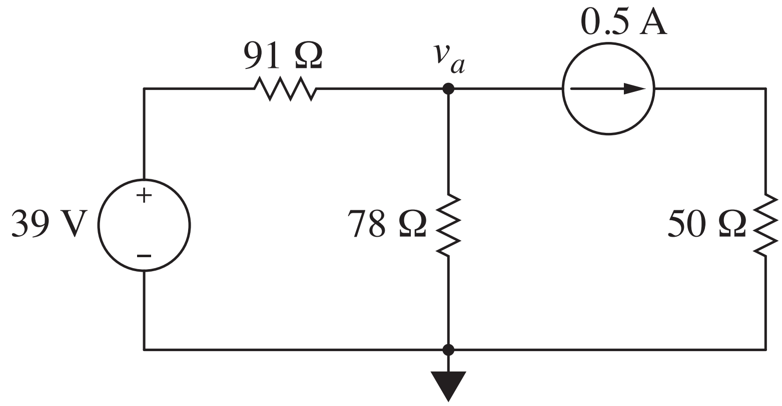
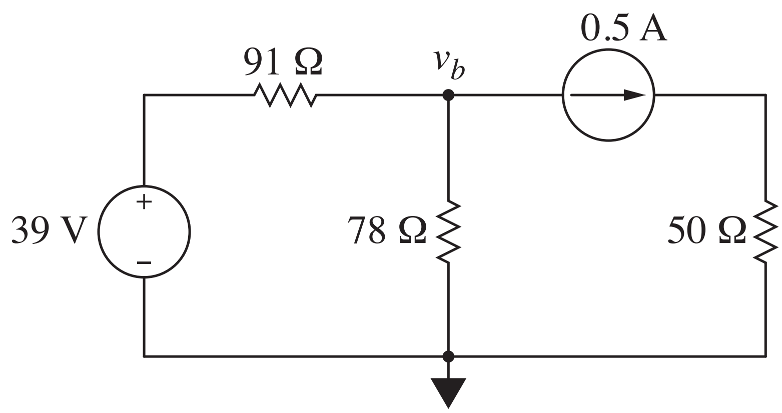
TEST #2 **EE 261** **Spring 2025**

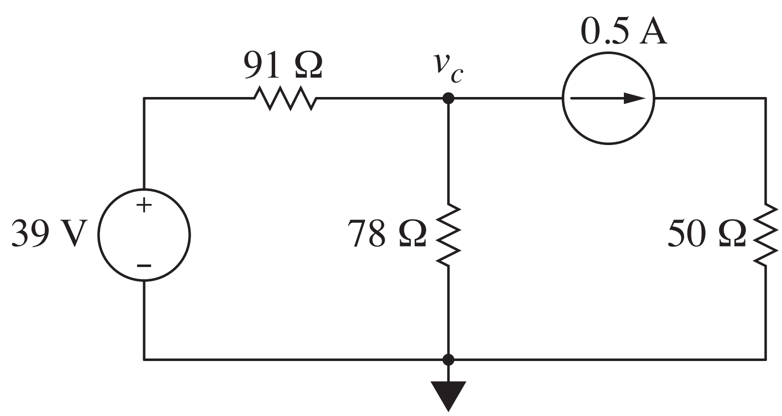
NAME: ______________________________

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.


