EE 261 **Spring 2025** **Homework 6—Handwritten**

Due Monday, Feb. 24, 2025 by 11:59 p.m.

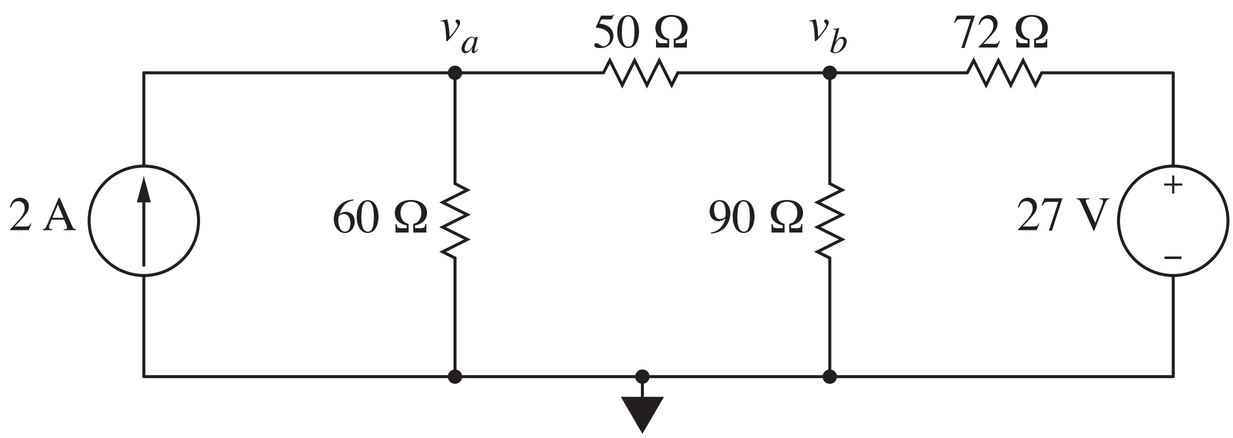
NOTE: This is only the "handwritten" portion of Homework 6. There are also problems you must do online via the Mastering site. For this handwritten portion, you must submit a PDF scan of your work at Canvas. Please ensure your work is contained in a single file and is legible.

You must also complete the problems on the following pages which made up the second exam in this course from a previous semester. You may print this file and do your work on these pages as you would for the exam, or you may provide your solution on separate paper (or via some other document-capture technique that shows your work).

Shown below are the rules that pertained to this exam, but you are free to treat this assignment like any other homework assignment. These rules are provided merely so that you can become familiar with them as the rules for your exam on Feb. 26th will be similar.

The rules:

- Relax!
- Closed book.
- Closed notes except you are allowed two $8.5'' \times 11''$ sheets of notes (whether handwritten or typeset or some combination thereof). You may use the front and back for a total of four pages.
- All work must be your own. Merely *looking* at the work of others is cheating and may carry all the consequences associated with cheating. Focus on doing your best while completely ignoring your classmates.
- **No work, no credit.** Show your work.
- **Neatness and clarity count.** If your work can't easily be interpreted, you won't get credit.
- You may use the "standard" scientific functions of a calculator. Programmed calculations are not permitted. (A programmable calculator is allowed, but you are not allowed to program it or use pre-installed programs.)
- No cell phones or other electronic devices (other than a calculator).
- If you submit your test before 50 minutes from the start of the exam, the number of missed points will be tripled. Take your time and check your work!
- The value of each question is indicated within brackets, e.g., [10]. (Questions with equal value are not necessarily of equal difficulty.)
- Unless told otherwise, you are free to use any suitable approach to obtain the answer. Just be sure to properly document your work so it is clear how you arrived at the answer.
- When asked to provide an equation, you merely need to write the correct equation. You do not need to reduce or simplify it.
- Note: The answers to all the questions can be obtained without significant work. If you find yourself doing a lot of work, you may want to pause and rethink what you are doing.



