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

EECS 40 Spring 2000
Introduction to Microelectronic Devices

MIDTERM EXAMINATION #1

Time allotted: 80 minutes

NAME: _____ _____
(print) Last First Signature

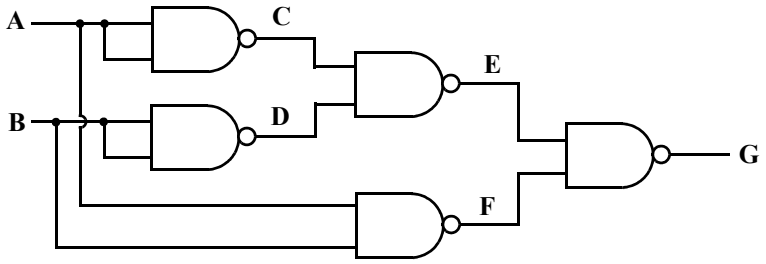
STUDENT ID#:_____

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. Numerical answers must be accurate to within 10% unless otherwise noted.**
4. Remember to specify the units on answers whenever appropriate.
5. **Do not unstaple the pages of this exam.**

SCORE:	**1** _____	**/ 20**
	2 _____	**/ 30**
	3 _____	**/ 25**
	4 _____	**/ 25**
	Total: _____	**/ 100**

Problem 1: Logic Gates and Timing Diagrams [25 points]

Consider the following digital logic circuit:



a) Fill out the truth table for the logic function G. **[8 pts]**

A	B	G
0	0	
0	1	
1	0	
1	1	

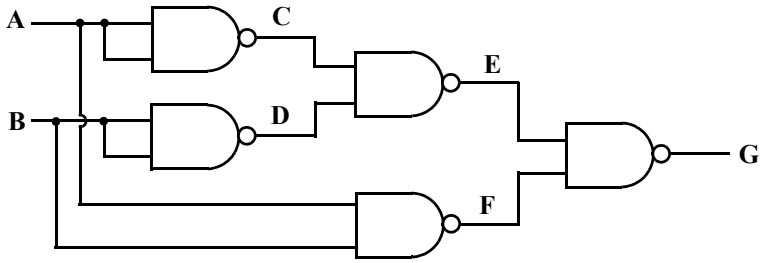
b) Write a simple logical expression for the function G. **[5 pts]**

G = _____

c) How many unit gate delays are there between the inputs (A and B) and the output (G)? **[2 pts]** (In other words, how many unit gate delays must you wait, after changing A and/or B, before you can trust the value of G to be valid?)

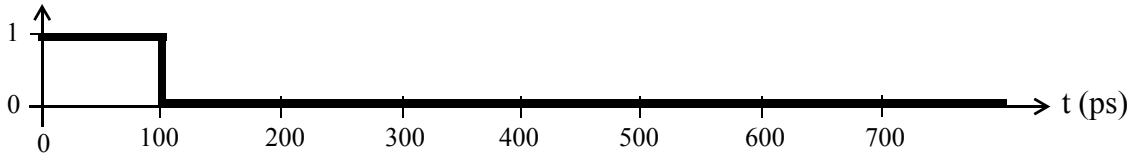
_____ unit gate delays

Problem 1 (continued)

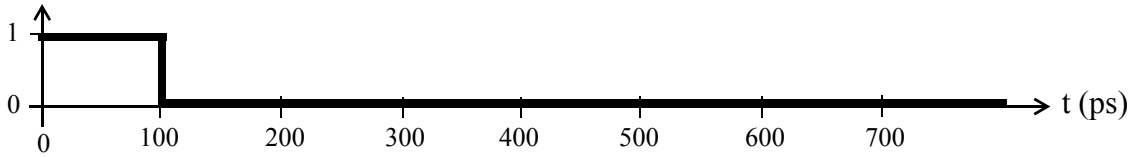


d) Assume each logic gate has a unit gate delay τ = 100 ps.
Draw the timing diagrams for t=0 to t=700 ps, for the given logic input values A and B. **[10 pts]**

