

MAE140 - Linear Circuits - Fall 14
Midterm, November 6

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 80 minutes
- (iii) Do not forget to write your **name** and **student number**

Good luck!

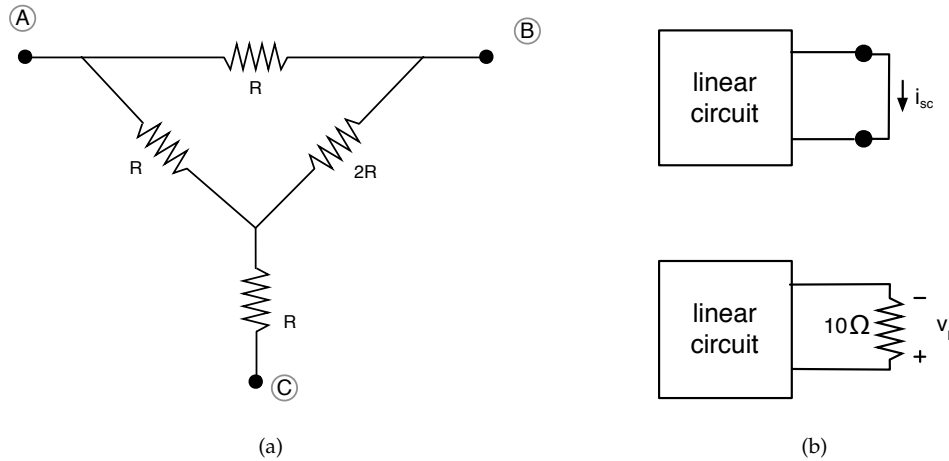


Figure 1: Circuits for question 1.

1. Equivalent circuits

Part I: [5 points] For the circuit in Figure 1(a), find the equivalence resistances as seen from terminals (A) and (B), (A) and (C), and (B) and (C).

Part II: [5 points] A TA performed two experiments on a linear circuit composed only of independent sources and resistors. As indicated in Figure 1(b), the short-circuit current $i_{sc} = 10mA$ was measured and, after connecting a 10Ω resistor load, the voltage drop $v_R = -75mV$ was observed. Use this information to construct the Norton and Thévenin equivalent circuits of the linear circuit.

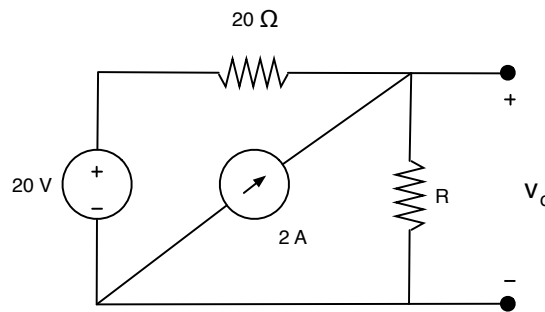


Figure 2: Circuit for question 2.

2. (10 points) Superposition

For the circuit in Figure 2, use only superposition, voltage division, and current division to determine the value of the resistance R if the measured output voltage is $v_o = 10V$.

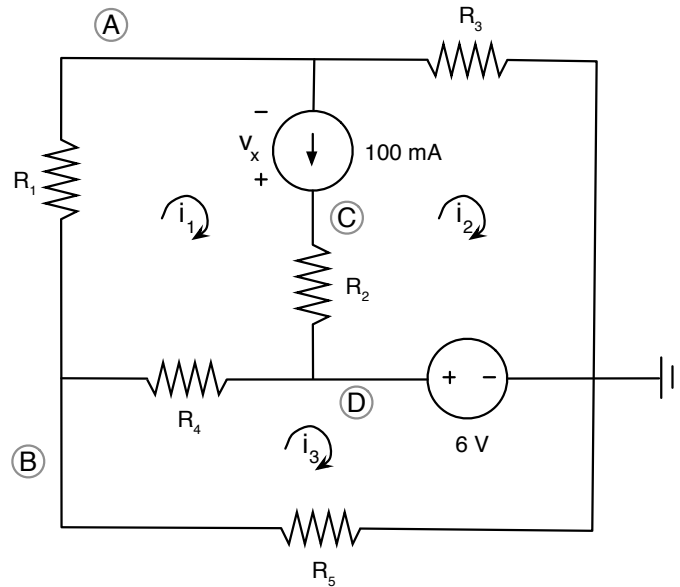


Figure 3: Circuit for question 3.

3. Node voltage and mesh current analysis

Part I: [5 points] Formulate node-voltage equations for the circuit in Figure 3. Use the node labels (A) through (D) 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 resistor values R_1 through R_5 . **Do not modify the circuit or the labels.** No need to solve any equations!

Part II: [5 points] Formulate mesh-current equations for the circuit in Figure 3. Use the mesh currents shown in the figure and clearly indicate how you handle the presence of the current source. The final equations should only depend on the unknown mesh currents and the resistor values R_1 through R_5 . **Do not modify the circuit or the labels.** No need to solve any equations!

Part III: [3 bonus points] Would removing the resistor R_2 have any effect on the currents of the circuit? Would it have any effect on the voltage drop from node D to node A? How about on the voltage drop v_x seen by the independent current source? Justify your answers.