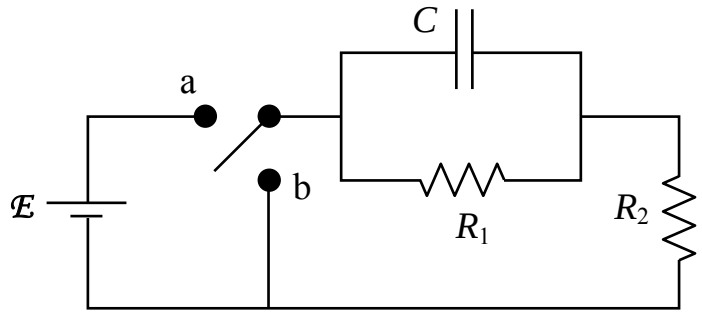
Discussion Question 7A

P212, Week 7

RC Circuits

The circuit shown initially has the capacitor uncharged, and the switch connected to neither terminal. At time $t = 0$, the switch is thrown to position a.



$\mathcal{E} = 12$ V
$C = 5$ μF
$R_1 = 3\ \Omega$
$R_2 = 6\ \Omega$

(a) At $t = 0+$, immediately after the switch is thrown to position a, what are the currents I_1 and I_2 across the two resistors?

What does the uncharged capacitor *look like* to the rest of the circuit at time 0? Does it offer *any* resistance to the flow of charge? (Why or why not?)

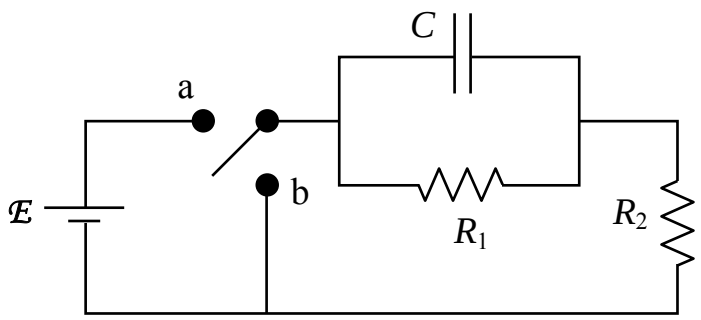
(b) After a very long time, what is the instantaneous power P dissipated in the circuit?

After a very long time, what will have happened to the capacitor? *Now* what will it look like to the rest of the circuit?

(c) After a very long time, what is the Q charge on the capacitor?

To determine Q, you need the voltage across the capacitor ...

Next, after a very long time T, the switch is thrown to position b.



(d) What is the time constant τ that describes the discharging of the capacitor?

We have a nice formula available for time constants: $\tau = RC$. But the R in the formula refers to the *total resistance through which the capacitor discharges*. Redrawing your circuit might help you to determine this R .

(e) Write down an equation for the time dependence of the charge on the capacitor, for times $t > T$. Your answer for $Q(t)$ should depend only on the known quantities $\mathcal{E}$, R_1, R_2, C, and T.

You know the general form for the time dependence of a discharging capacitor. All you have to do is fix the constants in this expression to match the charge at $t = T$ and at $t = \infty$.

(f) What is the charge Q_{20} on the capacitor 20 μsec after time T?

(g) What is the current through R_2 20 μsec after time T ?