CSC 3210
Computer Organization and Programming
Assignment #1
Spring 2022
Due on 02/03/2021, 11:59 PM Eastern Time (US and Canada)

Objective: Learn some core concepts closely relating to assembly language.

Total 15 points

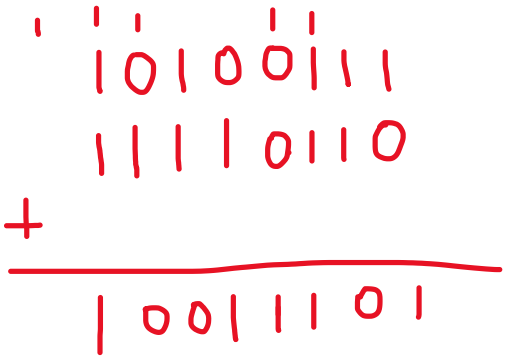
1. **(1 point)** Why 2's complement is necessary to perform subtraction in hardware level? Explain your answer.
    a. The 2's complement is necessary because by using this we can subtract two binary numbers. It's necessary in the hardware level because by using 2's it's easy to represent the negative integers represented by taking its positive binary value and inverting all the bits and adding 1. It's useful in the hardware because using 2's complements its easier to identify the negative and positive integers, if the starting decimal is 1, then the integer is negative, if it starts with 0 then it's a positive integer. The benefit of using 2's complement to perform subtraction is that we can perform the subtraction without changing the bits

2. **(1 point)** Assume that you have three 8-bit storages (called registers) named A, B, and C to store binary numbers. Register A contains 10100111 and register B contains 11110110. Compute A+B and store the value in C register. What is the content of register, C after the computation? **Show the computation in details with carries.**

