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

Professor Oldham — Fall 1999

EECS 40 — MIDTERM #1

29 September 1999

Name: ________________________________ **Student ID:** _________

Last, First

TA: ❑ Kusuma
❑ Chang

Guidelines:

1. Closed book and notes except 1 page of formulas.
2. You may use a calculator.
3. Do not unstaple the exam.
4. Show ***all your work and reasoning on the exam*** in order to receive full or partial credit.
5. This exam contains 12 pages plus the cover page and 2 sheets of scratch paper included at the end of the exam. You can remove these from the rest of the exam if you wish.

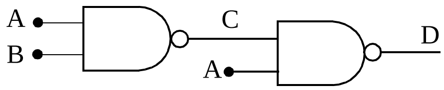
Problem	**Points Possible**	**Your Score**
1	20	
2	15	
3	15	
4	20	
5	15	
6	15	
Total	**100**	

$K = 10^{3}$
$m = 10^{-3}$
$\mu = 10^{-6}$
$n = 10^{-9}$
$p = 10^{-12}$
$f = 10^{-15}$

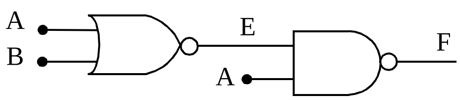
<u>Problem 1 “Static Logic”</u> (20 points)

Fill in the logic values in the table below for input values given. Note that the value for “C” is given as an example.

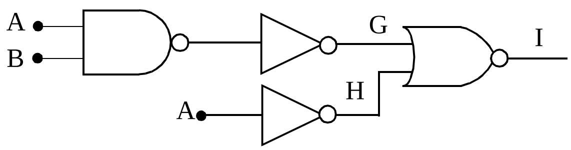
a)



b)



c)



Fill in boxes →
(zero or 1)

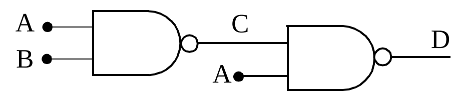
	Intermediate Values and Outputs for A = 1, B = 0						
	C	**D**	**E**	**F**	**G**	**H**	**I**
Value	1						

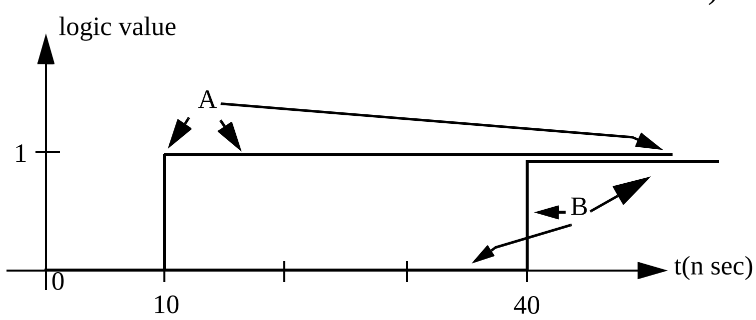
Prob. 1 (cont.)

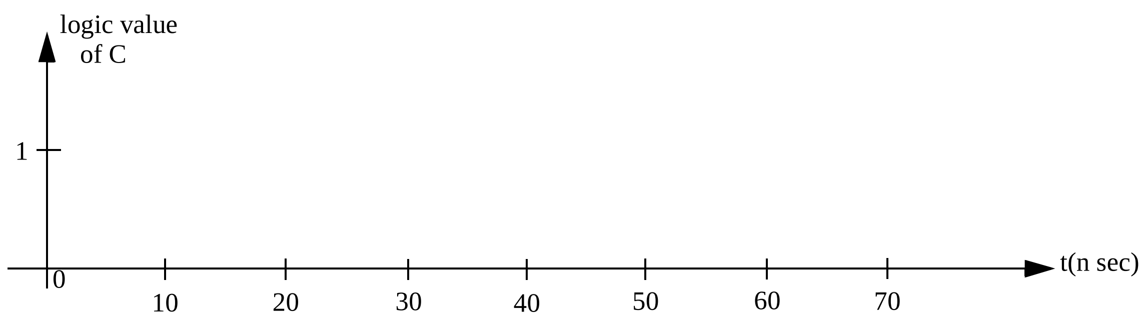
e) All logic blocks in the above figures have a unit gate delay of 10n sec.

