

Name: _____ UT EID: _____ Instructor _____

ECE 302

Please answer ALL questions

100 points total.

Fall 2024, Midterm Exam I

Time: 600-800 PM

26 Sept. 2024

PLEASE ATTEMPT ALL PROBLEMS AND SHOW ALL WORK!

WRITE ALL EXAM SOLUTIONS IN THE SPACES PROVIDED ON THE EXAM SHEETS.

YOU MAY USE THE BACK OF EACH PAGE FOR SCRATCH, BUT ONLY THE FRONT SIDES WILL BE SCANNED AND GRADED.

No class notes, books, homework assignments, or other materials are allowed. You may use a calculator for the exam. Any calculator that does not have phone/communication/photo capability is allowed. Your calculator's memory should not have any information or programs that are not allowed for use on the exam. You have 120 minutes from the start of the exam to complete the exam.

NOTES: Unless otherwise stated, you may assume all numerical quantities given in the exam problems are known to 3 significant figures, and calculate your answers accordingly. You must show all of your work to receive credit. If you need to make an assumption to answer a question, state it explicitly.

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 within the space for the answer, you should choose the option to have Gradescope take a picture of your page. You should scan all pages of this exam booklet including the first page and any blank pages in the correct order. Gradescope will automatically assign your answers to each question according to the template.

b. If your response does not fit in the space for the answer and you used extra sheets, you must take pictures of each page with your camera app and choose the option to upload the solution. You will need to assign the answer for each question in Gradescope.

3) DOUBLE CHECK YOUR SUBMISSION

4) Turn in your paper exam to the proctor (this will be used as a reference)

Q1 (25 points)

(a) (4 points) A lithium-ion battery in a smartphone produces 4 V between its terminals and supplies 1 A of current to the circuitry in the phone. Express your answers to the questions below to three significant digits.

(i) Calculate how many lithium ions must be flowing between the terminals of the battery per second. Lithium ions can be considered to have a positive charge equal to the magnitude of the electron charge = 1.6E-19 coulomb.

(ii) Calculate how much energy in joules is consumed by the phone in 1 day.

(b) (8 points) Consider circuit in figure 1b.

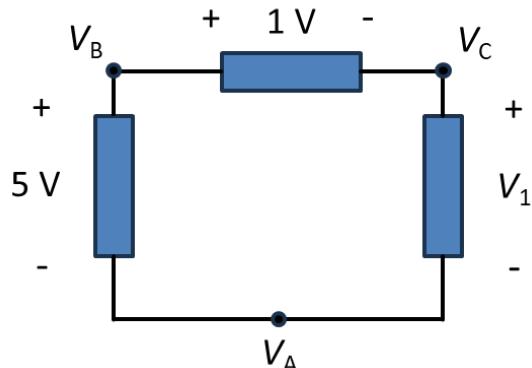


Figure 1b

(i) With A as ground, what are the numerical values of V_B , V_C ?

(ii) With B as ground, what are the numerical values of V_A , V_C ?

(c) (3 points) Consider the circuit in figure 1c.

With $V_{S1} = 1 \text{ V}$, $I_{S2} = 0 \text{ A}$ you find $V_L = 2 \text{ V}$.

With $V_{S1} = 0 \text{ V}$, $I_{S2} = 1 \text{ A}$ you find $V_L = 4 \text{ V}$.

Write an expression relating V_L , V_{S1} and I_{S2} .

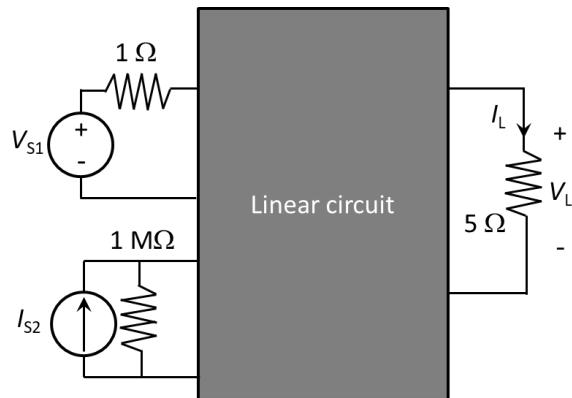


Figure 1c

(d) (5 points) Consider the circuits shown in figure 1d. Draw the Thevenin equivalent circuit making sure to label nodes a, b on your drawings.

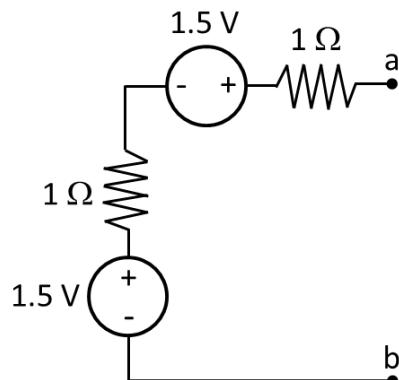


Figure 1d

(e) (5 points) Consider the circuits shown in figure 1e. Draw the Thevenin equivalent circuit making sure to label nodes a, b on your drawings.