0.5 A
91 Ω
v_a
39 V
+
−
78 Ω
50 Ω
(a)


0.5 A
91 Ω
v_b
39 V
+
−
78 Ω
50 Ω
(b)

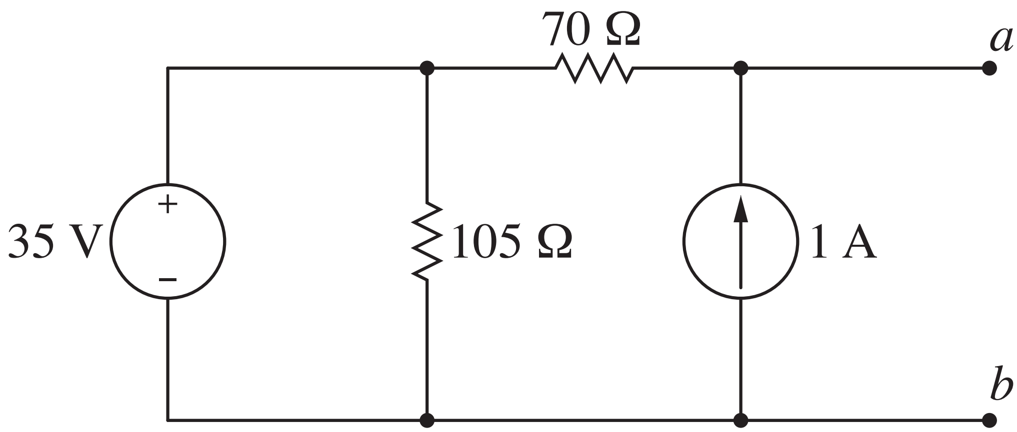

0.5 A
91 Ω
v_c
39 V
+
−
78 Ω
50 Ω
(c)

1. The following questions pertain to the circuits shown on the previous page which are actually the same circuit but labeled slightly differently to match the separate scenarios you are asked to consider.

   (a) **[6]** In circuit (a), what is v_a when the current source is deactivated and the voltage source is on?

   (b) **[6]** In circuit (b), what is v_b when the voltage source is deactivated and the current source is on?

   (c) **[6]** In circuit (c), what is v_c when both sources are on? The way in which you obtain v_c is up to you and you could, in fact, simply use your answers from (a) and (b), but that would be a bad idea. Better to use a different approach as this can serve to verify the answers above (or point out the need to rethink your prior work).



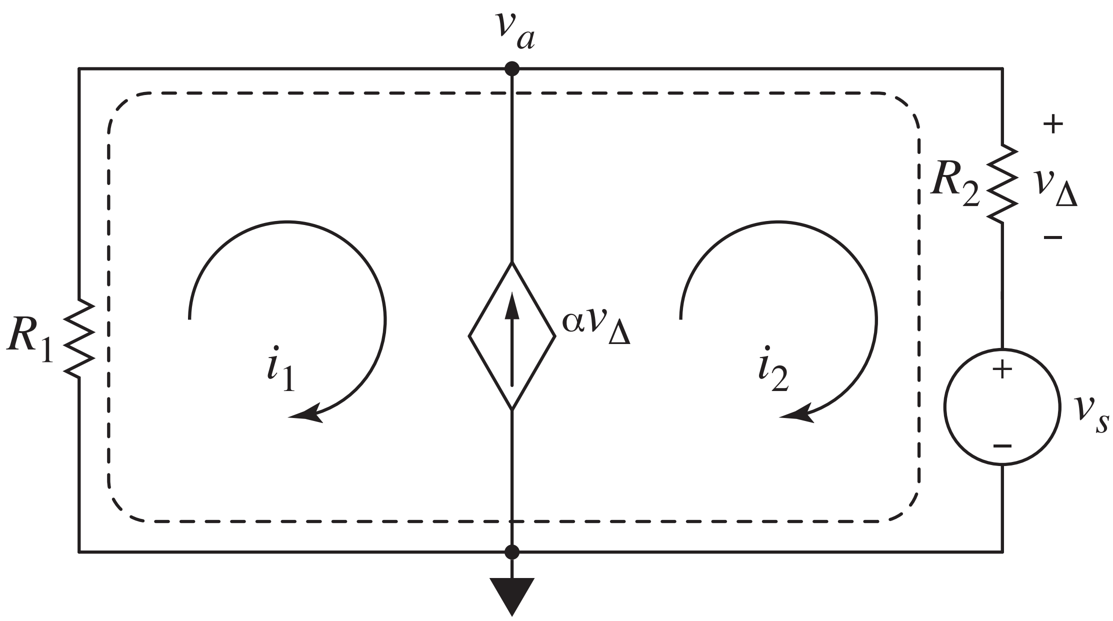
70 Ω
a
35 V
+
−
105 Ω
1 A
b

2. The following questions pertain to the circuit shown on the previous page for which we wish to find the Norton equivalent circuit.

