

MAE140 - Linear Circuits - Fall 13
Midterm, October 31

Instructions

- (i) 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
- (ii) You have 70 minutes
- (iii) Do not forget to write your **name, student number, and instructor**

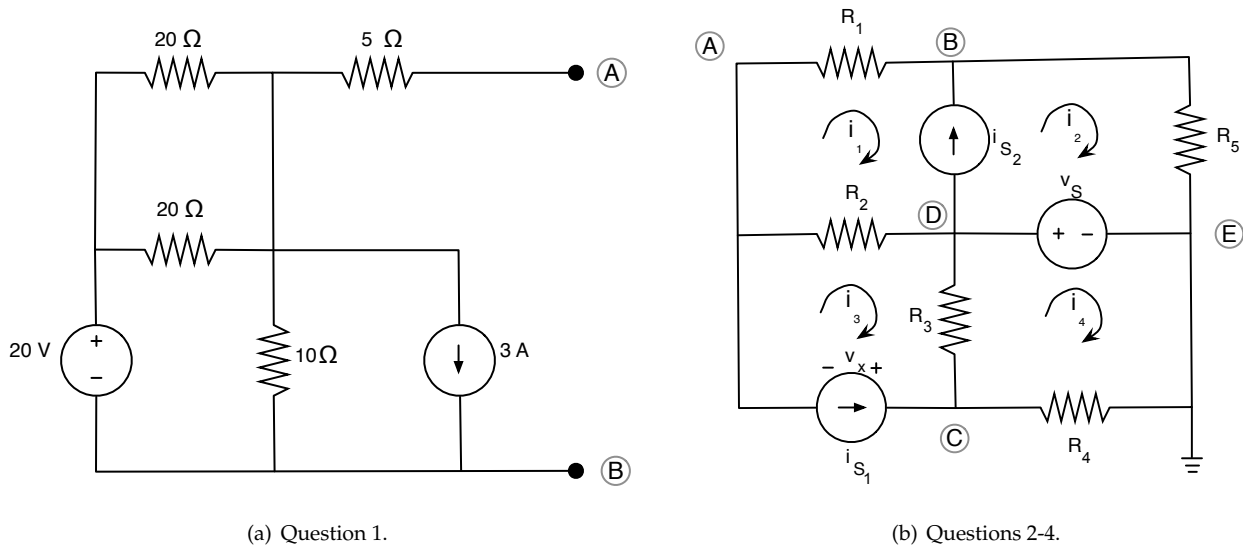


Figure 1: Circuits for questions 1-4

1. Equivalent circuits

Part I: [2 points] Turn off all the sources in the circuit of Figure 1(a) and find the equivalent resistance as seen from terminals A and B.

Part II: [3 points] Find the Thévenin equivalent as seen from terminals A and B.

Hint: If you want, you can use the result obtained in Part I. When you are deciding what source transformation to use, be careful not to lose track of terminals A and B!

Part III: [1 point] Show that the power absorbed by a 40Ω resistor that is connected to terminals A and B is $0.4W$.

2. Node voltage analysis

[6 points] Formulate node-voltage equations for the circuit in Figure 1(b). Use the node labels A through E provided in the figure and clearly indicate how you handle the presence of a voltage source. The final equations must depend only on unknown node voltages and the source values v_S , i_{S1} , and i_{S2} . **Do not modify the circuit or the labels.** No need to solve any equations!

3. Mesh current analysis

[6 points] Formulate mesh-current equations for the circuit in Figure 1(b). Use the mesh currents shown in the figure and clearly indicate how you handle the presence of each of the current sources. The final equations should only depend on the unknown mesh currents and the source values v_S , i_{S1} , and i_{S2} . **Do not modify the circuit or the labels.** No need to solve any equations!

4. Bonus question

[1 point] Express v_x in the circuit of Figure 1(b) in terms of the node voltage variables of Question 2 and also in terms of the mesh current variables of Question 3.