UNIVERSITY OF CALIFORNIA
College of Engineering
Department of Electrical Engineering and Computer Sciences

EE40 Frank Liao
Summer 09

MIDTERM EXAMINATION #1
Time allotted: 90 minutes

NAME: _____ _____
(print) Last First

STUDENT ID#: _____

DISCUSSION SECTION: _____/_____
Day / Time

LAB SECTION: _____/_____
Days / Time

INSTRUCTIONS:

1. **SHOW YOUR WORK. Partial credit will be given only if your methods are clear to the grader.**
2. **Clearly mark (BOX or UNDERLINE) your answers.**
3. **Specify the units on answers whenever appropriate. Points will be deducted for missing units.**
4. **Closed book, closed notes. You are allowed ONE 8.5" x 11" sheet of notes.**
5. **Calculators are allowed.**

I acknowledge that the UC rules on academic honesty apply. _____
Signature

SCORE: **1 _____ / 15**

2 _____ / 20

3 _____ / 24

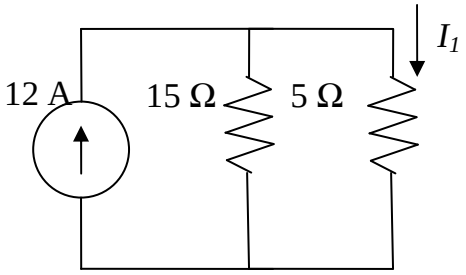
4 _____ / 20

5 _____ / 16 **TOTAL: _____ / 95**

Problem 1 [15 points]: Circuit Basics

a) Multiple Choice Questions. Select only ONE choice. No credit will be given to multiple answers. **[5 pts each]**

1) What is the current in I_1?



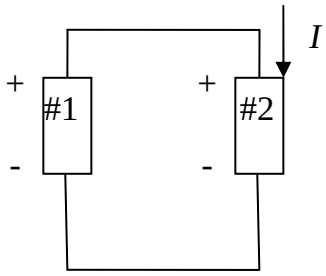
a) 3 A

b) 6 A

c) 9 A

d) 12 A

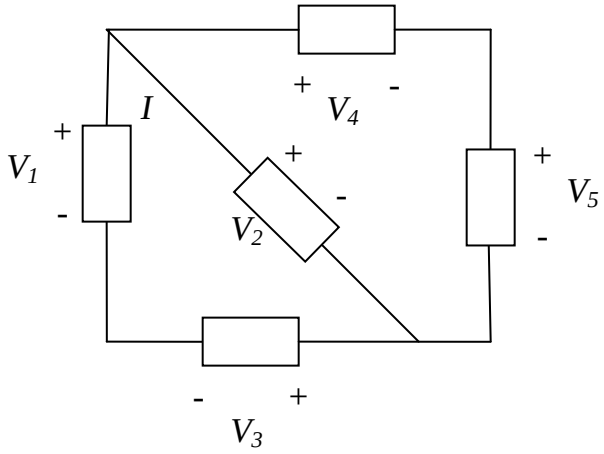
2) Which element is absorbing power?



a) #1

b) #2

3) If V_1 = 2 V, V_2 = -3 V, V_3 = 5 V, V_4 = 5 V, what is V_5?