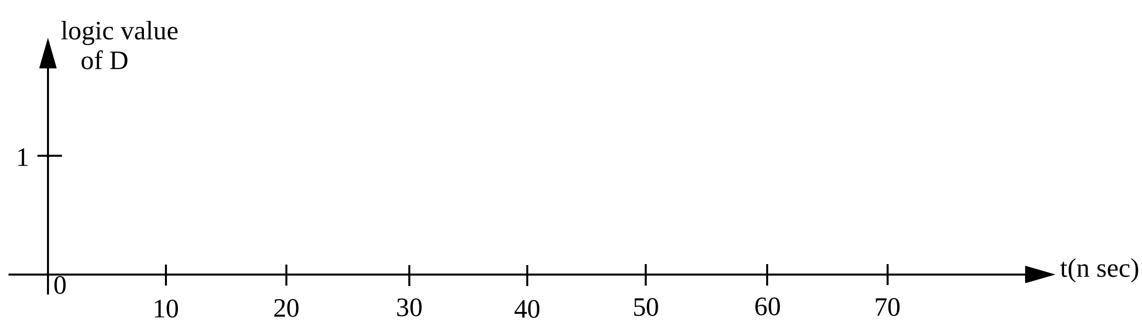
Show the logic values versus time (for t = 0 to 70n sec) for outputs C and D of example a), given the logic input values (A and B) shown below:

a)





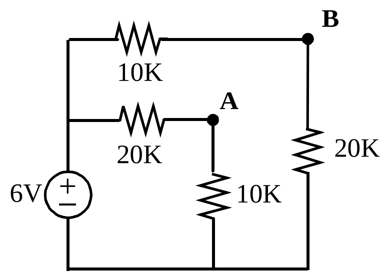




<u>Problem 2 "Circuit Solution by Inspection"</u> (15 points)

Each of these problems should take no more than 1-2 minutes. WRITE ANSWER IN PLACE PROVIDED. There is no partial credit on these mini-problems.

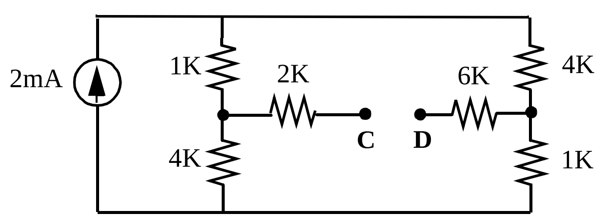
a)



Find V_{AB}

V_{AB} = ______________ V

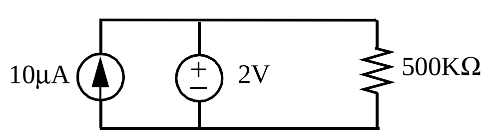
b)



Find V_{CD}

V_{CD} = ______________ V

c)

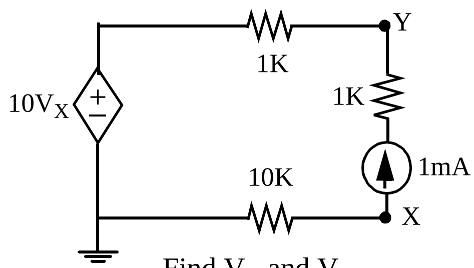


Find power dissipated in 500K resistor

P = ______________ W

Problem 2 (cont.)

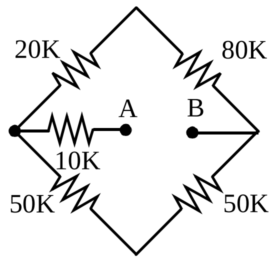
d)



Find V_X and V_Y

V_X = _______________ V
V_Y = _______________ V

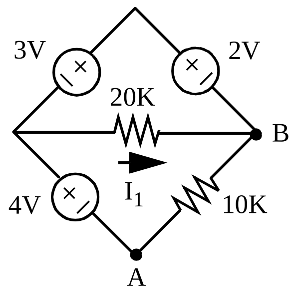
e)



Find R_{AB}

R_{AB} = _______________ KΩ

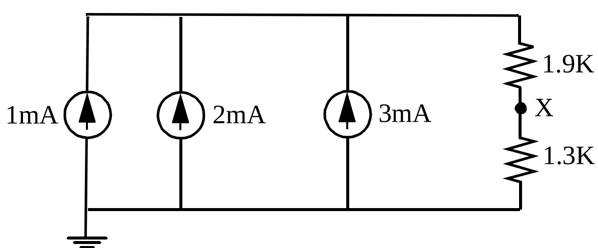
f)



Find I_1

I_1 = _______________ μA

g)



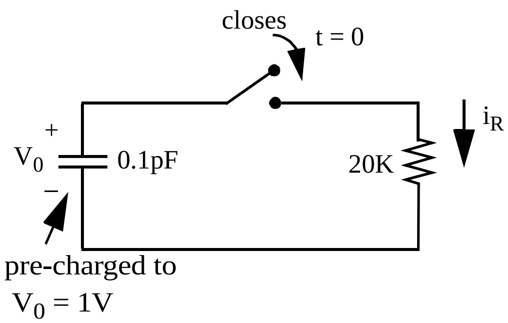
Find V_X

V_X = _______________ V

<u>Problem 3 “Initial Conditions”</u> (15 points)

