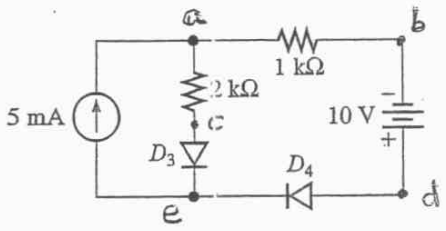
FINAL EXAM

All problems have equal weight.

1. In the circuit below, there are two ideal diodes, D_3 and D_4. Find the voltages at each of the nodes a through e, and the currents through each of the diodes.



2. Note that parts a and b are independent.

a. For the logic table given below, synthesize a logic circuit using the minimum number of logic gates you can. You may use gates with up to three inputs.

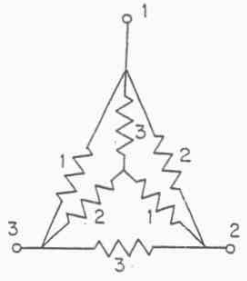
CD \ AB	00	01	11	10
00	1	0	1	1
01	1	1	1	1
11	1	1	1	1
10	0	0	1	0

b. A dc voltage source provides 1 V between terminals 1 and 2 in the circuit shown below. What voltage would a voltmeter read between terminals 1 and 3?

Hint: you may find the following formulas to be useful.

$$Z_i = \frac{Z_{ij}Z_{ki}}{Z_{ij}+Z_{jk}+Z_{ki}}$$

$$Z_{ij} = \frac{Z_iZ_j + Z_jZ_k + Z_kZ_i}{Z_k}$$



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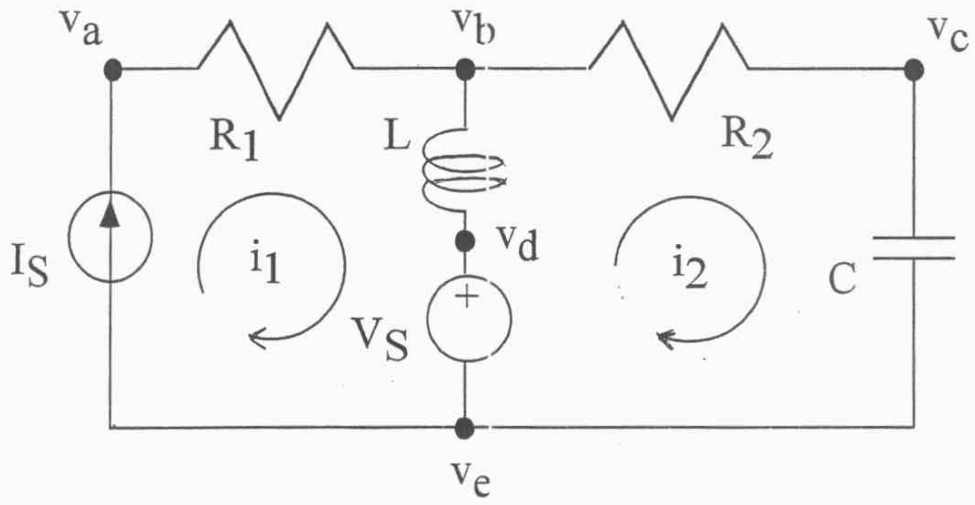
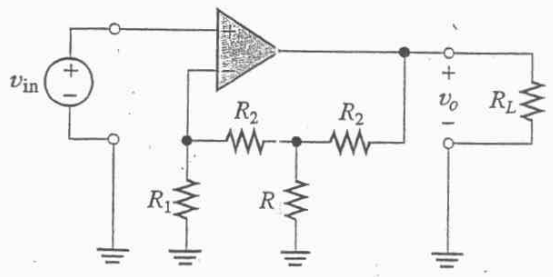
3. Please note that parts a and b are unrelated.

a. Construct the dual of the circuit below. For extra credit, locate the duals of V_a, V_b, V_c, V_d, V_e, I_1, and I_2 on the new schematic.



b. Find an expression for the voltage gain, v_0/v_{in}, for the circuit shown below. Hint: I suggest starting with two equations in two unknowns, and eliminating the unwanted unknown to obtain a single equation relating v_0 and v_{in}.



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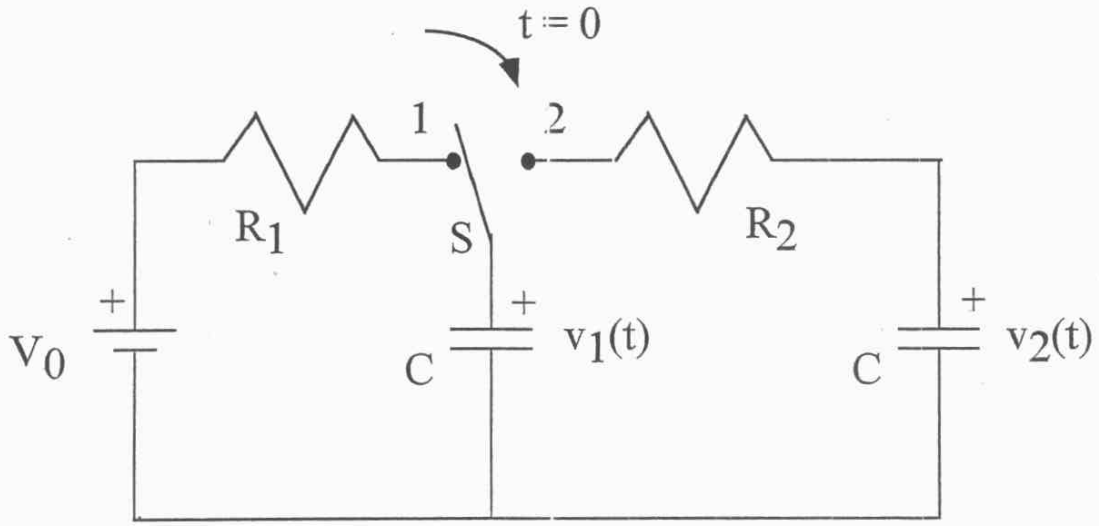
4. In the circuit below, the switch S is in position 1 for a long time. At time t = 0, S moves to position 2.

a. How much energy is stored in the capacitor on the left at t = 0-?

b. Write expressions for $v_1(t)$ and $v_2(t)$. How much energy is stored in each C? How much energy has been dissipated by the resistor R_2? Compare to the energy stored in the capacitor on the left at t = 0- and determine whether energy has been conserved. What happens to this energy balance equation if R_2 has a negligible resistance? Please explain.



5. Short Answer Questions (unrelated)

a. Describe the difference between the natural (homogeneous) and forced (particular) responses of a circuit.

b. What is impedance? Briefly describe as many uses of impedance as you can.

c. Give examples of a simple high pass filter, a simple low pass filter, and a simple band pass filter.

d. What are pole-zero plots, and why are they useful? How are they related to Bode plots? Explain (briefly) what "s" is.

e. What are phasors and why do we use them?

f. Describe two possible ways to solve for voltages and currents in a circuit with a nonlinear element.