MAE140 - Linear Circuits - Winter 18
Midterm, February 8

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 75 minutes

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

Good luck!

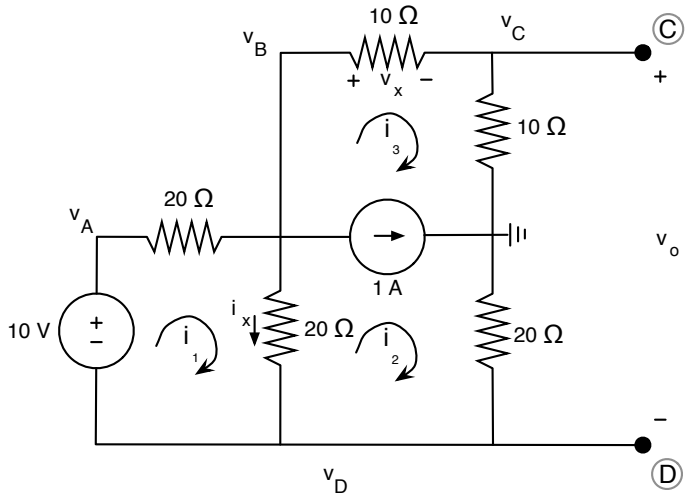

Figure 1: Circuit for all questions.

1. **Equivalent circuits**

   Part I: [2 points] Turn off all the sources in the circuit of Figure 1 and find the equivalent resistance as seen from terminals Ⓒ and Ⓓ.

   Part II: [5 points] Find the voltage v_0 using only superposition, source transformations, association of resistors, Ohm's law, voltage division, and current division.

   Part III: [1 point] What is the Thévenin equivalent of the circuit as seen from terminals Ⓒ and Ⓓ?

   Part IV: [1 bonus point] If we short-circuit terminals Ⓒ and Ⓓ, what would be the short-circuit current?

2. **Node voltage analysis**

   Part I: [5 points] Formulate node-voltage equations for the circuit in Figure 1. Use the node labels provided in the figure. Clearly indicate how you handle the presence of a voltage source (if you have more than one choice to deal with it, use the simplest). The final equations must depend only on unknown node voltages. **Do not modify the circuit or the labels**. No need to solve any equations!

   Part II: [1 point] Provide expressions for the voltage v_x and the current i_x in terms of node voltages.

   Part III: [1 bonus point] Could you have used another method to deal with the voltage source? How can you determine v_A if you knew v_B, v_C, and v_D? Justify your answer.

3. **Mesh current analysis**

   Part I: [5 points] Formulate mesh-current equations for the circuit in Figure 1. 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. **Do not modify the circuit or the labels**. No need to solve any equations!

   Part II: [1 point] Provide expressions for the voltage v_x and the current i_x in terms of mesh currents.