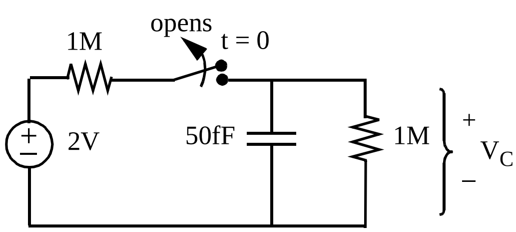
In each of the problems below, find the value of the current or voltage just after the switch moves ($t = 0^+$). (What is requested is just a numerical value, NOT an equation or function of time.)

a)



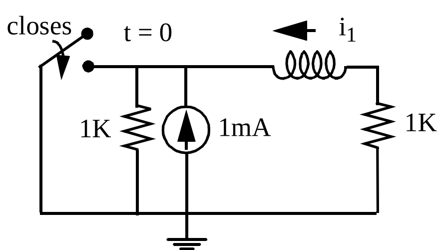
i_R = ________________ μA

b)



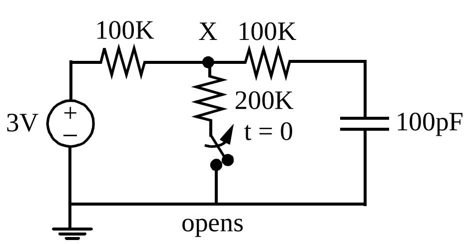
V_C = ________________ V

c)



i_1 = ________________ mA

d)

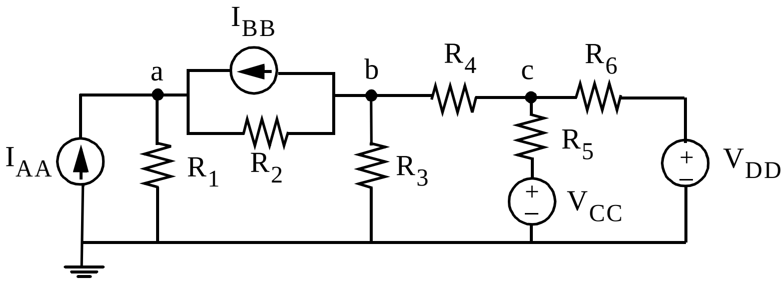


V_X = ________________ V

Problem 3 Worksheet

Problem 4 "Nodal Analysis" **(20 points)**

a. For the circuit below you are asked to write sufficient equations to find the unknowns. **You MUST put the equations into the space indicated.** Do any scratch work on the page opposite. **Do not solve**.

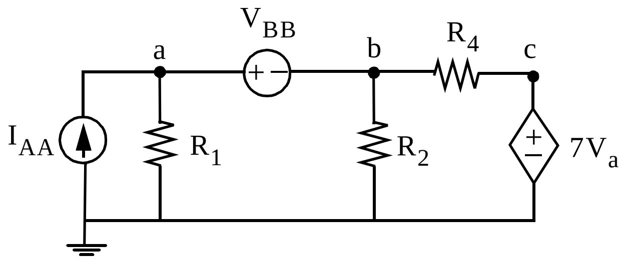


Unknowns: V_a, V_b, V_c

Write final equations here:

Problem 4 (cont.)

b. Similar to part a, you are asked to write sufficient equations to find the unknowns. Do not solve. **You must** put the equations in the space indicated below.

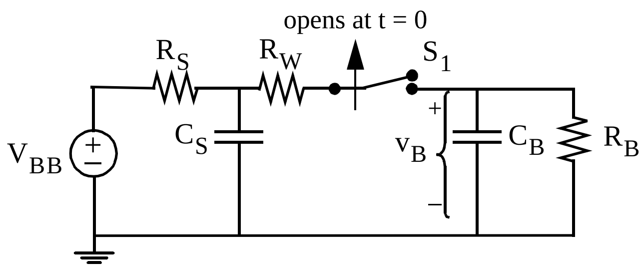


Unknowns: V_a, V_b, V_c

Put final form for equations here:

<u>Problem 5</u> (15 points)

The following circuit is used to study one phase of the operation of a DRAM cell — the slow decay of a stored "1". First the switch S_1 is closed and kept closed to write a "1". Then it opens and the storage capacitor C_B is supposed to maintain the stored information. In this memory, a valid "1" is any voltage v_B in the range of 1 to 3V.



