

task_tb6pi8dgh0m2e2pw_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

Table of Contents

Exercise E1 Charging Capacitors (written test, approx. 16 % of a 60-minute written test,
WS2022) 2

Charging Capacitors, dc network analysis, pure resistor network simplification, delta wye transformation, exam ee1 WS2022

Exercise E1 Charging Capacitors

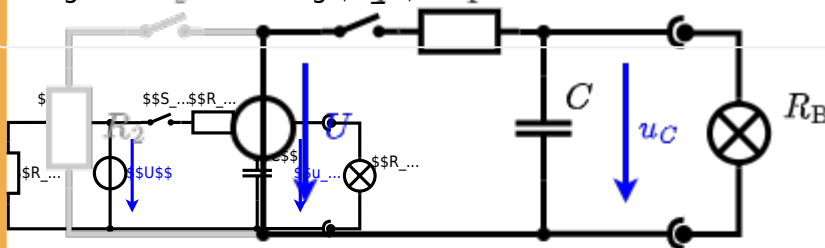
(written test, approx. 16 % of a 60-minute written test, WS2022)

The circuit (with the real solution) is in the picture of R_{B1} and R_{B2} and applying S_1 is closed. Resulting $u_C(t_0)$ on the voltage across the capacitor is again 0 V at the moment $t_0=0 \text{ s}$ when the switch S_1 is closed. Calculate the voltage $u_C(t_2)$ across the capacitor at $t_2=1 \text{ ms}$ after closing the switch.

Solution
Hint: To solve this, first create an equivalent linear voltage source from U , R_1 , and R_B .
$$\Delta U = U \cdot \frac{R_B}{R_1 + R_B}$$

Solution
The circuit contains a voltage source $U=12 \text{ V}$, a switch S_1 , a resistor of $R_1=20 \text{ }\Omega$ and a capacitor of $C=100 \text{ }\mu\text{F}$.
The switch S_2 to an additional consumer R_2 will be considered to be open for the first tasks. At the moment $t_0=0 \text{ s}$ the switch S_1 is closed, the voltage across the capacitor is $u_C(t_0)=0 \text{ V}$.

On an alternative view, one can try to create an equivalent linear voltage source again. Then, the internal resistance is given by substituting the ideal voltage source is again short-circuiting R_1 .



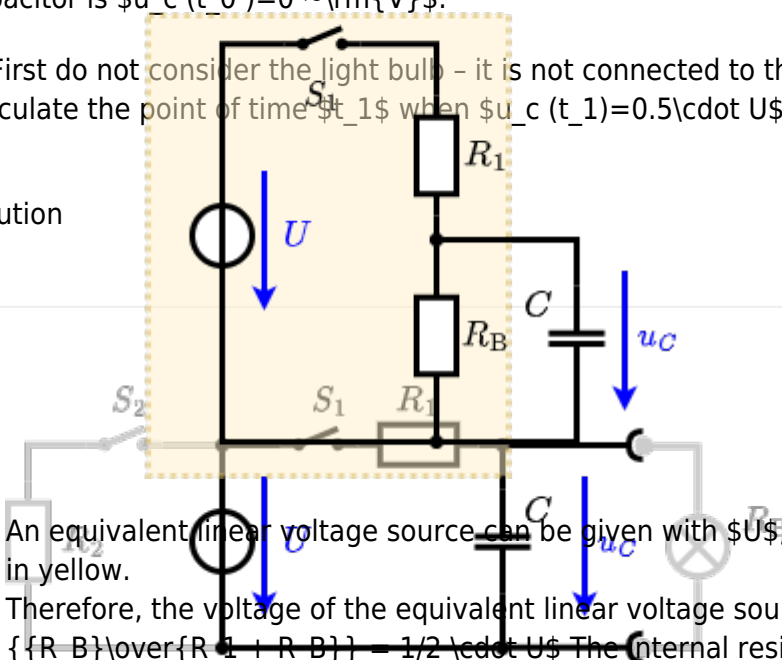
The circuit contains a voltage source $U=12 \text{ V}$, a switch S_1 , a resistor of $R_1=20 \text{ }\Omega$ and a capacitor of $C=100 \text{ }\mu\text{F}$.

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

.. 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 , 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 ($=0 \text{ }\Omega$, short-circuit).

So if we only R_1 and C give t we have $t = \frac{1}{\omega} \arctan\left(\frac{\omega R_1 C}{1}\right)$

The following formula describes the time course $U(t)$ which has $\{1 \text{ V}\}$ $U(t) = 0.5 \cdot (1 - e^{-t/\tau})$ $\tau = R_1 C$ $\tau = 10 \text{ ms}$ $U(t) = 0.5 \cdot (1 - e^{-t/10 \text{ ms}})$ It has to be rearranged to $t = \tau \cdot \ln(0.5)$ $t = 10 \text{ ms} \cdot \ln(0.5)$ $t = 6.93 \text{ ms}$

From:
<https://wiki.mexle.te.hs-heilbronn.de/> - MEXLE Wiki

Permanent link:
https://wiki.mexle.te.hs-heilbronn.de/electrical_engineering_1/task_tb6pi8dgh0m2e2pw_with_calculation?rev=1680242524

Last update: 2023/03/31 08:02

