電路學(EE2210)第一次期中考

2013年10月28日
時間：2 小時
Close Book

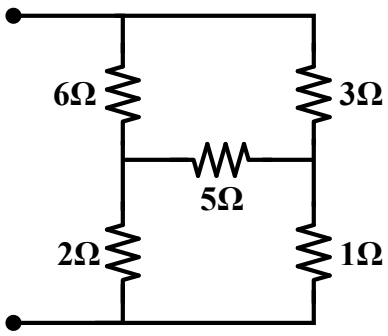
學號：_____

姓名：_____

- There are 11 pages in this midterm exam, including this cover page. Please check that you have them all.
- Please write your **學號 姓名** in the space provided above.
- **IMPORTANT:** The problems in this exam vary in difficulty; moreover, questions of different levels of difficulty are distributed throughout the exam. If you find yourself spending a long time on a question, consider moving on to later problems in the exam, and then working on the challenging problems after you have finished all of the easier ones.
- Do your work and enter your answer for each question within the boundaries of that question. You may do your work on the back of the preceding page.
- Remember to include the sign and units for all numerical answers.
- This is a closed-book exam, but you may use a calculator.
- You have 2 hours to complete this exam.
- Good luck!

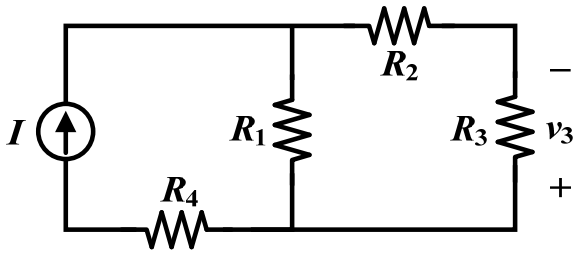
1.	2.	3.	4.	5.
6.	7.	8.	9.	10.
11.	12.			
Total Grade				

1. Find the equivalent resistance R_{eq} between the indicated terminals (all resistances in ohms) in following Figure. (5%)



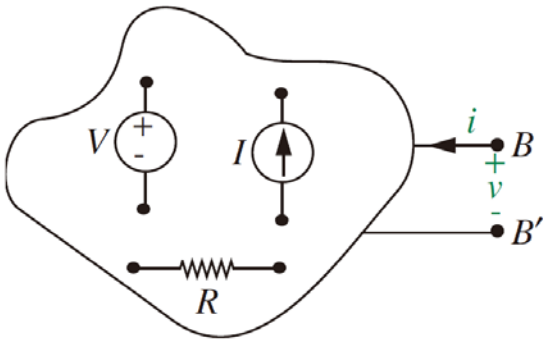
R_{eq} =_____.

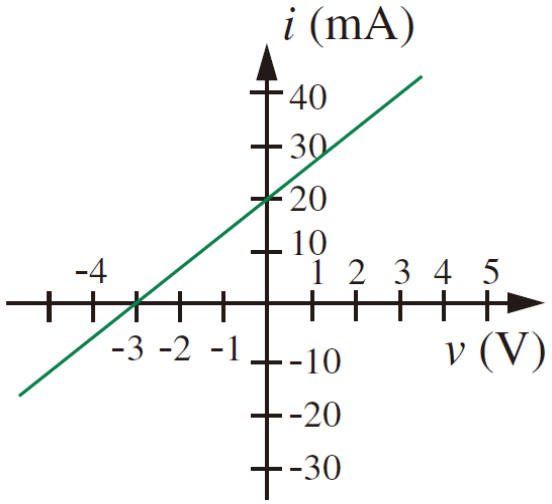
2. Determine explicitly the voltage v_3 in the following circuit in terms of R_1, R_2, R_3, R_4, and I. (5%)



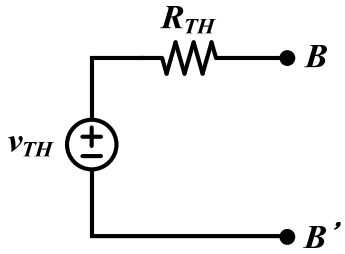
v_3 =_____.

