Mid-term exam

EE1C1 “Linear Circuits A”

Place: Drebbelweg Exam Hall 2
Date: 30-09-2025
Time: 9:00 – 11:00

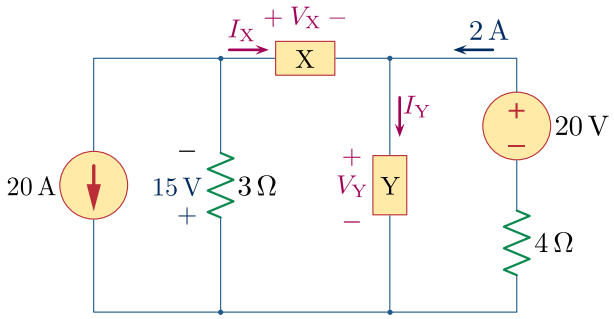
- This exam consists of 4 exercises.
- Each exercise accounts for **10 points**; the total number of points to be obtained is **40**. The exam grade is obtained by dividing the total number of points by 4, rescaling linearly the result to the 1-10 scale and rounding off to 1 decimal/to half-a-point, after accounting for the bonus points.
- **Each exercise must be solved on a separate double-sheet.** Writing more solutions on the same sheet may result in only one of the solutions being graded!
- Indicate your name and study number on **each** submitted sheet. **You must hand in (blank) signed sheets even for the exercises that you do not handle.**
- Students benefitting of the “Extra Time” (ET) rule are entitled to a 20 minutes extension of their exam provided they produce the relevant supporting document.
- Should any question not be completely clear, you are allowed to ask the instructors in the exam hall; the answer will be confined to rephrasing the text of the exercise such that to make it more intelligible.
- Should a part of an exercise depend on a previous result, mistakes made at a previous step will only be penalised once.
- Give your solution as completely as possible and never state numerical results without indicating how you derived them. **Simply stating numerical results will yield no points.**
- **When requested, fill in the measure units for all calculated quantities.** This holds for intermediate results but definitely for the final ones.
- Write clearly and avoid messy solutions. Should errors occur in your solution, cross the erroneous part out and give clear indications on where the correct solution resumes.
- For this exam you are allowed to use:
    i. a simple calculator – programmable and graphic calculators are explicitly prohibited;
    ii. a handwritten, double-sided A4 sheet with formulas.
- The text of this exam is offered only in English. Inasmuch as possible, instructors will assist you with the Dutch translation of formulations that you may have difficulties to understand.

The Linear Circuits team wishes you a lot of success!

- Take a new double-sheet -

Exercise 1

Consider the circuit in the figure below, with the voltage polarities and the current directions being specified for each element. Some values of these voltages and currents are listed in the Table.



Element	V (V)	I (A)	P (W)
20 A current source		20 A	
3 Ω resistance	15 V		
20 V voltage source	20 V		
4 Ω resistance		-2 A	
X			
Y			
		SUM	0

a) Complete the missing elements in the table, while keeping Tellegen's Theorem Consistent. (8 points)

Hint: Mind the polarity of the voltage across the 3Ω resistance → see the schematic.

b) What type of element is X with respect to absorbed/delivered power; justify your answer → no points will be given if no justification is provided. (1 point)

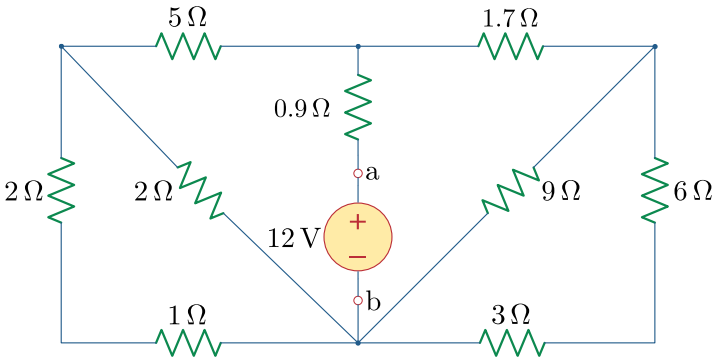
c) What type of element is Y with respect to absorbed/delivered power; justify your answer → no points will be given if no justification is provided. (1 point)

Indicate the measure units for all calculated quantities. Show all steps in your reasoning and never give numerical results without justification.

- Take a new double-sheet -

Exercise 2

Consider the circuit in the figure below:



a) Find the equivalent resistance seen by the voltage source at the terminals a—b. (6 points)

b) Find the current supplied by the source. (2 points)

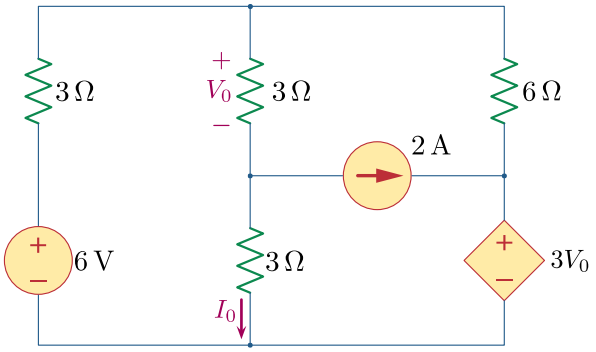
c) Find the power supplied by the voltage source. (2 points)

Indicate the measure units for all calculated quantities. Show all steps in your reasoning and never give numerical results without justification.

