Name: _____UT EID: _____Lecture Instructor: _____

ECE 302H **Please answer ALL questions**

100 points total.

Fall 2023, Midterm Exam I **Time: 600-800 PM**

21 Sept. 2023

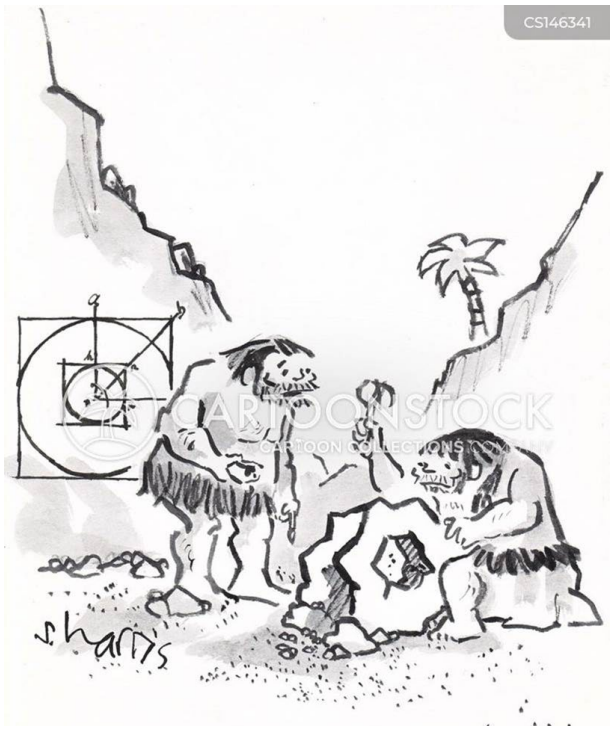
Instructions for turning in your exam:

After completing your exam, you may turn on your phones

0) Please write your EID on every page of the exam
1) Log in to Gradescope and find MT1 or Midterm I
2) For each problem: a. If your response is ≤ 1 page, you may choose the option to have Gradescope take a picture of your page
b. If your response is ≥ 1 page, you must take pictures of each page with your camera app and choose the option to upload the solution

3) DOUBLE CHECK YOUR SUBMISSION
4) Turn in your paper exam to the proctor (this will be used as a reference)

Q1	a	6 points
	b	6 points
	c	6 points
	d	7 points
Q2	a	5 points
	b	5 points
	c	15 points
Q3	a	6 points
	b	19 points
Q4	a	8 points
	b	12 points
	c	5 points



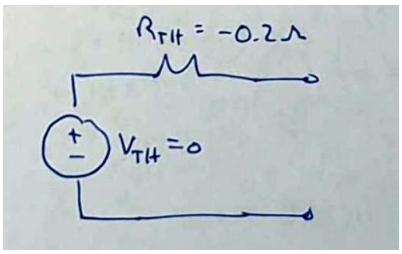
Early ECE 302 Labs

UT EID:

1. (a)

Not linear.

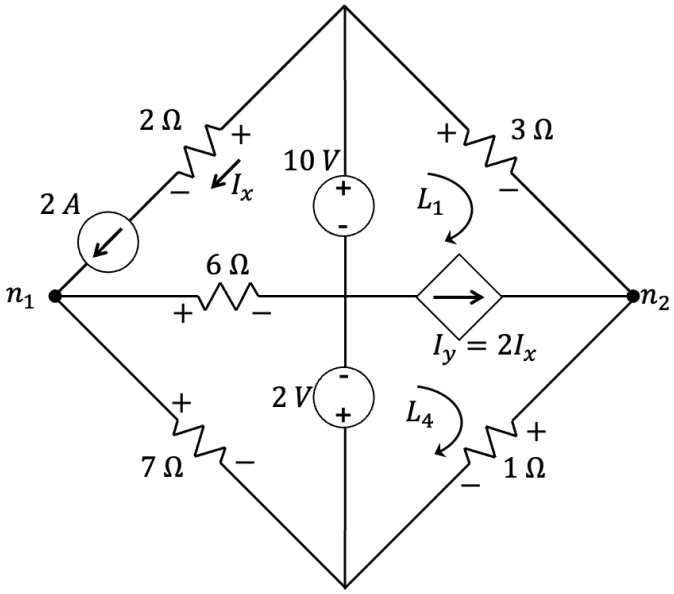
(b)



(c)

5

2. (a) For the circuit, write down the KVL equations for loop 1 (L_1) and loop 4 (L_4). If a quantity is unknown, give it a label and label it in the circuit.



