Midterm 1
EE40
Spring 2014

NAME:_____

Instructions

Read all of the instructions and all of the questions before beginning the exam.

There are 4 problems in this exam. The total score is 100 points. Points are given next to each problem to help you allocate time. Do not spend all your time on one problem.

IMPORTANT

- **If you do not put your answers within the boxes labeled 'Solution' THEY WILL NOT BE COUNTED (no matter how correct they may be in the bottom left back corner of the third to last page of the exam.)**
- **If you have more than one solution in the box, that box will be given zero points.**

Unless otherwise noted on a particular problem, you must show your work in the space provided, on the back of the exam pages or in the extra pages provided at the back of the exam.

Be sure to provide units where necessary.

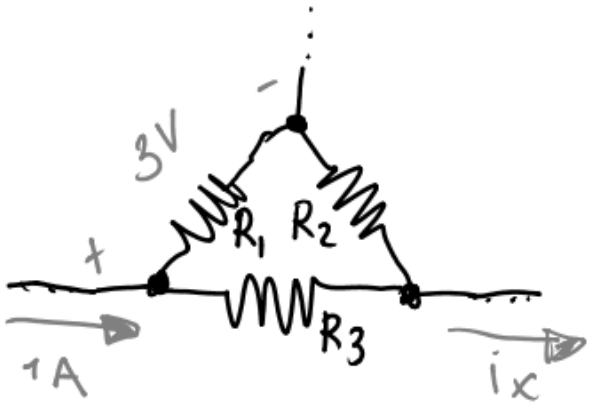
GOOD LUCK!

PROBLEM	POINTS	MAX
1		33
2		25
3		15
4		27

"Los zorros del desierto de Sechura aúllan como demonios cuando llega la noche; ¿sabes por qué?: para quebrar el silencio que los aterroriza."
— Mario Vargas Llosa, La ciudad y los perros

Problem 1 *Warm-up*

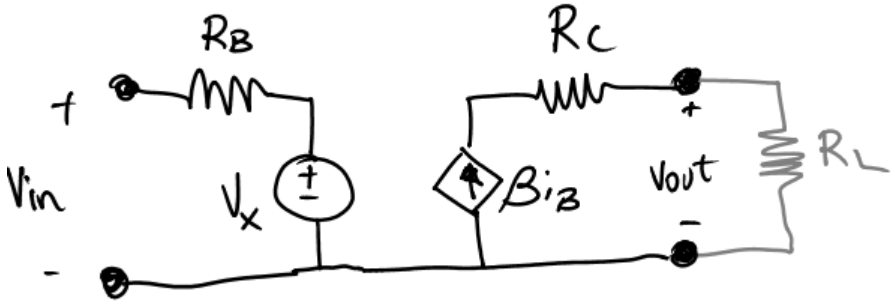
a) Consider the circuit below. $R_1 = R_2 = R_3 = 1\ \Omega$ (5 points)



Provide a numerical value for I_X with units.

Solution:

b) Consider the circuit below.



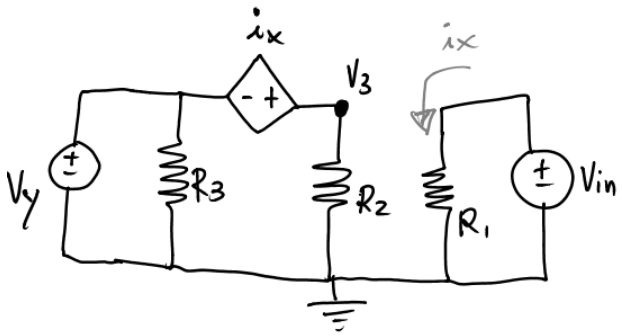
What value should R_C have such that maximum power is transferred to R_L? (2 points)

Solution:

What should R_B be to maximize the current through R_C? (2 points)

Solution:

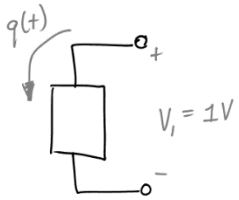
c) Consider the circuit below.



Provide and expression for V_3. (4 points)

Solution:

d) Consider the following element. We know the cumulative charge that has flowed through the device up to time t is $q(t) = 3e^{4t}$ (C).



