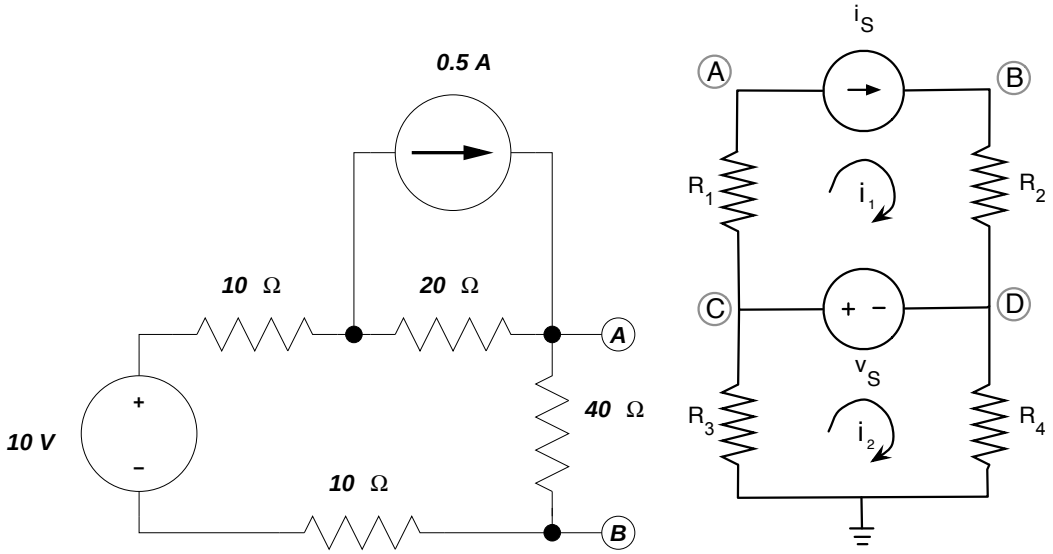
MAE140 - Linear Circuits - Fall 09
Midterm, November 10

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**



(a) Question 1. (b) Question 2.

Figure 1: Circuits for questions 1 and 2.

1. **Equivalente Circuits**

   Part I [4 points] Use source transformations and association of resistors to find the Thevenin equivalent to the circuit in Fig. 1(a) as seen from terminals A and B.

   Part II [4 points] A classmate was arguing with you that one would "extract" the most power out of this circuit by connecting a very small resistance between terminals A and B. You argued that he/she was wrong and that a 20 Ω resistor would be a better choice. Who is right and why?
   Hint #1: Don't complicate: all you need to do is compare the two options!
   Hint #2: Use the Thevenin equivalent computed in Part I to answer the question.

2. **Mesh Current and Node Voltage Analysis**

   Part I [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 a current source, the final equations, and the unknowns they must be solved for. **Do not modify the circuit or the labels**. No need to solve any equations!

Part II [4 points] Formulate node-voltage equations for the circuit in Figure 1(b). Use the node labels provided in the figure and clearly indicate how you handle the presence of a voltage source, the final equations, and the unknowns they must be solved for. **Do not modify the circuit or the labels**. No need to solve any equations! *Hint: Use a supernode*

Part III [1 bonus point] If you were allowed to select the ground node in the circuit of Figure 1(b), describe what would you do in order to avoid having to use a supernode in Part II? **Do not write or solve any equations**!

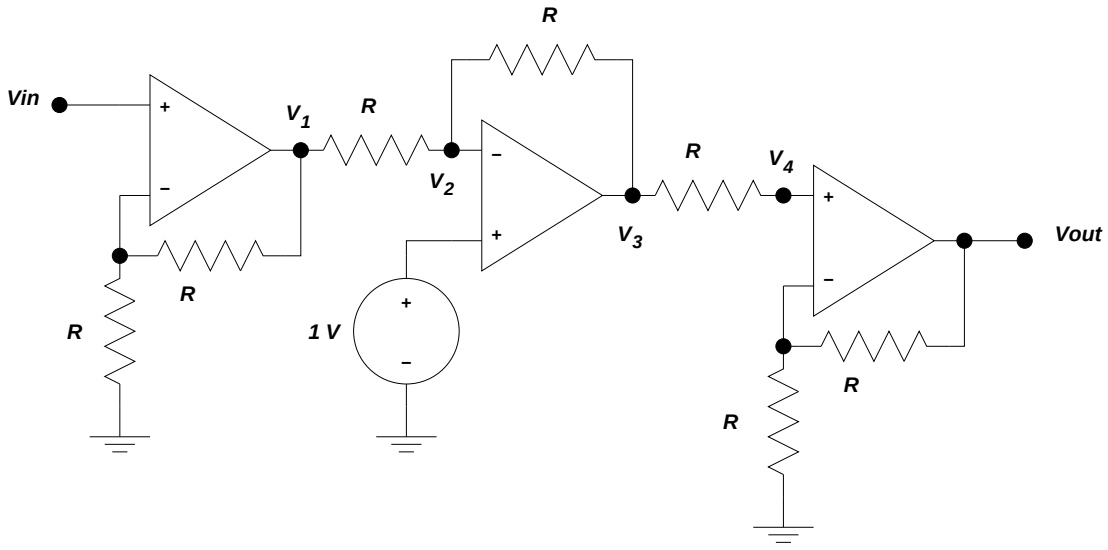


Figure 2: Circuit for question 3.

3. **Operational Amplifier Analysis and Design**

Part I [4 points] Determine all voltages indicated in the circuit of Figure 2 in terms of V_{in}. Use these voltages to show that it realizes the following function:

$$V_{\text{out}} = 4(1 - V_{\text{in}}).$$

Part II [4 points] Design a circuit using a single OpAmp that would realize the exact same function using a single 1 V source. Name one advantage/disadvantage of your design versus the design of Figure 2.