Circuit for Q2

Loop 1: $3I_{3\Omega} - V_y - 10\ V = 0$ for labels defined as shown.

Loop 4: $1I_{1\Omega} + 2\ V + V_y = 0$ for labels defined as shown.

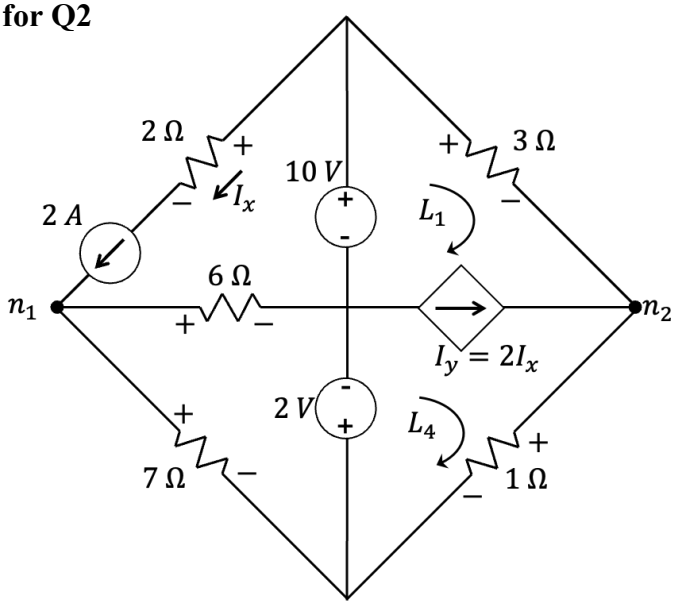
(b) For the above circuit, write down the KCL equations for nodes n_1 and n_2, making sure that the signs of your labels are consistent with part (a).

n_1: $2A - I_{6\Omega} - I_{7\Omega} = 0$ for labels defined as shown.

n_2: $I_{3\Omega} + 4A - I_{1\Omega} = 0$ for labels defined as shown.

2.(c) What is the power of the dependent current source, and is it a supply or a dissipator?

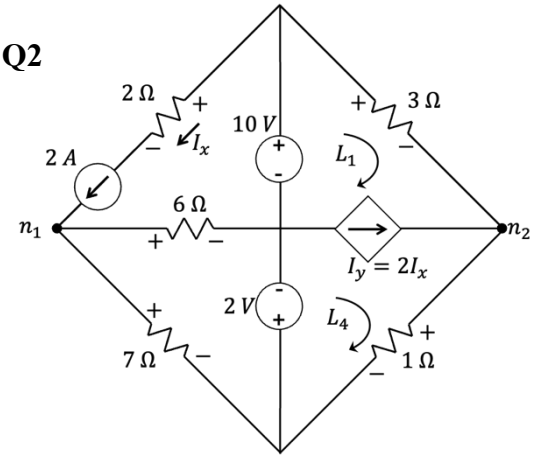
Circuit for Q2



$P_y = -28\ W, supply$

2(c) answer continued:

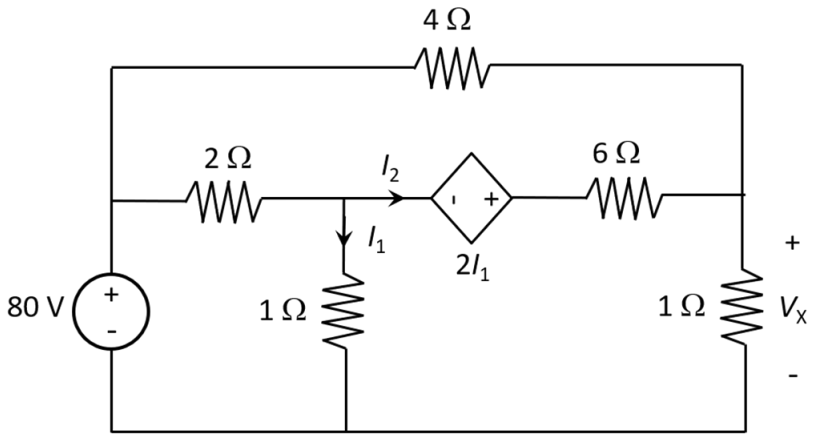
Circuit for Q2



3. (a) Two students are given a circuit which has 3 nodes *a, b, c* with voltages V_a, V_b, V_c.The first student chooses node *b* as ground and, using node voltage analysis, calculates $V_a = 1$ V, $V_c = -1$ V. If the second student chooses node *a* as ground, what should they calculate for V_b and V_c? Express your answer with appropriate units.

