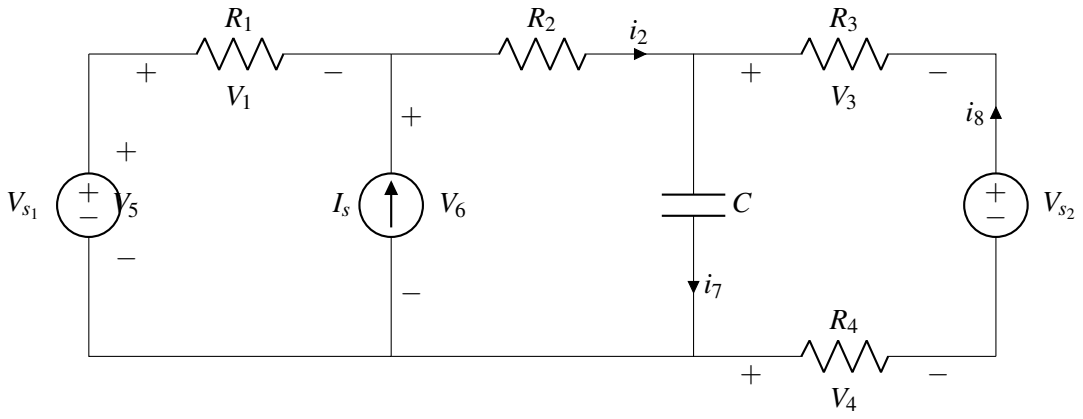
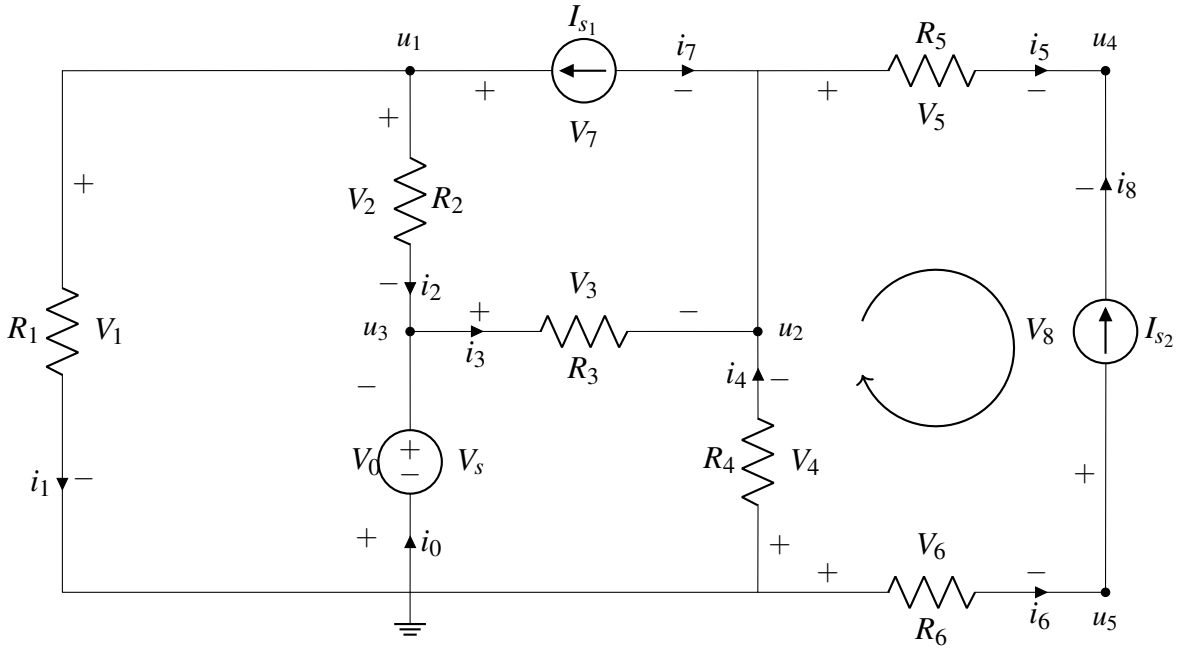
EECS 16A Designing Information Devices and Systems I
Spring 2023 Exam Prep 11A

1. Just Solvin' a Circuit (Fall 2022 Midterm 2 Question 4)

(a) For **this part only**, consider the following circuit. For *each* element in the circuit **(including the sources)**, label the missing current or voltage **using passive sign convention**. Please label directly on the given circuit below. Voltage labels should have +/- terminals. For example, the voltage source V_{s_1} has its voltage already labeled (V_5) but is missing its current label.



Now, **for the remaining parts**, consider an entirely different circuit which is already labeled.



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(b) Write the KVL equation for the labeled loop in terms of element voltages (V_1, V_2, ... ,V_8) only.

(c) Write the KCL equations for nodes u_1 and u_2 only in terms of I_{s1}, I_{s2}, node voltages, and resistances.

