ExamPle

Example of a 285 Final Exam

This is a reasonable exam for ECE285.

Due 12/13. Students successfully completing this exam and turning it in on Friday, 12/13, will receive extra-credit.

While during the real exam there won't be any consulting of notes or friends, for the purposes of this ExamPle it is ***fair*** to use your notes, ask questions of your friends about strategies, use calculators and books. In case you want extra-credit for doing this exam, it is **UNFAIR** to check your answers with your friends. Think on your own about the multiple choice questions (1 to 6) and the concepts questions (12 and 13).

Question	Max points	Grade
1	2	
2	2	
3	2	
4	2	
5	1	
6	1	
7	16	
8	16	
9	16	
10	16	
11	16	
12	5	
13	5	
total		

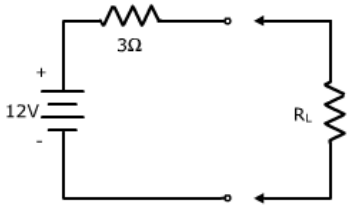
On this exam please assume, unless otherwise specified, that:

- 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 usually don't saturate.

1.

Convert the Thevenin circuit below to a Norton equivalent circuit. How much is the maximum power the circuit can supply to load resistor R_L?

- I_{Nort} = 9A, R_{Nort} = 9Ω & P_{max} = 27W
- I_{Nort} = 6A, R_{Nort} = 6Ω & P_{max} = 54W
- I_{Nort} = 4A, R_{Nort} = 3Ω & P_{max} = 12W



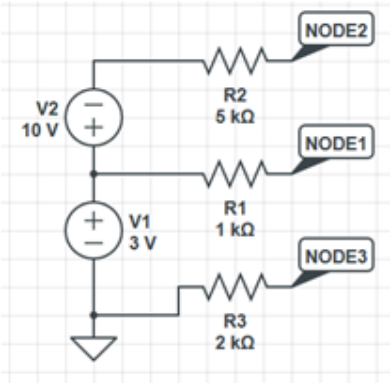
Answer: third line

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

a) Current through the first one will go up.
b) Nothing changes, as they are in parallel.
c) Required power from the supply will stay constant.
d) Current through the first will go down.
e) None of the above.
Obs – a better choice "b" would be: current through the first light buld doesn't change.

3. If nodes 1 and 3 are shorted:

a) The voltage in node 1 (referenced to ground) goes from 3V to 0V.
b) The voltage across R1 goes from zero to 1V.
c) The current through R1 stays the same.
d) The voltage across R2 goes from zero to 10V.
e) Two or more of the previous statements are true.



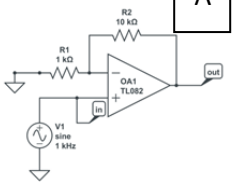
4. You are analyzing a circuit on a breadboard. The oscilloscope shows an almost perfect sinewave with 16.67ms period. The most likely scenario is:

a) The circuit is a sinewave generator.
b) The circuit isn't working.
c) The circuit is a notch filter.
d) The circuit is definitely working.
e) You pressed "auto setup" on the scope, so it is showing the 60Hz.

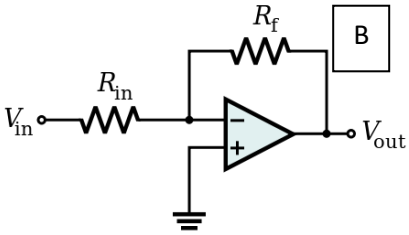
5. From the images below, select the summing amplifier: D

