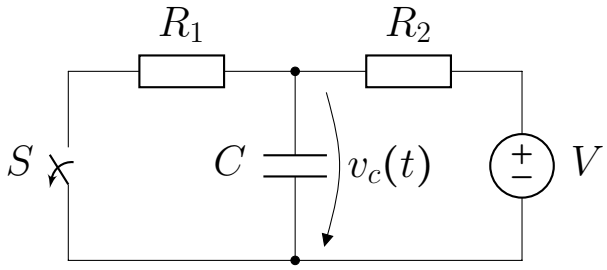
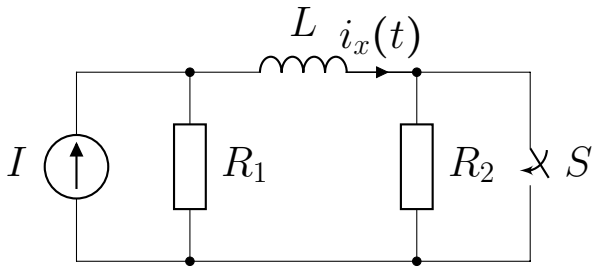
Seminar - 11th week

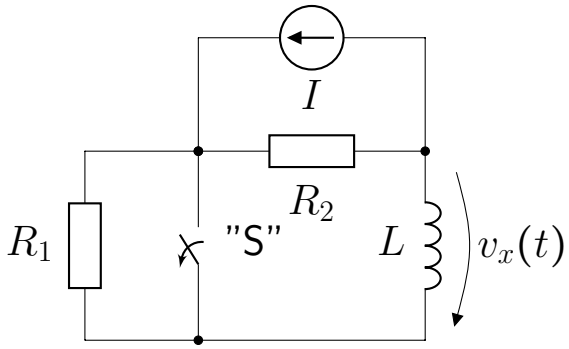
1. The switch in the circuit has been closed for a long time, and it is opened at $t = 0$. Calculate $v_c(t)$ for $t \geq 0$. Draw its waveform both at $t < 0$ and $t \geq 0$. V = 18 V, R_1 = 1.2 kΩ, R_2 = 3.6 kΩ, C = 3 µF.



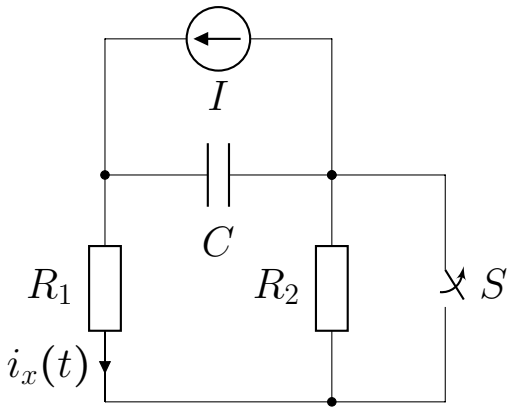
2. The switch in the circuit has been opened for a long time, and it is closed at $t = 0$. Calculate $i_x(t)$ for $t \geq 0$. Draw its waveform both at $t < 0$ and $t \geq 0$. I = 0.8 A, R_1 = 180 Ω, R_2 = 270 Ω, L = 7.2 mH.



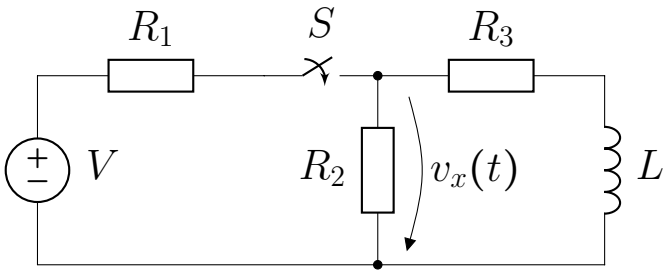
3. The switch in the circuit has been closed for a long time, and it is opened at $t = 0$. Calculate $v_x(t)$ for $t \geq 0$. Draw its waveform both at $t < 0$ and $t \geq 0$. I = 25 mA, R_1 = 820 Ω, R_2 = 180 Ω, L = 0.25 H.