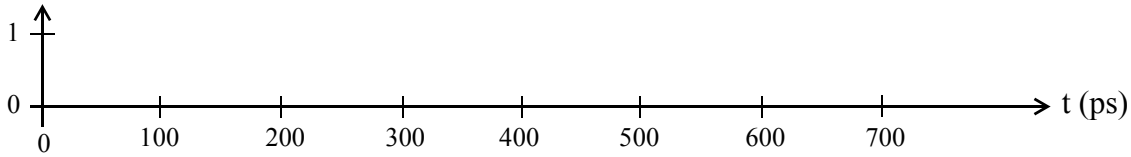
logic value of **A**



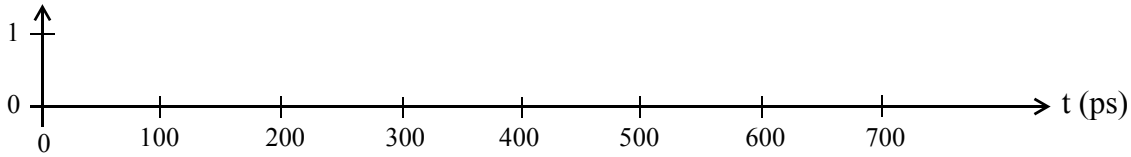
logic value of **B**



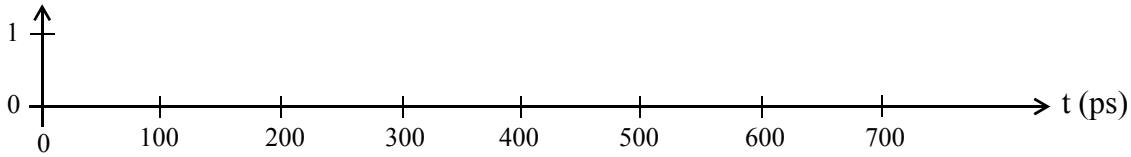
logic value of **C**



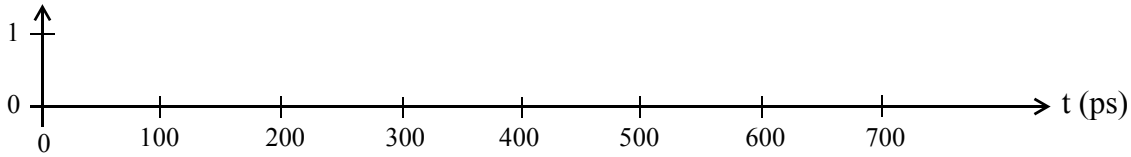
logic value of **D**



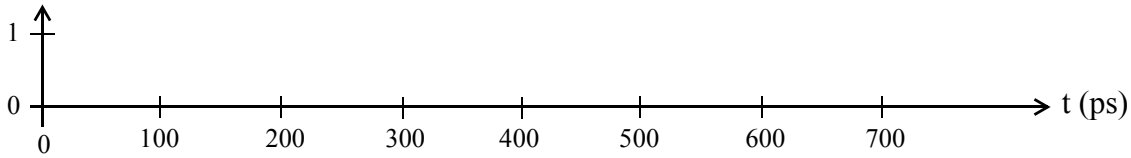
logic value of **E**



logic value of **F**

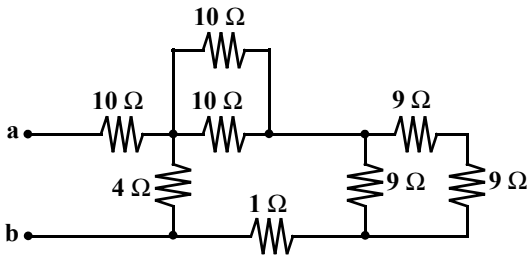


logic value of **G**



Problem 2: Resistive Circuits [30 points]

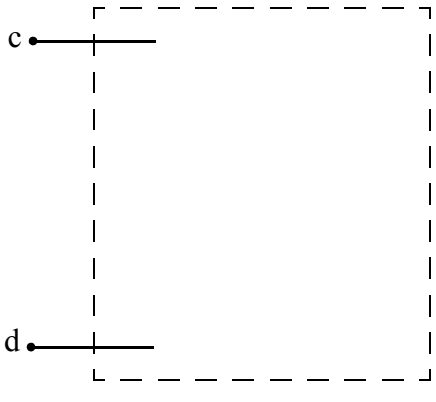
a) Find the equivalent resistance R_{ab} for the following circuit. **[6 pts]**



R_{ab} = _____ Ω

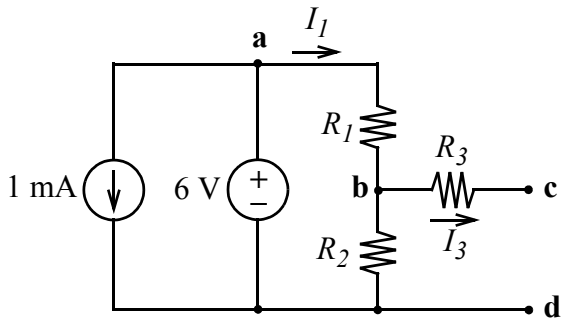
b) Suppose you need a **6 kΩ** resistor for your Tutebot project, but your TA gives you only a supply of 10 kΩ resistors. Being a clever Cal student, how would you connect several 10 kΩ resistors together, to achieve a 6 kΩ resistance? **[7 pts]**

