Name:_____

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

Signature:_____ Date:_____

25 points total.

1. Using 8-bit binary….

A. Convert 4C from hexadecimal to binary.

01001100

B. Convert C4 from hexadecimal to binary.

11000100

C. Find the sum of 4C + C4 in binary.

with the carry flag in parentheses as a ninth bit, (1)00010000

D. Interpreting the three numbers (addends and sum) as unsigned binary, convert them all to base 10. Is the arithmetic correct in base 10? If there's any ambiguity involving the carry flag, just explain.

76+196=272 or 16, depending on whether the carry flag is included as a ninth bit.

E. Interpreting the three numbers (addends and sum) as 8-bit two's complement, convert them all to base 10. Is the arithmetic correct in base 10?

76-60=16. This is correct.

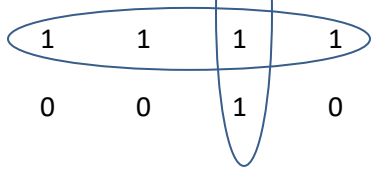
F. What is the carry flag? 1

G. What is the overflow flag? 0

2. Iron Man, the Hulk, Black Widow, and Captain America are voting on whether to make another Avengers movie (because of course these decisions are made by the fictional characters themselves). Iron Man's vote counts as a regular vote, and it also determines how the Hulk's vote is counted: If Iron Man votes 0, the Hulk's vote doesn't count, and a majority of the three remaining votes determines the outcome. If Iron Man votes 1, the Hulk's vote counts as two votes, and a majority of the five votes determines the outcome. In all cases, 1 as an input is a vote to make another movie, and 1 as an output is the final decision to make it.

A. Write out a K map to design a circuit that indicates the outcome of the vote.

		BC			
		00	01	11	10
IH	00	0	0	1	0
	01	0	0	1	0
	11	1	1	1	1
	10	0	0	1	0



B. Write out an equivalent logic equation that requires at most three **standard** gates with any number of inputs. (Standard gates: NOT, AND, OR, NAND, NOR, XOR, XNOR).

movie = I&H | B&C

C. (Three points.) Without using an always block, write a Verilog module to implement the circuit.

```
module partC (input I, input H, input B, input C, output movie);

assign movie = I&H | B&C;

endmodule
```

D. (Ten points.) Write a Verilog module to implement the circuit using only one assign statement, which assigns to "sum" the direct sum of the four votes (before modifying the Hulk's vote).

```
module partE (input I, input H, input B, input C, output reg movie);

wire [2:0] sum;

assign sum = I + H + B + C;

always @ (*)

begin

movie=0;

if ((I==0) & (sum-H>=2)) movie=1;

if ((I==1) & (sum+H>=3)) movie = 1;

end

endmodule
```

3. The trustees of Karnaugh University (Alice, Bob, Carol, and David) are voting on whether to demolish the university and replace it with luxury condominiums. The outcome of this important vote is determined by extremely nonsensical rules.

If Alice and Bob cast opposite votes, then David's vote determines whether the university will be demolished.

If Alice and David cast opposite votes, then once again David's vote determines whether the university will be demolished.

If all four trustees vote the same way (whether 0 or 1), the university will be demolished.

In all other cases, the trustees don't even care whether the university is demolished.

A. Write out a K map to solve this problem, where 1 as an input is a vote to demolish the university, and 1 as an output is a final decision to demolish the university. X as an output represents "don't care."

		CD			
		00	01	11	10
AB	00	1	1	1	X
	01	0	1	1	0
	11	0	X	1	0
	10	0	1	1	0

B. Write out any logic equation that implements the K map. You may use as many gates as you like.

demolish = ~(A|B) | D

C. Write out an equivalent logic equation that requires at most two **standard** gates with any number of inputs. (Standard gates: NOT, AND, OR, NAND, NOR, XOR, XNOR). Your responses to B and C may be identical.

demolish = ~(A|B) | D