

MAE140 - Linear Circuits - Fall 2016
Midterm, October 27th

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 70 minutes.
3. Write your answers on your "Blue Book".
4. Do not forget to write your name, student number, and instructor.

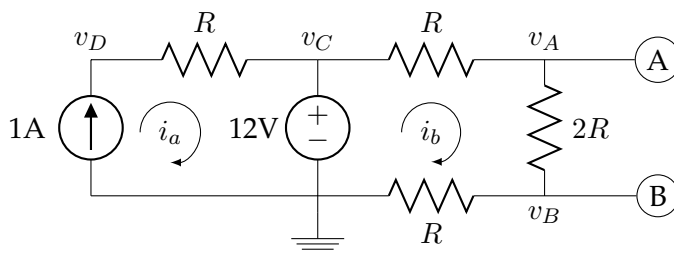


Figure 1: Circuit for Questions 1, 2, and 3

1. Equivalent Circuits

- (a) (5 points) For the circuit in Fig. 1, find the Thevenin and Norton equivalent circuits as seen from terminals A and B by performing open-circuit and short-circuit experiments.
- (b) (1 point (bonus)) Explain the role played by the current source in the equivalent circuits.

2. Node Voltage Analysis

- (a) (4 points) Formulate node-voltage equations for the circuit in Fig. 1. Use the node-voltages and labels provided in the figure and clearly indicate the final equations and circuit variable unknowns. Make sure your final equations involve only node-voltages.
- (b) (1 point) Explain how you could solve for the mesh-current i_b after having calculated the node-voltages.

3. Mesh Current Analysis

- (a) (4 points) Formulate mesh-current equations for the circuit in Fig. 1. Use the mesh-currents and labels provided in the figure and clearly indicate the final equations and circuit variable unknowns. Make sure your final equations involve only mesh-currents.
- (b) (1 point) Explain how you could solve for the node voltages v_A and v_B after having calculated the mesh-currents.

4. OpAmp Circuit

- (a) (5 points) Design an OpAmp circuit that realizes the following arithmetic operation:

$$v_o = v_1 - v_2 - v_3$$

where v_1 , v_2 and v_3 are given voltage sources. Do not forget to select values for resistors!

- (b) (1 point (bonus)) You get a bonus point if your circuit uses only one OpAmp.