   (a) **[7]** What is the Norton resistance?

   (b) **[7]** What is the Norton current?

   (c) **[4]** If a load resistor is attached between the terminals a and b that maximizes the power delivered to the load, what will that power be? (Use positive for consumed power and negative for delivered power.)



v_a
R_1
i_1
αv_Δ
i_2
R_2
+
v_Δ
−
+
v_s
−

3. We want to analyze the circuit on the previous page using mesh analysis. Although you are not given numeric values, assume R_1, R_2, α, and v_s are known. Because of the current source that is common to the two meshes, we must use a super mesh which is indicated by the dashed path. Provide the requested equations or expressions.

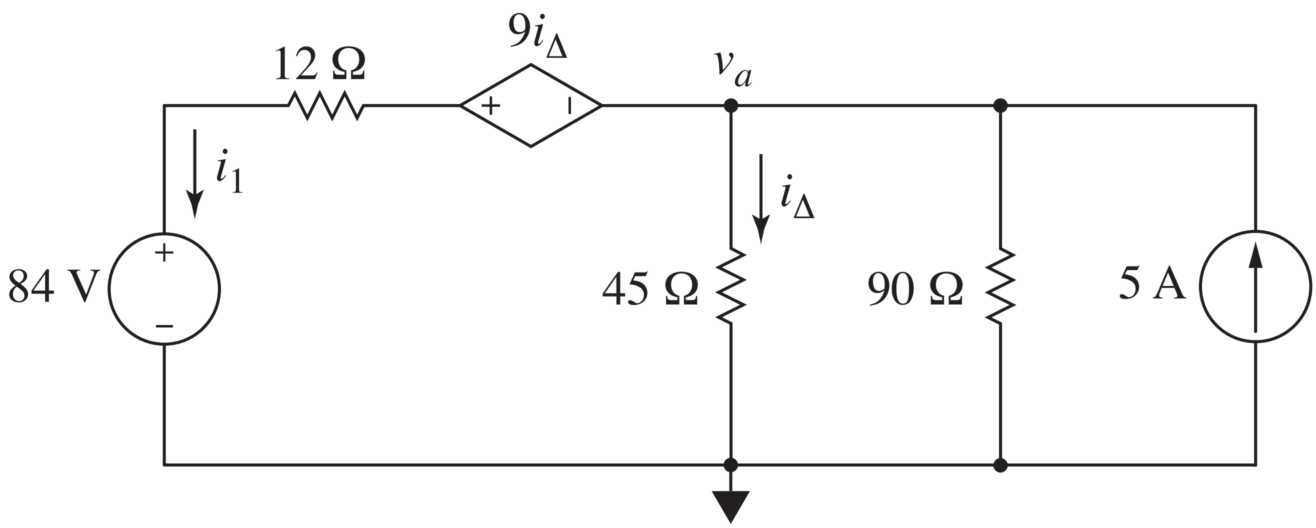
   (a) **[5]** What is v_Δ in terms of a mesh current or the mesh currents? (There is a complicated answer and a simple answer. The correct answer is the simple one that merely requires Ohm's law.)

   (b) **[5]** What is the constraint equation that relates i_1 and i_2? (The only unknowns in this equation should be the mesh currents.)

   (c) **[5]** What is the mesh equation that pertains to the super mesh? (The only unknowns in this equation should be the mesh currents.)

   (d) **[4]** What is an equation for v_a in terms of i_1? (Your equation may include any term other than i_2.)

   (e) **[4]** What is an equation for v_a in terms of i_2? (Your equation may include any term other than i_1.)