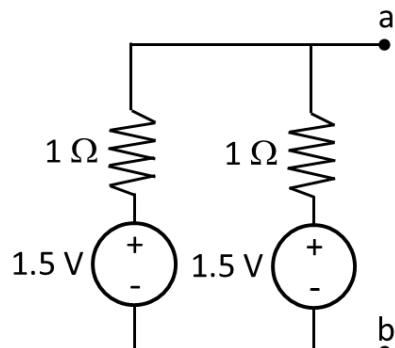
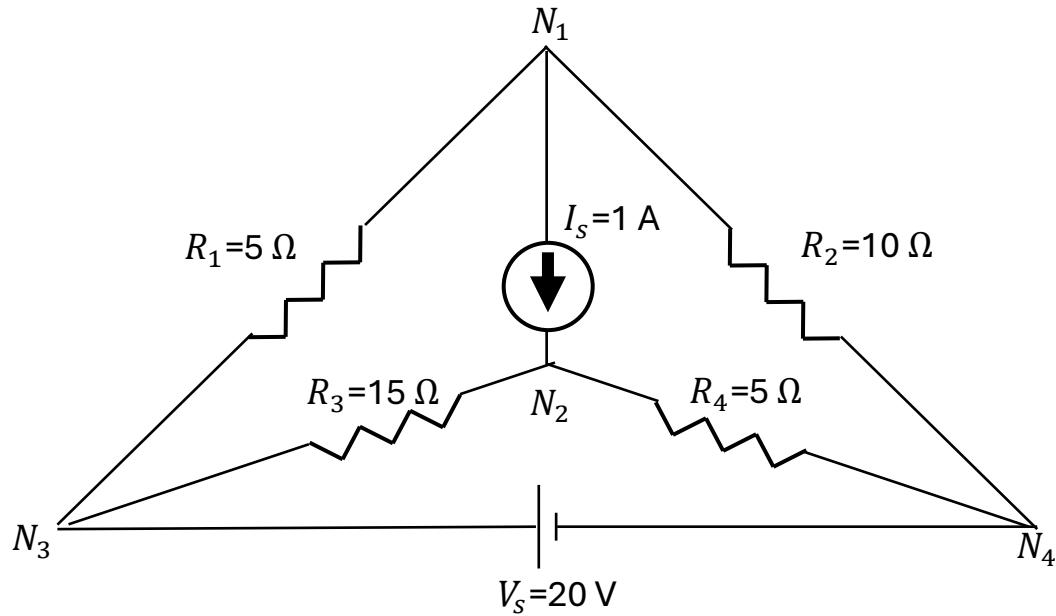


Figure 1e

Q2 (25 points) Consider the circuit to the below

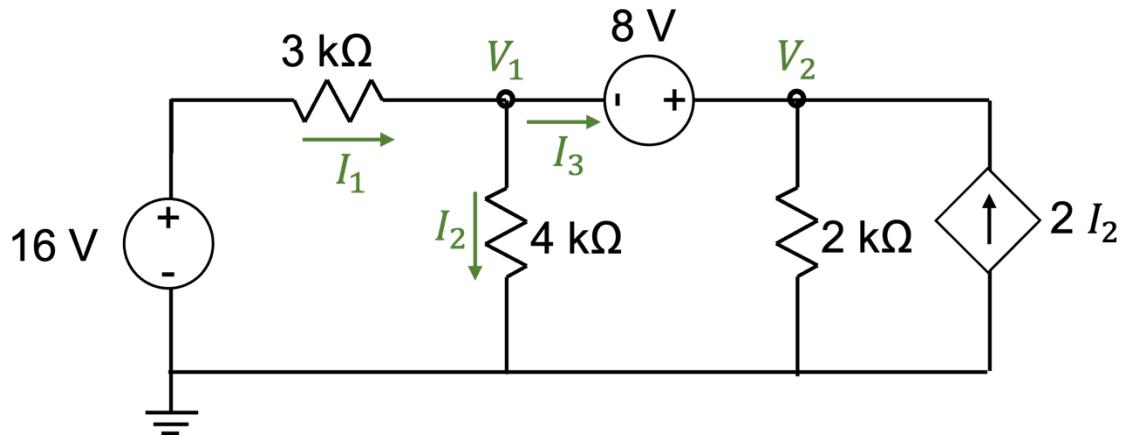


(a) (6 points) Write down KCL equations at node N_1 and N_2 . Please label all necessary currents on the circuit.

(b) (6 points) Write down KVL equations for loop $(N_3 \rightarrow N_1 \rightarrow N_4 \rightarrow N_3)$ and loop $(N_3 \rightarrow N_2 \rightarrow N_4 \rightarrow N_3)$. Please label all necessary voltages on the circuit.