3. Measurements made on terminals *BB'* of a linear circuit as shown, which is known to be made up only of independent voltage sources and current sources, and resistors, yield the current-voltage characteristics as shown.
   (a) Find the Thévenin equivalent of the circuit. (5%)
   (b) Over what quadrants, if any, of the *i*-*v* characteristics does this circuit absorb power? (5%)





(a) Thévenin equivalent circuit:

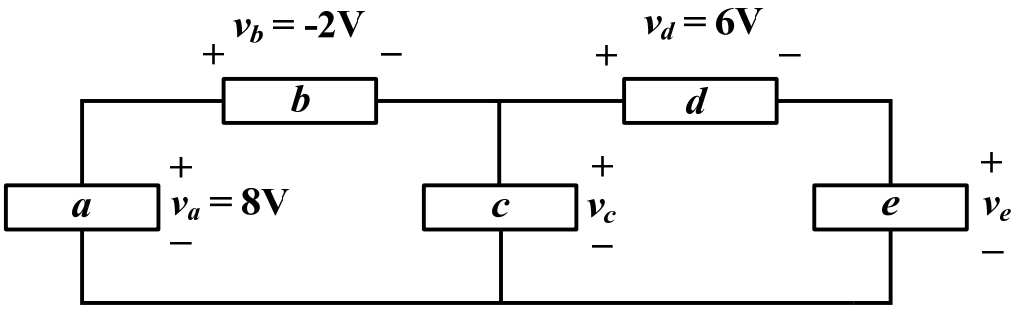


v_{TH} = _____, R_{TH} = _____.

(b) Please circle the answer.

Quadrants (You can choose more than one): 1st, 2nd, 3rd, 4th, none.

4. For the circuit as shown below, there are five elements which observe the *Associated Variables Convention*. Among the five elements, the voltages for three elements are given on the figure. The current for element *b* is i_b = 2A and for element *b* is i_d = 3A. By using the KVL and KCL, please find (i) the current of element *a*, (ii) the voltage, the current and the power of element *c*, (iii) the voltage of element *e*. (10%)

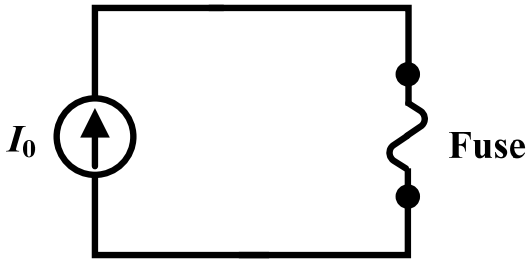


(i) i_a =_____.

(ii) v_c =_____, i_c =_____, p_c =_____.

(iii) v_e =_____.

5. A fuse is a wire with a positive temperature coefficient of resistance (in other words, its resistance increases with temperature). When a current is passed through the fuse, power is dissipated in the fuse, which raises its temperature.



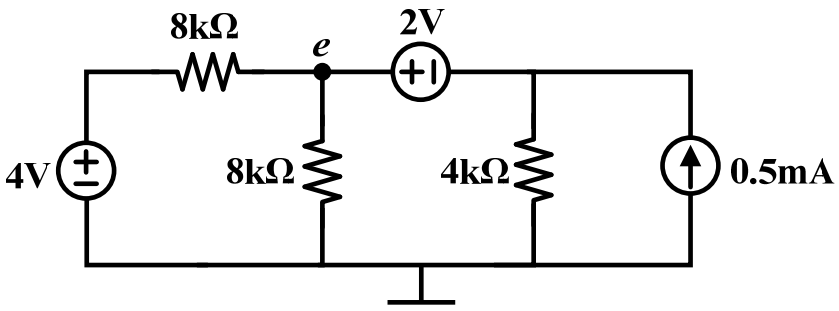
Use the following data to determine the current I_{max} at which the fuse will blow (i.e., its temperature goes up without limit). (10%)

Fuse Resistance:
$R = 1 + aT$ (Ω)
$a = 0.001$ (Ω/°C)
T = *Temperature rise above ambient*

Temperature rise:
$T = \beta P$
$\beta = 1/0.225$ (°C/W)
P = *power dissipated in fuse*

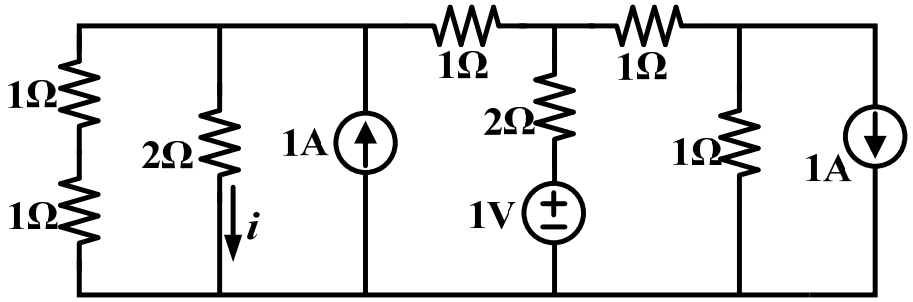
I_{max} =_____.

