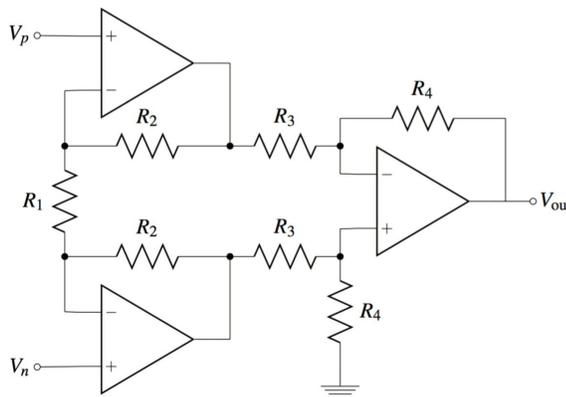


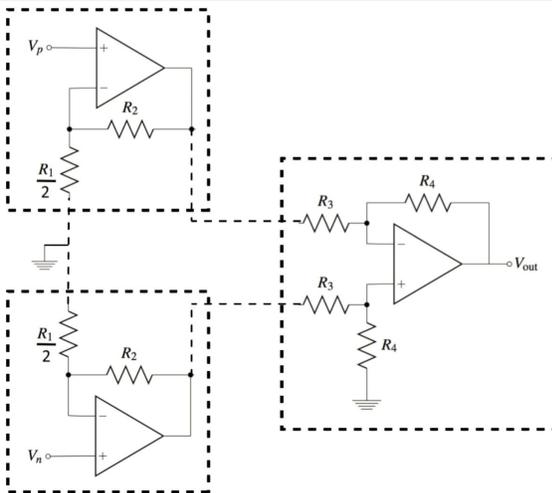
This homework is due August 29, 2017, at 11:59.

1. Op-amp review

Let us look at the circuit below:



- Write down all the branch and node equations using the golden rules of Op-Amps.
- Notice that there exists a symmetry between the two op-amps at the first stage of this circuit. What are the directions of the currents going through the two R_2 s? How do the currents of R_2 s influence the current through R_1 ?
- What is the current through R_1 ?
- What are the output voltages of the two op-amps at the first stage?
- Compute the voltage at the + terminal of the second-stage op-amp.
- What is V_{out} ?
- If we broke R_1 into two series resistors, each with a value of $\frac{R_1}{2}$. What is the voltage at the node in between each of these resistors?
- Based on the above analysis, if $V_p = -V_n$ we could introduce a "fake ground" in the middle of the resistor R_1 and come up with the following circuit:



Now, each of the first two op-amps is being used in a form that resembles building blocks that you have seen before. What are the gains of those blocks?

What is $V_{out}/(V_p - V_n)$ for this revised circuit?

2. KVL

Now consider the circuit shown below:

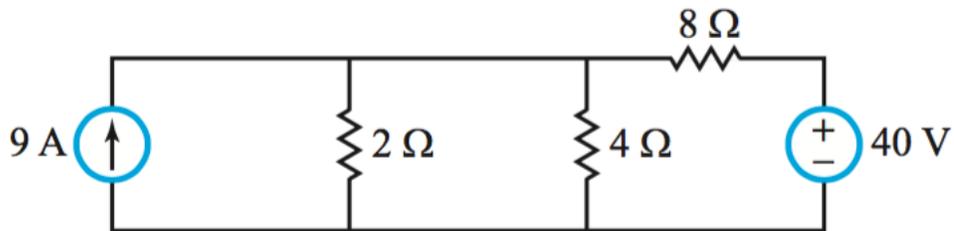


Figure 1: From Ulaby, Maharbiz, Furse. *Circuits*. Third Edition.

Determine the amount of power supplied by the voltage source.

3. KCL

Now consider the circuit shown below:

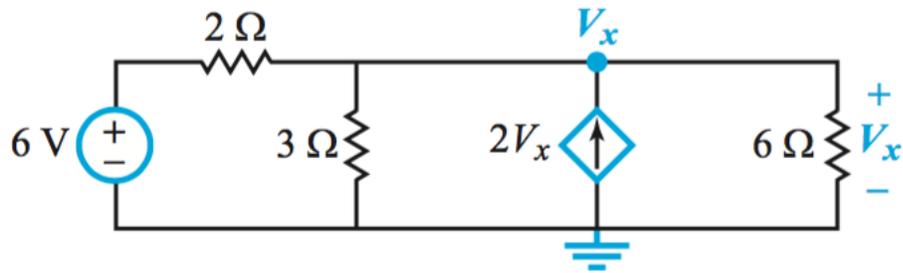


Figure 2: From Ulaby, Maharbiz, Furse. *Circuits*. Third Edition

Determine the voltage V_x .

4. Circuits and gaussian elimination

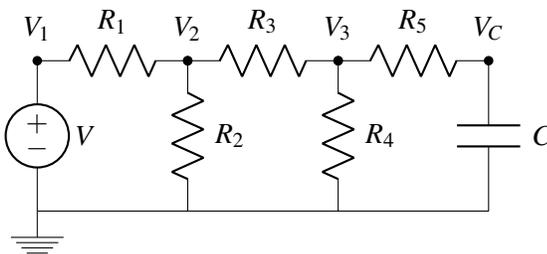


Figure 3: Example Circuit

- Find a system of linear equations that could be solved to find the steady-state node voltages.
- Given that the component values are $R_1 = 500\Omega$, $R_2 = 3000\Omega$, $R_3 = 1000\Omega$, $R_4 = 2000\Omega$, and $R_5 = 4000\Omega$, solve the circuit equations using Gaussian elimination.
- What's the voltage V_C across the capacitor?
- How would you check your work? Do so.

Contributors:

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