$V_{BB} = 2V$

$C_S = 100pf$

$C_B = 50fF$

$R_S = 10K$

$R_B = 10^{13}\Omega$

$R_W = 100\Omega$

a) What is the value of v_B, just after the switch S_1 opens, i.e., at $t = 0^+$? (1% accuracy is sufficent.)

v_B = ________________ V

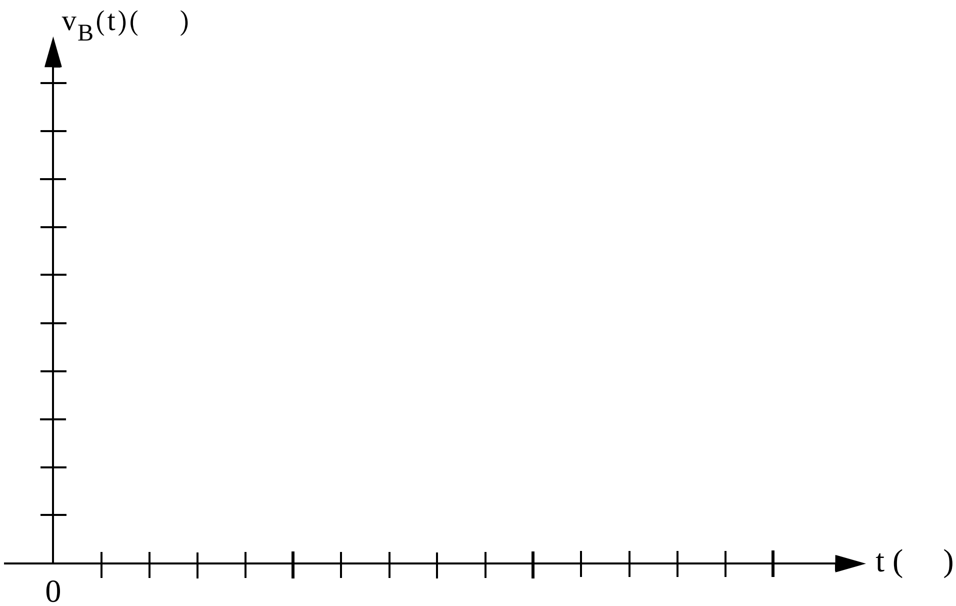
b) What is the value of v_B much later (e.g., 1 hour later)?

v_B = ________________ V

c) On the axes provided on the facing page, **<u>neatly</u>** sketch the graph of $v_B(t)$ versus time. **<u>You must label axes with units</u>**.

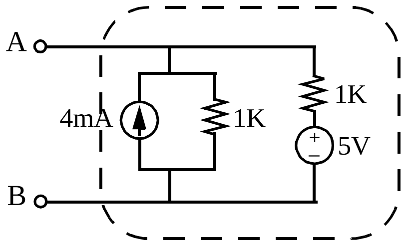
d) Write an equation for v_B as a function of time.

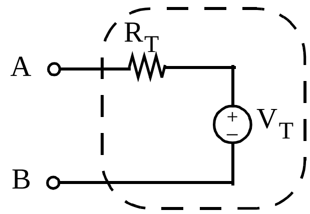
Problem 5 (cont.)



Problem 6 (15 points)

a) Find the Thévenin Equivalent Circuit of the following:

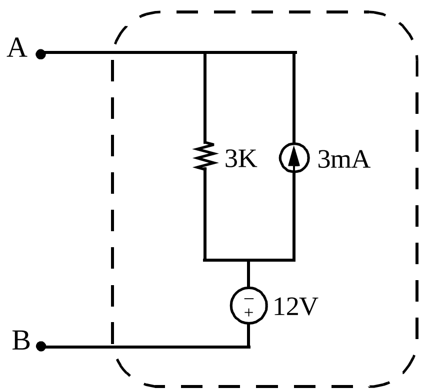


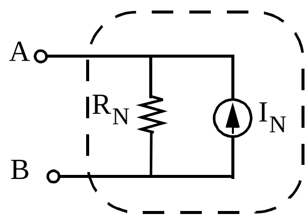


V_T = ________________ V

R_T = ________________ K

b) Find the Norton Equivalent of the following linear circuit:

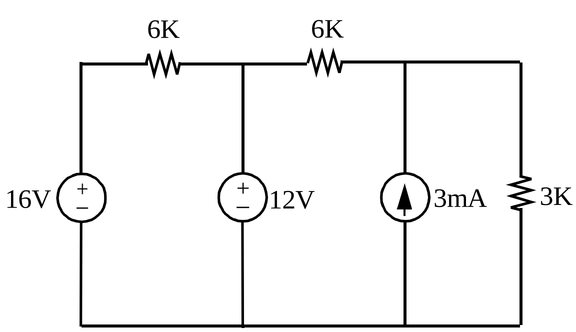




I_N = ________________ mA

R_N = ________________ K

c) Find the power supplied by the 12V voltage source in the following circuit.



Power out = ________________ W

Problem 6 Worksheet