ECEN 2350: Digital Logic

Assignment #2

1. [4 points.] Complete the truth tables for AND, OR, NAND, NOR, and XOR.

		AND	OR	NAND	NOR	XOR
a	b	$a \cdot b$	$a + b$	$\overline{a \cdot b}$	$\overline{a + b}$	$a \oplus b$
0	0					
0	1					
1	0					
1	1					

2. [5 points.] Write a truth table for a logic circuit that compares two 2-bit numbers A and B. The circuit should have two outputs, Z_A and Z_B that, together, tell whether $A < B$ ($Z_B = 1$), $A = B$ ($Z_A = Z_B = 00$), or $A > B$ ($Z_A = 1$). The two outputs are never both 1 at the same time. Here's a partially filled table to clarify the format:

A_1	A_0	B_1	B_0	Z_A	Z_B
0	0	0	0	0	0
0	0	0	1	0	1
0	1	0	0	1	0
0	1	1	1	0	1
1	1	1	0	1	0
1	1	1	1	0	0

3. [6 points.] Write equations for Z_A and Z_B from the table of Exercise 2. For instance, we can see Z_A is 1 when $A_1 = 0, A_0 = 1, B_1 = 0, B_0 = 0$. One of the products in Z_A will therefore include $\overline{A}_1 A_0 \overline{B}_1 \overline{B}_0$. Write sum-of-product expressions, as in $Z_A = WX + WY + XY$, by "reading out" the lines of the table. Each of the sums you write should have six products (including the one just given for Z_A), because there are six ones in each output column of the table.

4. [5 points.] Use truth tables to prove that $\overline{a + b} = \overline{a} \cdot \overline{b}$.

5. [5 points.] Build a truth table for the compound statement $p \odot (p + q)$. (where $\odot$ is exclusive NOR (XNOR)) From your truth table derive another, simpler, expression that is equivalent to the given one. Recall that the exclusive NOR is defined by $a \odot b = ab + \overline{a}\,\overline{b}$.