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EE 40

Midterm 2

October 17, 2002

PLEASE WRITE YOUR NAME ON EACH ATTACHED PAGE

PLEASE SHOW YOUR WORK TO RECEIVE PARTIAL CREDIT

Problem 1: 10 Points Possible ______

Problem 2: 10 Points Possible ______

Problem 3: 20 Points Possible ______

Problem 4: 20 Points Possible ______

Problem 5: 20 Points Possible ______

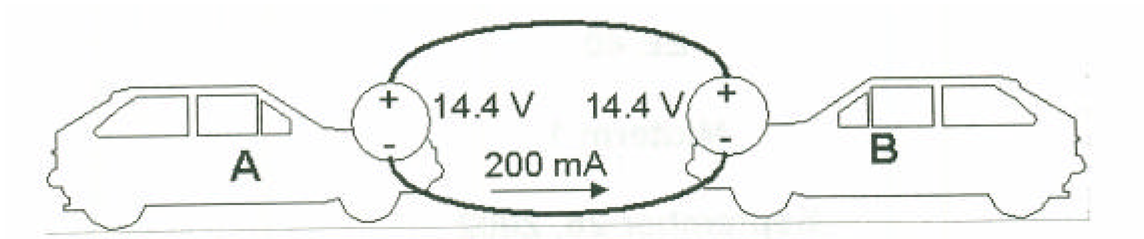
Problem 6: 20 Points Possible ______

TOTAL: 100 Points Possible ______

Problem 1: 10 Points Possible

Prof. Ross's lovely blue Honda Civic has a dead battery. A passerby offers to recharge her battery using his car battery. Unfortunately, he is one of thousands of people in the Bay Area driving an identical Honda Civic, and once the cards are hooked up, Prof. Ross cannot tell which car is hers!

Luckily, she carries a digital multimeter wherever she goes, and determines that a 200 mA Current is flowing as shown between the 14.4 V batteries.



a) Draw a circuit diagram showing how the multimeter is attached to measure current. (You don't need to draw the cards, just the circuit)

b) Which car belongs to Prof. Ross (which battery is being charged)? Justify your answer.

c) How much power is Prof. Ross's battery absorbing?

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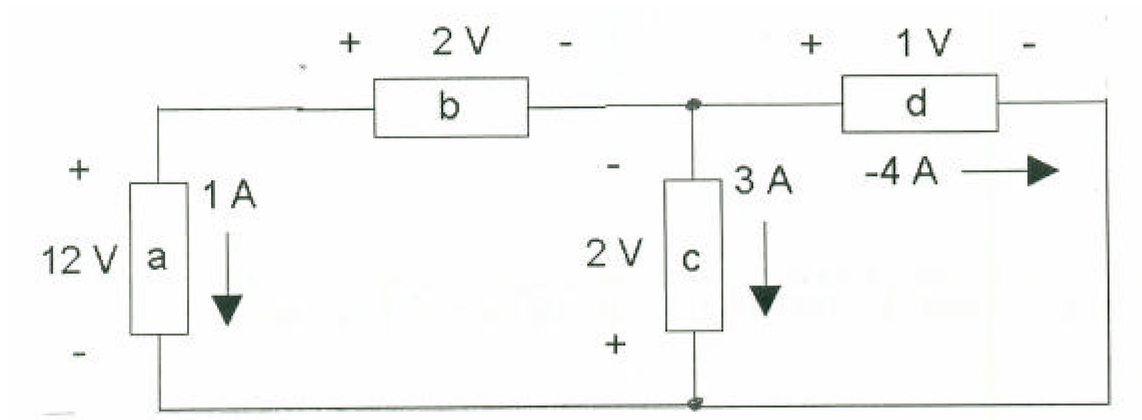
Problem 2: 10 Points Possible

A certain absent-minded professor does not always proofread her notes and homework carefully, and a student mentions that there is "something wrong" with the following circuit that was assigned in a homework.



Is there something wrong with this circuit? If so, what?