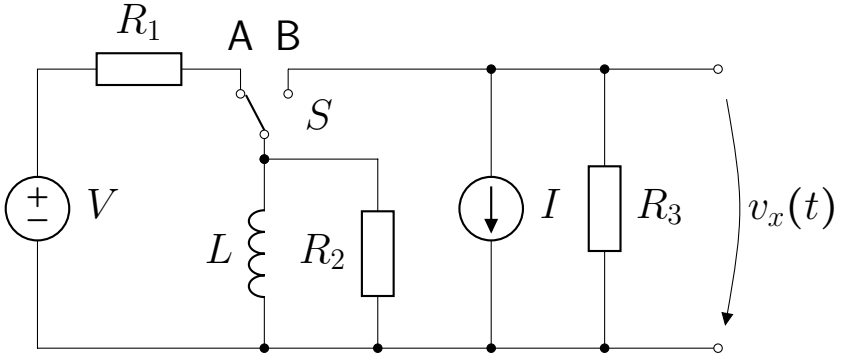
4. The switch in the circuit has been closed for a long time, and it is opened at $t = 0$. Calculate $i_x(t)$ for $t \geq 0$. Draw its waveform both at $t < 0$ and $t \geq 0$. I = 22 mA, R_1 = 400 Ω, R_2 = 600 Ω, C = 20 µF.



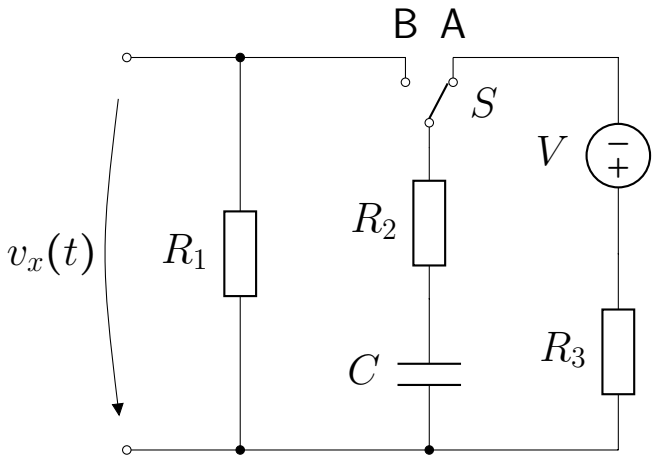
5. The switch in the circuit has been opened for a long time, and it is closed at $t = 0$. Calculate $v_x(t)$ for $t \geq 0$. Draw its waveform both at $t < 0$ and $t \geq 0$. V = 50 V, R_1 = 2 kΩ, R_2 = 3 kΩ, R_3 = 800 Ω, L = 10 mH.



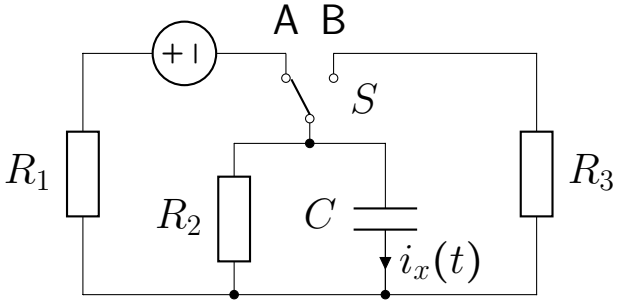
6. The switch in the circuit has been in the position A for a long time. At time $t = 0$ the switch was switched in position B. Calculate $v_x(t)$ for $t \geq 0$. Draw its waveform both at $t < 0$ and $t \geq 0$. V = 12 V, I = 50 mA, R_1 = 1.2 kΩ, R_2 = 20 kΩ, R_3 = 30 kΩ, L = 0.3 H.



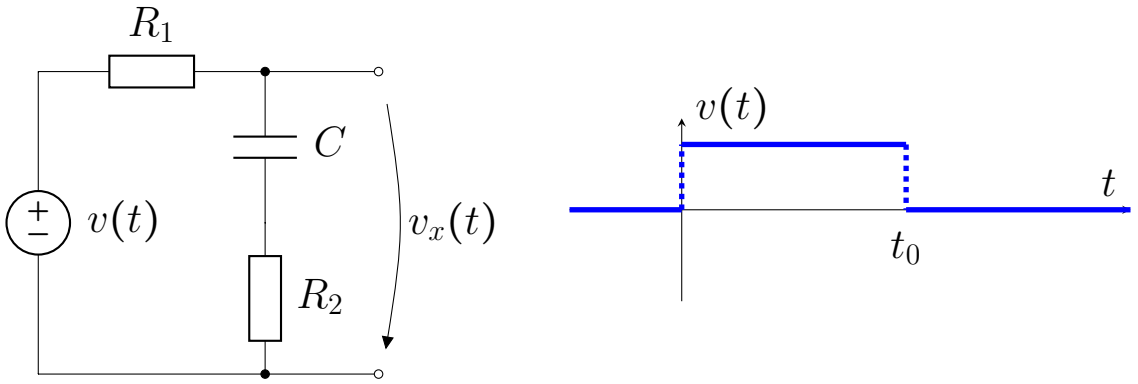
7. The switch in the circuit has been in the position A for a long time. At time $t = 0$ the switch was switched in position B. Calculate $v_x(t)$ for $t \geq 0$. Draw its waveform both at $t < 0$ and $t \geq 0$. V = 20 V, R_1 = 6 kΩ, R_2 = 4 kΩ, R_3 = 2 kΩ, C = 2 µF.