Circuit diagram of 10-kΩ resistors connected to give R_{cd} = 6 kΩ:



Problem 2 (continued)

c) Consider the following circuit:



$R_1 = 1\ \text{k}\Omega$
$R_2 = 2\ \text{k}\Omega$
$R_3 = 2\ \text{k}\Omega$

i) Find V_{cd}. **[3 pts]**

$V_{cd} =$ _____ V

ii) Find the power developed/absorbed by the current source, P_1. **[3 pts]**

$P_1 =$ _____ W
[developed, absorbed]
(circle correct choice)

iii) Indicate in the table below (by checking the appropriate boxes) how various circuit parameters would change if the terminals **c** and **d** were to be shorted together. Justify your answers. **[6 pts]**

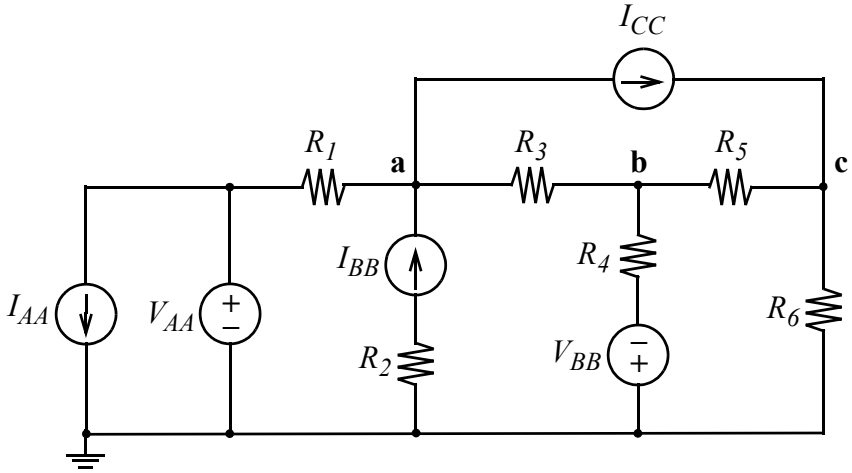
Parameter	**Value will:**			**Brief Explanation/Justification**
	increase	decrease	not change	
V_{bd}				
I_1				
Power developed by voltage source				

iv) What is the value of I_3 when the terminals **c** and **d** are shorted together? **[5 pts]**

$I_3 =$ _____ A

Problem 3: Nodal Analysis [20 points]

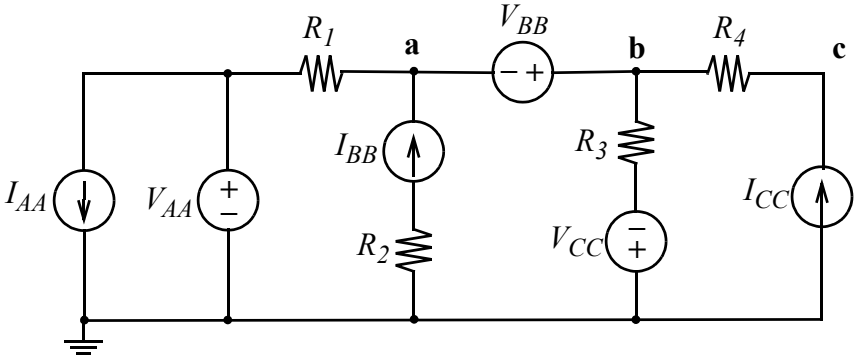
a) In the circuit below, the independent source values and resistances are known.
Use the nodal analysis technique to write 3 equations sufficient to solve for V_a, V_b, and V_c.
To receive credit, you must write your answer in the box below. **[10 pts]**
DO NOT SOLVE THE EQUATIONS!



Write the nodal equations here:

Problem 3 (continued)

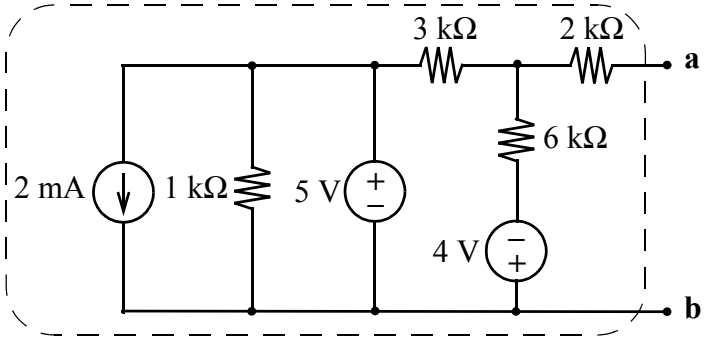
b) Similarly to part (a), use the nodal analysis technique to write 3 equations sufficient to solve for V_a, V_b, and V_c. To receive credit, you must write your answer in the box below. **[10 pts]** DO NOT SOLVE THE EQUATIONS!

