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

EECS 40 Fall 2003
Introduction to Microelectronic Circuits

MIDTERM EXAMINATION #1

September 29, 2003
Time allotted: 50 minutes

NAME: _____, _____
(print) **Last** **First**

Signature: _____ STUDENT ID#: _____

Discussion Section: _____[1 pt]

1. This is a **CLOSED BOOK** exam. However, you may use 1 page of notes and a calculator.
2. **SHOW YOUR WORK** on this exam. **(Make your methods clear to the grader.)**
3. **Write your answers clearly in the spaces (lines, boxes, or plots) provided.**
4. Remember to specify the units on answers whenever appropriate.

SCORE: **1 _____ / 15**

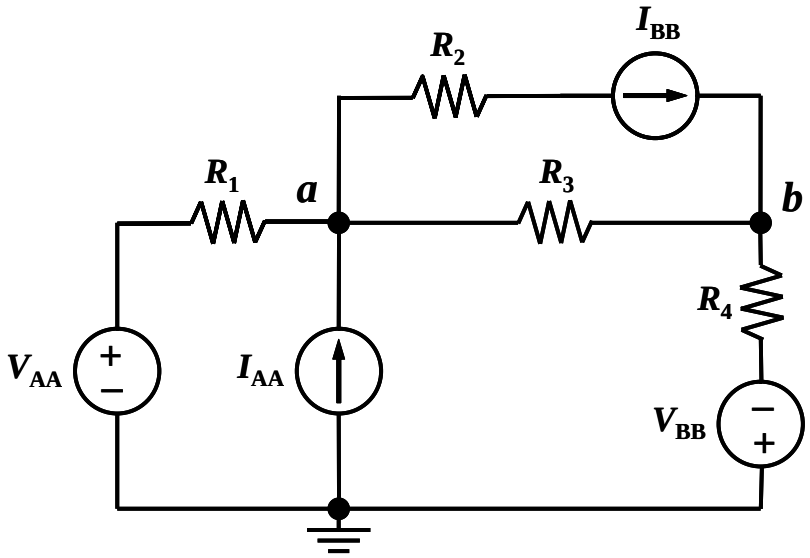
2 _____ / 20

3 _____ / 14

Total: _____ / 50

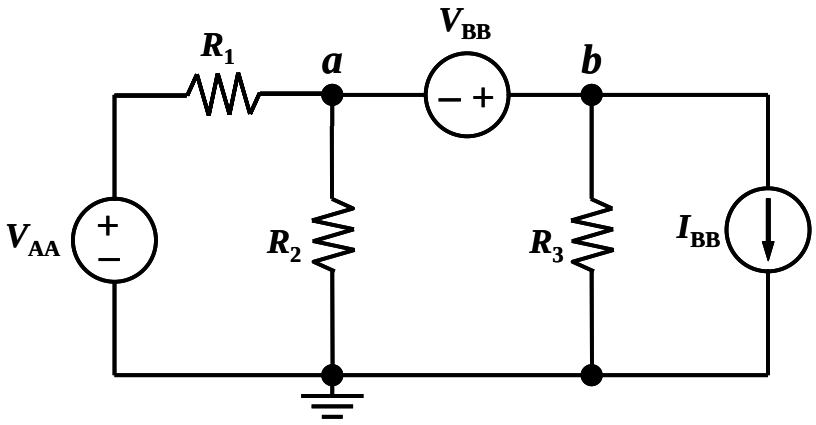
Problem 1: Circuit Analysis [15 points in total]

a) In the circuit below, the independent source values and resistances are known. Use the node-voltage method to write 2 equations sufficient to solve for V_a and V_b. To receive credit, you must write your answer in the box below. **[5 pts]**
DO NOT SOLVE THE EQUATIONS!



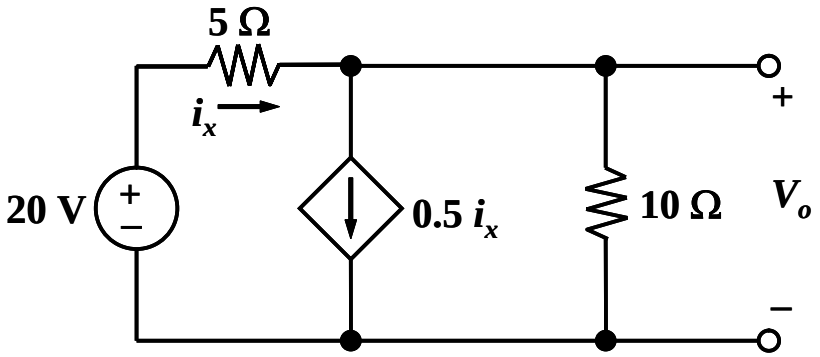
Write your equations here:

b) In the circuit below, the independent source values and resistances are known. Use the node-voltage method to write 2 equations sufficient to solve for V_a and V_b. To receive credit, you must write your answer in the box below. **[5 pts]**
DO NOT SOLVE THE EQUATIONS!



Write your equations here:

c) Find V_o. **[5 pts]**



V_o = _____

Problem 2: Equivalent Circuits [20 points in total]

a) Suppose you are given five resistors, each of value 10 kΩ.