a) 8 V

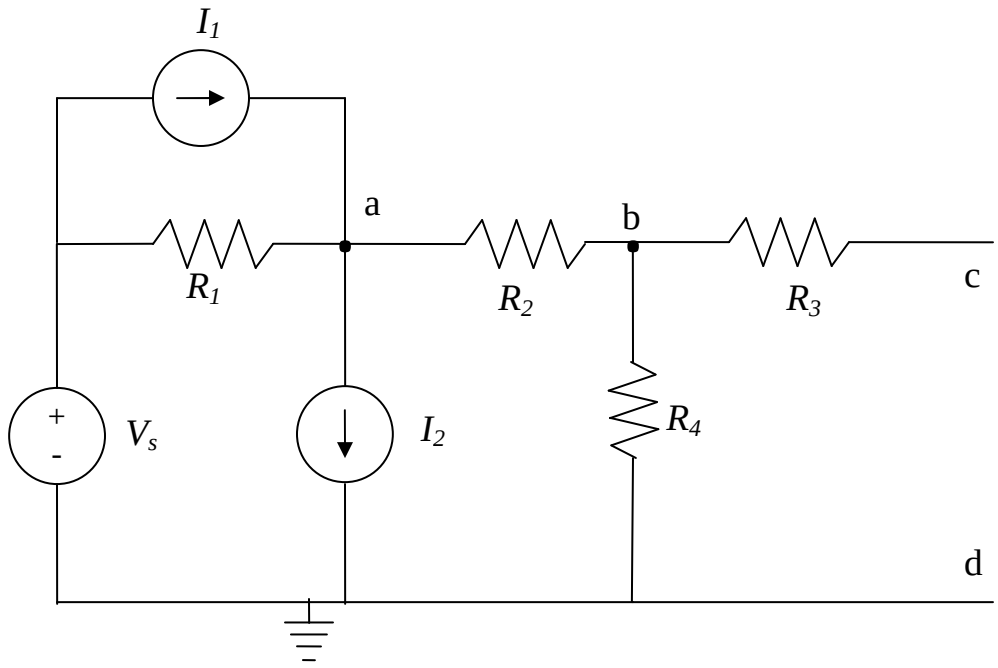
b) 2 V

c) -8 V

d) -2 V

Problem 2 [20 points]: Circuit Basics

1) Consider the circuit below:

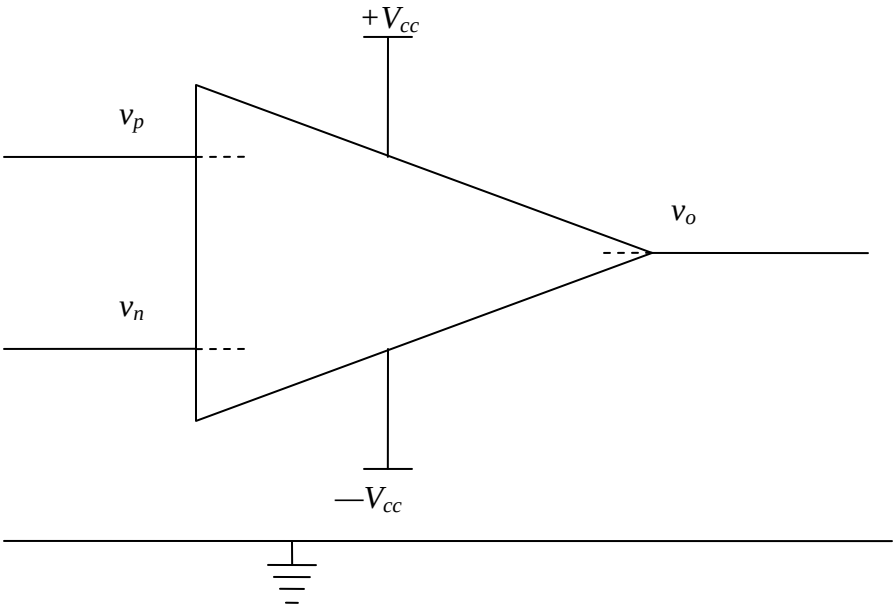


a) Write a KCL expression for node *a*. Be sure to label any new variables you create on the circuit diagram above. **[5 pts]**

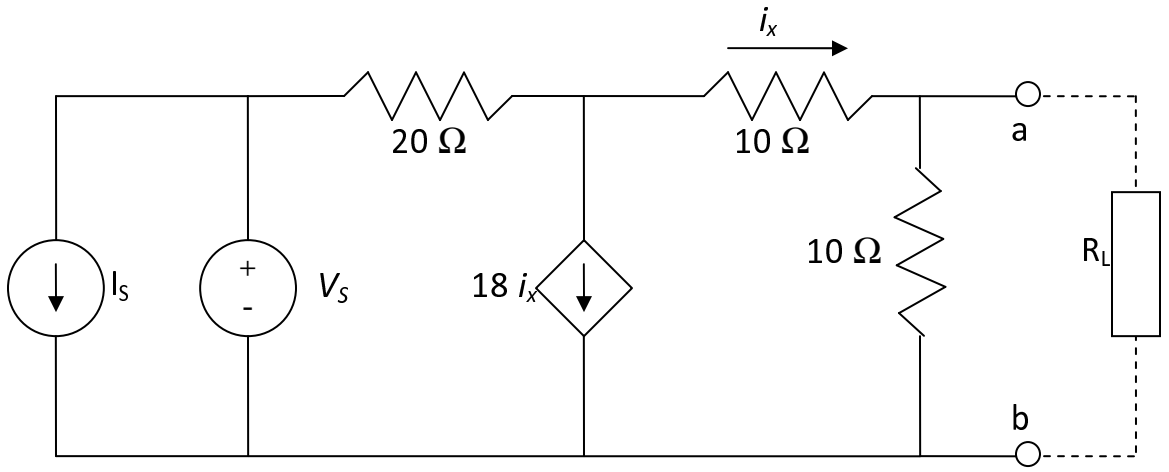
b) Write a KCL expression for node *b*. Be sure to label any new variables you create on the circuit diagram above. **[5 pts]**

c) What is R_{TH} between nodes *c* and *d*? **[5 pts]**

2.) Draw the equivalent circuit model of an op amp in the linear range: **[5 pts]**
Be sure to label all the elements.



