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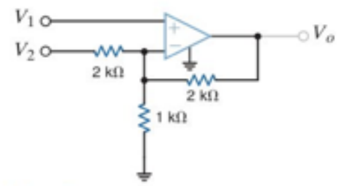
Exam 2 Redo
11/2/2012

Problem #1

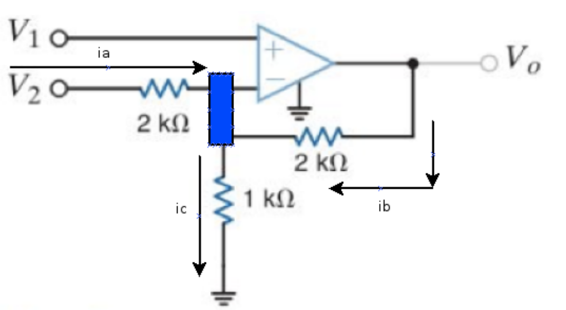
1. Derive an expression for V_o as a function of V_1 and V_2.



Step 1.

Know that V+ = V- = v1

Step 2. Label each current



Step 3. Define the currents

ia = (v2 - v1) / 2

ib = (vo - v1) / 2

ic = (v1 - vg) = v1

Step 4. Do KCL for the blue node

ia + ib = ic

(v2-v1)/2 + (vo - v1) /2 = v1

Step 5.

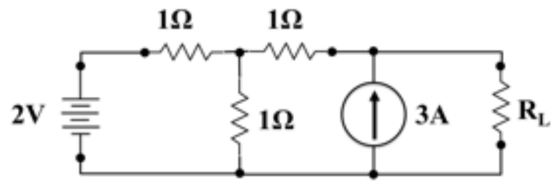
Solve for vo

Solve for vo in terms of v1 and v2

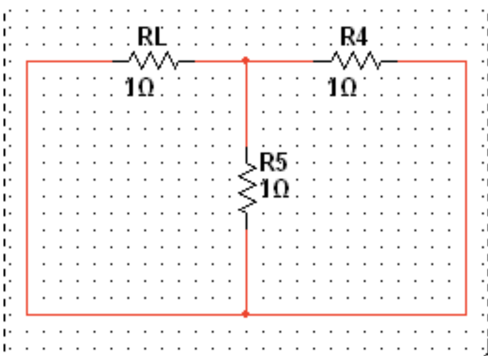
Answer: vo = 4v1 - v2

Problem #2

2. (a) Using superposition, **find** the value of R_L that maximizes the power dissipated in R_L. Compute the portion of this power due to the voltage source only, and the portion due to the current source.



Step 1) Find Rth by shorting the voltage source and removing the current source.



This becomes Rth = 3/2.

Step 2) Remove the current source and solve for the load across the Resistor Load. VL.

Use KCL to solve for V1 by finding all of the currents.

i1 (current from 2v source through R4)
i2 (current between top node through R6 to ground)
i3 (current between top node through R5 to ground)

i1 = (2 - Va)
i2 = Va - Ground = Va
i3 = Va

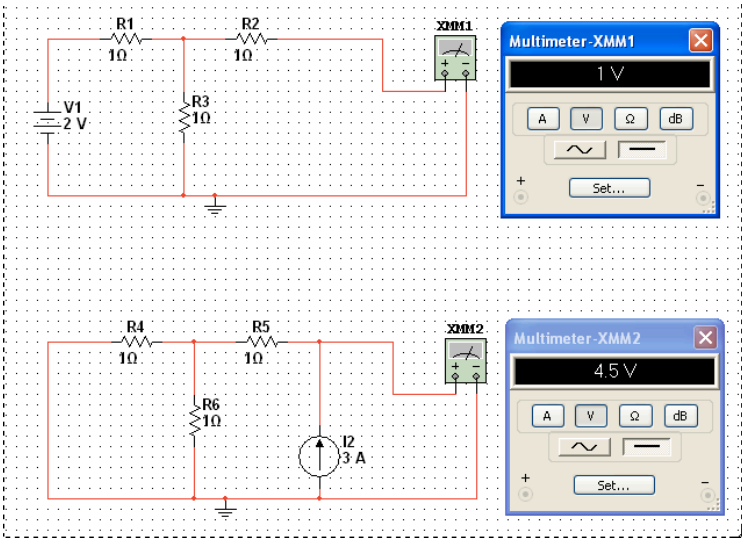
KCL at Va:

We now know that Va = 2/3 and we can now use the the voltage divider to determine what it would be through the 1 Ohm resistor leading to our RL.

