EECS 40/43
Pre-Lab #3
(Note: You must show your work to receive full credit.)

Name: _____
TA: _____
Section: _____

Recall that a current is a flow of charges. When a current flows into a capacitor of value C, the charges, Q, don't pass through (although to maintain local charge balance an equal number of the same polarity charges leave the other plate of the device) but remain in the device, increasing the voltage across the capacitor. This fundamental relationship is given by the equation Q = CV. Since Q is the integration of current over time, we can write:

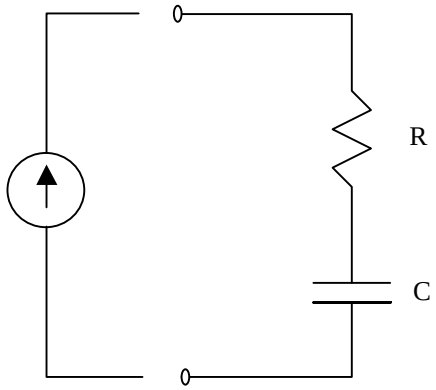
$$V = Q/C = [\int i(t)dt\ ] / C$$

Differentiating this equation, we obtain $i(t) = C(dV/dt)$

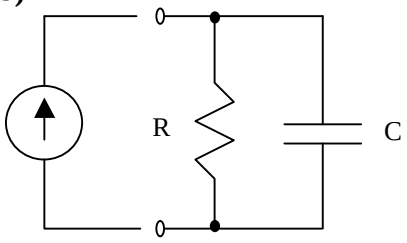
1. If a constant current of 1.0 mA were to flow into a 200 μF (microfarad) capacitor, what would be the voltage across the capacitor after 3 seconds? **[10pts]**

2. Describe what would happen theoretically if you were to connect an ideal current source to the following circuits. **[15 pts]**

a)



b)



3. [15 pts] An RC (resistor + capacitor) circuit will have an exponential voltage response of the form v(t) = A + B exp(-t/RC) where A and B are constants that express the final voltage and the difference between the initial voltage and the final voltage, respectively. (exp(x) is e to the x power, where e = 2.718, the base of the natural logarithm.) The product RC is called the **time constant** and is represented by the Greek letter τ. When the time has reached a value equal to the time constant, τ, then exp(-t/RC) = exp(-1) = 0.3678, or about 5/8 of the way from the initial value to the final value.

a. Given R = 10 kΩ and C = 0.1 μF, a starting voltage of 5 Volts and an ending voltage of 0 Volts, what will the voltage be at t = 1 ms?

b. At what time will the voltage be 0.5 Volts?

4. In the experiment, you will be given two black boxes, which have either a series or parallel combination of R and C. Since you won't be able to measure in-between the R and the C in the black box, how will you go about determining R and C using the signal generator, the oscilloscope and an external resistance? **[10 pts]**