Problem 3: 20 Points Possible

Consider the following truth table for a Boolean Function F with inputs A, B, and C:

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

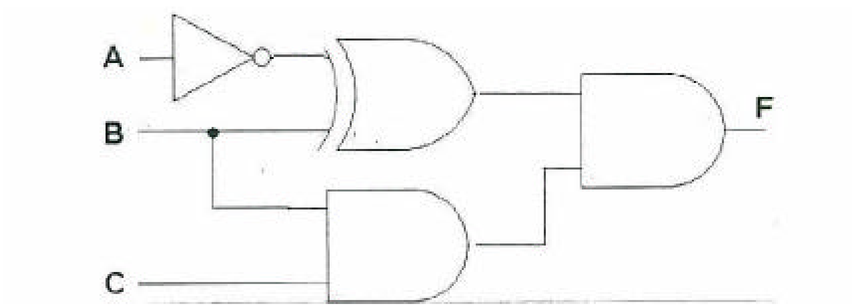
a) Use the "sum of products" method to implement a logic circuit for this function. YOU DO NOT NEED TO SIMPLIFY THE CIRCUIT. You may use three-input gates.

b) Implement the above circuit using only NAND and NOT (inverter) gates. YOU DO NOT NEED TO SIMPLIFY THE CIRCUIT. You may use three-input gates.

c) Can every Boolean function be implemented using only two-input NAND gates? Why or why not?

Problem 4: 20 Points Possible

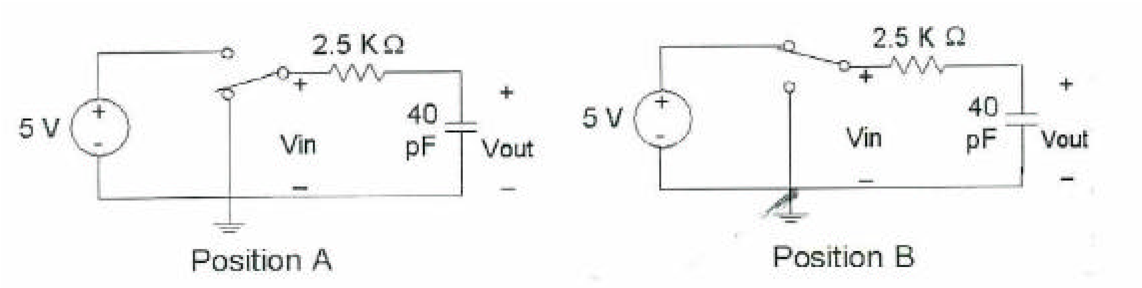
Consider the logic circuit below. Assume that inputs A, B, and C have been at logic zero for a long time, and then instantaneously change to logic 1 at time t=0. Assume also that each logic gate has propagation delay t.



Draw a timing diagram indicating the logic transitions of the output F.

Problem 5: 20 Points Possible

Consider the usual RC circuit model for gate delay shown below, with the switch implementing the step changes in Vin.



a) What is Vin when the switch is in Position A?

b) What is Vin when the switch is in Position B?

c) Suppose the switch is in Position A for a long time, then instantaneously switches to Position B at time t=0. Write the equation for Vout(t).

d) Graph Vout(t), indicating the value of Vout after one time constant.

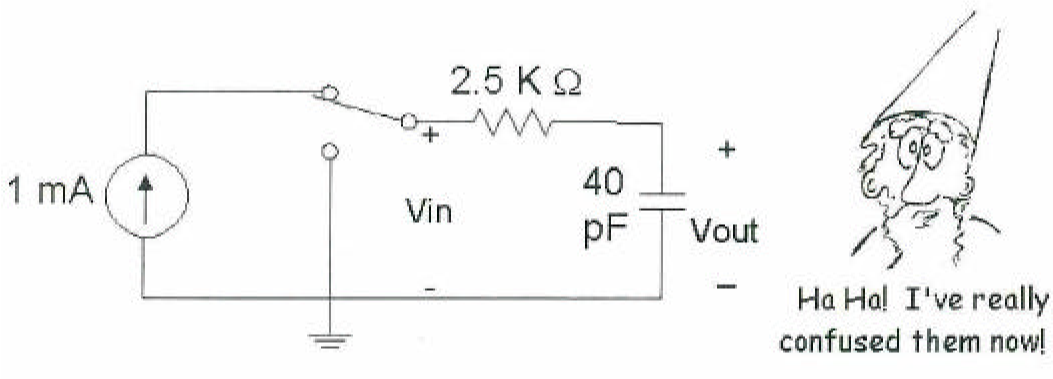
e) Suppose I know that the voltage source will blow a fuse if the current through it reaches 1 A in magnitude. Will the voltage source blow a fuse in this case?

Problem 6: 20 Points Possible

Refer back to Problem 5, where the circuit instantaneously switches from Position A to Position B at t=0 (after being in Position A for a long time).

Suppose that at t = 100 ns, a magician comes along and instantaneously turns the voltage source into a 1 mA current source.

So the circuit is in Position A for t < 0, moves to Position B for $0 \leq t < 100$ ns, and switches to the circuit below at t = 100 ns:



a) Graph Vout(t), indicating the value of Vout at 100 ns and 200 ns.

b) Write the equation for Vout(t) for t>0. If your equation has multiple parts, be sure to specify when each part is valid.