

Name & UID: _____

Circle Your Section!			
0101 (10am: 3120, Ladan)	0102 (11am: 3120, Ladan)	0103 (Noon: 3120, Peter)	
0201 (2pm: 3120, Yi)	0202 (10am: 1121, Vikas)	0203 (11am: 1121, Vikas)	0204 (9am: 2117, Karthik)
0301 (9am: 3120, Huijing)	0302 (8am: 3120, Huijing)	0303 (1pm: 3120, Yi)	250H (10am: 2117, Peter)

1. (30 points) Consider the following Truth Table.

P	Q	R	$Value$
T	T	T	T
T	T	F	T
T	F	T	F
T	F	F	F
F	T	T	T
F	T	F	F
F	F	T	F
F	F	F	F

- (a) Use the method from class to provide the Boolean formula matching the table.
- (b) Give the circuit for your formula using ONLY 2-input AND gates, 2-input OR gates, and NOT gates. Do not simplify your solution from part (a) before drawing the circuit.

- (c) Simplify the formula that you provided for item (a), using Boolean algebra. Show your work.

- (d) Draw the new circuit using only 2-input AND gates, 2-input OR gates, and NOT gates.

2. (40 points) Consider two 2-bit binary numbers given by a_1a_0 , and b_1b_0 (each letter represents a single bit). We can do long multiplication with these two number using a three-step process. Step 1: multiply a_1a_0 by b_0 . Step 2: multiply a_1a_0 by b_1 , and append a “0” to the right of the answer. Step 3: add the results of steps 1 and 2. The product of these two number is a 4-bit number that can be represented as $p_3p_2p_1p_0$.

- (a) The following multiplication tableau can be used to complete steps 1 and 2. Fill in the 3 missing entries.

	a_1	a_0
$\times$	b_1	b_0
0		$a_0 \wedge b_0$
		0

- (b) Draw a circuit that takes a_1 , a_0 , b_1 , and b_0 as inputs, and outputs the product bits $p_3p_2p_1p_0$. You may use half adders and full adders to perform single-bit addition.

3. (15 points)

(a) Convert 156_7 to base 2. Show your work.

(b) Use your binary representation to convert 156_7 into hexadecimal.

4. (15 points) Consider the hexadecimal number $(3A)_{16}$.

(a) Find the **8-bit** binary representation of $(3A)_{16}$.

(b) Find the **8-bit** one's-complement binary representation of $-(3A)_{16}$.

(c) Find the **8-bit** two's-complement binary representation of $-(3A)_{16}$.