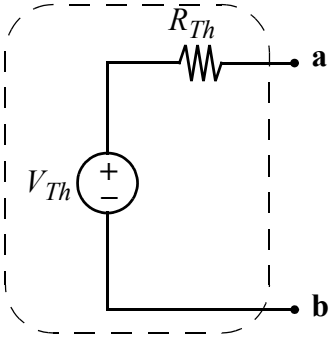


Write the nodal equations here:

Problem 4: Thevenin and Norton Equivalent Circuits [25 points]

a) Find the Thevenin Equivalent Circuit for the following circuit. **[10 pts]**

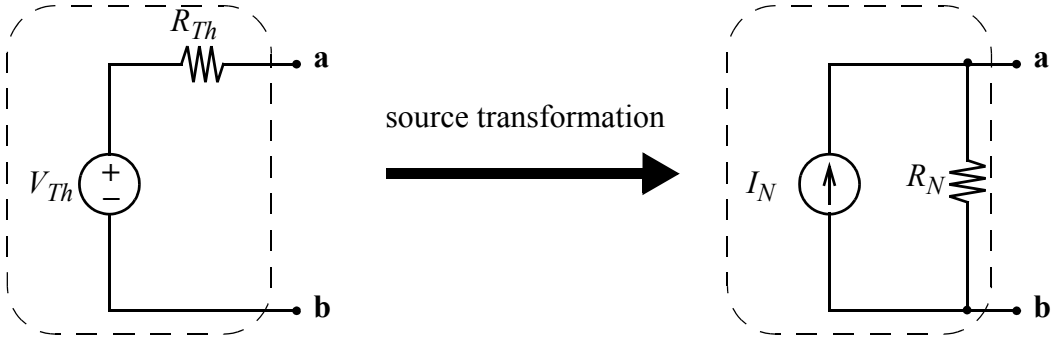




V_{Th} = _____ V

R_{Th} = _____ Ω

b) Use the source transformation method to obtain the Norton Equivalent Circuit for the circuit in part (a). **[5 pts]**

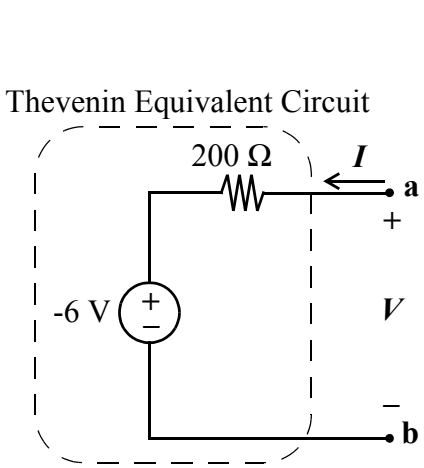


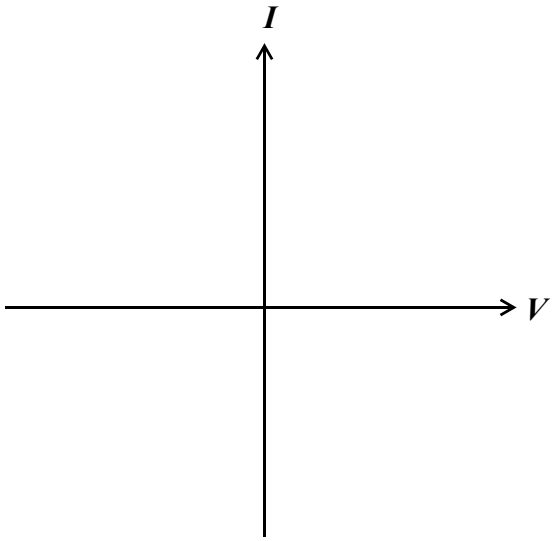
I_N = _____ A

R_N = _____ Ω

Problem 4 (continued)

c) The Thevenin Equivalent Circuit for a certain linear circuit is given below. Plot the current (***I***) versus the output voltage (***V***) for the circuit, **labelling the y-intercept and x-intercept**. **[5 pts]**





d) The circuit in part (c) is connected to a 1 kΩ load resistor (placed between the terminals **a** and **b**). Find the power absorbed in the load resistor, P_{1k}. **[5 pts]**

P_{1k} = _____ W