Arithmetic Units

Part A Complete the truth table for a one bit binary full-adder.

X	Y	$CARRY_{in}$	SUM	$CARRY_{out}$
0	0	0		
1	0	0		
0	1	0		
1	1	0		
0	0	1		
1	0	1		
0	1	1		
1	1	1		

Part B Implement a one bit binary full-adder using AND, OR, NAND, NOR, NOT, XOR, and XNOR gates. Label the inputs A, B, and $CARRY_{in}$. Label the outputs SUM and $CARRY_{out}$. Use mixed logic design methodology.

Part C The truth table for a one bit binary full-subtractor is given below. First determine the simplified expression for $DIFFERENCE$ and $BORROW_{out}$. Then implement this truth table using basic gates (AND, OR, NAND, NOR, NOT, XOR, and XNOR). Be sure to label the inputs X, Y, $BORROW_{in}$, and the outputs $DIFFERENCE$, and $BORROW_{out}$. Assume that you have the input signals and their complements.

X	Y	$BORROW_{in}$	$DIFFERENCE$	$BORROW_{out}$
0	0	0	0	0
1	0	0	1	0
0	1	0	1	1
1	1	0	0	0
0	0	1	1	1
1	0	1	0	0
0	1	1	0	1
1	1	1	1	1

$DIFFERENCE =$ ____

$BORROW_{out} =$ ____

Part D Using a four bit adder, build a four bit adder/subtractors. Use AND, OR, NAND, NOR, NOT, XOR, and XNOR gates plus the adder drawn below. Label your inputs X_3, X_2, X_1, X_0, Y_3, Y_2, Y_1, Y_0, and $\overline{Add}/Subtract$. Label your outputs Z_3, Z_2, Z_1, and Z_0.