ECE 2260 hw03

1.   Natural Response of an RL Circuit with a Switch

The switch in the circuit shown in Fig. 1 has been in position a for a long time before moving to position b at $t = 0$.
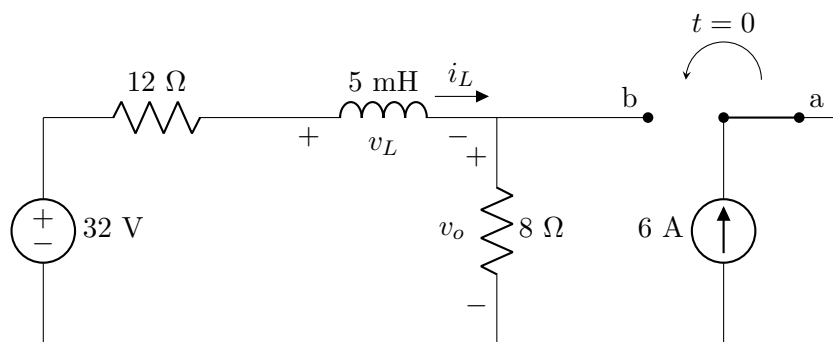

Figure 1: Circuit for problem.

a) Find the numerical expressions for $i_L(t)$ and $v_o(t)$ for $t \geq 0$.

b) Find the numerical values of $v_L(0^+)$ and $v_o(0^+)$.

2. Step Response of an RL Circuit

The switch in the circuit shown in Fig. 2 has been in position a for a long time. At $t = 0$, the switch moves instantaneously to position b.
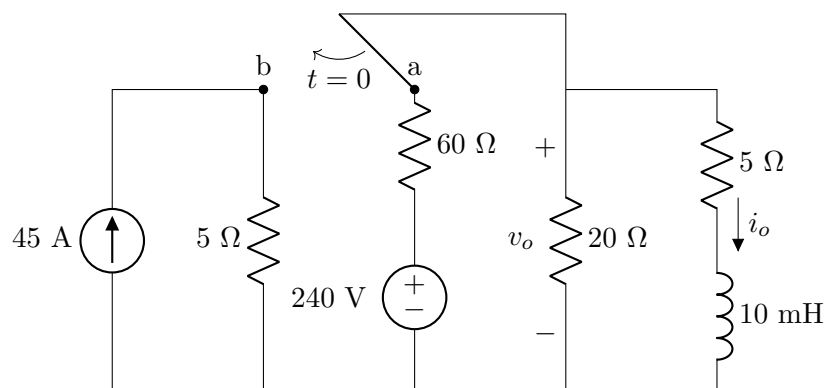

Figure 2: Circuit for step response problem.

a) Find the numerical expression for $i_o(t)$ when $t \geq 0$.

b) Find the numerical expression for $v_o(t)$ for $t \geq 0^+$.

c) Now assume that the switch has been in position b for a long time before moving to position a at $t = 0$. Repeat parts (a) and (b).

3. Step Response with Dependent Source

The switch in the circuit in Fig. 3 has been open a long time before closing at $t = 0$. Find $i_o(t)$ for $t \geq 0$.
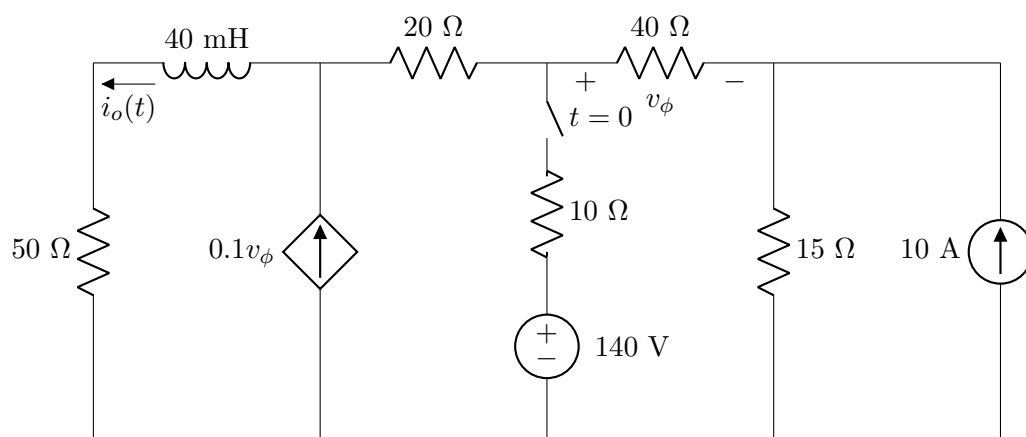

Figure 3: Circuit for problem.

