EECE 2210 - Electrical Engineering
Quiz 9

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Student Name: _____

The figure shows the de–bounce circuit for a switch as we discussed in class. In this case, $V_s = 5\,\text{Volts}$, $R_1 = 20\,\text{kOhms}$, $R_2 = 40\,\text{kOhms}$, and $C = 1\,\mu\text{F}$. The switch is a normally–open pushbutton that "bounces" when it is pressed and/or released. The plot in the upper left shows when the switch is opened and closed. The indicated times are $t_1 = 1\,\text{ms}$ and $t_2 = 4\,\text{ms}$.

1. What is the time constant for charging the capacitor when the switch is open?

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2. What is the time constant for discharging the capacitor when the switch is closed?

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3. Up until time t_1 the switch has been changing in some unknown way, but just before t_1, the voltage on the capacitor is $v\left(t_1^-\right) = 4.5\,\text{Volts}$. What is the voltage on the capacitor at time t_2??

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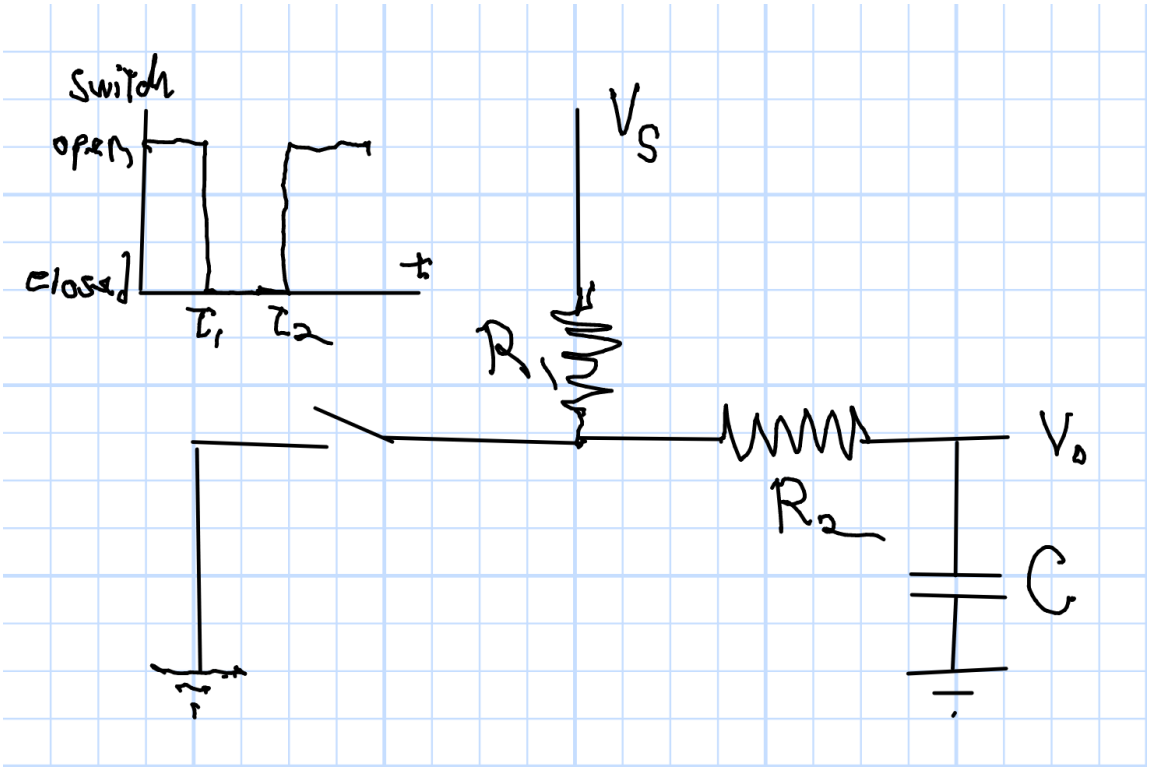
4. Now suppose instead that the voltage at t_1 is $v\left(t_1^-\right) = 5\,\text{Volts}$, the maximum possible. I press the button from from t_1 to t_2, without bouncing, and I want the voltage on the capacitor to fall to 1 Volt. The time t_2 is not sufficient. What must t_2 be for this to work?

_____ .


Switch
open
closed
t
τ_1
τ_2
V_S
R_1
R_2
V_o
C

1. $\tau_{charge} = (R_1 + R_2)\, C = 60\,\text{ms}.$
2. $\tau_{discharge} = R_2 C = 40\,\text{ms}.$
3. $V(t_2) = V(t_1)\, e^{-(t_2 - t_1)\tau_{discharge}} = 4.17\,\text{Volts}$
4. $t_2 = -\log_e\left(\frac{1}{5}\tau_{discharge}\right) + t_1 = 65\,\text{ms}$