FINAL EXAM

Dec 16th , 2013, 10:30am-1:15pm

Honor pledge: "On my honor I have neither given nor received aid on this exam."

Name:_____ Signature:_____

- **Calculators allowed.**
- **Single sided 8.5x11 sheet with formulas and circuits allowed.**
- No books, no cell phones allowed.
- Write in English. Write clearly. Write neatly.
- All your answers must be in these stapled pages. If you use the backside you need to indicate this on the front. Back of pages are usually **NOT** graded.
- Do not take the staple off.
- Do not expect the answers to be integers.

For this exam please assume, unless otherwise specified, that:

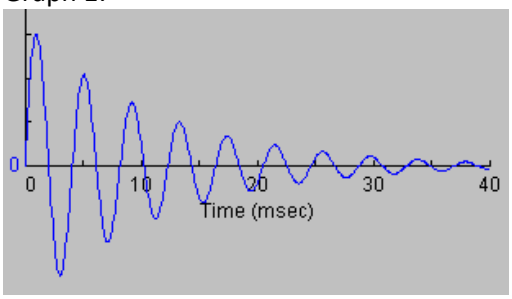
- Voltages are measured in reference to ground.
- Light bulbs are resistances.
- All switches are actuated in the direction shown by their arrows at t=0s, unless otherwise noted by the switch.
- Operational amplifiers are properly powered, so that they don't saturate.

Question	Max points	Grade
1	2	
2	2	
3	2	
4	2	
5	1	
6	1	
7	20	
8	20	
9	20	
10	20	
11	5	
12	5	
total		

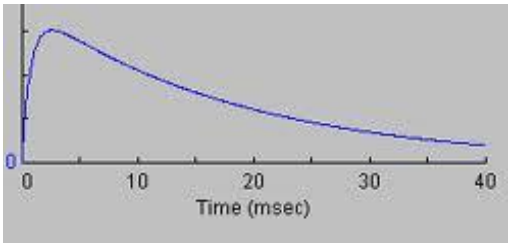
1. Which of the following graphs shows the natural response of an RLC circuit that is underdamped?

a) Graph 1
b) Graph 2
c) Graph 3
d) Either graph 1 or 2
e) None of the above

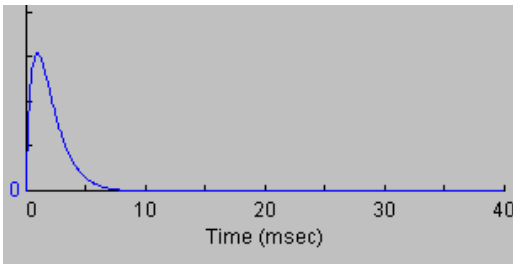
Graph 1:



Graph 2:



Graph 3:



2. A light bulb is connected to a voltage supply and lights up. When a second one is connected in series to the first one:

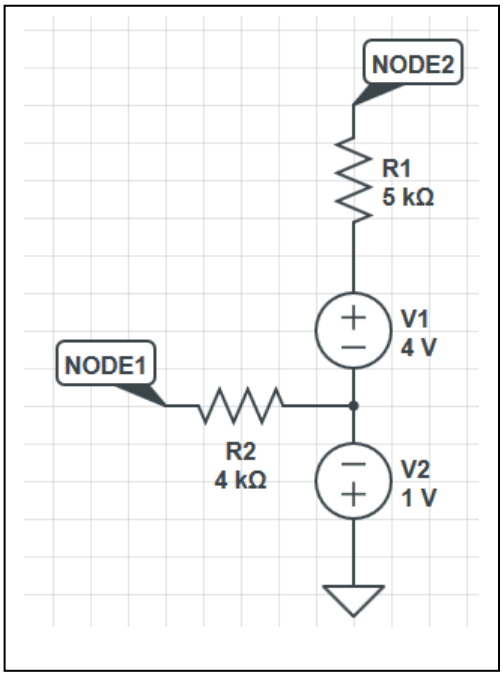
a) Current through the first one will go up.
b) This won't work, as light bulbs need to always be connected in parallel.
c) Required power from the supply will go up.
d) Current through the first one will go down.
e) None of the above.

3. This question refers to the figure with the resistors and voltage supplies. The voltage measured by a multimeter connected to node 2, in reference to node 1, is:

a) 0V
b) 4V
c) 2V
d) -3V
e) -4V

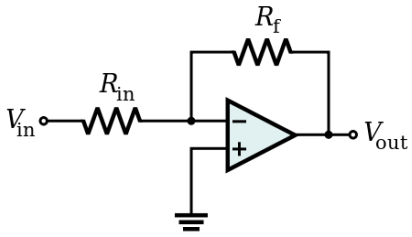
4. Referring still to the same circuit, if node 2 is shorted to ground, the voltage on node 1, in reference to ground:

a) Doesn't change.
b) Goes to zero.
c) Changes to 1V.
d) Goes to 3V.
e) None of the above.



