

EE 111 Electric Circuits Midterm 2
April 29 2019, 8:00 AM – 10:00 AM

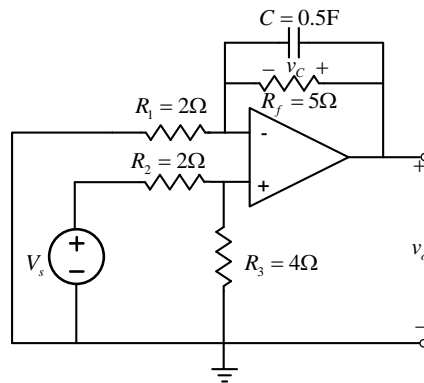
6 Problems (1 A4 crib sheet allowed)

Answer the Questions in English and on Answer Sheets only

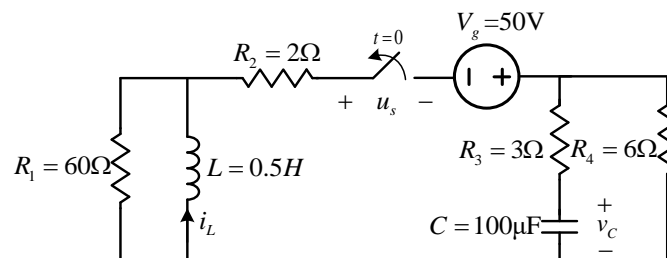
Draw the circuits on Answer Sheets for all problems

Show your work (for partial credits)

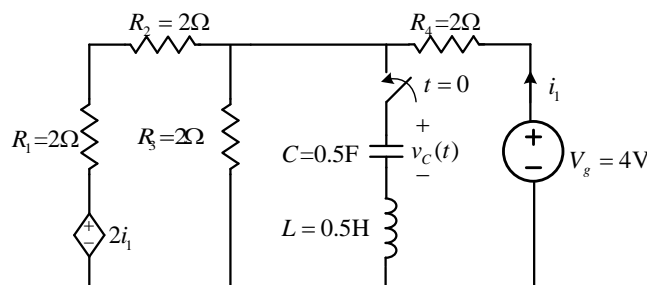
1. **(16 points)** The voltage source $V_s(t) = 5e^{-2t}$ V ($t \geq 0$), the capacitor voltage at $t = 0_-$ is $v_C(0_-) = 2$ V. Assume the operational amplifier works in linear mode all the time, find $v_o(t)$ for $t \geq 0$.



2. **(16 points)** The switch has been on for a long time. At $t = 0$, the switch is turned off.
- (1) Find $i_L(0_-)$ and $v_C(0_-)$;
 - (2) Find $i_L(t)$ for $t \geq 0$;
 - (3) Find $v_C(t)$ for $t \geq 0$;
 - (4) Find the voltage $u_s(t)$ for $t \geq 0$, where $u_s(t)$ is the voltage across the switch.



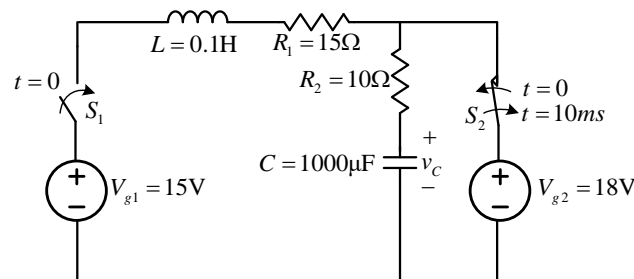
3. **(16 points)** The switch has been off for a long time and turned on at $t = 0$. Find $v_C(t)$ for $t \geq 0$.



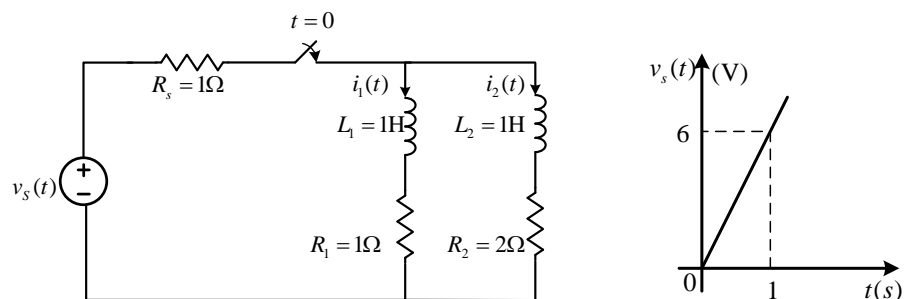
4. **(16 points)** When $t < 0$, the switch S_1 is off and the switch S_2 is on. The circuit has reached steady state before $t = 0$. At $t = 0$, S_1 is turned on and S_2 is turned off. Then at $t = 10\text{ms}$, S_2 is turned on again.

(1) Find $i_L(0_-)$ and $v_C(0_-)$;

(2) Find $v_C(t)$.



5. **(16 points)** The switch has been open for a long time and is closed at $t = 0$. The waveform of $v_s(t)$ is given in the figure. Find $i_1(t)$ for $0 \leq t \leq 1\text{s}$.



6. **(20 points)** The switch has been open for a long time and is closed at $t = 0$. Find $i(t)$ for $t \geq 0$ by completing the following steps:

(1) We can observe that there are three meshes in the circuit. Assume that the currents in the meshes are $i_1(t)$, $i_2(t)$ and $i_3(t)$, as shown in the figure. Use $i_1(t)$, $i_2(t)$, $i_3(t)$ and mesh analysis to find three independent equations that describe the physical laws of the circuit for $t \geq 0$;

(2) From the three equations derived in (1), eliminate $i_2(t)$ and $i_3(t)$ to obtain one equation with one unknown variable $i_1(t)$ for $t \geq 0$. What is the circuit order? (first-order, second-order, N-order...);

(3) With the one equation derived in (2), solve $i_1(t)$ for $t \geq 0$;

(4) From the solved $i_1(t)$ and the three equations derived in (1), find $i_2(t)$, $i_3(t)$ for $t \geq 0$. Afterwards, find $i(t)$ for $t \geq 0$.