v_a
50 Ω
v_b
72 Ω
2 A
60 Ω
90 Ω
27 V
+
−

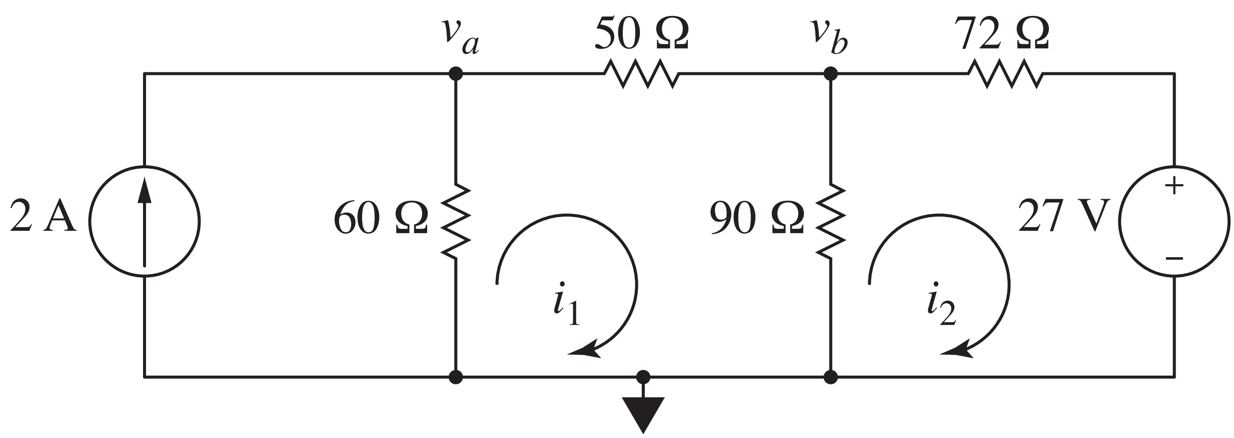
1. The following questions pertain to the circuit shown on the previous page.
   Hints: Your answers should work out to be whole numbers. If not, keep trying. Voltage division may come in handy.

   (a) **[6]** What is the equivalent resistance seen by the current source *when the **voltage** source is deactivated*?

   (b) **[6]** What is the voltage v_a *when the **voltage** source is deactivated*?

   (c) **[6]** What is the voltage v_b *when the **current** source is deactivated*?

   (d) **[6]** What is the voltage v_a *when the **current** source is deactivated*?



v_a
50 Ω
v_b
72 Ω
2 A
60 Ω
90 Ω
27 V
+
−
i_1
i_2

2. The following questions pertain to the circuit shown on the previous page. You merely need to write the correct form of the requested equations. You do not need to solve them.

   (a) **[5]** What is the node-voltage equation (i.e., KCL equation) that pertains to v_a?

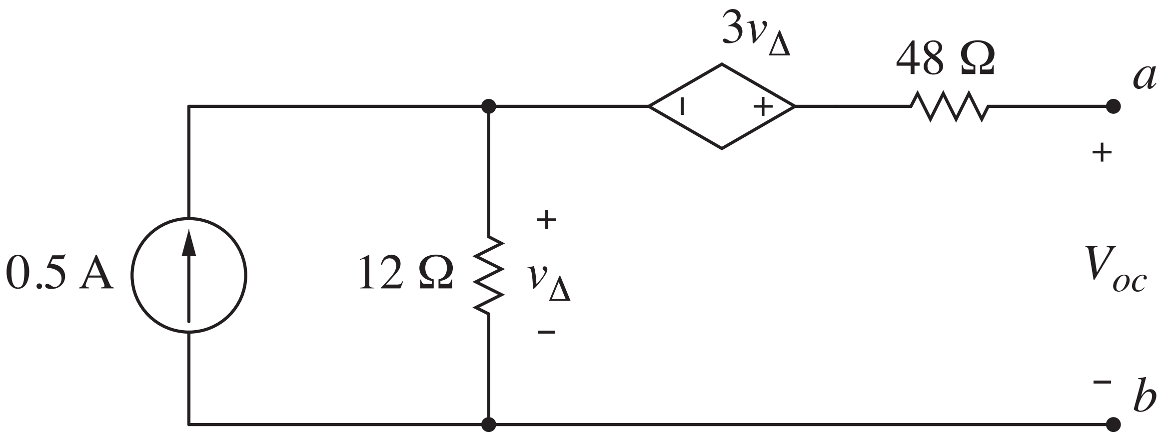
   (b) **[5]** What is the node-voltage equation (i.e., KCL equation) that pertains to v_b?

