

task_tb6pi8dgh0m2e2pw_with_calculation

Student Group

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Exercise E1.1 Charging Capacitors

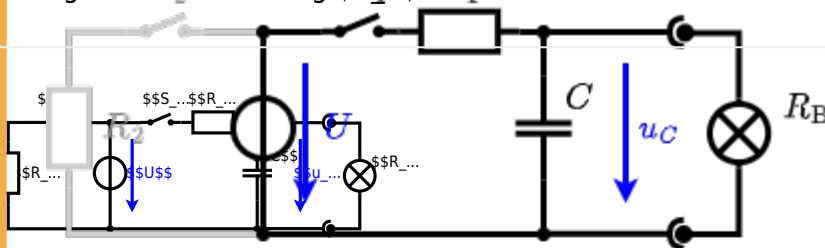
(written test, approx. 16 % of a 60-minute written test, WS2022)

The circuit (without the calculation) is in the picture of $R_1 = 20 \Omega$, $R_2 = 10 \Omega$, $R_B = 10 \Omega$, $C = 100 \mu F$, and $U = 12 V$. The voltage across the capacitor is again $0 V$ at the moment $t_0 = 0 s$ when the switch S_1 is closed. Calculate the voltage $u_c(t_2)$ across the capacitor at $t_2 = 1 ms$ after closing the switch.

Solution
Hint: To solve this, first create an equivalent linear voltage source from U , R_1 , and R_B .

Solution
The circuit contains a voltage source $U = 12 V$, a switch S_1 , a resistor of $R_1 = 20 \Omega$ and a capacitor of $C = 100 \mu F$.

The switch S_2 to an additional consumer R_2 will be considered to be open for the first tasks. At the moment $t_0 = 0 s$ the switch S_1 is closed, the voltage across the capacitor is $u_c(t_0) = 0 V$.

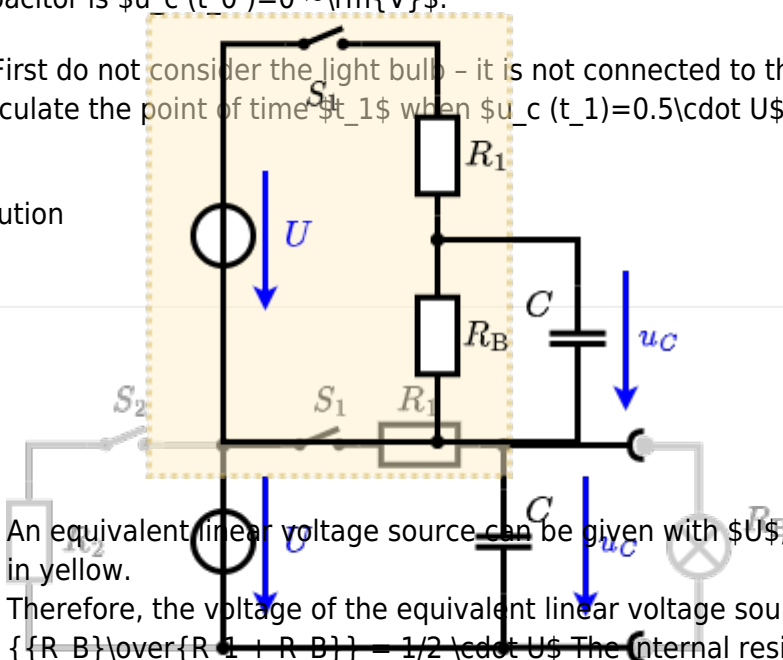


The circuit contains a voltage source $U = 12 V$, a switch S_1 , a resistor of $R_1 = 20 \Omega$ and a capacitor of $C = 100 \mu F$.

The switch S_2 to an additional consumer R_2 will be considered to be open for the first tasks. At the moment $t_0 = 0 s$ the switch S_1 is closed, the voltage across the capacitor is $u_c(t_0) = 0 V$.

First do not consider the light bulb - it is not connected to the RC circuit. Calculate the point of time t_1 when $u_c(t_1) = 0.5 \cdot U$.

Solution



An equivalent linear voltage source can be given with U_s , R_1 , and R_B as seen in yellow.

Therefore, the voltage of the equivalent linear voltage source is: $U_s = U \cdot \frac{R_B}{R_1 + R_B} = 1/2 \cdot U$. The internal resistance is given by substituting the ideal voltage source with its resistance ($= 0 \Omega$, short-circuit).

