**Written Part**

1. Add the following unsigned binary numbers (show the carry and overflow bits)

11111 1000 0010 🡨Carry Bits

0010 0110 1001

+ 1111 1100 0101

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1 0010 0010 1110

^ Overflow Bit

2. Subtract the following unsigned binary numbers (show the borrow and underflow bits). Do not convert to two's-complement.

0011 0111 0101 🡨 885 in decimal

­ 1110 1000 1110 🡨 2841 in decimal

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🡪 Answer is negative thus cannot be computed with unsigned numbers

3. Convert the following decimal numbers to binary numbers (represent each as a 16-bit number):

1639: Remainder

1639/2 = 819 1 ~LSB

819/2 = 409 1

409/2 = 204 1

204/2 = 102 0

102/2 = 51 0

51/2 = 25 1

25/2 = 12 1

12/2 = 6 0

6/2 = 3 0

3/2 = 1 1

1/2 = 0 1 ~ MSB

1639 🡪 0000011001100111

48265: Remainder

48265/2 = 24132 1 ~LSB

24132/2 = 12066 0

12066/2 =6033 0

6033/2 = 3016 1

3016/2 = 1508 0

1508/2 = 754 0

754/2 = 377 0

377/2 = 188 1

188/2 = 94 0

94/2 = 47 0

47/2 = 23 1

23/2 = 11 1

11/2 = 5 1

5/2 = 2 1

2/2 = 1 0

1/2 = 0 1 ~ MSB

48265 🡪1011110010001001

1010: Remainder

1010/2 = 505 0 ~LSB

505/2 = 252 1

252/2 = 126 0

126/2 = 63 0

63/2 = 31 0

31/2 = 15 1

15/2 = 7 1

7/2 = 3 1

3/2 = 1 1

1/2 = 0 1 ~ MSB

1010 🡪 0000001111110010

4. Convert the following unsigned binary numbers to decimal numbers:

Number 1: 10000001 01011110

🡪 2^15 + 2^8 + 2^6 + 2^4 + 2^3 + 2^2 + 2^1 = 33118

Number 2: 00000110 01010011

🡪 2^10 + 2^9 + 2^6 + 2^4 + 2^1 + 2^0 = 1619

5. Convert the following decimal numbers into 9-bit binary numbers (with sign-magnitude):

48: Remainder

48/2 = 24 0 ~LSB

24/2 = 12 0

12/2 = 6 0

6/2 = 3 0

3/2 = 1 1

1/2 = 0 1 ~ MSB

48 🡪 000110000

-126: Remainder

126/2 = 63 0 ~LSB

63/2 = 31 1

31/2 = 15 1

15/2 = 7 1

7/2 = 3 1

3/2 = 1 1

1/2 = 0 1 ~ MSB

-126 🡪 101111110

-34: Remainder

34/2 = 17 0 ~LSB

17/2 = 8 1

8/2 = 4 0

4/2 = 2 0

2/2 = 1 0

1/2 = 0 1 ~ MSB

-34 🡪 100100010

6. Convert the following 9-bit binary numbers (with sign-magnitude) to decimal numbers:

010011110:

🡪 2^7 + 2^4 + 2^3 + 2^2 + 2^1 = 158

100110111:

🡪 2^5 + 2^4 + 2^2 + 2^1 + 2^0 = -55

110101010:

🡪 2^7 + 2^5 + 2^3 + 2^1 = -170

7. Convert the following decimal numbers into 9-bit binary numbers in 1's complement form:

56: Remainder

56/2 = 28 0 ~LSB

28/2 = 14 0

14/2 = 7 0

7/2 = 3 1

3/2 = 1 1

1/2 = 0 1 ~ MSB

56 🡪 000111000

-145: Remainder

145/2 = 72 1 ~LSB

72/2 = 36 0

36/2 = 18 0

18/2 = 9 0

9/2 = 4 1

4/2 = 2 0

2/2 = 1 0

1/2 = 0 1 ~ MSB

145 = 010010001

-145 🡪 101101110

52: Remainder

52/2 = 26 0 ~LSB

28/2 = 13 0

14/2 = 6 1

7/2 = 3 0

3/2 = 1 1

1/2 = 0 1 ~ MSB

52 = 000110100

-52 🡪 111001011

8. Convert the following 8-bit binary numbers in 1's complement to decimal numbers:

01010011:

🡪 2^6 + 2^4 + 2^1 + 2^0 = 83

11010010: = -(00101101)

🡪 -1 \* (2^5 + 2^3 + 2^2 + 2^0) = -45

11110111: = -(00001000)

🡪 -1 \* 2^3 = -8

9. Convert the following decimal numbers into 9-bit binary numbers in 2's complement form:

196: Remainder

196/2 = 98 0 ~LSB

98/2 = 49 0

49/2 = 24 1

24/2 = 12 0

12/2 = 6 0

6/2 = 3 0

3/2 = 1 1

1/2 = 0 1 ~ MSB

196 🡪 011000100

-17: Remainder

17/2 = 8 1 ~LSB

8/2 = 4 0

4/2 = 2 0

2/2 = 1 0

1/2 = 0 1 ~ MSB

17 = 000010001

-17 🡪 111101111

-95: Remainder

95/2 = 47 1 ~LSB

47/2 = 23 1

23/2 = 11 1

11/2 = 5 1

5/2 = 2 1

2/2 = 1 0

1/2 = 0 1 ~ MSB

95 = 001011111

-95 🡪 110100001

10. Convert the following 8-bit binary numbers in 2's complement to decimal numbers:

01010101:

🡪 2^6 + 2^4 + 2^2 + 2^0 = 85

10111101: = -((01000010) + 1) = -(01000011)

🡪 -1 \* (2^6 + 2^1 + 2^0) = -67

11010000: = -((00101111) + 1) = -(00110000)

🡪 -1 \* (2^5 + 2^4) = -48