VL = 1 V

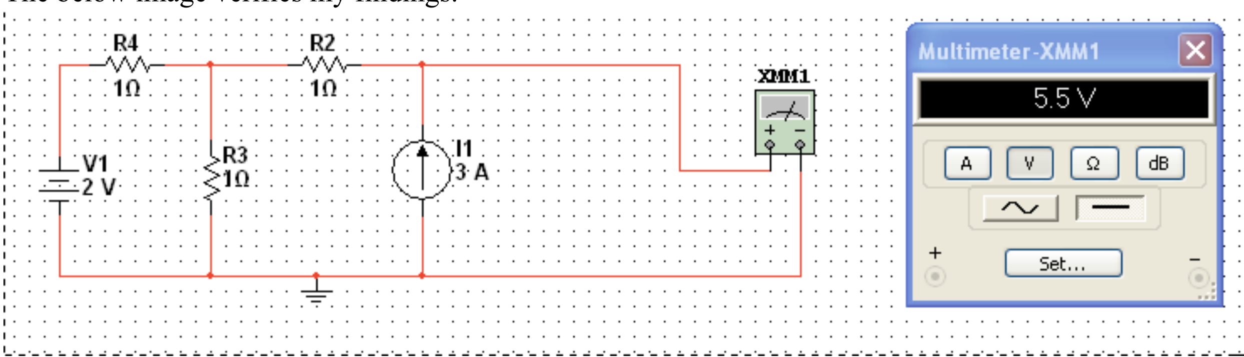
Step 3) Short the voltage source and solve for the load across the Resistor Load. VL.
Combine the resistors and determine the voltage through VL to be 4.5.

VL = 4.5

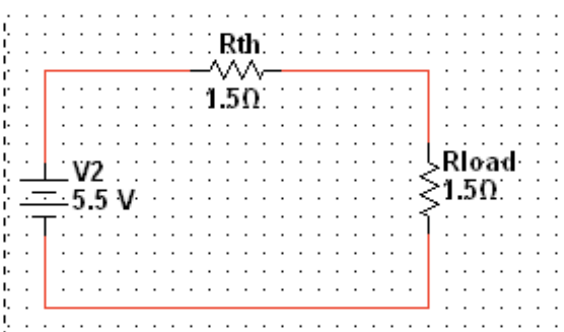


Step 4) Add both of the voltages found together to find **VL = 5.5**

The below image verifies my findings.



Step 5) Redraw the Thevenin equivalent circuit using VL = 5.5 and Rth = 3/2



ANSWER:

See that we make the Rload = Rth because this is when maximum power happens, so **Rload = 1.5.**

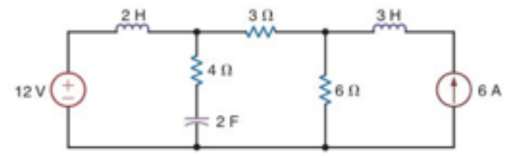
Problem 2b

2(b). Remove the current source by treating it as an open circuit. Find the value of RL that maximizes the power dissipated in RL. Explain why this value is the same, or different, than the answer to (a). Justify your conclusion whether it should be the same or different.

ANSWER:
Our answers would be the same because our process would be quite similar. Instead of using the thevenin equivalent we would be finding the norton equivalent instead. All of our answers are identical because in circuits it does not matter which way we analyze anything as long as it works, many tools can be used for the same job. It us up to use to choose the one that we are best at or is most simple to use.

