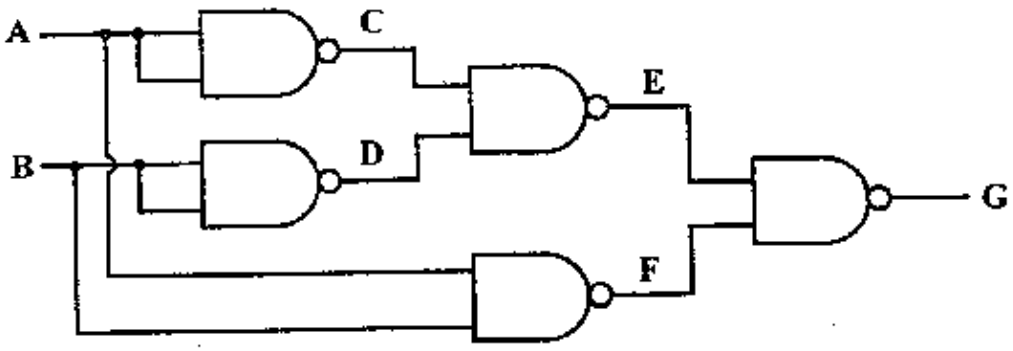
EECS 40 MIDTERM 1

(note letters following a _ means subscript, ex V_ab means the voltage from a to b)

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

Consider the following digital logic circuit:

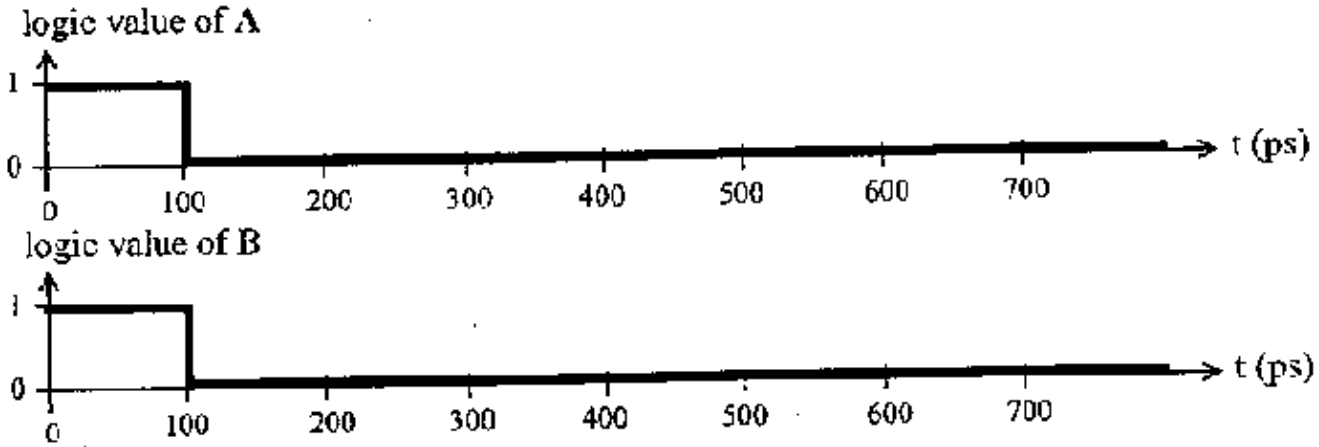


a) Fill out the truth table for the logic function G. [8 points]

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

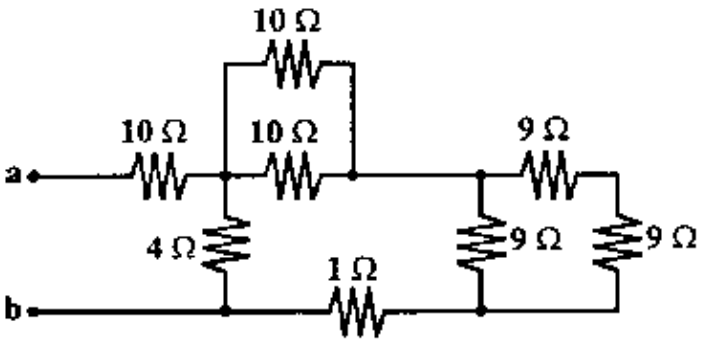
c) How many unit gate delays are there between the inputs (A and B) and the output (G)? [2 points]
(in other words, how many unit gate delays must you wait, after changing A and/or B, before you can trust the value of G to be valid?)