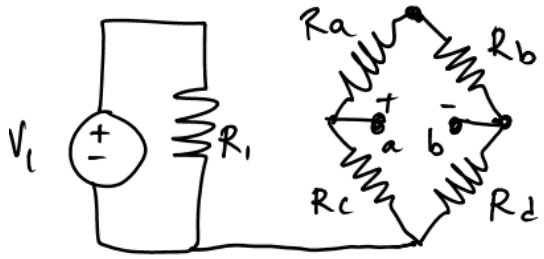
Is the element supplying or absorbing power? (3 points)

Solution:

What is the total energy supplied/delivered between t = 0 s and t = 1 s? (3 points)

Solution:

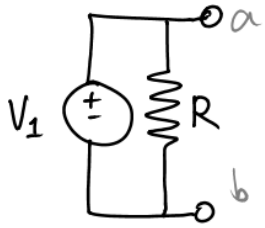
e) Consider the circuit below.



What is the value of V_{ab}? (3 points)

Solution:

f) Consider the circuit below.



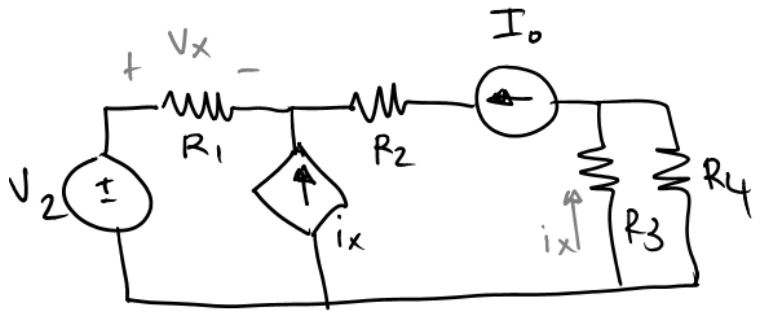
Provide an expression for V_{th}, the Thevenin equivalent voltage across terminals a,b. (3 points)

Solution:

Provide an expression for I_n, the Norton equivalent source across terminals a,b. (3 points)

Solution:

g) Consider the circuit below. $R_1 = R_2 = 1\ \Omega$; $R_3 = R_4 = 1k\Omega$

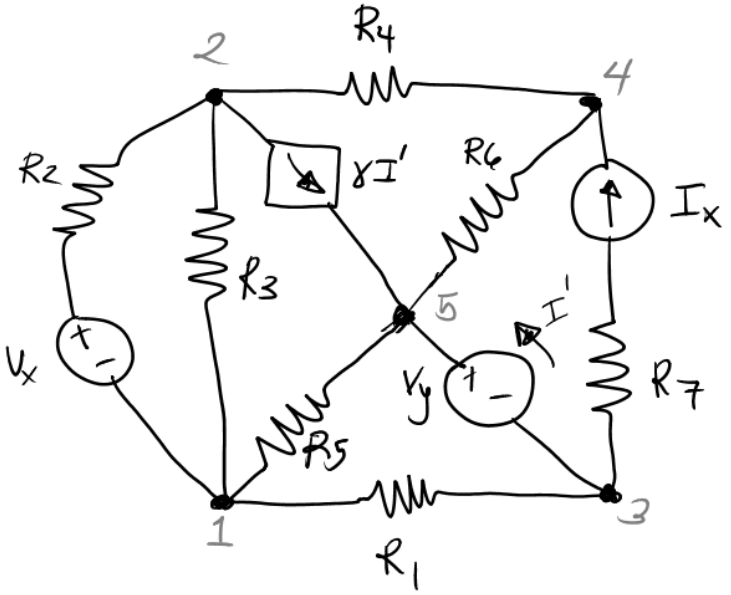


What must the value of I_0 be if we would like $V_x = 1.5$ V? (5 points)

Solution:

"KHAAAAANNNNN!"
- Captain Kirk, Star Trek II: The Wrath of Khan

Problem 2 (25 points)
Consider the circuit below.



Complete the equations below by entering numerical values in all the boxes.
Not all boxes needed be filled.
PLEASE TREAT NODE 4 as GROUND or you will lose points.