PROBLEM #3

3. Find the energy stored in the 2F capacitor and 3H inductor. (Hint: find all voltages and currents first.)

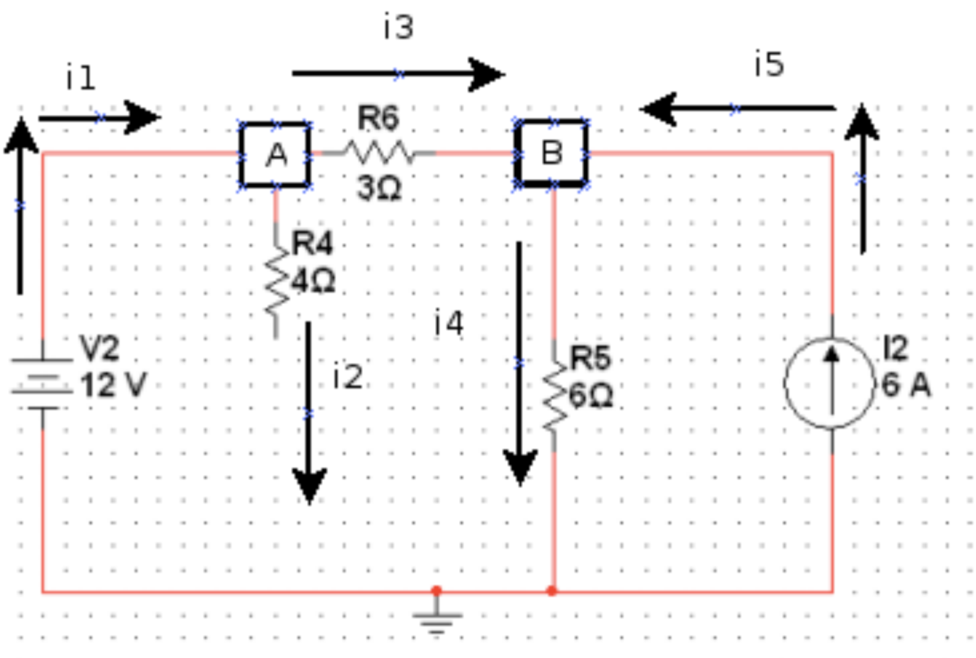


Step 1.)

Short the inductors and open the capacitors.

Step 2.)

Define the currents and label nodes.



i1 = i3

i2 = 0

i3 = (12 - vb)/3

i4 = (vb - vg)/6

i5 = 6

Step 3.)

KCL for node A and node B

Node A:

i1 = i2 + i3

i1 = i3

Replace i3 w/ (12 - vb)/3

i1 = (12 - vb)/3

Node B:

i3 + i5 = i4

(12 - vb) /3 + 6 = vb / 6

Step 4.)

Solve for unknowns:

vb = 20v

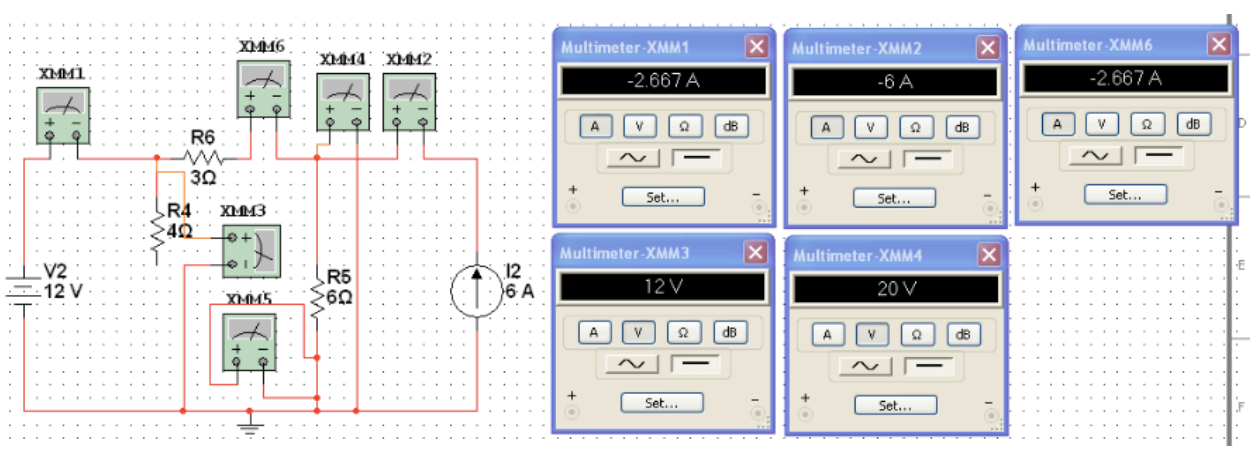
va = 12v

i1 = i3 = -8/3

i3 = -8/3

i4 = 10/3

i5 = 6



Step 5.)

Use the information found in step 4 to solve for the energy stored in each component.

Find the energy stored in the capacitor via the following equation.

U = (1/2)(C)(V^2)

Answer:

U = (1/2)(2)(12^2) = 144.

Find the energy stored in the 3H inductor via the following equation.

U = (1/2)(L)(I^2)

Answer:

U = (1/2)(3)(6^2) = (3/2)(36) = 54.

Find the energy stored in the 2H inductor via the following equation.

U = (1/2)(L)(I^2)

Answer:

U = (1/2)(2)(-8/3)^2 = 7.111111 repeated