(d) Solve for the voltage V_1 across and current I_1 through R_1 given the following values:

$$R_1 = 4\Omega,\ R_2 = 2\Omega,\ R_3 = 1\Omega,\ R_4 = 1\Omega,\ R_5 = 7\Omega,\ R_6 = 4\Omega$$
$$V_s = 6V,\ I_{s1} = 9A,\ I_{s2} = 3A$$

You do not need to solve for all quantities in the circuit nor use all of the values above in your answer.

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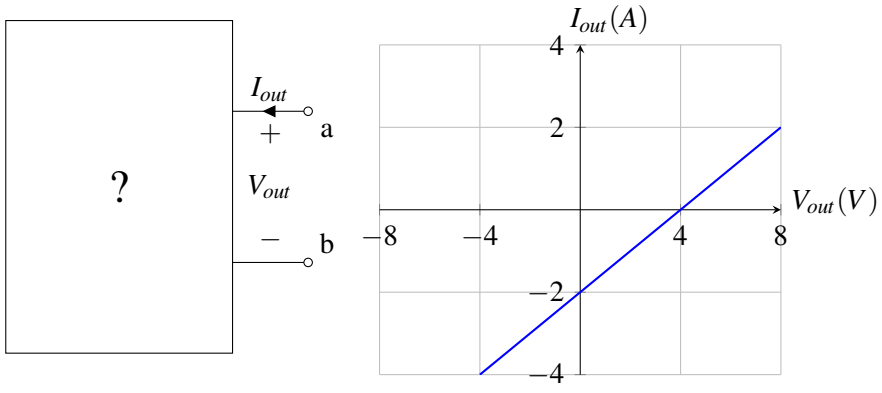
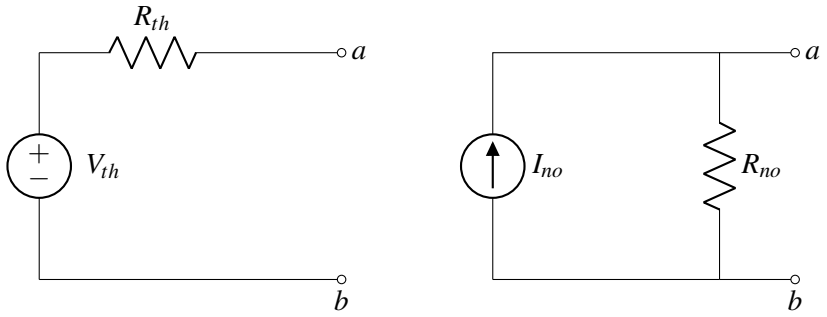
2. Making circuits equivalent (Fall 2022 Midterm 2 Question 7)

(a) Suppose you are given a mysterious circuit element shown below. You are also given the IV curve of the circuit at nodes a and b (also shown below).



Now you would like to model this mysterious circuit two different ways. One with each circuit below:



Find the values V_{th}, R_{th}, I_{no}, and R_{no} such that all 3 circuits (the mystery circuit and the two above) are equivalent. **Note the direction of I_{out} in the mysterious circuit!**

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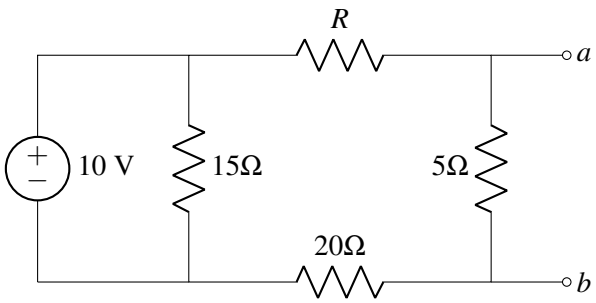
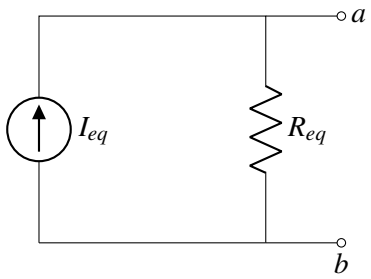
(b) Suppose now we are given a new circuit (shown below), but this time we know all the components except one resistor R:



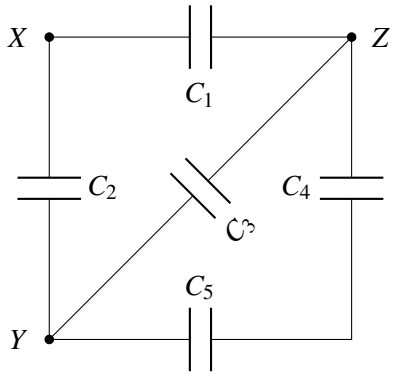
We also know that we can model the circuit at nodes a and b using the following equivalent circuit:



Find the resistor value R in the new circuit such that $I_{eq} = 0.25A$.

3. Capacitors in the Wild (Fall 2022 Midterm 2 Question 8)

(a) For the following circuit, find the equivalent capacitance between the specified nodes in terms of the given capacitors, C_i. You may use the *parallel operator* $\|$ for simplification (e.g. a valid answer format could be $C_{eq} = C_6 + (C_7 \parallel (C_8 + C_9))$).



(b) (4 points) Find the equivalent capacitance between nodes X and Y.

(c) (4 points) Find the equivalent capacitance between nodes Y and Z.