Homework 3

Due date: 25th, Oct.

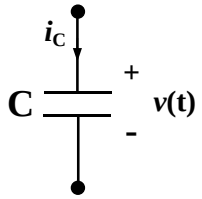
Turn in your homework in class

Rules:

- Work on your own. Discussion is permissible, but extremely similar submissions will be judged as plagiarism.
- Please show all intermediate steps: a correct solution without an explanation will get zero credit.
- Please submit on time. No late submission will be accepted.
- Please prepare your submission in English only. No Chinese submission will be accepted.

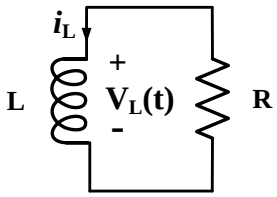
1. (a). A capacitor with 10mF capacitance has the terminal voltage:

$$v(t) \begin{cases} 15\ \text{V} & t \le 0 \\ Ae^{-100t} + Be^{-500t}\ \text{V} & t \ge 0 \end{cases}$$

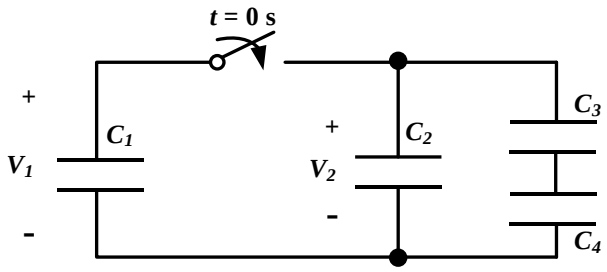


Assuming that the initial current (t=0s) on the capacitor is 5 A, please find: (1). constants A and B, (2). the capacitor current for t > 0, and (3). the energy of capacitor at t=1ms.

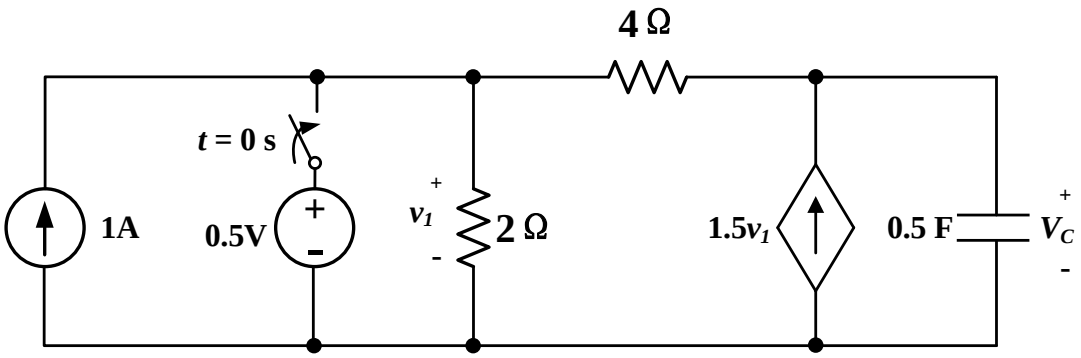
(b). A 200-mH inductor is connected in parallel with a resistor. The current through the inductor is $\boldsymbol{i_L(t)} = 10e^{-800t}\,mA$. Please find the voltage $\mathbf{V_L}(t)$ on the inductor with respect to time, as well as the energy of the inductor at t = 1ms.



(c). For the capacitance circuit below, $\boldsymbol{C_1}$=1 μF, $\boldsymbol{C_2}$=0.125 μF, $\boldsymbol{C_3}$ = $\boldsymbol{C_4}$=0.25 μF. Initially the switch is at "off state", and the voltage on the capacitor $\boldsymbol{C_1}$ is 10 V while other capacitors have the same voltage drop of 0 V. At $\boldsymbol{t}$ =0s, the switch is closed. Please find the voltage $\boldsymbol{V_2}$ after the circuit becomes stable. Note that no loss need to be considered.

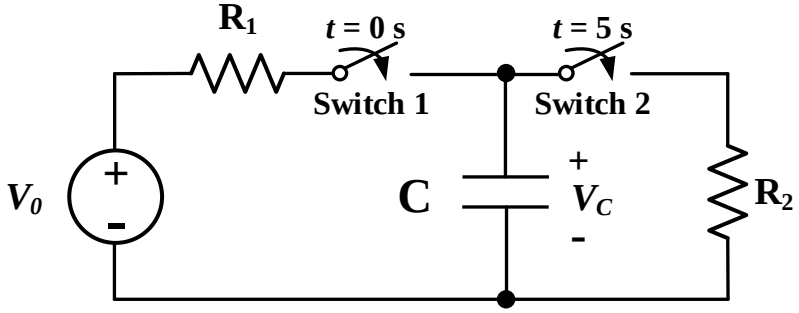


2. In the following circuit, the switch is open for a long time for $t<0$s. At $t=0$s, the switch closes immediately. Please find out the voltage on 0.5 F capacitor ($V_C(t)$) when $t \geq 0$s.