6. Find the node potential e in the following circuit. (5%)



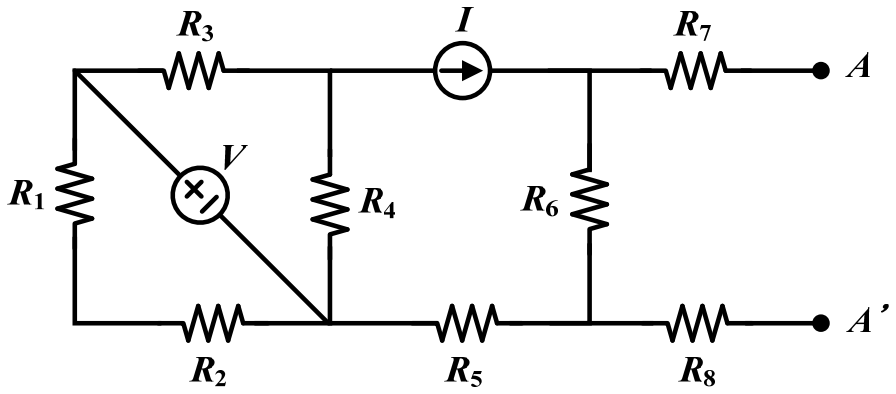
e = _____.

7. Find the current i of the following network by superposition. (5%)

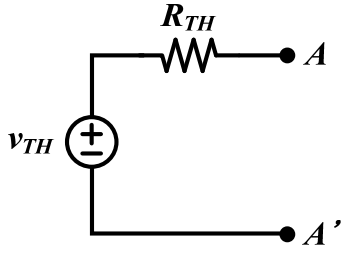


i = _____.

8. Find the Thévenin equivalent of the circuit for the terminals marked *AA'*. (10%)

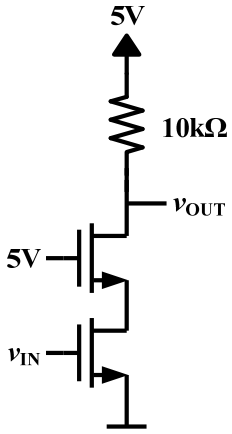


Thévenin equivalent circuit:



v_{TH} =_____, R_{TH} =_____.

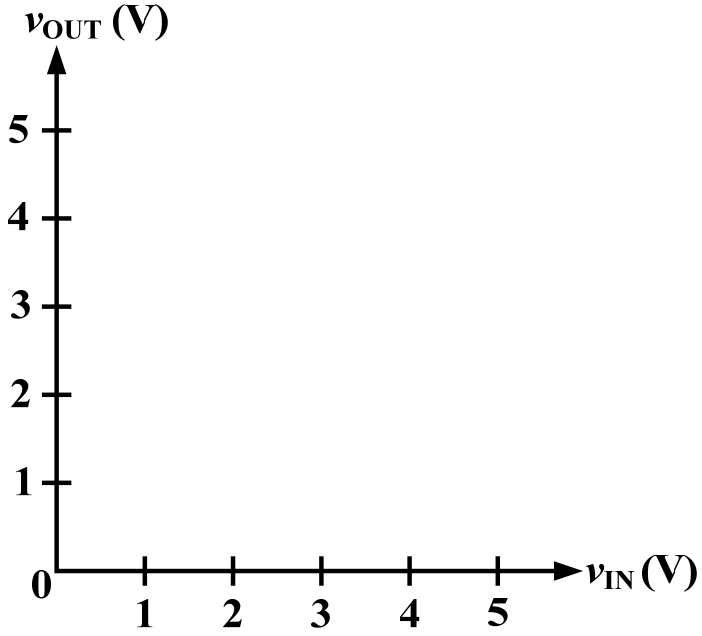
9. Draw the voltage transfer characteristics for the NAND gate circuit shown. Can this gate be operated in a digital system characterized by a static discipline with the voltage thresholds below? (10%)



For both MOSFET: $V_T = 2.1$ V
$R_{on} = 1$ kΩ

Static Discipline: $V_{OL} = 1$ V $V_{OH} = 4$ V
$V_{IL} = 2$ V $V_{IH} = 3$ V

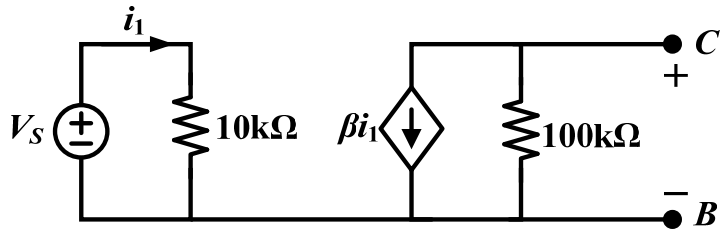
Voltage transfer characteristic (VTC):



