

MAE 140 – Linear Circuits – Summer 2007
Midterm

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 90 minutes.
- 3) On the questions for which I have given the answers, please provide detailed derivations.

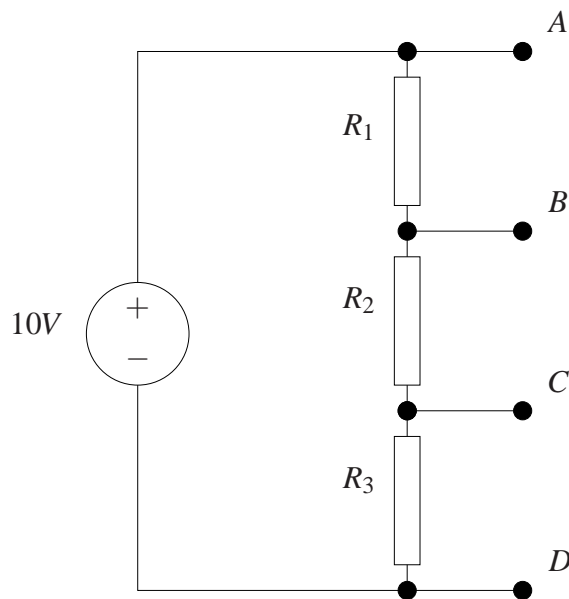
Question 1 [Circuit variables]

You went to the store and bought a $100W$ bulb. When you got home you hooked it in the socket and noticed that the light was very dim. You then checked the bulb and discovered that the bulb was rated $100W/220V$.

- a) [2 marks] What is the resistance and the power dissipated by the wrong bulb at your home? (Consider the voltage at your home to be $127V$)
- b) [1 mark] What is the resistance of a bulb rated $100W/127V$?

Question 2 [Voltage divider]

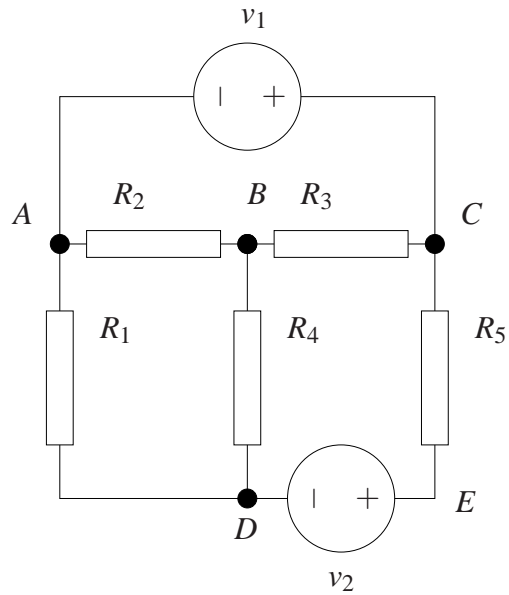
Regarding the following voltage-divider circuit



- a) [2 marks] Show that if $R_1 = R_3 = R\Omega$ and $R_2 = 2R\Omega$ then $v_A - v_B = v_C - v_D = 2.5V$ and $v_B - v_C = 5V$.
- b) [2 marks] Use Thevenin's equivalence to show that at terminals B and C the equivalent resistance is $R\Omega$. Draw the equivalent Thevenin circuit.
- c) [1 mark] Draw the Norton equivalent circuit as seen from terminals B and C.

Question 3 [Node-voltage analysis]

Regarding the following circuit



- [2 marks] Transform the series connection of the voltage source v_2 and the resistor R_5 into an equivalent current source in parallel with a resistance and draw the resulting circuit.
- [3 marks] Formulate node-voltage equations for the resulting circuit. Remember to properly choose the ground node! Clearly state the unknowns and the equations to be solved.
- [BONUS - 1 mark] Can you formulate node-voltage equations for the above circuit without transforming the voltage source v_2 into an equivalent current source?