4. Step Response of an RL Circuit with Multiple Sources

The switch in the circuit in Fig. 4 has been open a long time before closing at $t = 0$. Find $v_o(t)$ for $t \geq 0^+$.
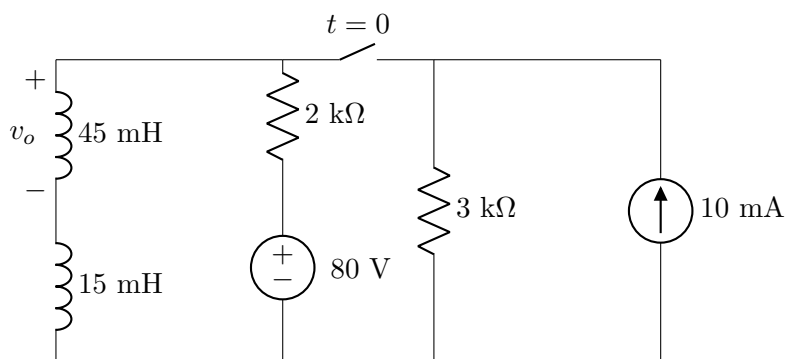

Figure 4: Circuit for problem.

5. RC Circuit with Switch and Multiple Sources

Assume that the switch in the circuit of Fig. 5 has been in position a for a long time and that at $t = 0$ it is moved to position b.
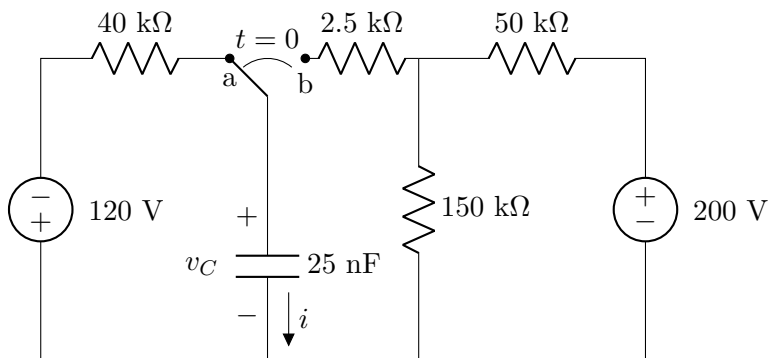

Figure 5: Circuit for problem.

a) Find $v_C(t)$ where $t \geq 0$.

b) Next find the expression for $i(t)$ where $t \geq 0^+$.

6. Step Response with Dependent Voltage Source

The switch in the circuit shown in Fig. 6 has been in the OFF position for a long time. At $t = 0$, the switch moves instantaneously to the ON position. Find $v_o(t)$ for $t \geq 0$.
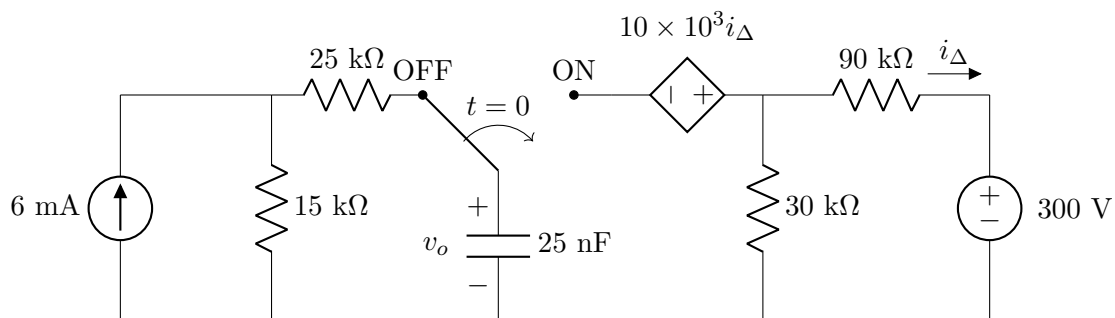

Figure 6: Circuit for problem.