- Take a new double-sheet -

Exercise 3

Consider the circuit in the figure below, for which I_0 and V_0, must be determined:



a) Label the nodes in the network and assemble the corresponding system of equations for nodal analysis, when applied to this circuit **– do not solve the system of linear equations yet!** (4 points)

Hint: Examine the circuit carefully and try to account for the minimum number of nodes that allows determining the unknowns.

b) Label the meshes in the network and assemble the corresponding system of equations for mesh analysis, when applied to this circuit **– do not solve the system of linear equations yet!** (4 points)

Hint: Examine the circuit carefully and make sure that the quantities controlling the dependent sources are accounted for.

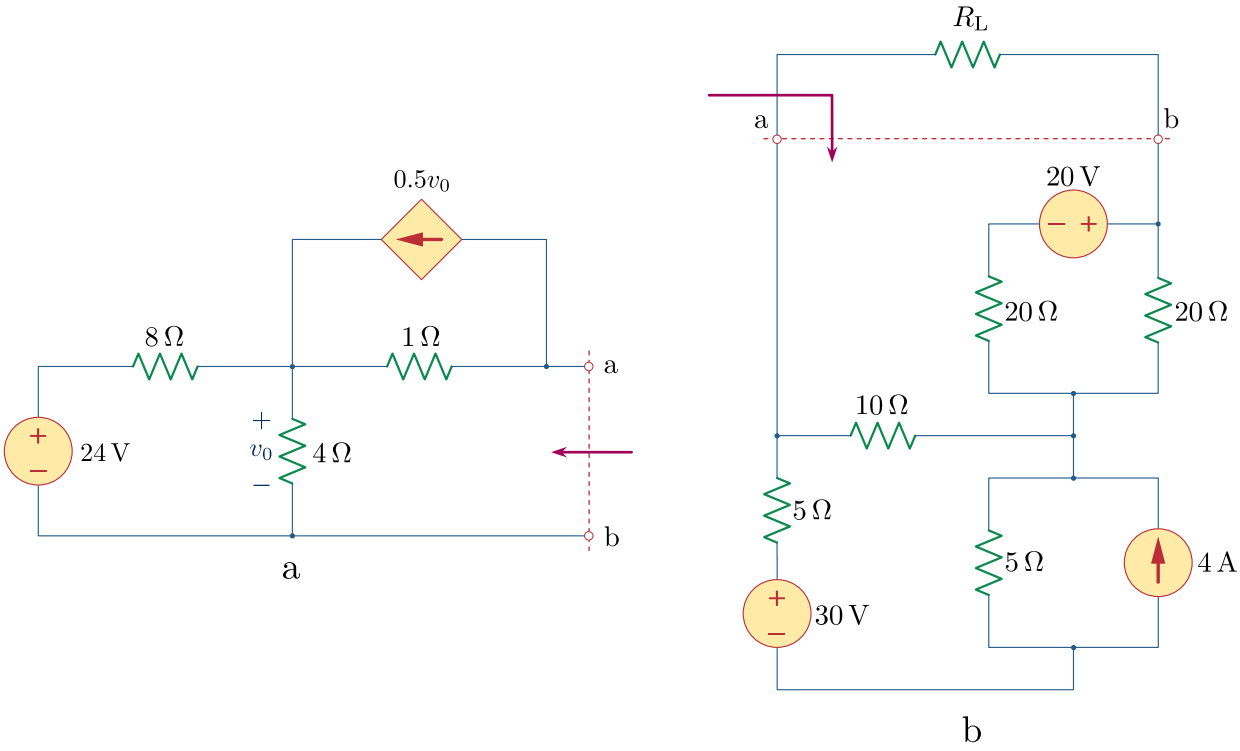
c) Now solve the system of equations obtained via nodal analysis and calculate I_0 and V_0. (2 points)

Indicate the measure units for all calculated quantities. Show all steps in your reasoning and never give numerical results without justification.

- Take a new double-sheet -

Exercise 4

Consider the circuit in subfigure a.



a) Find the Norton equivalent at the terminals a—b of the circuit. (5 points)

Consider the second circuit in subfigure b.

b) Use source transformation to find the Thévenin equivalent circuit of the circuit at the terminals a—b (the arrow points into the circuit to be examined). (3 points)

c) Find R_L for the maximum power deliverable to R_L. (1 point)

d) Determine the corresponding maximum power P_{max}. (1 point)

Indicate the measure units for all calculated quantities. Show all steps in your reasoning and never give numerical results without justification.