EECS 40 MIDTERM 1

FALL 2004
Prof. White

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Problem 1 General Questions [6]

[1] To measure the voltage drop of a current-carrying resistor you put your voltmeter in series with the resistor. True ___ False ___

[1] The amount of current flowing in a resistor decreases linearly as we go from its positive terminal to its negative terminal. True ___ False ___

[1] The equivalent circuit for three inductors in parallel is like that for three resistors in parallel except that L's replace R's. True ___ False ___

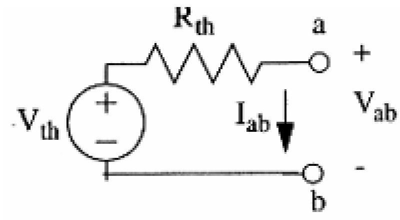
[1] List the circuit elements that are linear: ____________________________________

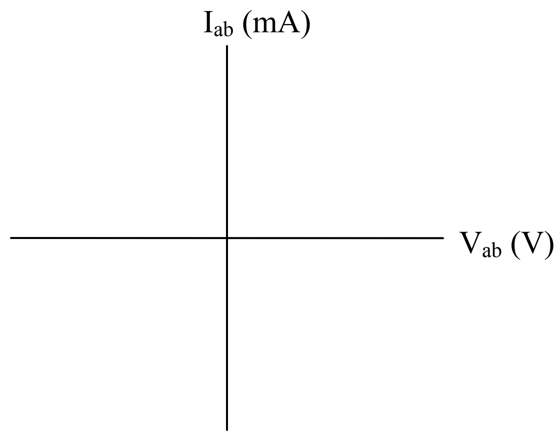
[1] List the circuit elements that dissipate energy: ______________________________

[1] The conductance of a 47 Ω resistor is _____________ (value) __________ (unit)

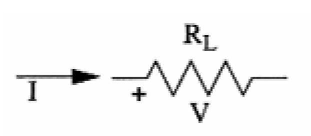
Problem 2 I-V Plots [13]

[8] a. On the axes given plot the I-V curve for the Thevenin equivalent circuit below, where V_{th} = 10 V and R_{th} = 200 Ω. (Note: of course for a finite current I_{ab} to flow, something must be connected between terminals a and b.)





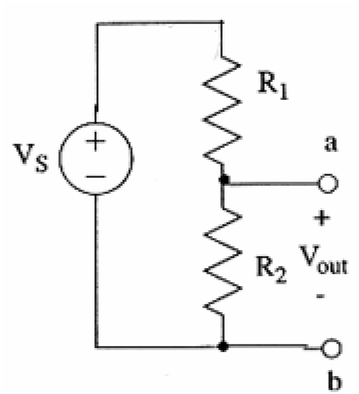
[5] b. On the same I-V axes plot the I-V curve for a resistor R_L = 400 Ω



Problem 3 Voltage Divider, Maximum Power Transfer [20]

[5] a. The voltage divider shown below is supposed to have an output of 5 V and is to draw no more than 100 mA from the voltage source when the voltage divider output is not loaded (open-circuited). Find R_1 and R_2 give Vs = 12 V.

Answer: R_1 = ______ R_2 = ______



[5] b. Find the Thevenin equivalent circuit at terminals a, b for the circuit of Part a. Make your method clear. Give both the values and units in your answer.

Answer: Vth = ______ R_{th} = ______

Note: Answers from here on may cause the maximum current limit to be exceeded.

[4] c. If we connect a variable resistive load across terminals a, b, what is the maximum current we could draw through the load?

Answer: Maximum current = ______

[4] d. What load resistance would produce the maximum power transfer from the voltage divider, and what is the value of that power?

Answer: Load Resistance = _______ Max. Power = ______

[4] e. Thought question: If we had a 100 Ω load resistor R_L connected to the output of a Thevenin equivalent circuit having a fixed V_{th} = 2 V and a variable R_{th}, what value of R_{th} would produce maximum power dissipation in R_L?

Answer: R_{th} = ______ Maximum possible power dissipation in load = ______

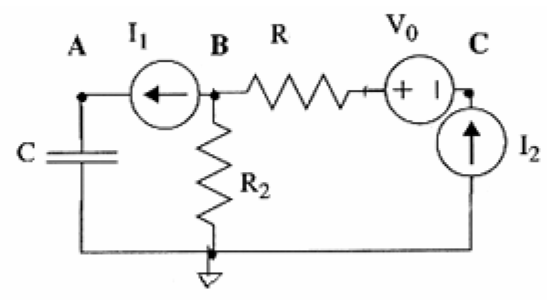
Problem 4 Nodal Analysis [14]

[9] a. For the circuit below write a set of three nodal equations. (Apply KCL at nodes A, B, and C, and use $i_C = C dv_C/dt$ for the capacitor.) DO NOT SOLVE ANY EQUATIONS.