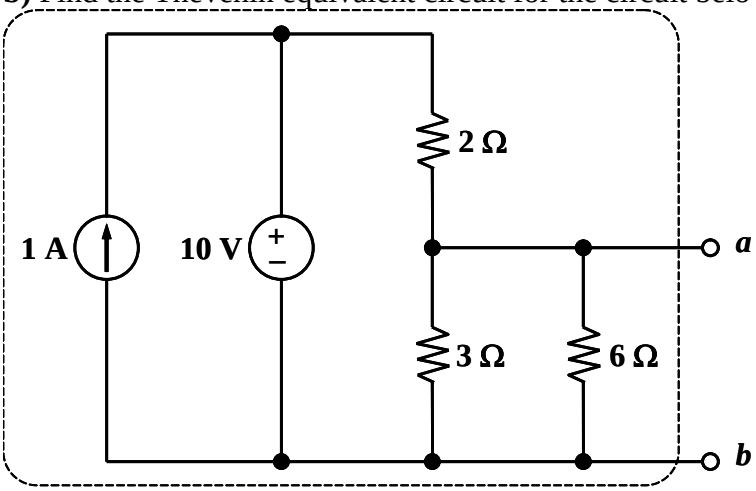
i) What is the **maximum resistance** which can be achieved by connecting these five resistors? Show how they should be connected in this case. **[3 pts]**

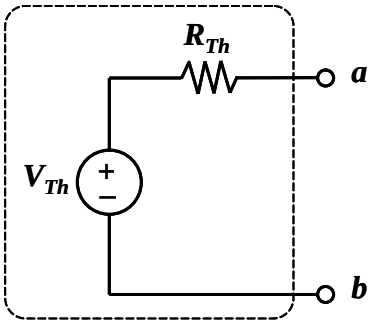
Circuit diagram of resistors connected to give a **maximum resistance value** of _____ **Ω**:

ii) What is the **minimum resistance** which can be achieved by connecting these five resistors? Show how they should be connected in this case. **[3 pts]**

Circuit diagram of resistors connected to give a **minimum resistance value** of _____ **Ω**:

b) Find the Thévenin equivalent circuit for the circuit below. **[8 pts]**

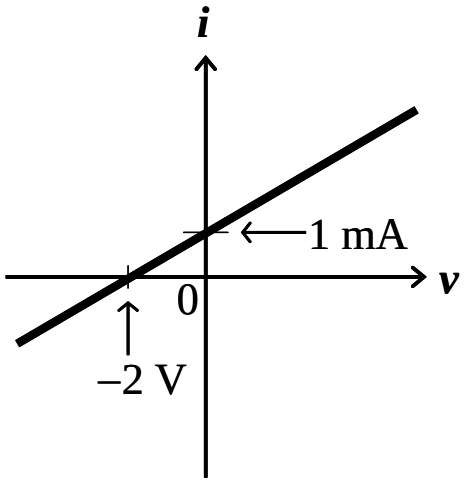


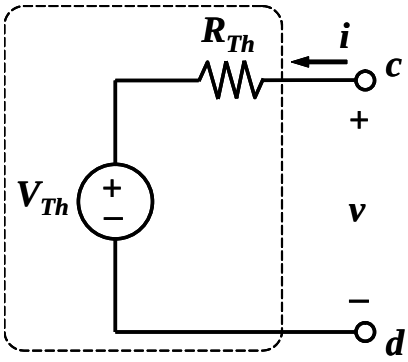


V_{Th} = _____

R_{Th} = _____

c) The *I-V* characteristic of a linear circuit is given below. Find the Thévenin equivalent of this circuit. **[3 pts]**





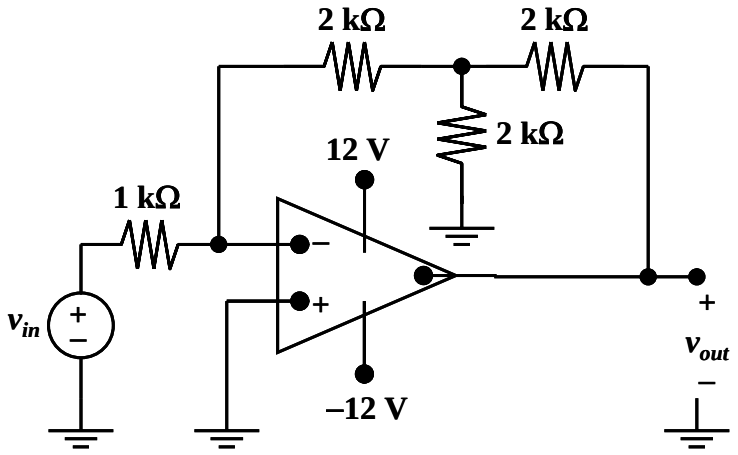
V_{Th} = _____

R_{Th} = _____

d) Suppose the circuit in part **(c)** is loaded with a resistor of resistance R_L (connected between terminals ***c*** and ***d***). What is the maximum power that can be delivered to this load resistor? **[3 pts]** (Hint: You should choose the value of R_L which results in the maximum power absorbed by the load resistor, and then calculate that power.)

P_{max} = _____

Problem 3: Op Amp Circuit [14 points in total]
Consider the op amp circuit below:



a) Assuming the op amp is operating in its linear region, find an expression for v_{out} (as a function of v_{in}). **[10 pts]**

v_o = _____

b) Sketch the voltage transfer characteristic for the op-amp circuit, for v_{in} ranging from –5 Volts to +5 Volts. Indicate the minimum and maximum values of v_{out}. **[4 pts]**