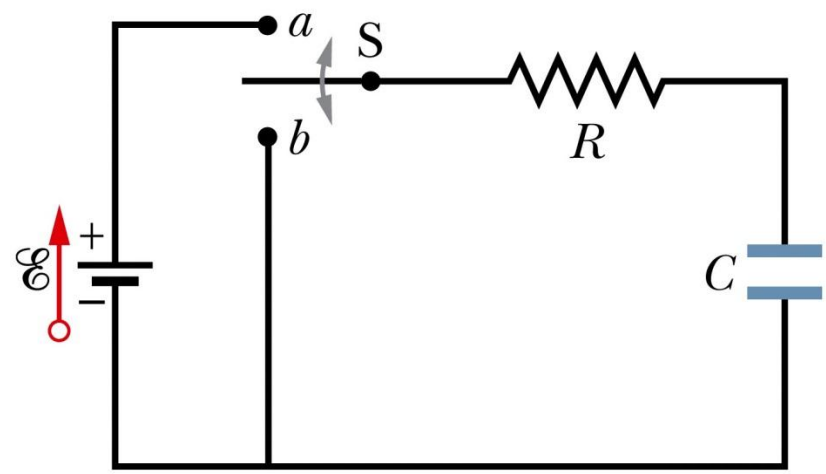
Interactive Problem Set 20, SP212 Spring 2013

Topic: Capacitor Charging and Discharging



1. The capacitor of capacitance C in the figure above is initially uncharged. To <u>*charge*</u> it, we close switch S on point a. This completes an *RC series circuit* consisting of the capacitor, an ideal battery of emf $\mathscr{E}$, and a resistance R.

a. During the charging process, how do the charge $q(t)$ on the capacitor, the current $i(t)$ through the loop, and the voltage $V_C(t)$ across the capacitor vary with time?

b. $\mathscr{E}$ = 12.0 V, R = 1.40 MΩ, and C = 1.80 μF.

(i) Calculate the time constant.

(ii) Find the maximum charge that will appear on the capacitor during charging.

(iii) How long does it take for the charge to build up to 16.0 μC?

2. Assume now that the capacitor of the above figure is fully charged to a potential V_0 (equal to the emf $\mathscr{E}$ of the battery). At a new time t = 0, switch S is thrown from a to b so that the capacitor can <u>*discharge*</u> through R.

a. How do the charge $q(t)$ on the capacitor and the current $i(t)$ through the discharge loop of capacitor and resistance now vary with time?

b. $\mathscr{E}$ = 12.0 V, R = 1.40 MΩ, and C = 1.80 μF.

How long does it take for the capacitors to lose

(i) the first one-third of its charge and

(ii) two-thirds of its charge?

Reading for next class: Chapter 27