d) Assume each logic gate has a unit delay T = 100ps.
Draw the timing diagrams for t=0 to t=700ps, for the given logic input values A and B. [10 points]
(in other words, draw the timing diagrams for C, D, E, F, and G)



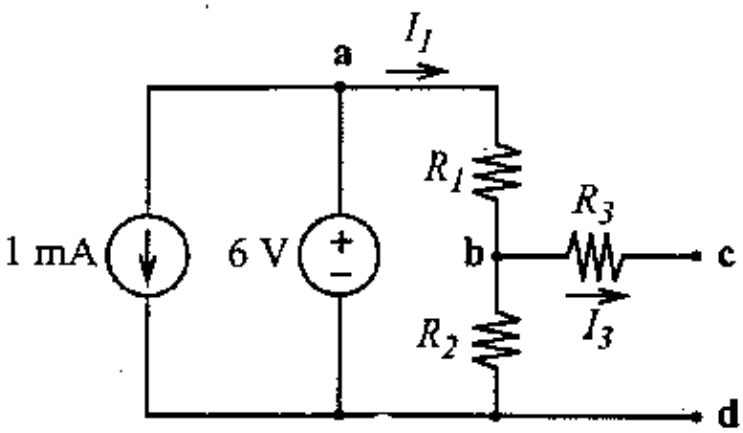
Problem 2: Resistive circuits [30 points]

a) Find the equivalent resistance R_ab for the following circuit. [6 points]



b) Suppose you need a 6k ohm resister for your Tutebot project, but your TA gives you only a supply of 10k ohm resistors. Being a clever Cal student, how would you connect several 10k ohm resistors together, to achieve a 6k ohm resistance? [7 points]
(draw the circuit diagram)

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 points]

ii) Find the power developed/absorbed by the current source, P_I

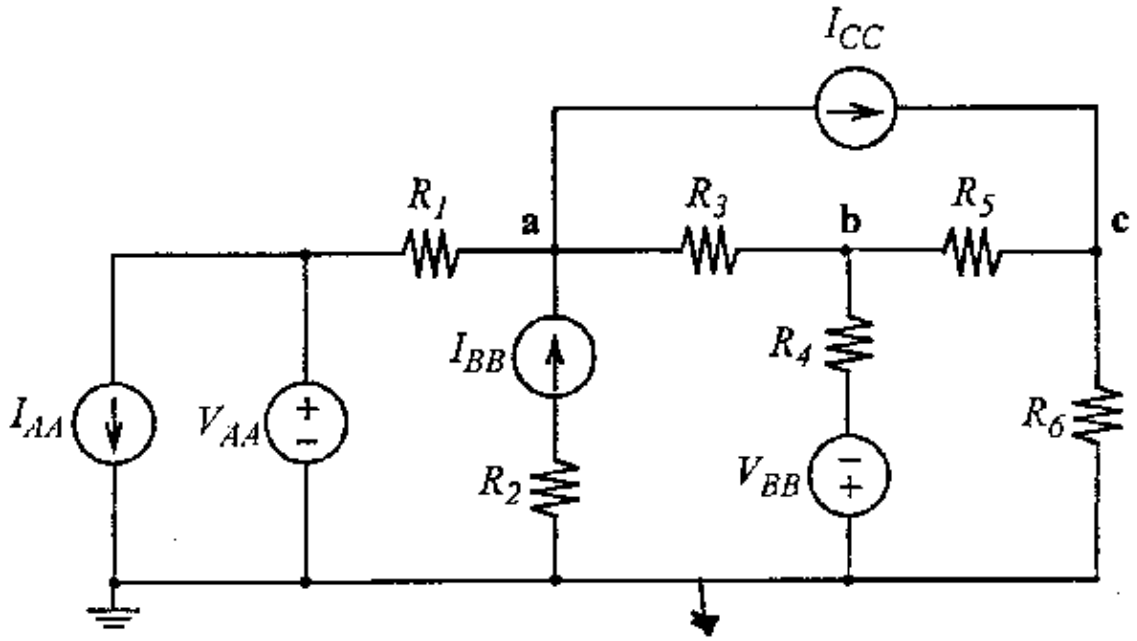
iii) Indicate in the table below (by checking the appropriate boxes) how various circuit parameters would change if the terminals **c** and **d** were to be shorted together. Justify your answers. [6 points]

