Name:_____

Honor Pledge: I am adhering to the Honor Code while taking this test.

Signature:_____   Date:_____

25 points total.

1. (One point.) Convert **10101010** (assuming two's complement representation) into base 10.

2. (Six points.) Compute the binary sums, indicating the values of the carry and overflow flags.

      10101010

   +10101010

                 Carry: Overflow:

      01010101

   +01010101

                 Carry: Overflow:

3. (Five points.) The trustees of Karnaugh University (Alice, Bob, Carol, and David) are at it again! They're voting on a proposal to eliminate the physics department, in retaliation for certain instances of irreverent humor. If the number of YES votes (to eliminate the physics department) is 2 or 3, the physics department will be eliminated. If the number of YES votes is 0, the physics department will be saved. If the number of YES votes is 1, the University doesn't even care whether the physics department is eliminated or saved. (However, to save money, the University prefers to use only one logic gate in the circuit that indicates the outcome of the vote.)

 A. Complete this truth table, where 1 as an input represents a YES vote, and 1 as an output represents the elimination of the physics department. X as an output represents "don't care."

A	B	C	D	ELIMINATE
0	0	0	0	0
0	0	0	1	X
0	0	1	0	X
0	0	1	1	1
0	1	0	0	X
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	X
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

B. Write out a K map equivalent to the truth table.

C. Write out any logic equation that implements the truth table. (You may use as many gates as you like.)

D. Draw the circuit diagram equivalent to your response to part C.

E. Write out a logic equation that implements the truth table using only one gate. (What's good for logic minimization may be bad for the physics department.) Your responses to C and E may be identical.

4. Harry, Hermione, and Ron are voting to decide whether to skip their final year at Hogwarts. A 1 is a vote to skip Hogwarts (and instead to hunt Horcruxes and battle Death Eaters). **Harry's vote counts twice**: sum = 2×(Harry's vote) + (Hermione's vote) + (Ron's vote). The output of a circuit is 1 if the sum is 2, 3, or 4; the output is 0 if the sum is 0 or 1. The inputs are Harry's, Ron's, and Hermione's votes. Your first task is to construct the circuit using **logic gates**—the future of Hogwarts is in your hands!

A.   (One point.) Write out the K map for the necessary circuit.

B. (One point.) Write out a minimized logic equation (using as few gates as possible) equivalent to the K map. (Hint: Only two gates are required.)

C. (One point.) Draw the circuit diagram equivalent to your minimized logic equation.

D. (Three points.) Write a Verilog module (including the **module** and **endmodule** statements) that uses an **assign** statement to implement your circuit.

E. (Seven points.) Now ignore your K map and directly implement the vote-counting: write a Verilog module that computes a sum and uses an **if** statement (but no explicit Boolean operators) to implement the circuit.