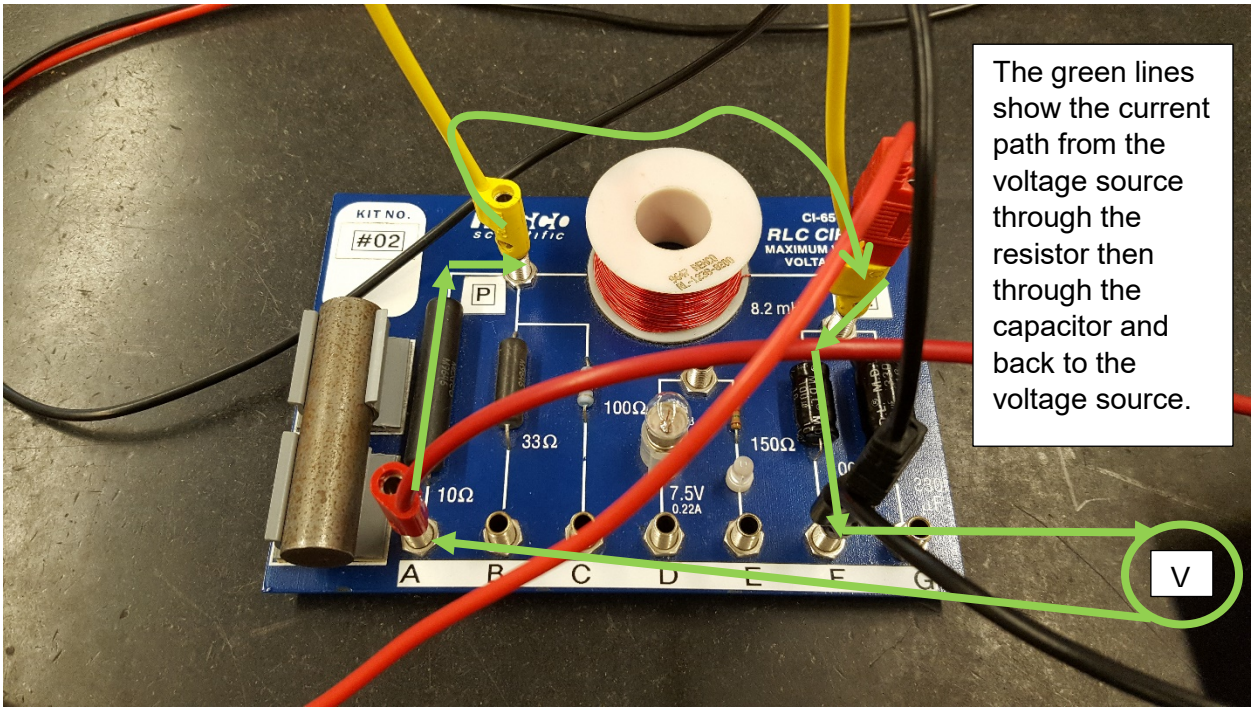
RC circuits are used in cameras to enable the flash to work. The capacitor becomes charged and then the charge is quickly dissipated while releasing light when the shutter button is pressed.[1] Another application of RC circuits is within the nitrogen laser. Capacitors are charged to 30,000 V and then discharged across nitrogen gas. The excited gas then releases light at 337 nm. There are also many applications for RC circuits in alternating current circuits, which will be covered in a few labs. For a review of basic capacitor properties, play with the Phet Sims at:

https://phet.colorado.edu/en/simulation/capacitor-lab-basics.

Read over your lab manual about RC circuits.[2] An RC circuit has a voltage source, a resistor, a capacitor, and a switch all in a circuit. When the switch is open, there is no current flowing in the circuit because the circuit is open. The moment the switch is closed, the capacitor has no charge and the full current is flowing through the resistor. As the capacitor is charged, the current through the resistor exponentially decays (due to Ohm's Law). Once the capacitor is fully charged, then the current through the resistor is zero.

In this lab, you will use a function generator, an oscilloscope, and an RC circuit board. Instead of using a physical switch like you used in the Joule Equivalent of Electrical Energy lab, you will use a voltage source that turns on and off by a square wave. This square wave is created by the function generator. To get enough points to analyze for the charging and discharging capacitor voltage, the frequency of the square wave is adjusted.





Questions:

1. Recall that resistors have tolerances. Capacitors do also. Too few of sampling points will limit your resolution of your measurements. What should the sampling rate be for the 10 Ω, 330 μF combination (see your Excel table)?

2. How will your theoretical values for your time constant τ change if the capacitor value changes by 10% and the resistor value changes by 10%?

References:

[1] Macaulay, David. *The New Way Things Work*, Houghton Mifflin Company: Boston 1998.

[2] Parks, James E. *Contemporary Introductory Physics Experiments, 2nd Edition*, Hayden-McNeil Publishing: Plymouth 2014.