$$\square\, V_1 + \square\, V_2 + \square\, V_3 + \square\, V_5 = \square$$

$$\square\, V_1 + \square\, V_2 + \square\, V_3 + \square\, V_5 = \square$$

$$\square\, V_1 + \square\, V_2 + \square\, V_3 + \square\, V_5 = \square$$

$$\square\, V_1 + \square\, V_2 + \square\, V_3 + \square\, V_5 = \square$$

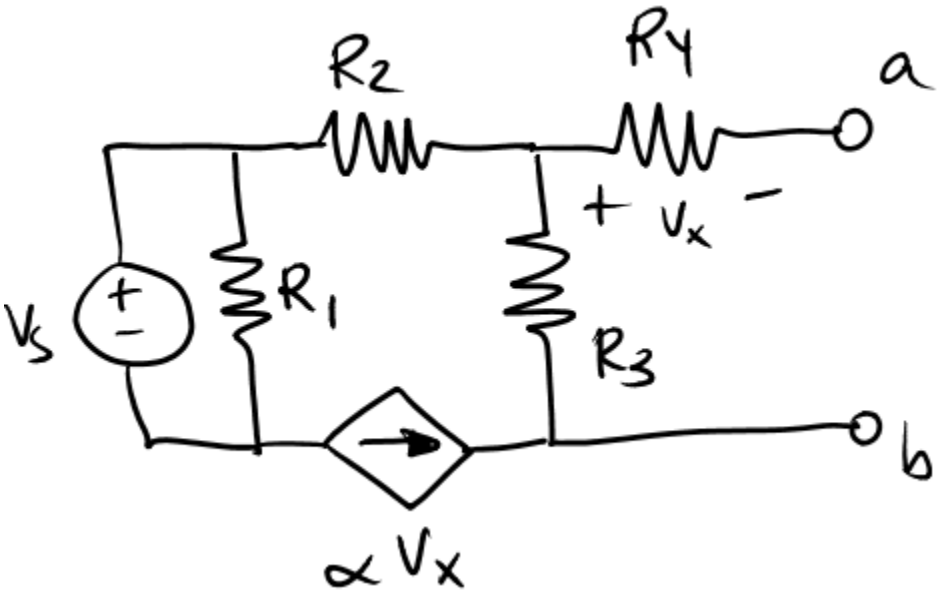
$$\square\, V_1 + \square\, V_2 + \square\, V_3 + \square\, V_5 = \square$$

Extra Space

Peter Venkman: *Ray has gone bye-bye, Egon... what've you got left?*
Egon Spengler: *Sorry, Venkman, I'm terrified beyond the capacity for rational thought.*
-Ghostbusters

Problem 3 (15 points)

Consider the circuit below. $R_1 = R_2 = 1k\Omega$; $R_3 = R_4 = 100\ \Omega$; $V_S = 100$ mV; $\alpha = 0.01$



Provide the Thevenin equivalent resistance, R_{th}, of the circuit above across terminals a,b. Provide a numerical answer with units.

Solution:

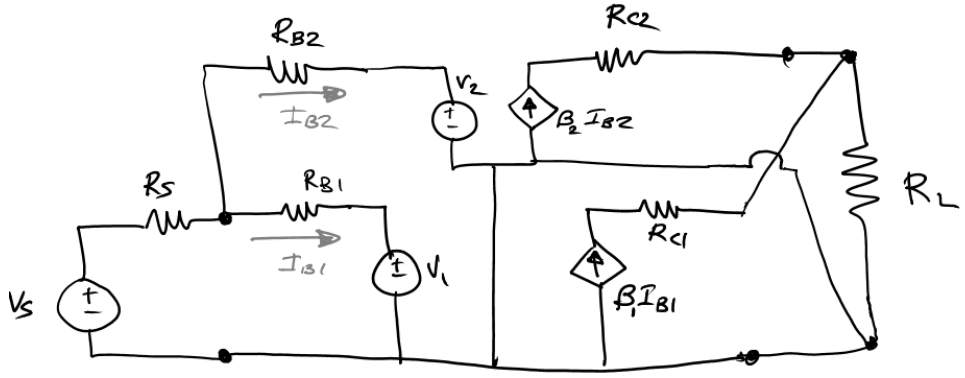
Extra Space

The Bride: *Wiggle your big toe.*
-Kill Bill, vol. 1

Problem 4 (27 points)

Consider the circuit below.

$V_1 = V_2 = 0.5$ V; $V_S = 1$ V; $R_S = 100$ Ω; $R_{B1} = R_{B2} = 1$ kΩ; $\beta 2 = 0.1$; $R_L = 144$ MΩ



a) Is it possible to set $\beta 1$ such that R_L delivers 1 W to the rest of the circuit? If so, what is the value of $\beta 1$ that will accomplish this?

Solution:

b) Is it possible to set $\beta 1$ such that R_L consumes 1 W from the rest of the circuit? If so, what is the value of $\beta 1$ that will accomplish this?

Solution:

Extra Space