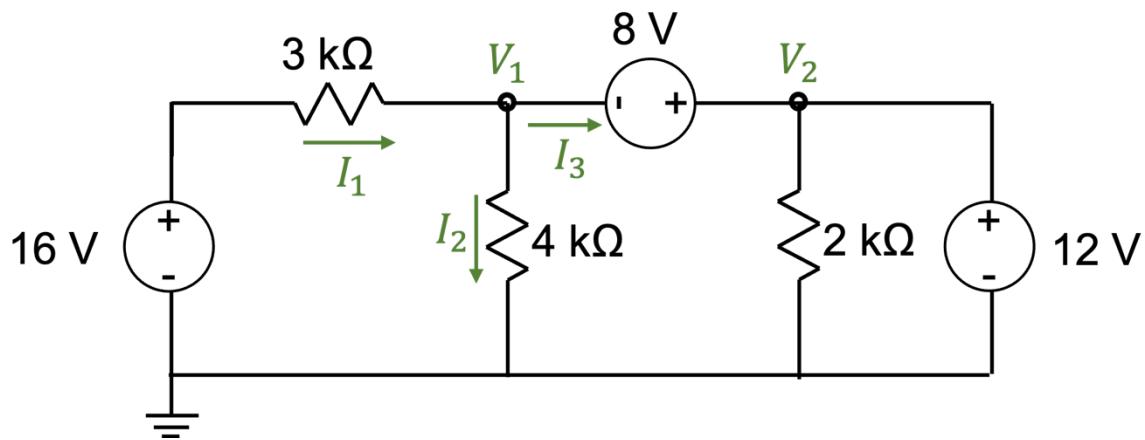
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(c) (13 points) What are the powers of the voltage source and current source? Do they supply or dissipate power?

Q3 (25 points)(a) (20 points) Solve the following circuit for V_1 , V_2 , I_1 , I_2 , and I_3 using node-voltage method.

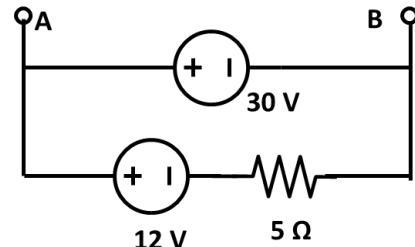
3 (a) answer continued:

(b) The right dependent current supply is replaced with a voltage source, as shown below. Solve for V_1 and V_2 of this modified circuit (here, any method is OK).



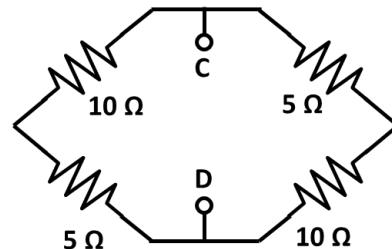
Q4. (25 points) Please find the Thevenin equivalent (V_{th} and R_{th}) of the following four circuits. Please clearly specify the method and reasonings for each step. For the final answer, please label the node names in the Thevenin circuit.

- (a) (5 points) Draw Thevenin equivalent circuit (V_{th} and R_{th}) between nodes A and B in figure Q4(a)



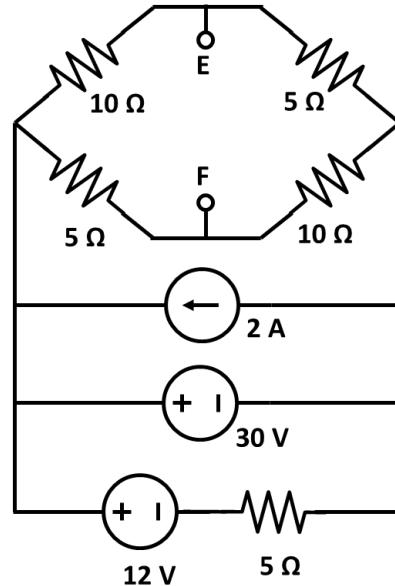
Q4 (a)

- (b) (5 points) Draw Thevenin equivalent circuit (V_{th} and R_{th}) between nodes C and D in figure Q4(b)



Q4 (b)

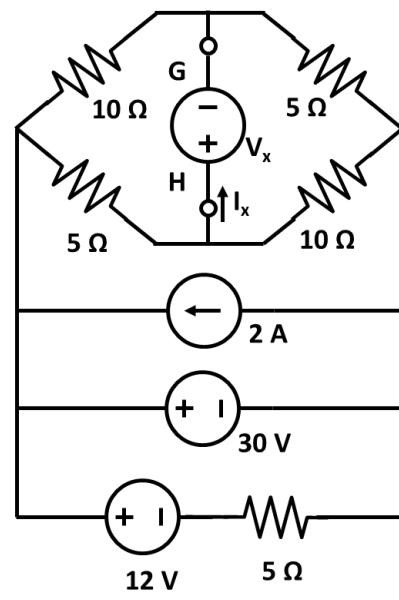
(c) (10 points) Draw Thevenin equivalent circuit (V_{th} and R_{th}) between nodes E and F in figure Q4(c)



Q4 (c)

4(c) answer continued:

(d) (5 points) We add a voltage source V_x between nodes E and F in Q4(c) to get the circuit in figure Q4(d). If the current I_x is 0 A, please find out the value of V_x . Hint: you may use the Thevenin equivalent circuit you found in Q4(c).



Q4 (d)