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 2D from hexadecimal to binary.

00101101

B. Convert D2 from hexadecimal to binary.

11010010

C. Find the sum of 2D + D2 in binary.

11111111

D. Interpreting the three numbers (addends and sum) as unsigned binary, convert them all to base 10. Is the arithmetic correct in base 10?

45+210 = 255. It's correct.

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?

45-46 = -1. It's correct.

F. What is the carry flag? 0

G. What is the overflow flag? 0

2. The trustees of Karnaugh University (Alice, Bob, Carol, and David) are voting on whether to shut down the university and replace it with a landfill. The outcome of this important vote is determined by extremely nonsensical rules.

If Alice and Bob cast opposite votes, then Carol's vote determines whether the university is converted to a landfill.

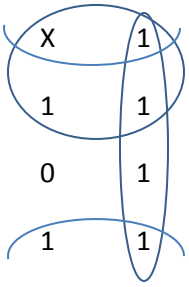
If Carol and David cast opposite votes, then once again Carol's vote determines whether the university is converted to a landfill.

If all four trustees vote the same way (whether 0 or 1), the university is not converted to a landfill.

In all other cases, the trustees don't even care whether the university is converted to a landfill.

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

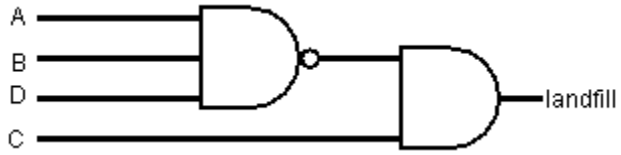
		CD			
		00	01	11	10
AB	00	0	0	X	1
	01	0	0	1	1
	11	X	0	0	1
	10	0	0	1	1



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

landfill = C&~D | ~A&C | ~B&C = C & (~A|~B|~D) = C&(~(A&B&D))

C. Write out the circuit diagram equivalent to the logic equation.



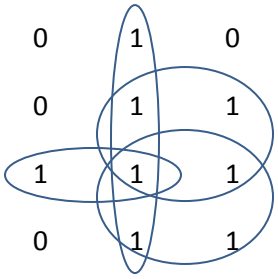
D. Write out an equivalent logic equation that requires at most two **standard** gates with any number of inputs. (Standard gates: NOT, AND, OR, NAND, NOR, XOR, XNOR). Your responses to B and D may be identical.

landfill = C&(~(A&B&D))

3. Parzival, Aech, Art3mis, and Shoto are voting on whether to push the Big Red Button to destroy the virtual reality, OASIS. If Parzival and Art3mis vote the same way, their vote determines the outcome. Otherwise, the outcome of the vote is determined by the majority of the votes cast by Aech, Art3mis, and Shoto.

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

		AS			
		00	01	11	10
PH	00	0	0	1	0
	01	0	0	1	1
	11	0	1	1	1
	10	0	0	1	1



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

BRB = A&S | H&A | P&A | P&H&S = A&(S | H | P) | P&H&S

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

BRB = A&(S | H | P) | P&H&S

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

```
module partD (input A, input P, input H, input S, output BRB);

assign BRB = A&(S | H | P) | P&H&S;

endmodule
```

E. (Eight points.) Write a Verilog module to implement the circuit using only one assign statement, which assigns to "sum" the sum of the votes of Art3mis, Aech, and Shoto.

```
module partE (input A, input P, input H, input S, output reg BRB);

wire [1:0] sum;

assign sum = A + H + S;

always @ (*)

if (P==A) BRB = A;

else if (sum>1) BRB = 1;

else BRB = 0;

endmodule
```