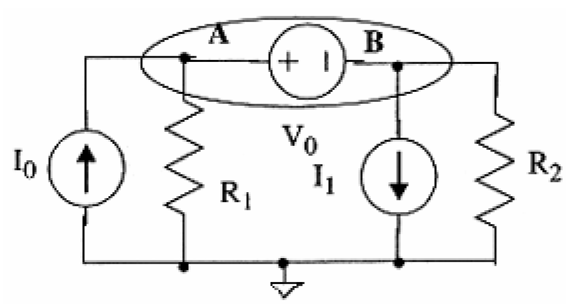
Answer: Node A:

Answer: Node B:

Answer: Node C:



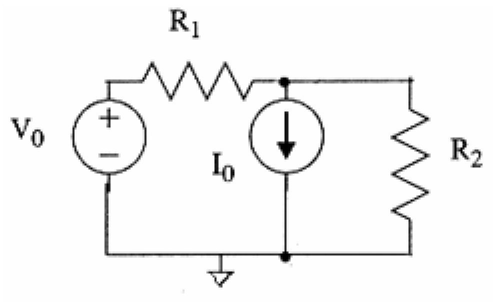
[5] b. A "supernode" is shown by the oval in the circuit below. Write the nodal equation that applies at the "supernode". DO NOT SOLVE THE CIRCUIT EQUATIONS.



Problem 5 Power [12]

Find the power that is either dissipated in or delivered by the current source I0 in the circuit below, and determine whether the power is dissipated or delivered. Make your methods clear to the grader. Given $V_0 = 5$ V; $I_0 = 2$ mA; $R_1 = 1$ kΩ; $R_2 = 2$ kΩ.

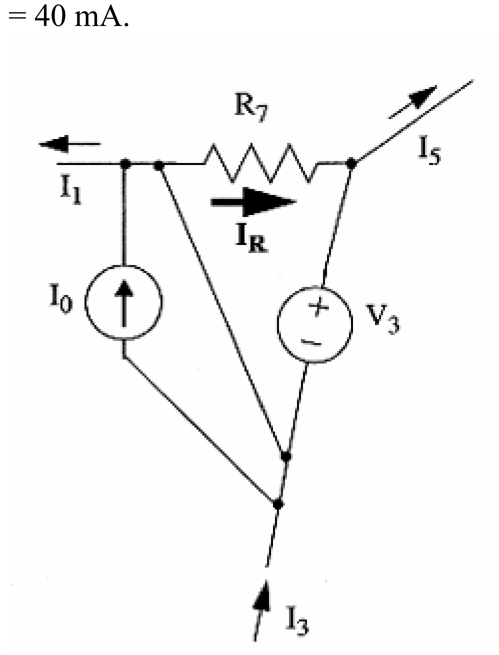
Answer: Power dissipated/delivered (circle one) is ______ (value) ______(unit)



Problem 6 Circuit Fragment [5]

A resistor in a portion of a very large circuit is shown. Find the current I_R given $R_7 = 100$ kΩ; $V_3 = 2$ V; $I_0 = 5$ mA; $I_1 = -15$ mA; $I_3 = 25$ mA; $I_5 = 40$ mA.

Answer: $I_R =$ ______



Problem 7 Superposition and Dependent Sources [20]

Analyze the circuit below to find V_{out} using the principle of superposition as follows:

[6] a. Draw each of the circuits whose solutions you will superpose to find V_{out}.

[6] b. Solve for V_{out} for each of those circuits.

Answer: V_{out1} = ____

Answer: V_{out2} = ____

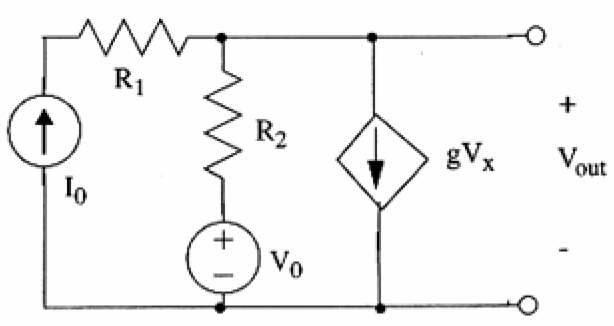
Answer: V_{out3} = ____

[6] c. Put it all together to find the actual V_{out}.

Answer: V_{out} = ____

[2] d. What are the units of the constant g?

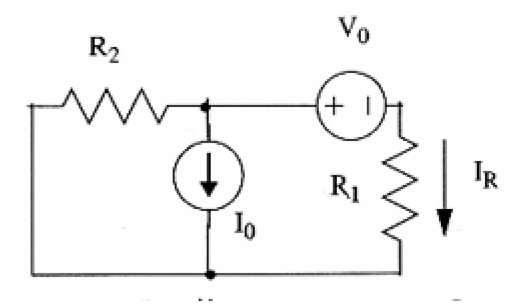
Answer: ____________



Problem 8 Mesh Analysis [10]

Find I_R using the mesh current method. Make your choices of mesh currents and your analysis clear to the grader.

Answer: I_R = ______ (value) ______ (unit)



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