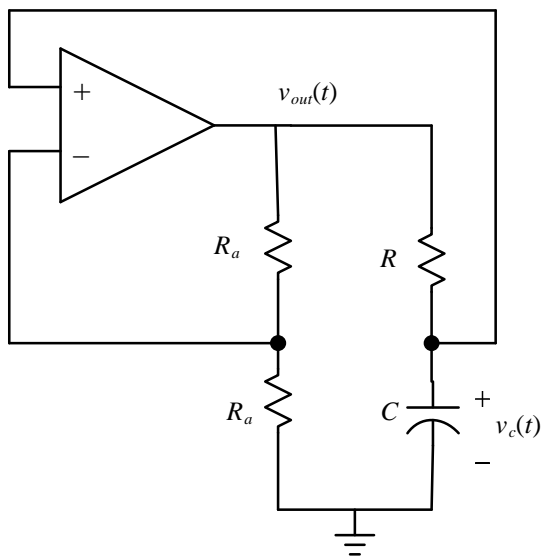


## LABORATORY 7

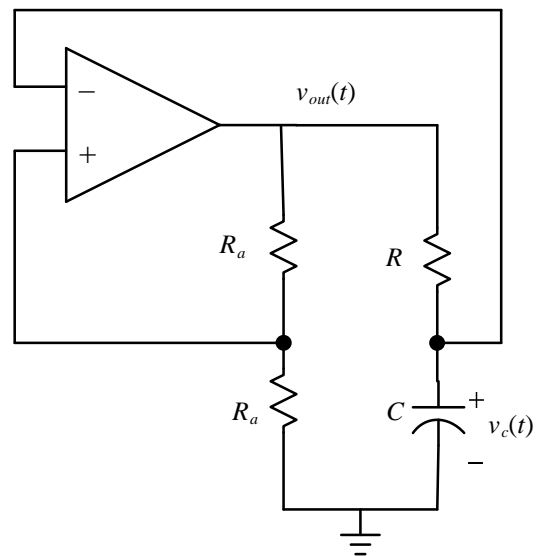
### Op Amp Clock Circuit

In this lab we will understand and build an “astable multivibrator” or clock circuit using a 741 op amp. The circuit output will be a square wave, and the period of the square wave can be adjusted by changing the resistor and capacitor values in the circuit.

Think about how circuit (b) will operate. Please be sure that you understand why the op amp output will oscillate between values of approximately +10 volts and –10 volts. Note that the “three zeros” of ideal op amp operation (with feedback) are *not* valid for this circuit!



(a)



(b)

**Question:** What does circuit (a) do? Will it oscillate? Does it operate differently than circuit (b)?

#### Lab Activities:

Please sketch on a single plot the capacitor voltage  $v_c(t)$  and the op amp output voltage  $v_{out}(t)$  versus time for circuit (b). How is the period of the wave related to the values of  $R$  and  $C$ ? (Do analysis!!)

What value should you choose for the resistor  $R_a$ ? Hint: Keep the op amp output current  $< 10$  mA.

If  $R$  is a potentiometer that varies from 0 ohms to 100 k ohms, what value of  $C$  should you use to produce a clock frequency as low as 1000 hertz? How can you modify the circuit to produce clock frequencies in the range from 100 to 1000 hertz?

Set up and test your circuit. Demonstrate how the frequency of your clock circuit varies as you change the potentiometer. Observe both  $v_c(t)$  and  $v_{out}(t)$  on the oscilloscope, and compare with analysis.

**Another question:** What if the pair of resistors with value  $R_a$  are replaced by resistors with values that are *not* identical? Can you make a *triangle wave* generation circuit? Try it!!