

The R-C circuit and the time constant

Review the textbook on RC Circuits:

- **Phys 1402:** Serway/Vuille: Section. 18.5, Active Figure 18.17, Quick Quiz 18.9
- **Phys 2426:** Serway/Jewett: Section 28.4, Active Figure 28.16, Quick Quiz 28.5

1. In Figure 1, with the capacitor originally uncharged, the recording starts ($t = 0$) at the moment the switch is closed by connecting to A. What is the voltage across the capacitor at $t = 0$? What is the voltage across the capacitor at $t = \infty$? Why?

($V(0) = 0$ because there is no charge on the capacitor; $V(\infty) = 1.2\text{V}$ because the capacitor is fully charged)

2. The switch in Figure 1 is flipped from point A to point B disconnecting the battery and the capacitor starts discharging. During the process of the discharge, is there a current flowing through the Resistor? What direction (leftward or rightward)?

(Yes, there is a current flowing through the Resistor to the right)

3. During the process of the discharge, is there a current flowing through the Capacitor?

(No, there is no current through the Capacitor)

4. In Figure 1, the capacitance of the capacitor is $5.00\mu\text{F}$ and the resistance of the resistor is $3.50\text{M}\Omega$. What is the time constant for this circuit?

(17.5s)

5. In Figure 1, the capacitance of the capacitor is $5.00\mu\text{F}$ and the resistance of the resistor is $3.50\text{M}\Omega$. How long would it take to charge the capacitor up from zero to 63% of the battery voltage?

(Close to one time constant = 17.5s)

6. If the resistance of the resistor from Figure 1 is adjusted from $3.50\text{M}\Omega$ to a smaller value, how would it affect the time constant? Would the capacitor charge faster or slower?

(It will lower the time constant; the capacitor will charge faster)

7. If the capacitance of the capacitor from Figure 1 is adjusted from $50\mu\text{C}$ to a larger value, how would it affect the time constant? Would the capacitor charge faster or slower?

(It will increase the time constant; the capacitor will charge slower)

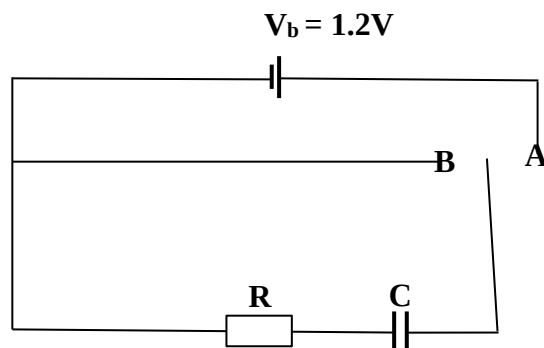


Figure 1. RC Circuit