6. From the images below, select the voltage follower: F

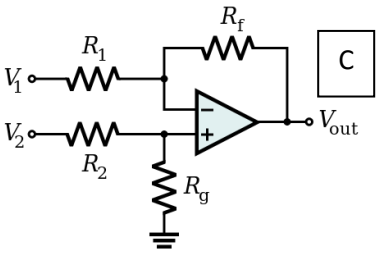
A



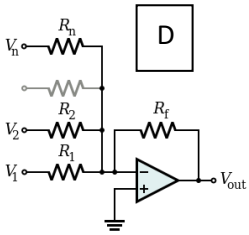
B



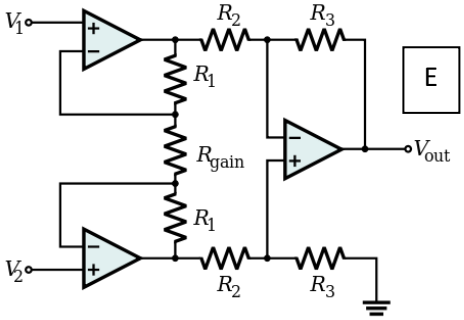
C



D

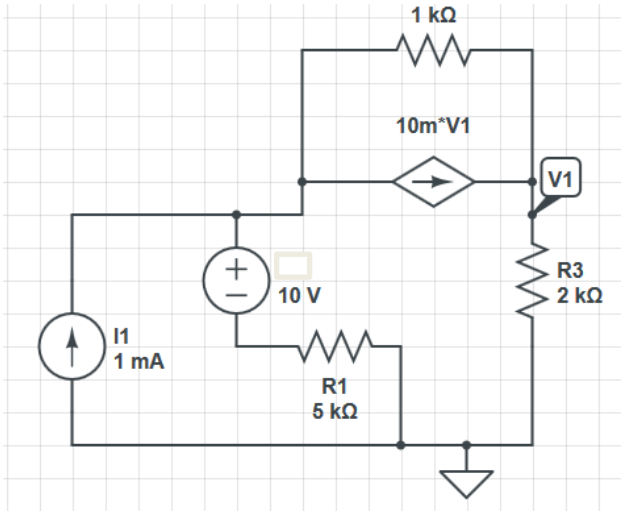


E



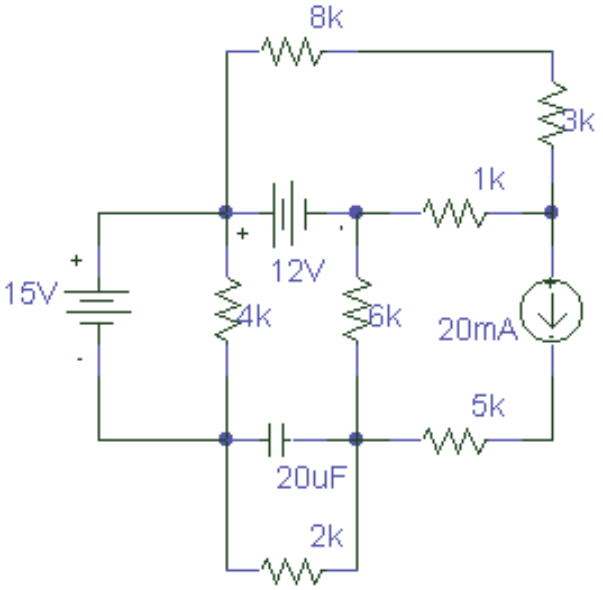
F (none of the above)

7. Find the current through R3. Indicate the direction. Use superposition.

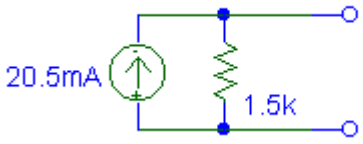


V1: answer is -2.5V. So the current flows up (toward V1) and it is 1.25mA

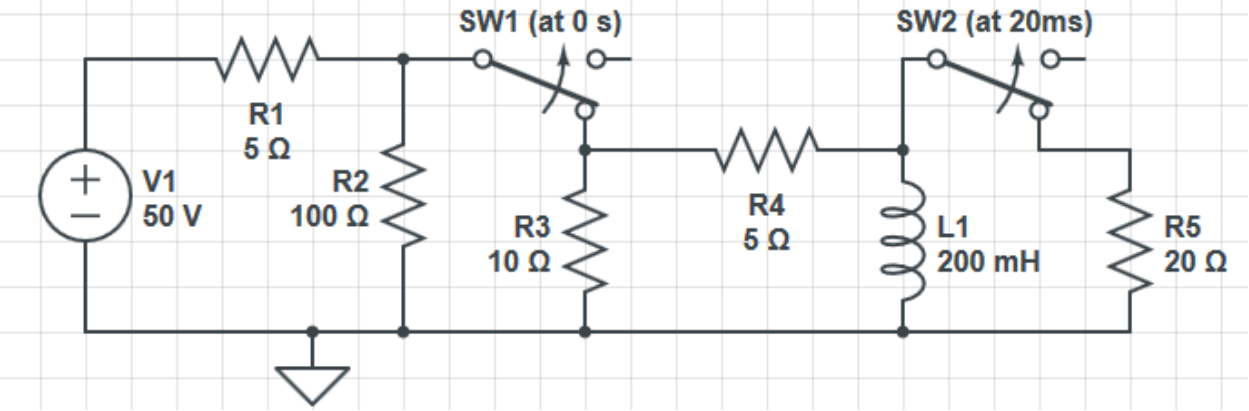
8. Find the Norton equivalent from the perspective of the 20uF capacitor.