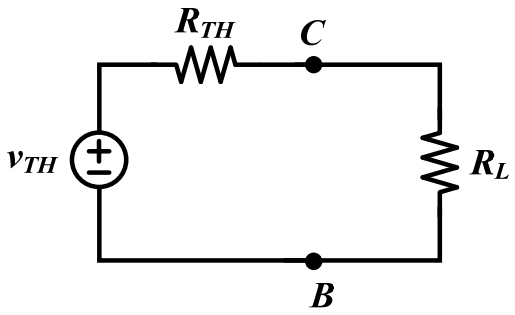
Can this gate be operated in a digital system characterized by the a static discipline? Explain.

Answer: _____.

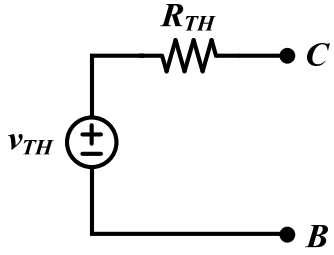
10. (a) Find the Thévenin equivalent for the network at the terminals *CB*. The current source is a controlled source. (8%)



(b) Now suppose you connect a load resistor across the output of your equivalent circuit as shown. Find the value of R_L which will provide the maximum power transfer to the load. (2%)



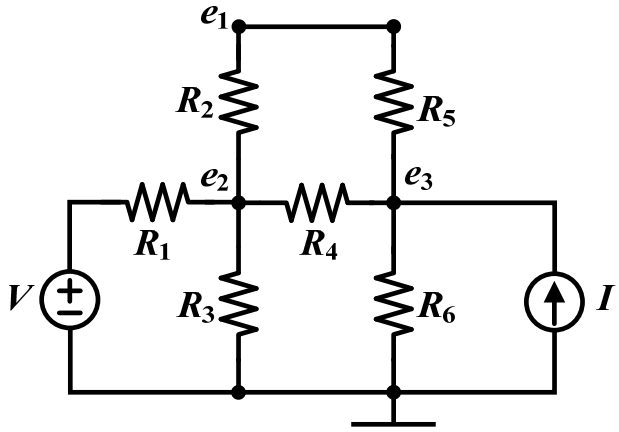
(a) Thévenin equivalent circuit:



v_{TH} =_____, R_{TH} =_____.

(b) R_L =_____.

11. The network shown below has three nodes with unknown node voltages e_1, e_2 and e_3. Use conductance instead of resistance to write the node equations. Simplify the equations by collecting terms and arranging them in the "standard" form for n linear equations in n unknowns. Express these n linear equations in matrix form as shown below. (*Do not solve the equations*.) (15%)



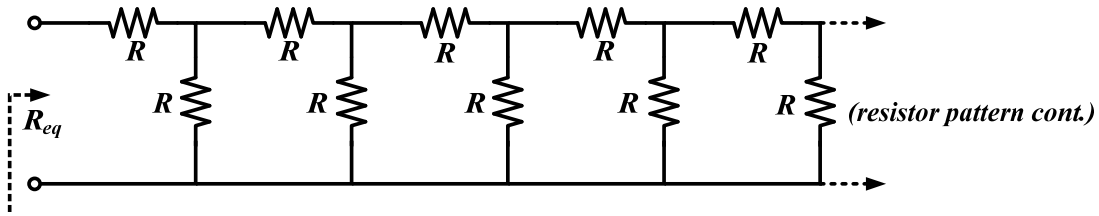
Matrix Form: $\begin{bmatrix} G_{11} & G_{12} & G_{13} \\ G_{21} & G_{22} & G_{23} \\ G_{31} & G_{32} & G_{33} \end{bmatrix} \begin{bmatrix} e_1 \\ e_2 \\ e_3 \end{bmatrix} = \begin{bmatrix} S_1 \\ S_2 \\ S_3 \end{bmatrix}$

G_{11} =_____, G_{11} =_____, G_{11} =_____, S_1 =_____,

G_{21} =_____, G_{22} =_____, G_{23} =_____, S_2 =_____,

G_{31} =_____, G_{32} =_____, G_{33} =_____, S_3 =_____,

12. Find the equivalent resistance R_{eq} between the indicated terminals. (5%)



R_{eq} = _____.