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

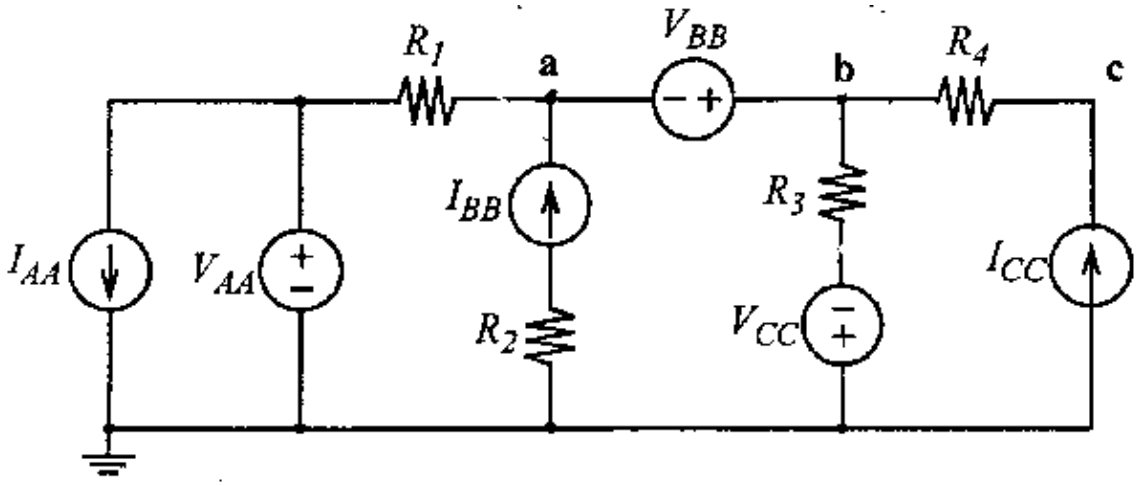
iv) what is the value of I_3 when the terminals **c** and **d** are shorted together? [5 points]

<u>Problem 3</u>: 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, V_c. [10 points]
DO NOT SOLVE THE EQUATIONS

