Homework 3

Due time: 10 p.m. Nov. 2nd, 2024

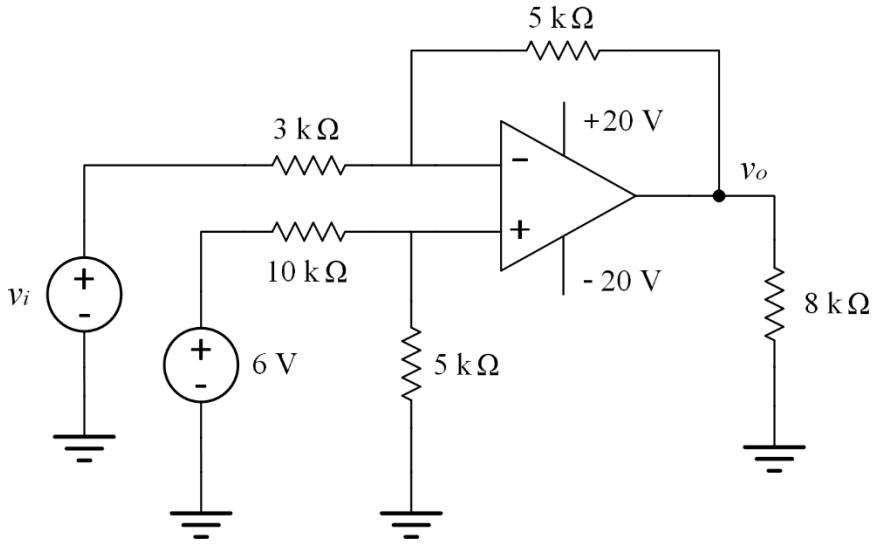
Turn in your hard-copy hand-writing homework at the entrance of

Room 3-324 SIST #3 Building.

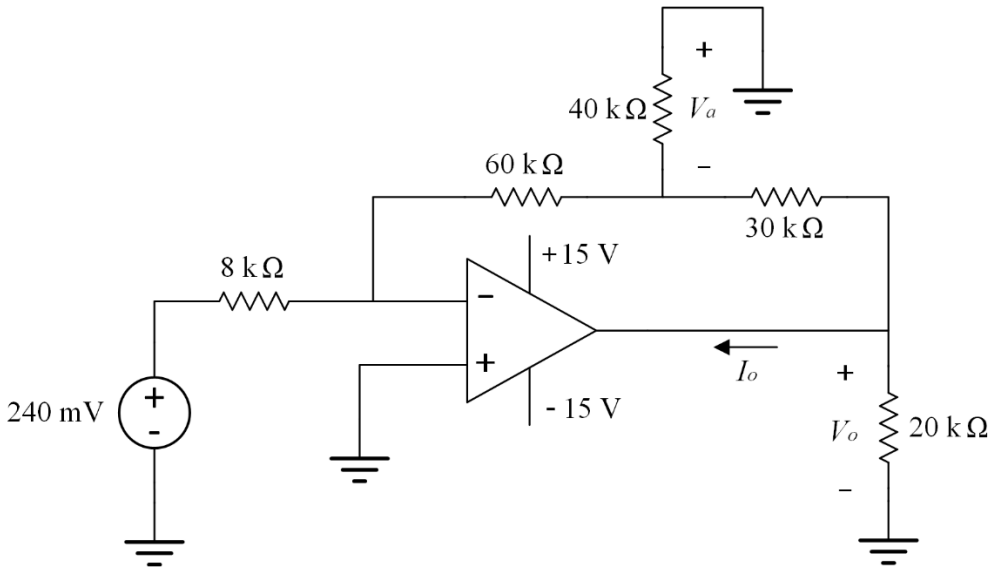
Rules:

- 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.
- All final answers must be rounded to **two decimal places**, and include the **appropriate units**.

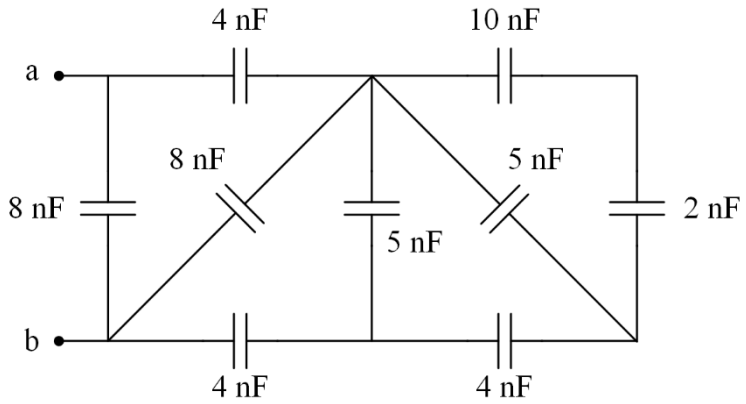
1. Consider the circuit given below, the ideal operational amplifier is working in the linear region. Find the relationship between v_o and v_i.