    The register A has the value: 10100111

    The register B has the value of : 11110110

    So, A + B =



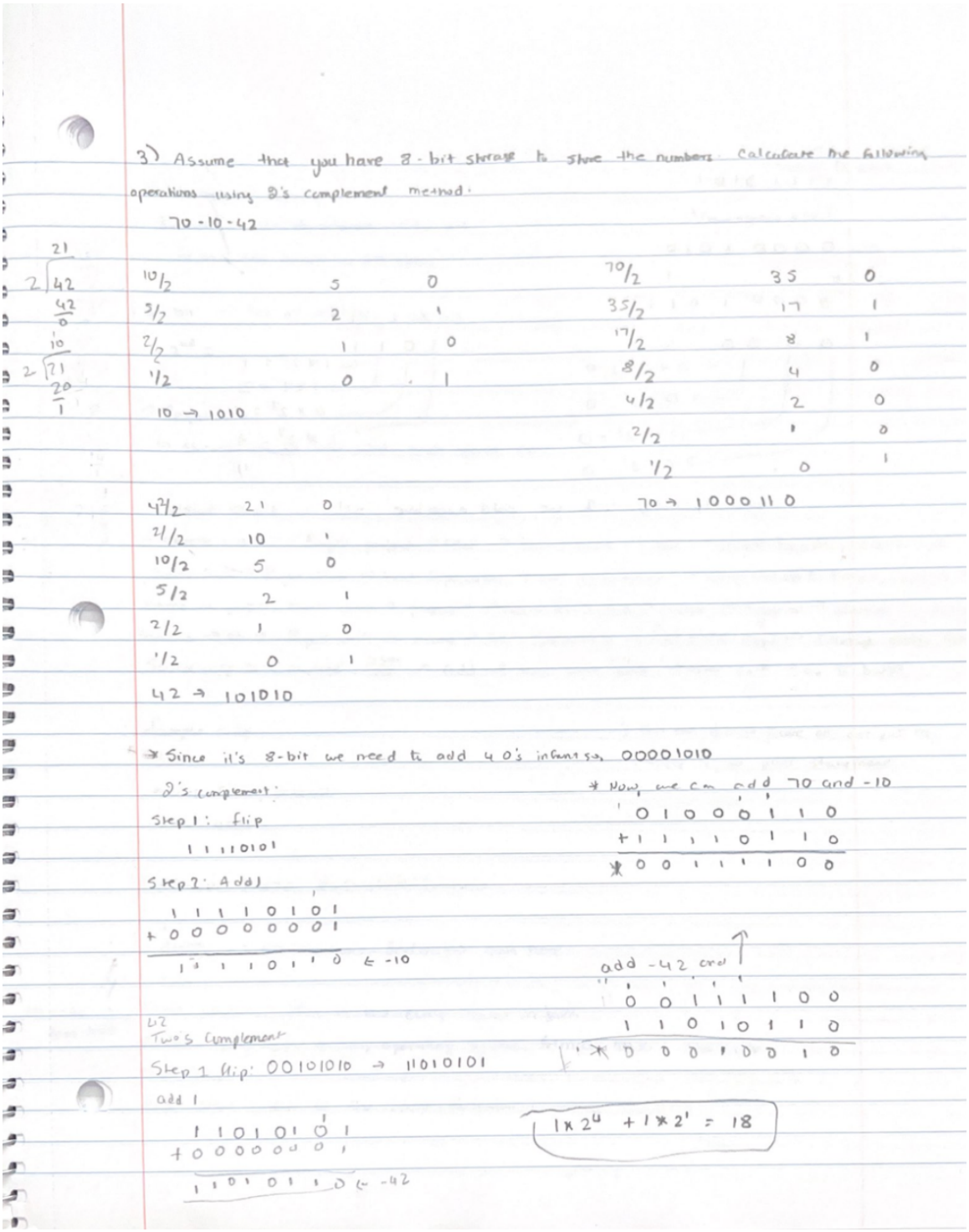
Therefore, A + B = 00011101

The content of the register C is 1001 1101

3. **(2 points)** Assume that you have 8-bit storage to store the numbers. Calculate the following operations using **two's complement method (in binary)**. (Assuming 8-bit registers are used)

70 – 10 - 42

[Hint: Perform the computation in binary system, then convert it back to decimal]