8. The switch in the circuit has been in the position A for a long time. At time $t = 0$ the switch was switched in position B. Calculate current $i_x(t)$ for $t \geq 0$. Draw its waveform both at $t < 0$ and $t \geq 0$. V = 30 V, R_1 = 4 kΩ, R_2 = 2 kΩ, R_3 = 8 kΩ, C = 1 µF.

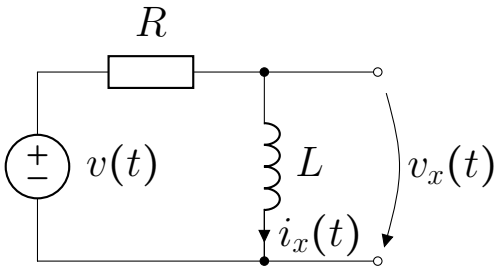


9. The circuit is supplied by the voltage source, which generates single rectangular pulse according to the figure. The pulse duration is t_0 = 10 ms, magnitude V = 10 V. Calculate voltage $v_x(t)$ for $t \geq 0$. Draw its waveform both at $t < 0$ and $t \geq 0$. R_1 = 3 kΩ, R_2 = 2 kΩ, C = 2 µF.

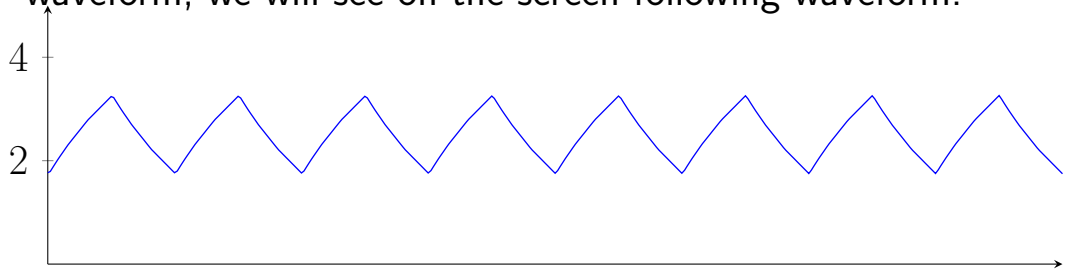


10. The circuit is supplied by the voltage source, which generates periodical rectangular waveform with frequency f = 100 kHz. Duty cycle is D =

75 %. Calculate current $i_x(t)$ and voltage $v_x(t)$ within the first period. Draw their waveforms. V = 10 V, R = 1 kΩ, L = 0.1 H. Simulate in Microcap waveforms of current and voltage both on inductor and resitor. Try to calculate mean value of current.



11. Derivative RC circuit with time constant τ = 0.2 ms (R = 10 kΩ, C = 20 nF) is supplied from the pulse voltage source (periodical rectangular waveform). The pulse has the magnitude of 5 V, period T = 5 µs and duty cycle D = 20 %. Simulate in MicroCap a transient within the time interval $t \in \langle 0,\ 200 \rangle\ \mu$s and $t \in \langle 950,\ 1000 \rangle\ \mu$s. Explain why the waveform is shifted above horizontal axis in the second case.
12. An integrating RC circuit with time constant τ = 0.2 ms (R = 10 kΩ, C = 20 nF) is supplied from the pulse voltage source (periodical rectangular waveform). The pulse has the magnitude of 5 V, period T = 5 µs and duty cycle D = 20 %. Simulate in MicroCap a transient within the time interval $t \in \langle 0,\ 200 \rangle\ \mu$s and $t \in \langle 950,\ 1000 \rangle\ \mu$s. Explain why the waveform is shifted above horizontal axis in the second case.
13. During of development of a microprocessor circuit we need to check, whether the clock oscillator is running. On the output of the oscillator should be rectangular waveform with magnitude V = 5 V and duty cycle D = 50 %. To measure the voltage, we connect an oscilloscope probe to the output of the oscillator. However, instead of rectangular waveform, we will see on the screen following waveform:



What can cause wrong shape of voltage waveform? Propose steps to find reason of the problem.