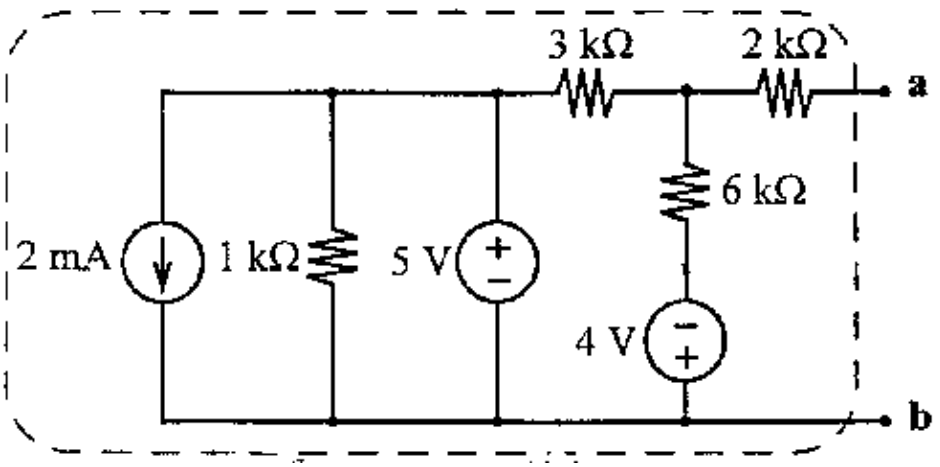


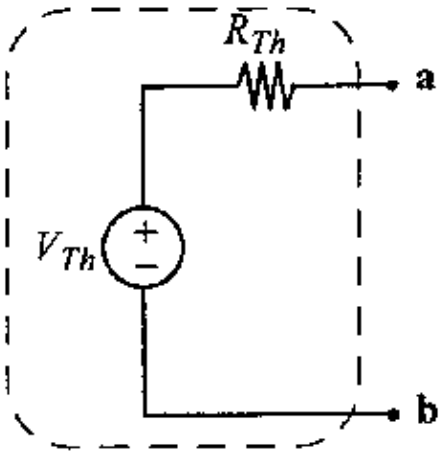
b) Similarly to part (a), use the nodal analysis technique to write 3 equations sufficient to solve for V_a, V_b, and V_c. [10 points]
DO NOT SOLVE THE EQUATIONS



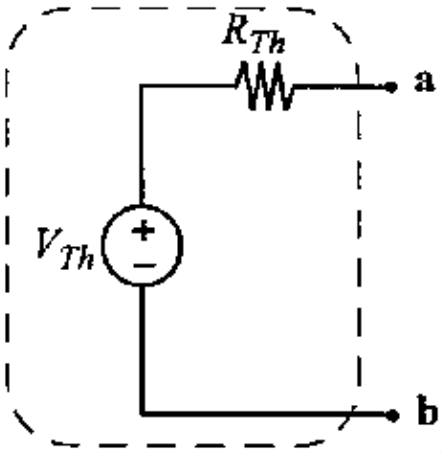
<u>Problem 4</u>: Thevenin and Norton Equivalent Circuits [25 points]

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

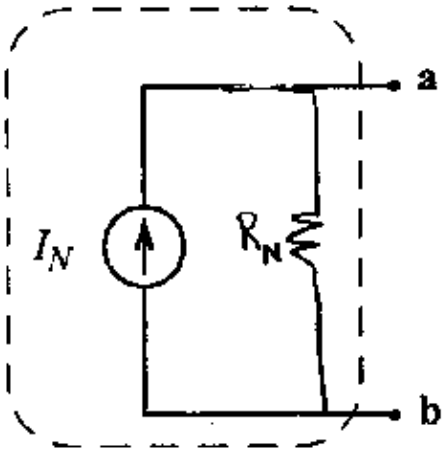




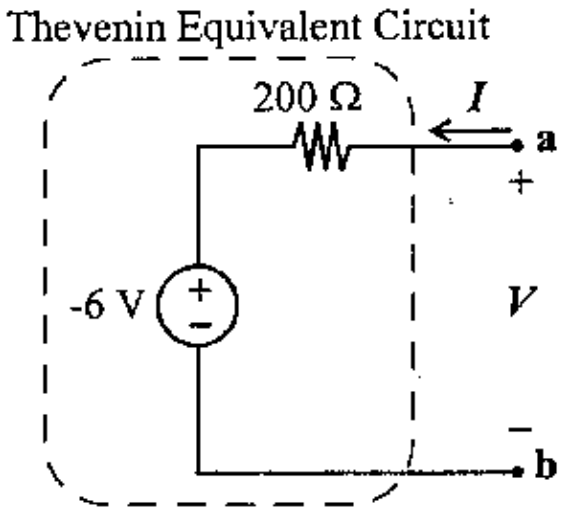
b) Use the source transformation method to obtain the Norton Equivalent Circuit for the circuit in part (a). [5 points]



source transformation-->



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 points]



d) The circuit in part (c) is connected to a 1k ohm load resistor (placed between the terminals **a** and **b**. Find the power absorbed in the load resistor, P_lk (this is what it says on the test, don't ask me). [5 points]