

MAE140 - Linear Circuits - Winter 16
Midterm, February 5

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 50 minutes
 - (iii) Do not forget to write your **name** and **student number**
- Good luck!

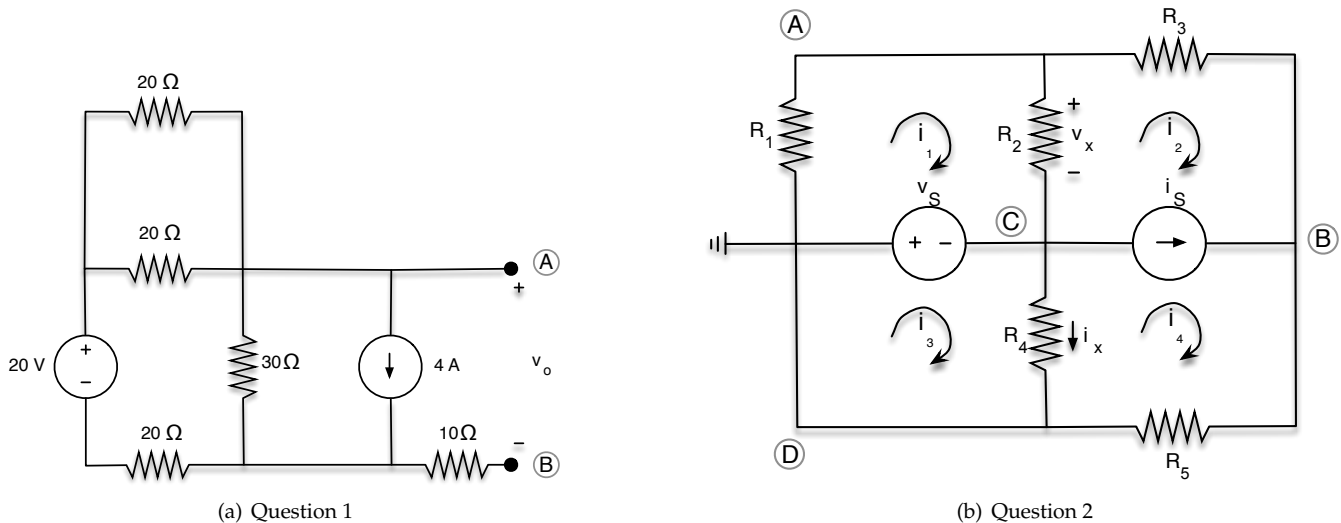


Figure 1: Circuits for all questions.

1. Equivalent circuits

- Part I:** [3 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:** [5 points] Find the voltage v_o using only superposition, association of resistors, voltage division, and current division.
- Part III:** [1 point] What is the Thévenin equivalent of the circuit as seen from terminals (A) and (B)?
- Part IV:** [1 point] Find the power absorbed by a $100\ \Omega$ resistor that is connected to terminals (A) and (B).

2. Node voltage and mesh current analysis

- Part I:** [4 points] Formulate node-voltage equations for the circuit in Figure 1(b). 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:** [4 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 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:** [2 points] Provide two expressions for the voltage v_x and the current i_x , one in terms of node voltages and the other one in terms of mesh currents.
- Part IV:** [2 bonus points] Is the independent voltage source in parallel with the resistor R_4 ? Removing the resistor R_4 and substituting it by an open circuit would eliminate mesh 3. Would this removal have any effect on the values of the node voltages or the other mesh currents? Would it have any effect on the current that flows through the independent voltage source? Justify your answers.