Lab #14: Basic Logic Circuits and Functions

Revision: November 14, 2007

Print Name:	Section:

Problem 1.   (7 points) Complete the truth tables below.

A	B	F

NOR

A	B	F

AND

A	B	F

EQV

A	F

INV

A	B	C	F
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

F=A'C + B

A	B	C	F
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

F=AB'C + BC'

A	B	C	F
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

F=BC' + B'C

Problem 2.   (8 points) Complete the truth tables for the circuit in Figure 1, using LLV and LHV in the physical truth table and "1's and 0's" in the logical truth table.

SW1	SW2	F

Physical truth table

SW1	SW2	F	G (= F')

Logical truth table

Describe in your own words how the circuit of figure 1 can be interpreted as implementing an AND relationship:

Describe in your own words how the circuit of figure 1 can be interpreted as implementing an OR relationship:

Problem 3. (6 points) Complete the truth tables for the circuit in Figure 2, using LLV and LHV in the physical truth table and "1's (for LHV) and 0's" in the logical truth table (2 points).

SW1	SW2	F

Physical truth table

SW1	SW2	F	G (= F')

Logical truth table

Which column (F or G or both) can show the AND relationship? _____

Complete the following sentence: The circuit in figure 2 demonstrates the OR relationship by driving the output F to _____ when the SW1 is _____ or SW2 is _____; and the AND relationship by driving the output F to _____ when SW1 is _____ and SW2 is _____.
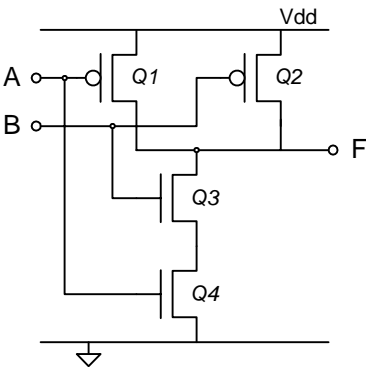
Sketch a circuit below using parallel switches and a single resistor that drives an output F to LLV if SW1 or SW2 are at LHV (assume LHV closes the switch). This amounts to rearranging the circuit configuration in figure 2.

Problem 4. (4 points) Based on these exercises, state a simple theorem for "converting" between an AND interpretation and an OR interpretation of a given circuit.

Problem 5:   (6 points) Sketch a circuit using just switches and resistors that can drive an output F to LLV if two signals A or B are at LHV, and if a third signal C is at LHV. Then, state an alternate interpretation of the circuit sketched in problem 5.
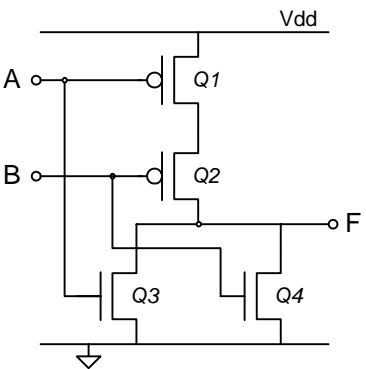
Alternate interpretation (Switch assertion levels, i.e. use "LLV" instead of "LHV" and vice-versa):

Problem 6:   (10 points) Complete the voltage truth tables below (enter "on" (closed) or "off" (open) under each transistor entry), and enter the gate name and schematic shapes in the tables.
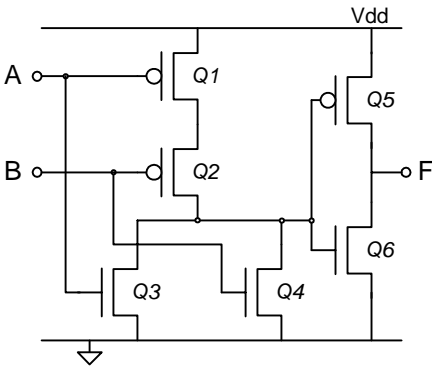

A	B	Q1	Q2	Q3	Q4	F
L	L					
L	H					
H	L					
H	H					

Gate Name	
AND shape	OR shape

A	B	Q1	Q2	Q3	Q4	F
L	L					
L	H					
H	L					
H	H					

Gate Name	
AND shape	OR shape

A	B	Q1	Q2	Q3	Q4	F
L	L					
L	H					
H	L					
H	H					

Gate Name	
AND shape	OR shape

A	B	Q1	Q2	Q3	Q4	F
L	L					
L	H					
H	L					
H	H					

Gate Name	
AND shape	OR shape

A	B	C	Q1	Q2	Q3	Q4	Q5	Q6	F
L	L	L							
L	L	H							
L	H	L							
L	H	H							
H	L	L							
H	L	H							
H	H	L							
H	H	H							

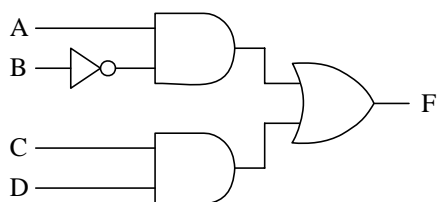Enter the logic equation for the 3-input circuit above: F =

Problem 7.   (6 points) Sketch circuits for the following logic equations (a ' following a variable means the variable should be inverted). Minimization of the circuit is not required.

F = A'•B•C + A'•B'•C' + A'•B'
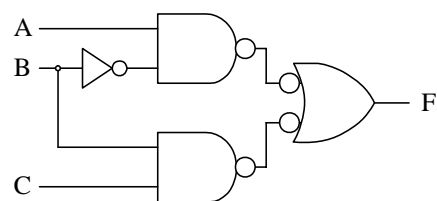
F = (A'•B') + (A' + B' + C)'

F = (A' + C)' • ((A' + C) • B')'

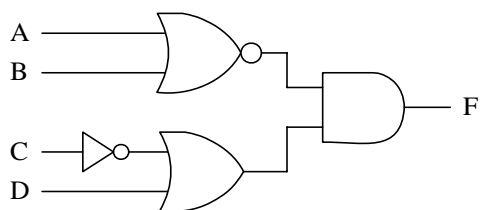**Problem 8.**   (8 points) Write logic equations for the following circuits. Minimization is not
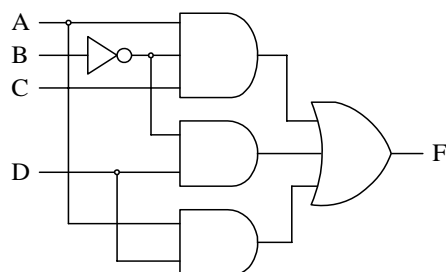   required.

F =

F =

F =

F =

Problem 9:   (10 points) Write the Boolean equation that defines the temperature controller problem, and the sketch the circuit:

F =

Problem 10:   (15 points) Build the temperature controller circuit on your breadboard, and then test the circuit. Complete the truth table as you proceed through the test. Demo this circuit to the lab assistant and have them initial your lab submission form.

demo date:

TA initials:

A	B	S	F
L	L	L	
L	L	H	
L	H	L	
L	H	H	
H	L	L	
H	L	H	
H	H	L	
H	H	H	

Problem 11:   (20 points) Build and test the light switch circuit. Complete the truth table as you proceed through the test. Write the Boolean equation and sketch the circuit. Demo this circuit to the lab assistant and have them initial your lab submission form.

demo date:

TA initials:

S1	S2	S3	F
L	L	L	
L	L	H	
L	H	L	
L	H	H	
H	L	L	
H	L	H	
H	H	L	
H	H	H	