

MAE 140 – Linear Circuits – Fall 2007
Midterm – November, 8th

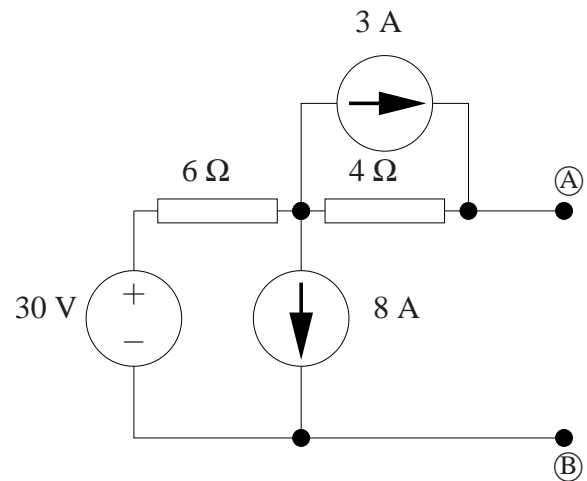
Instructions

- 1) This exam is open book. You may use whatever written materials you choose, including your class notes and textbook. You may use a hand calculator with no communication capabilities.
- 2) You have 60 minutes.
- 3) On the questions for which we have given the answers, please provide detailed derivations.

Question 1 [Thevenin equivalent]

Regarding the following circuit:

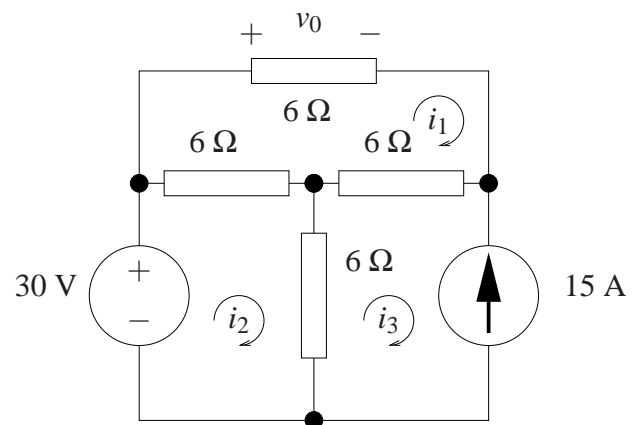
- a) [4 marks] Determine the Thevenin equivalent as seen from terminals **(A)** and **(B)** using source transformations only.
- b) [2 marks] How much power would be absorbed by a $10\ \Omega$ resistor connected between terminals **(A)** and **(B)**?



Question 2 [Superposition / Mesh analysis]

Regarding the following circuit:

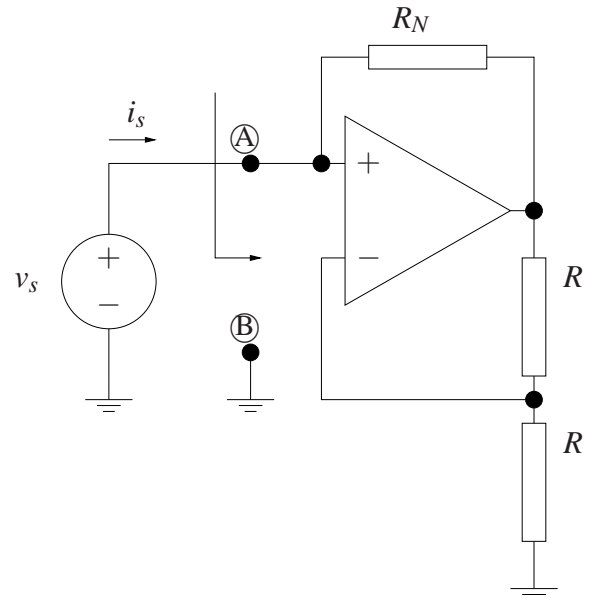
- a) [4 marks] Find v_0 using superposition.
- b) [4 marks] Formulate mesh-current equations for the circuit. Clearly indicate the equations to be solved and the unknowns. Use the mesh currents indicated in the drawing.
- c) [2 marks] Use the mesh-current equations to find v_0 .



Question 3 [OpAmp Circuit Analysis]

Regarding the following resistive OpAmp circuit:

- [4 marks] Show that the current $i_s = -v_s/R_N$.
- [2 marks] Draw the equivalent circuit as seen from terminals Ⓐ and Ⓑ in the direction indicated by the arrow. Explain why this circuit is called a “negative resistance”?
Hint: Recall that an equivalent circuit is one which has the same v - i characteristic.



Question 4 [OpAmp Circuit Analysis (bonus)]

[2 marks] Consider the connection of the “negative resistance” circuit of Question 3 in parallel with a load R_L as seen in the next circuit. What is the equivalent circuit as seen from terminals Ⓒ and Ⓓ? Draw the circuit. What happens when $R_L = R_N$?

Hint: Make use of Question 3.