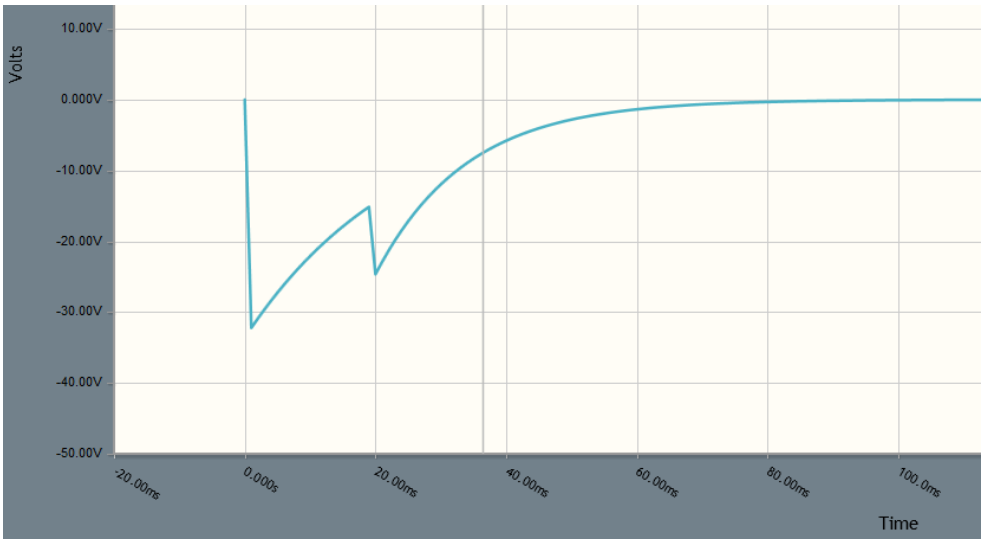
Answer:



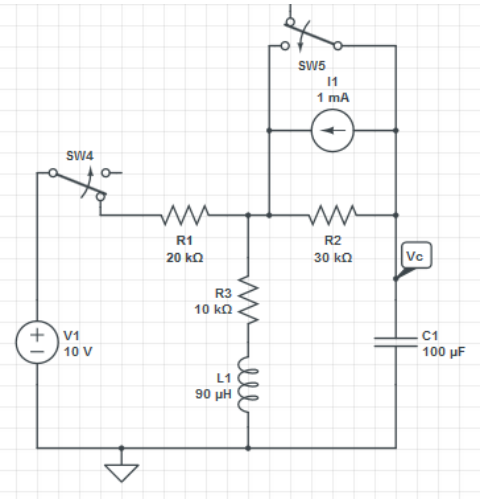
9. (a) Find the voltage across the inductor over time.
   (b) What is the voltage on the left terminal of the SW2 (switch 2, which opens at 20ms) at t=10s?zero



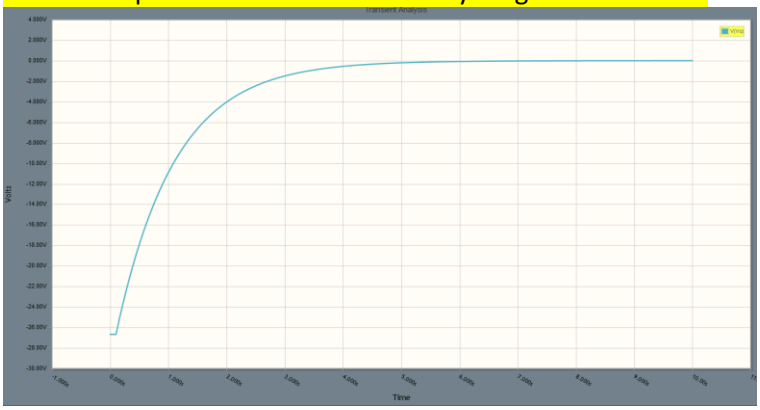
(a) answer: two lines, the first one with exponent as a function of t; the second one with (t-0.2) because of the second switch. This is a sequential switching question. Here's the simulation (voltage at the upper terminal of the inductor, referenced to ground:)