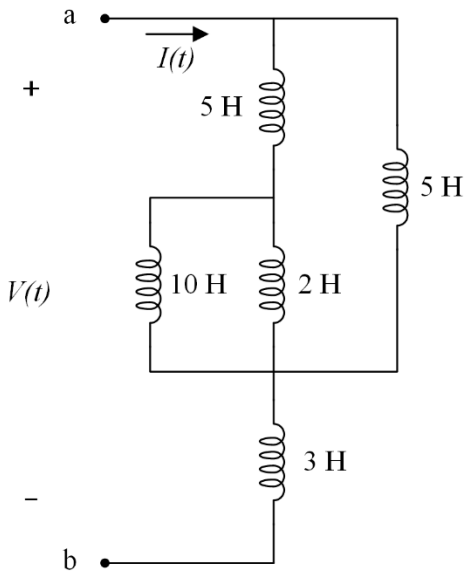
2. The op amp in the circuit below is working in the linear region, calculate:
   a. V_a
   b. V_o
   c. I_o



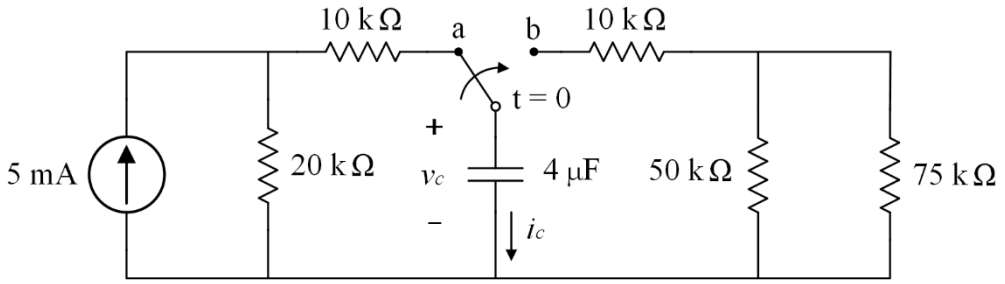
3. Find the equivalent capacitance C_{ab} of the circuit.



4. For the circuit below, $I(0^-) = 0\ A,$ and let $V(t) = 8e^{-3t}\ V$. The initial energy stored in all inductors is $0\ J$.
   a. Calculate the equivalent inductance L_{ab}.
   b. Find $I(t)$ for $t > 0$.



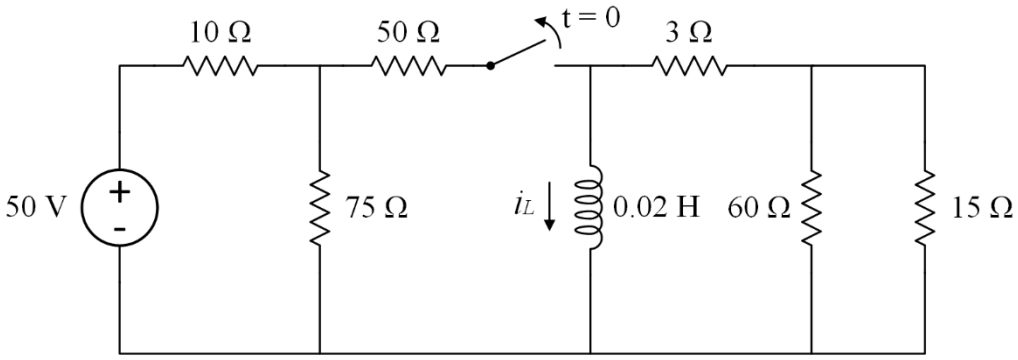
5. In the circuit shown, the switch is instantly moved from node **a** to **b** at $t = 0$. Assume the circuit was in steady state for $t < 0$. Determine the expressions for $v_c(t)$ and $i_c(t)$ for $t > 0$.



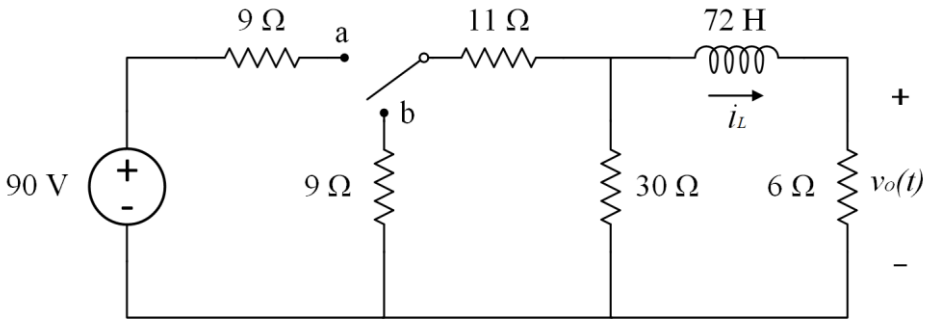
6. For the circuit below, the switch has been closed for a long time. At $t = 0$, the switch is opened.

a. Determine $i_L(t)$ for $t > 0$.

b. Calculate the initial energy stored in the inductor. Then, find the percentage of this initial energy that is eventually dissipated in the 15 Ω resistor.



7. For the circuit below, the switch has remained in position **a** for a long time. At $t = 0$, the switch is instantly moved to position **b**. After 12 s, the switch is moved back to position **a** instantaneously.
   a. Find $v_o(t)$ for $t > 0$.
   b. Sketch the curve of $i_L(t)$ as a function of t.



8. For the op amp in the given circuit operating in the linear region, find $v_o(t)$ for $t > 0$.