$9i_\Delta$
12 Ω
v_a
+
−
i_1
i_Δ
84 V
+
−
45 Ω
90 Ω
5 A

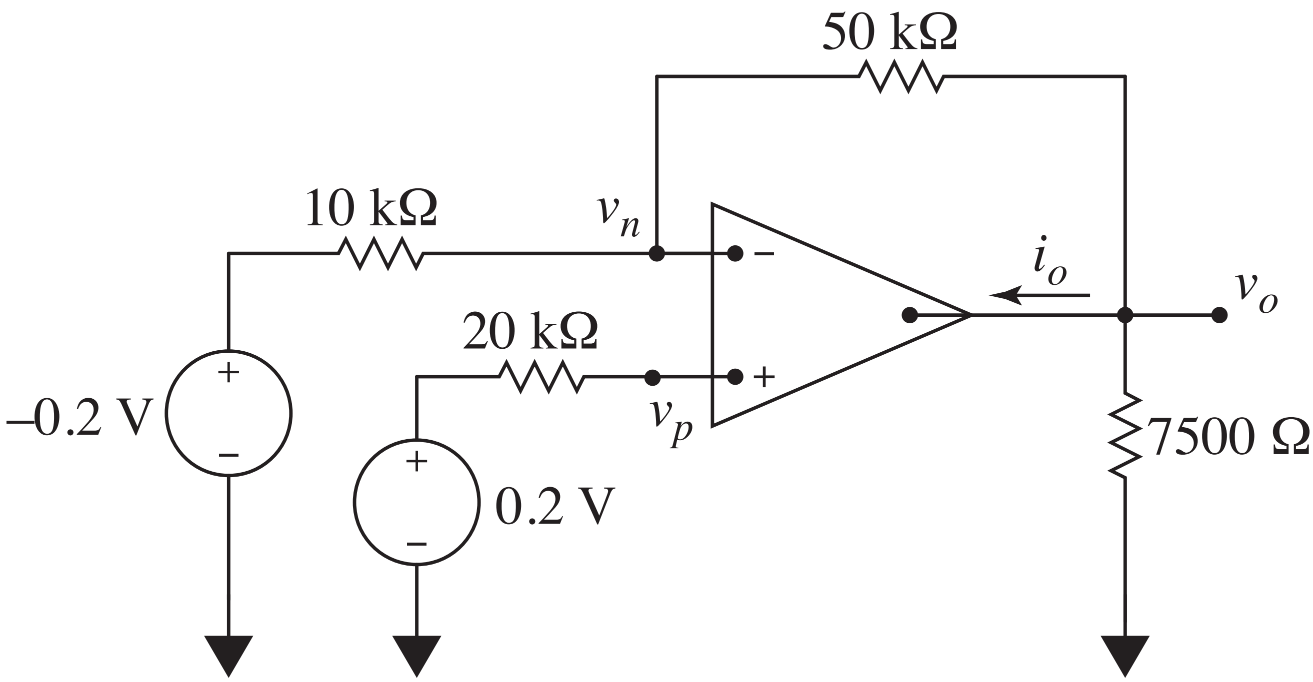
4. We want to find v_a in the circuit on the previous page using node analysis.

   (a) **[3]** What is i_Δ in terms of v_a?

   (b) **[5]** What is i_1, the current into the voltage source, in terms of v_a? Your answer should only have numeric values as well as v_a. Hint: Think about what is in series and the how the current through one of these elements in particular can be expressed.

   (c) **[5]** What is the node equation (KCL) that pertains for the v_a node? (You merely need to write the equation. You do not need to simplify it—yet.)

   (d) **[6]** Using your work above, what is v_a? (Provide a numeric value.)


50 kΩ
10 kΩ
v_n
i_o
v_o
20 kΩ
–0.2 V
v_p
7500 Ω
0.2 V

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

   (a) **[5]** What is the voltage v_p?

   (b) **[5]** What is the voltage v_n?

   (c) **[6]** Write the KCL equation that pertains at the inverting terminal, i.e., the v_n terminal. (Here you merely need to write this equation. You'll use it to solve for v_o in part (d).)

   (d) **[6]** Given your answer to (c), what is the voltage v_o?