   (c) **[5]** What is the mesh-current equation (i.e., KVL equation) that pertains to i_1?

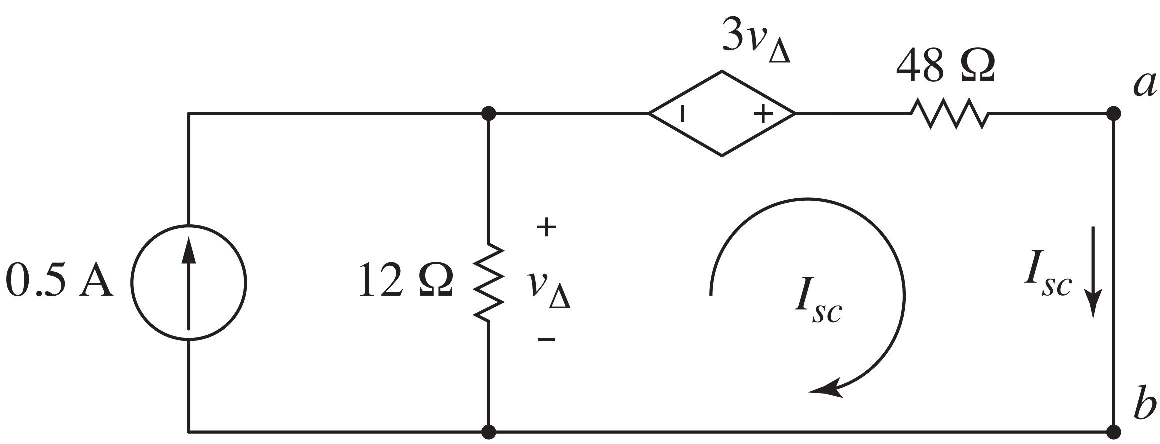
   (d) **[5]** What is the mesh-current equation (i.e., KVL equation) that pertains to i_2?

   (e) **[5]** Assume you solved for the mesh currents but you want v_a. What is the expression you would use to obtain v_a in terms of the mesh currents?

Aside: Although not required, using these equations you could find v_a which should be the same as the sum of the answers to parts (b) and (d) of question 1.



(a)



(b)

3. We want to find the Thévenin equivalent of the circuit shown on the previous page which is depicted with both an open circuit, which pertains to part (a), and a short circuit, which pertains to parts (b) through (d).

   (a) **[6]** What is the open-circuit voltage V_{oc}? (**Hint**: First determine what v_Δ must be.)

   (b) **[4]** Assume we want to use mesh analysis to find the short-circuit current I_{sc}. What is v_Δ in terms of I_{sc}?

   (c) **[5]** Write the mesh equation that pertains to I_{sc}. You merely need to write the equation. Your equation should have I_{sc} as the only unknown. (Your answer to (b) comes in handy.)

   (d) **[5]** Given your answer to part (c), what is I_{sc} (provide a numeric value)?

   (e) **[5]** What is the Thévenin equivalent resistance of this circuit?