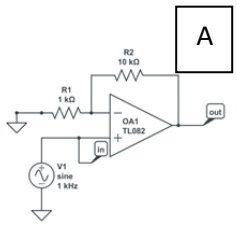
5. On the figure with the opamp, Rf=1k Ω and Rin=500 Ω. If Vin is 0.5V, what is Vout?

a) 2V
b) -1V
c) -2V
d) 1V
e) none of the above

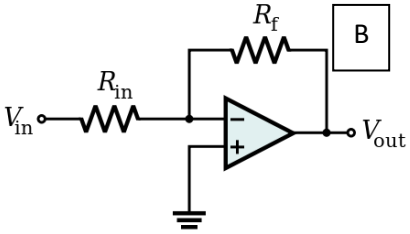


6. From the images below, select the instrumentation amplifier: ☐

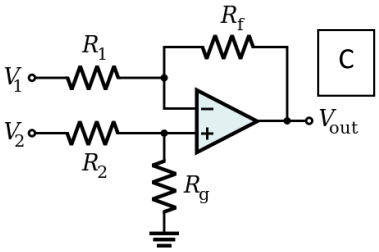
A



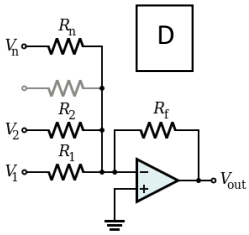
B



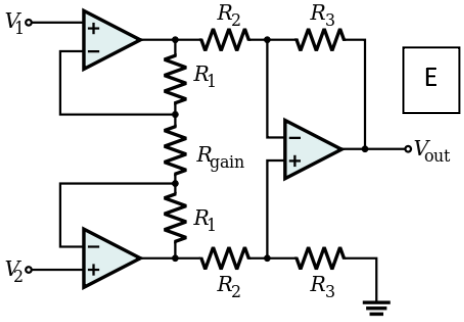
C



D

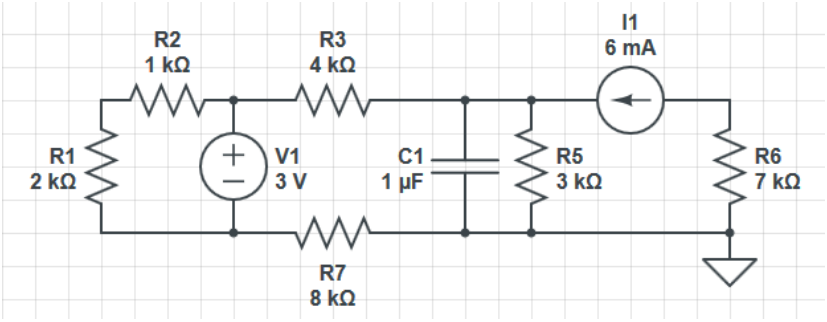


E



F (none of the above)

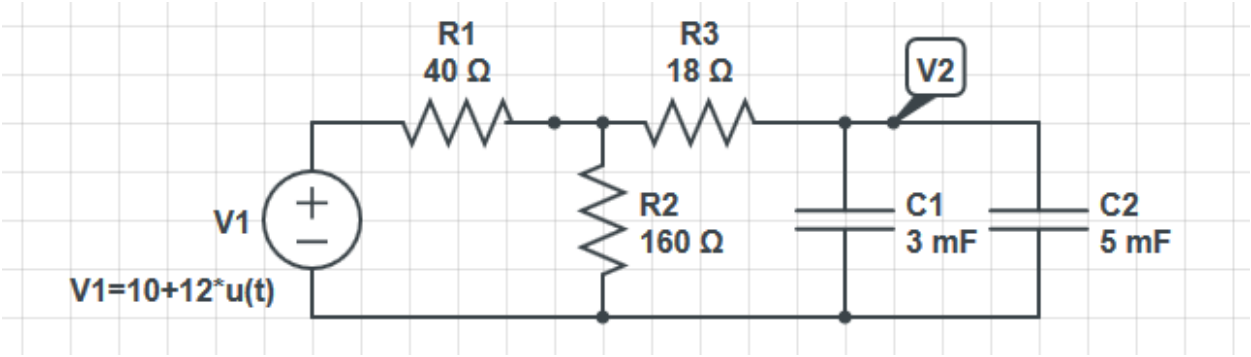
7. Find the Thèvenin equivalent from the perspective of the capacitor. (Hint: source transformation won't work here.) You can use any method you would like. Consider superposition one of them.