Problem 3 **[24 points]: Maximum Power Transfer**
Consider the circuit below:



a.) Find the Thévenin equivalent between *a* and *b* **[12 pts]**

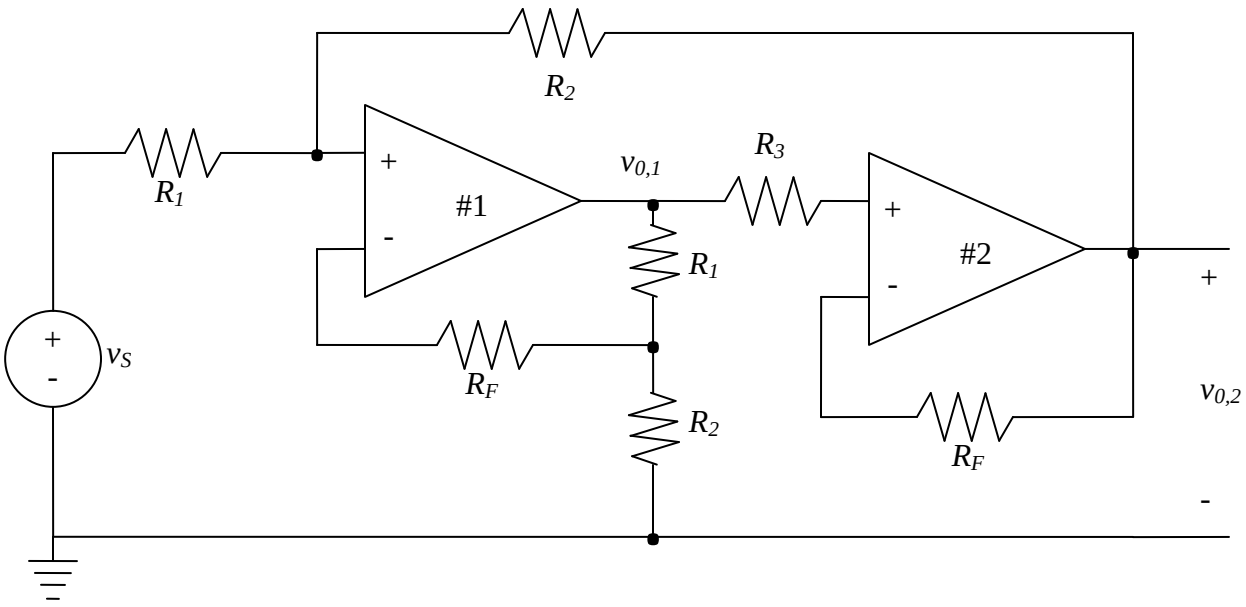
For parts (b) to (d), please use the values V_{TH} = 5 V and R_{TH} = 1kΩ INSTEAD of the values you found in part (a).

b.) Find the Norton equivalent between *a* and *b* **[6 pts]**

c.) Based on your answer in part (b), find the optimal R_L such that the power delivered to R_L is maximized. **[3 pts]**

d.) Based on your answer to part (c), what power is dissipated by R_L? **[3 pts]**

Problem 4 [20 points]: Op Amp Circuit
Consider the circuit below. Assume that both op-amps are ideal.



a) Write the KCL expression at the non-inverting input of op-amp #1. Be sure to label any new variables you create on the circuit diagram above. **[8 pts]**

b) Find the expression for the overall gain, G = $v_{o,2}/v_s$ in terms of the listed parameters. **[12 pts]**

<u>Problem 5</u> [16 points]: EE Technology and Circuit Basics
True or False Questions. Select only ONE answer. **[2 pts each]**

T F Moore's Law describes the phenomenon where the number of transistors on a computer chip doubles every 1.5 to 2 years.

T F The state-of-the-art solid-state transistor has dimensions on the order of 450 μm.

T F The maximum power that a solar cell can deliver in practice can be determined by i_{sc} x v_{oc}.

T F A good voltage source should have a small series resistance.

T F Any linear circuit can be reduced to an equivalent circuit comprising a voltage source with a series resistance.

T F The equivalent circuit from the previous question is called a Norton equivalent

T F A Wheatstone bridge is a circuit that can be used to measure change in resistance of a resistive sensor.

T F Multisim is a circuit simulator based on SPICE: Simulation Program with Integrated Circuit Emphasis.