7. Sequential Switching in RL Circuit

The action of the two switches in the circuit seen in Fig. 7 is as follows. For $t < 0$, switch 1 is in position a and switch 2 is open. This state has existed for a long time. At $t = 0$, switch 1 moves instantaneously from position a to position b, while switch 2 remains open. Ten milliseconds after switch 1 operates, switch 2 closes, remains closed for 10 ms and then opens. Find $v_o(t)$ 25 ms after switch 1 moves to position b.
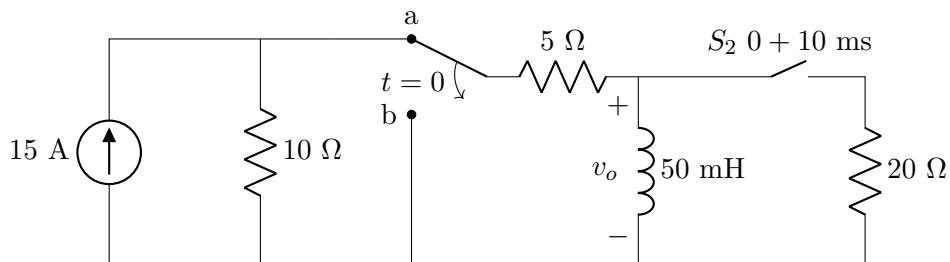

Figure 7: Circuit for problem.

8. Sequential Switching with Capacitor

There is no energy stored in the capacitor (i.e., both switches are open) in the circuit in Fig. 8 when switch 1 closes at $t = 0$. Switch 2 closes 2.5 ms later. Find $v_o(t)$ for $t \geq 0$.
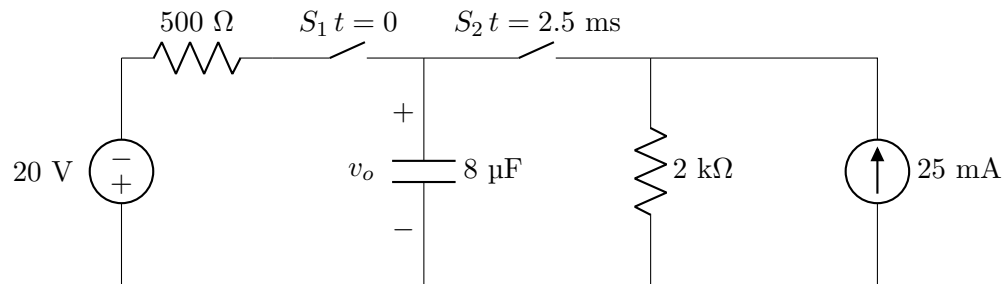

Figure 8: Circuit for problem.

9. Unstable RL Circuit with Dependent Source

The inductor current in the circuit in Fig. 9 is 25 mA at the instant the switch is opened. The inductor will malfunction whenever the magnitude of the inductor current equals or exceeds 5 A. How long after the switch is opened does the inductor malfunction?
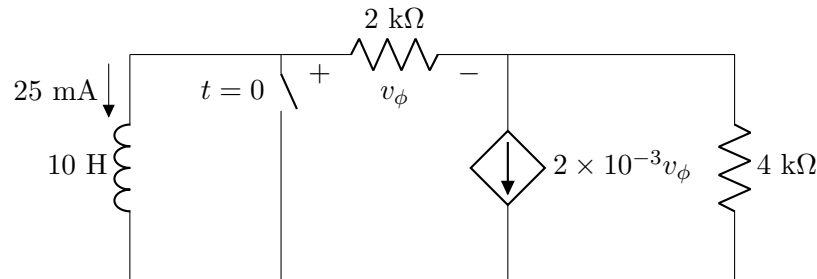

Figure 9: Circuit for problem.