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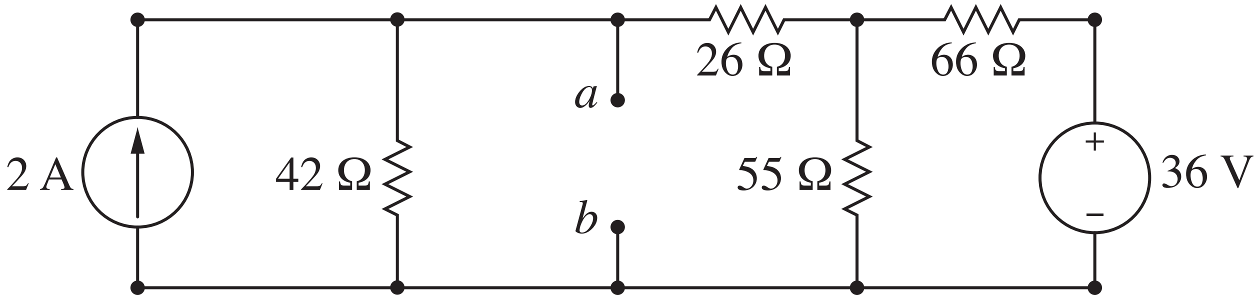
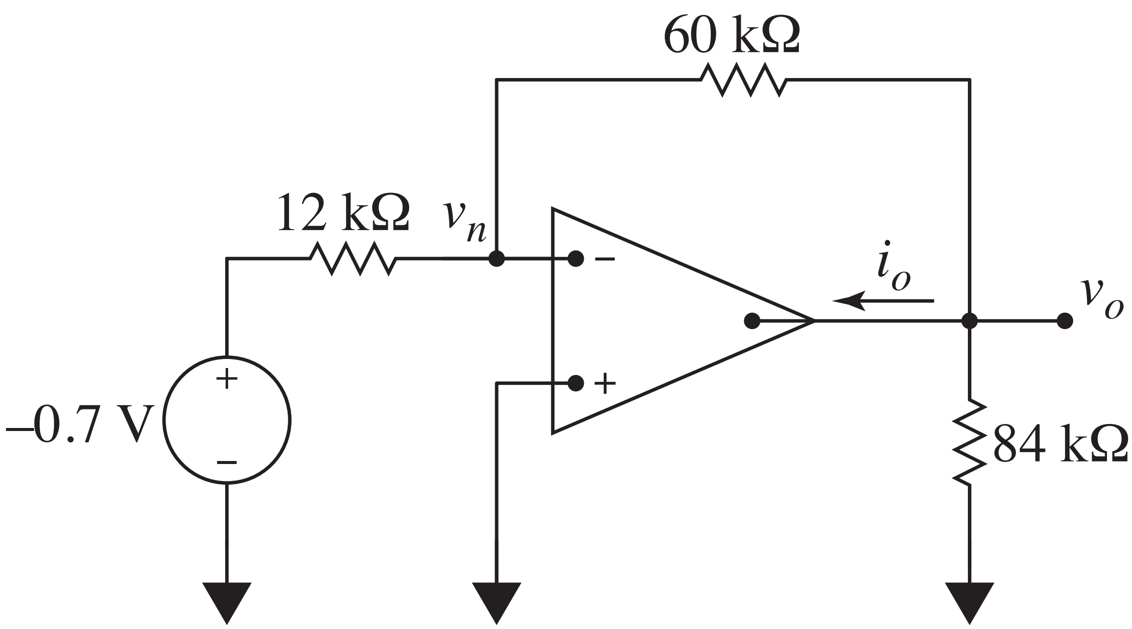


4. **[8]** For the circuit shown above, what load resistance placed between the terminals a and b will maximize the power delivered to that load?


60 kΩ
12 kΩ
v_n
i_o
v_o
–0.7 V
+
–
84 kΩ

5. The following questions pertain to the circuit shown on the previous page in which the op-amp is not saturated.

   (a) **[3]** What is the voltage v_n?

   (b) **[5]** Write the KCL equation that pertains at the inverting terminal, i.e., the v_n terminal. (You don't have to do anything with this equation other than write it.)

   (c) **[5]** Given your answer to (b), solve for the voltage v_o (provide a numeric value).

   (d) **[5]** What is the output current i_o? (You could start by writing the KCL equation that pertains at the output terminal, leaving the output voltage as merely v_o. Having obtained the equation, you can plug in the value you obtained for v_o in part (c).)