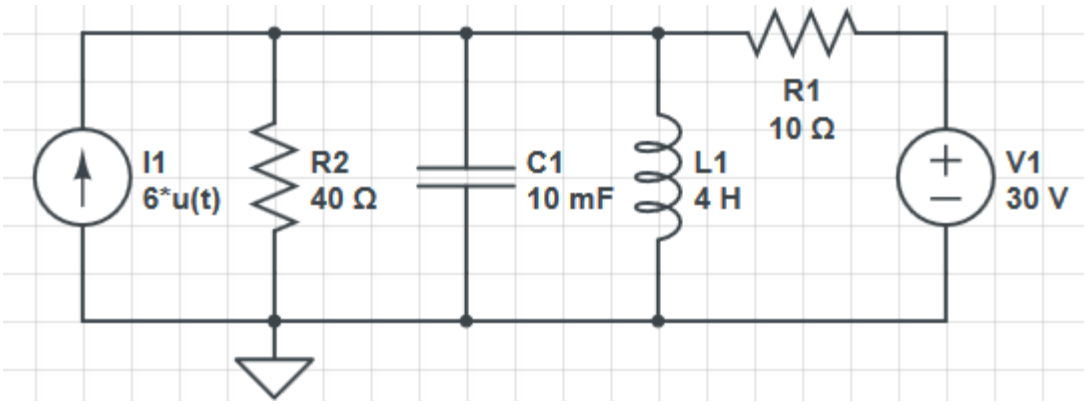
TEC:

8. Find the nodal voltage V2 for $t \geq 0$.

V2 =



9. a) Find the current through the inductor for t≥0. (8pts)
b) Find the voltage across the capacitor for t≥0. (7 pts)
c) Find the energy stored in both (L and C) at t=100ms. (5 pts)



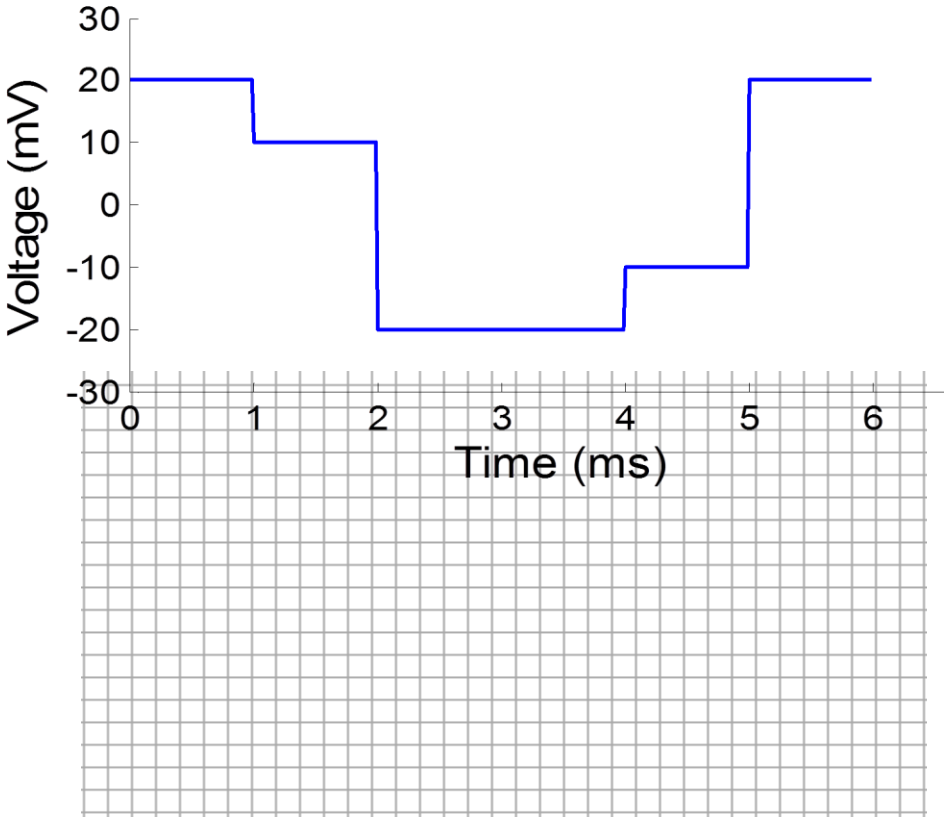
i(t) =

v(t)=

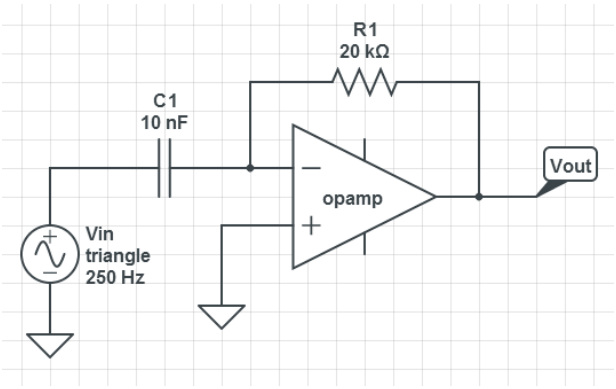
w1=

w2=

10. (a) An op amp integrator with R=4MΩ and C=1 μF is properly powered so that it doesn't saturate for the input given below. Sketch the output. (10 pts)



10 (b) Plot the output of the circuit below, given the input is a triangular wave with amplitude 10V (20V peak-to-peak) and frequency 250Hz. Draw both the input and output. (10 pts)



11. Explain in one paragraph how you would solve a circuit with sequential switches. What would be a characteristic of the answer that would indicate the “sequence”?

12. Describe the main technical challenge you encountered during ECP2 (Electric Circuits Project 2), and how you tackled it. The technical challenge needs to be focused around circuits.