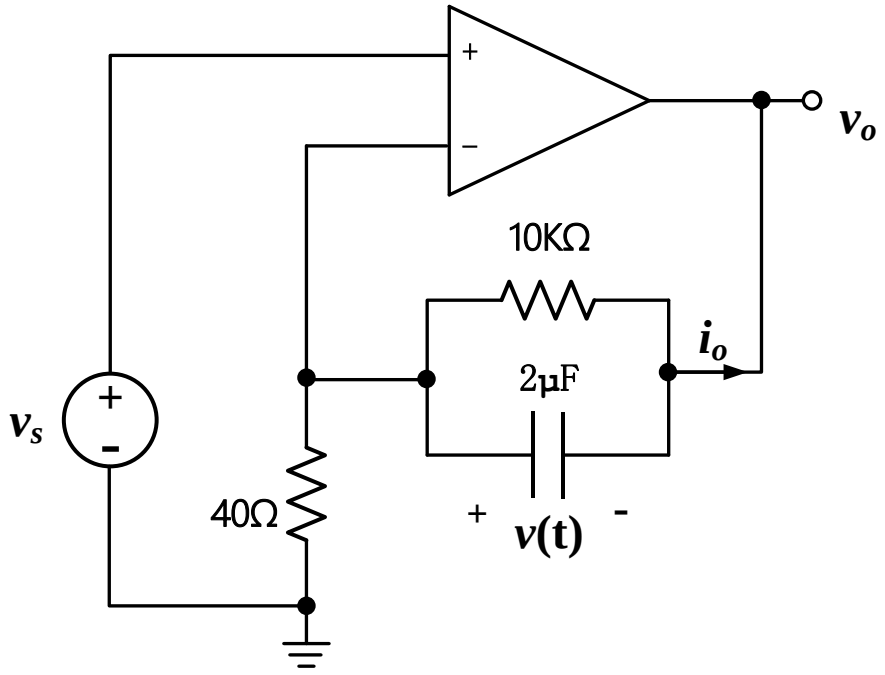


3. The circuit contains two switches, both of which have been open for a long time before t = 0. **Switch 1** closes at t = 0s, and **switch 2** closes at t = 5s. Determine $\boldsymbol{v_C(t)}$ for t ≥ 0, given that $\boldsymbol{V_0}$=24V, $\mathbf{R_1}$=$\mathbf{R_2}$=16kΩ, and **C**=250μF. Assume $\boldsymbol{v_C(0)}$=1 V.

Also, please sketch $\boldsymbol{v_C(t)}$, capacitor current $\mathbf{I_c(t)}$, current on $\mathbf{R_1}$ ($\mathbf{I_{R1}(t)}$), and voltage on $\mathbf{R_1}$ ($\mathbf{V_{R1}(t)}$) for t>0s, **respectively**.



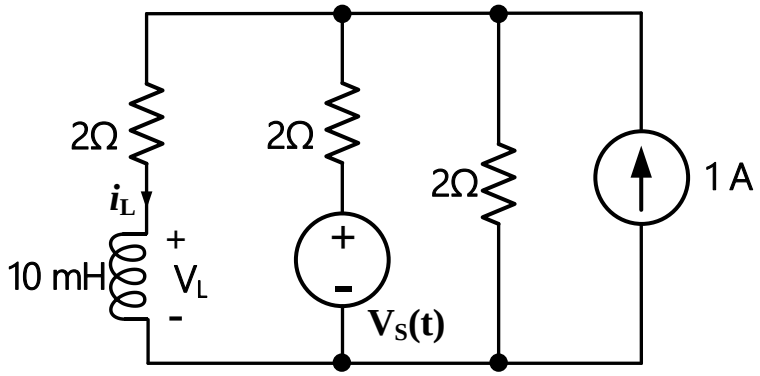
4. In the circuit below, find $v_o(t)$ and $i_o(t)$, given that $v_s = 4u(t)$ V and $v(0)$=1V. (Note that $u(t)$ is step function.)



5. For the circuit below, the independent voltage source has the voltage:

$$V_S(t) = \begin{cases} 0\ \text{V} & t < 0\text{s} \\ e^{-100t}\ \text{V} & t \geq 0\text{s} \end{cases}$$

Please find the current on the inductor in terms of time ($i_L(t)$) for $t \geqslant 0$s.



6. For the circuit below, assume the operational amplifier is always working in its linear mode, $\mathbf{V_C}(0^-) = 5\text{V}$, $\mathbf{R_1} = 5\text{k}\Omega$, $\mathbf{R_2} = 500\Omega$, $\mathbf{C}=5\mu\text{F}$, and

$$V_S(t) = \begin{cases} 0, & t \le 0 \\ e^{-200t}, & t > 0 \end{cases}$$ (unit for $V_S(t)$ is V)

Find the output voltage of the operational amplifier $v_0(t)$ for $t > 0$.