(a) $V_b = -1$ V, $V_c = -2$ V

(b) Determine V_X, I_1 and I_2 in the circuit below using node voltage analysis. Express your answer in decimal form to 3 significant digits with appropriate units.



Circuit for Q3(b)

$V_X = 21.8$ V, $I_1 = 21.8$ A, $I_2 = 7.27$ A

3(b) answer continued:

4. (a) A linear circuit has 2 independent sources (V_1 and I_1) and has a Thevenin voltage and resistance between two output nodes of V_{Th} and R_{Th}. When only source V_1 is deactivated, the Thevenin voltage and resistance of the resulting circuit between the same two output nodes are V_{Th1} and R_{Th1} respectively. When only source I_1 is deactivated, the Thevenin voltage and resistance of the resulting circuit between the output nodes are V_{Th2} and R_{Th2} respectively.

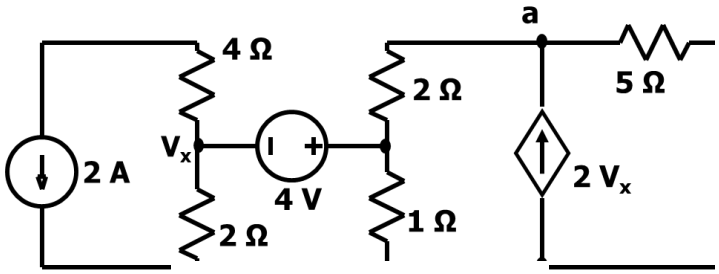
   (i) Write an equation relating V_{Th} to V_{Th1} and V_{Th2}. Briefly explain your answer.

If V_1 is deactivated (only one independent source I_1 is active), we have a $V_{OC1} = V_{Th1}$
Similarly $V_{OC2} = V_{Th2}$ when only V_1 is active and I_1 is deactivated.
Using the principle of superposition, $V_{OC} = V_{Th} = V_{OC1} + V_{OC2} = V_{Th1} + V_{Th2}$

   (ii) Write an equation relating R_{Th} to R_{Th1} and R_{Th2}. Briefly explain your answer.

The solution can be visualized by using the external source method to measure R_{Th}. In this method, ALL independent sources are deactivated before the Thevenin resistance is measured. Thus, it does not matter if one source (either V_1 or I_1) is initially deactivated; both of them must be deactivated before the Thevenin resistance is measured.
Hence, $R_{Th} = R_{Th1} = R_{Th2}$

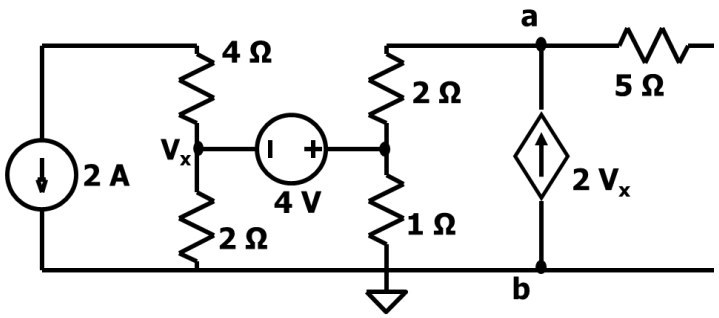
(b) Consider the linear circuit to right, with two independent sources. Find the Thevenin voltage between **a** and **b** using the principle of superposition after first calculating the Thevenin voltage due to



Circuit for Q 4(b)

each of the independent sources acting alone.

Circuit for Q 4(b)



Vab1 = $V_{Th\,1}$ = 20 V

Vab2 = V_{Th2} = 44 V

V_{Th} = 44 V +20 V = 64 V

(c) If the independent voltage source output (initially at 4 V as shown in the figure for 4(b)) falls to 3 V due to degradation from prolonged use, recalculate the Thevenin voltage between **a** and **b**.
[Hint: Remember that the circuit is linear, and you have already calculated the response due to the 4 V source]

We can use the linear properties of the circuit plus superposition. The 4 V source produces a V_{OC} of 44 V (from part (b)). Hence a 3 V source will produce a V_{OC} of (3/4)*44 V = 33 V

The overall Thevenin voltage (due to both independent sources acting together) is 20 V + 33 V = 53 V.