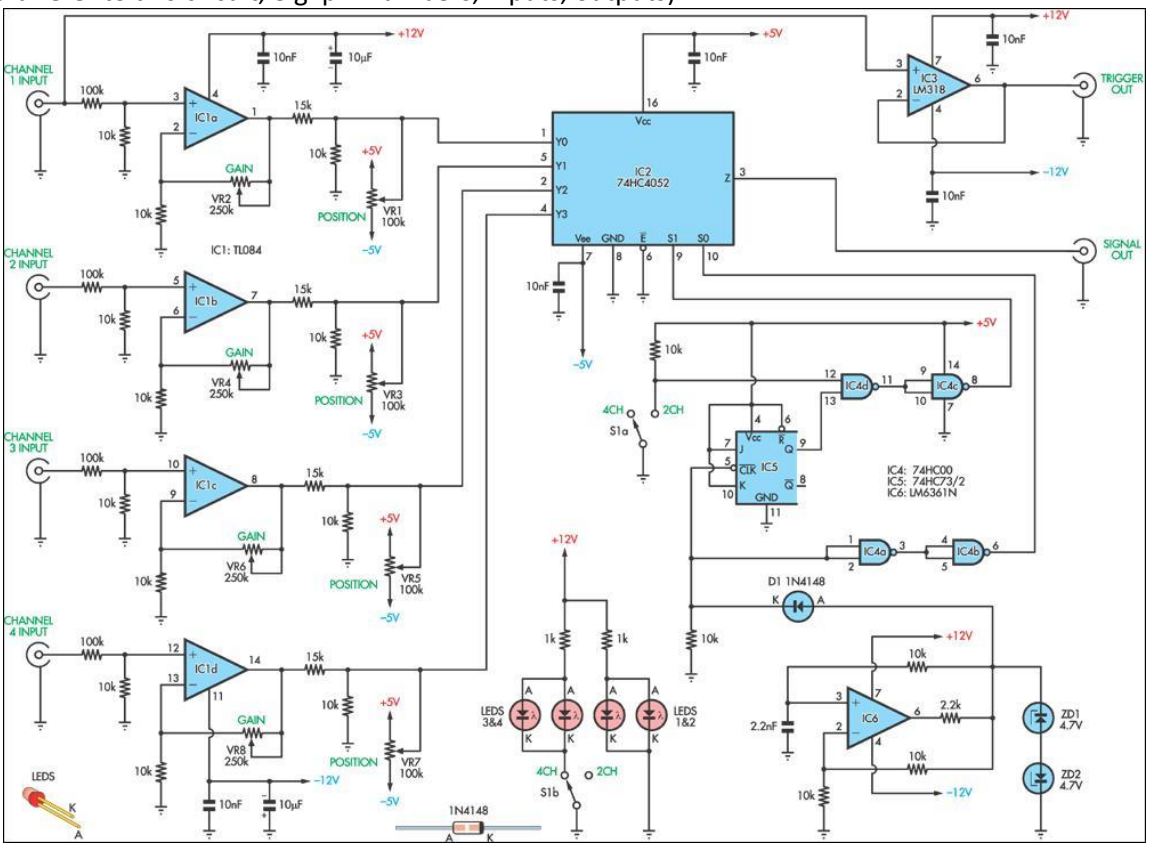
10. Find the voltage across C1 and sketch it out (the sketch needs to contain time marks and voltage marks on the axes). At what time does the capacitor have 33% of its final voltage?



Answer: exponential with an extremely long time constant.



11. The circuit below is part of a four channel oscilloscope. Engineers soldered it on a vector board and applied power (+12V, -5V, -12V, connected ground). Assume they have experience soldering and beeping the circuit. It still isn't working (even after the power was turned on). Give five suggestions of what they should do. Be as specific as possible (two suggestions may be generic, but the other three should refer to *this* circuit, e.g. pin numbers, inputs, outputs).



Concepts to measure: modular circuits with opamps (how to "separate" this circuit); how to setup an oscilloscope (worry about ground, about whether the channels are in DC or AC mode).
Insights expected: work on one channel at a time, switches S1a and S1b should be on 2CH, not on 4CH.

12. Explain in one paragraph how you would go about finding the Norton Equivalent of a circuit. Do not use the word "Thevenin" in your explanation. The circuit *may or may not* have dependent and independent sources.

Expected: if dependent sources are present, all the power sources (other than the dependent) are turned off; then a test voltage source of 1V or a test current source (1A) would be used instead of the load. If 1V is used, then the current through that 1V is evaluated. The Norton equivalent resistance will be 1V divided by the current found. The Norton current is the short circuit current for the circuit. In order to find that, one would short the load and find that current.

13. Discuss an application for the RC circuits you put together in the lab (lab 7). (maximum of one paragraph).

Expected: potential applications: filters, integrators, differentiators (finding solutions of math problems?)

Questions that did not make it to this exam, but may be on the final: an opamp circuit with two capacitors and resistors; Thevenin equivalent.