Name:_____

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

Signature:_____ Date:_____

20 points total.

1. (Two points.) Convert these base-10 numbers to 8-bit binary (using 8-bit two's complement for negative numbers).

100 = 01100100

-100 = 10011100

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

```
  10011001
 +01111101
  00010110          Carry:  1     Overflow:  0
```

```
  10101010
 +01111101
  00100111          Carry:  1     Overflow:  0
```

3. (Six points.) Alice, Bob, Carol, and David, the trustees of Karnaugh University, are meeting to decide whether to raise tuition 2000%. According to Karnaugh University's byzantine bylaws, tuition will be raised if

Alice and Bob vote NO or

Bob and David cast opposite votes (one YES, one NO) or

Alice votes YES and David votes NO.

Otherwise, tuition will not be raised.

A. Complete this truth table, where 1 as an input represents a YES vote, and 1 as an output represents raising tuition.

A	B	C	D	RAISE
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	0
1	1	1	0	1
1	1	1	1	0

B. Write out a logic equation equivalent to the truth table.

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

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

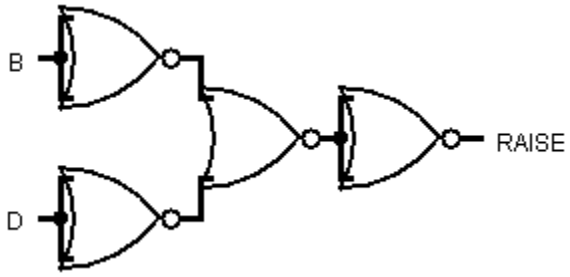
		CD			
		00	01	11	10
AB	00	1	1	1	1
	01	1	0	0	1
	11	1	0	0	1
	10	1	1	1	1

D. Write out a minimized logic equation (using as few gates as possible) equivalent to the truth table.
RAISE = ~B | ~D = ~(B&D)

E. Draw the circuit diagram equivalent to your minimized logic equation.

One NAND gate, with B and D as inputs.

F. Now draw an equivalent circuit containing only NOR gates.



4. (Six points.) Frodo, Sam, and Gollum are deciding whether enter Shelob's lair. Their decisions are recorded using a digital circuit.

If Sam votes 1, he is voting to enter the lair.

If Gollum votes 0, he is voting to enter the lair.

Frodo has the final decision. If Frodo votes 1, the group will follow Sam's vote. If Frodo votes 0, the group will follow Gollum's vote.

The output is 1 if the final decision is to enter Shelob's lair.

A. Complete the truth table:

Frodo	Sam	Gollum	Output
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

B. Write out a logic equation equivalent to the truth table.

Output = ~Frodo&~Sam&~Gollum | ~Frodo&Sam&~Gollum | Frodo&Sam&~Gollum
| Frodo&Sam&Gollum

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

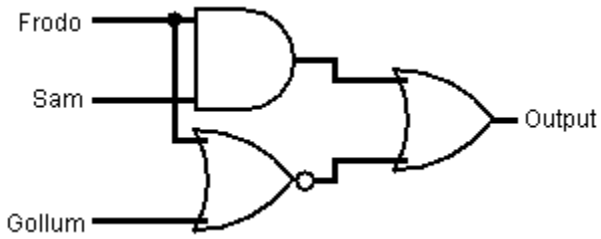
		SamGollum			
		00	01	11	10
Frodo	0	1	0	0	1
	1	0	0	1	1

D. Write out a minimized logic equation (using as few gates as possible) equivalent to the truth table.

Output = ~Frodo&~Gollum | Frodo&Sam Five gates

= ~(Frodo | Gollum) | Frodo&Sam Three gates

E. Draw the circuit diagram equivalent to your minimized logic equation.



F. Draw an equivalent circuit diagram containing only a multiplexer and a single logic gate.