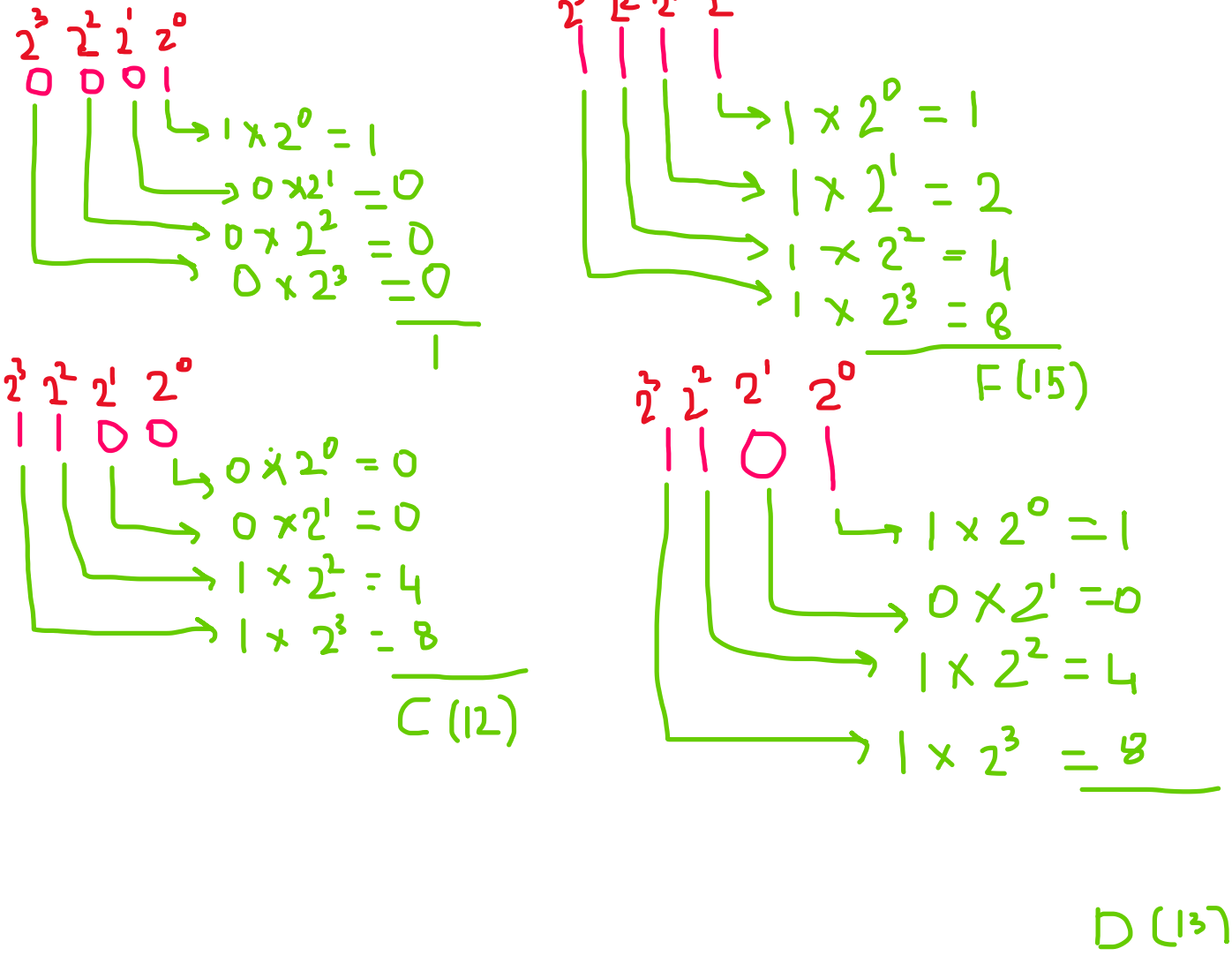


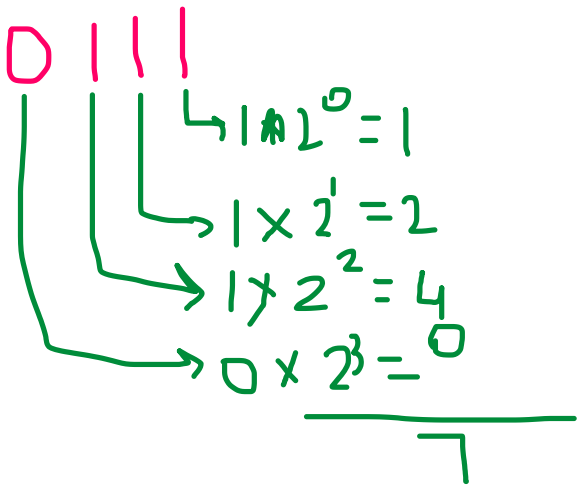
4. **(1 point)** What is the hexadecimal representation of the following binary numbers? Show the conversion in details.

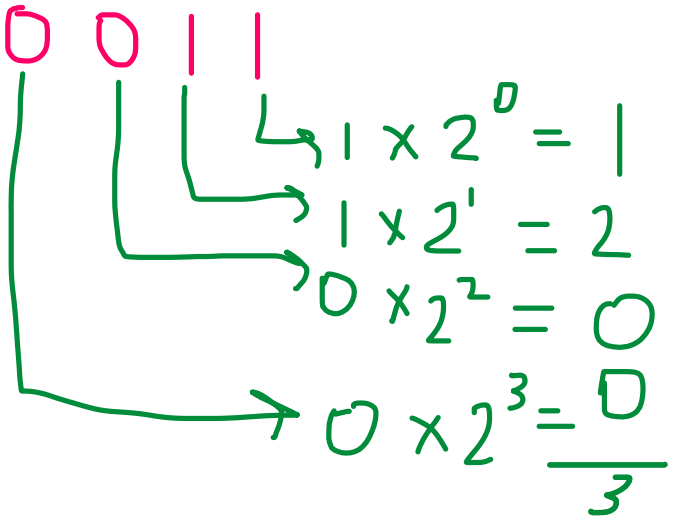
1101001101111101110011110001

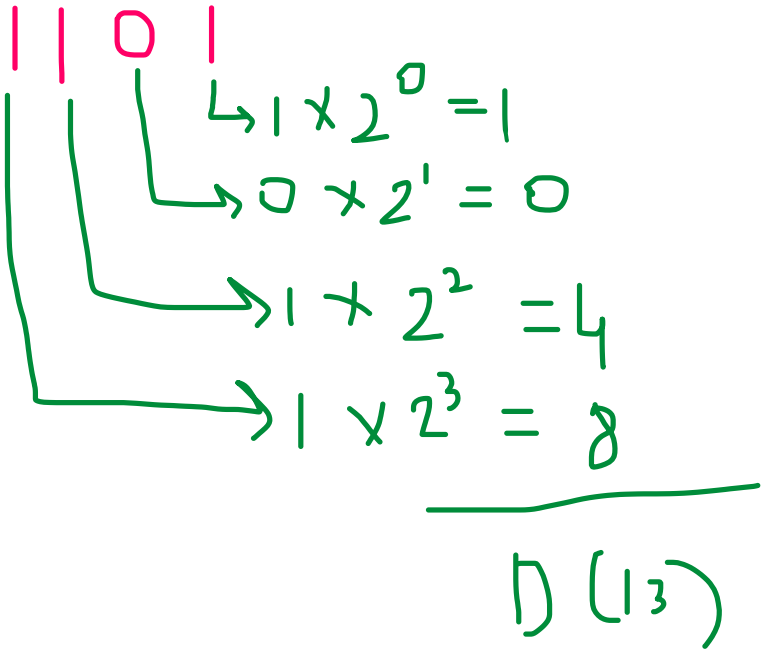
We have to sort the binary digits into groups of 4 and then convert the binary into hexadecimal

1101 0011 0111 1101 1100 1111 0001









Now we need to read it from bottom to top

Therefore, 1101 0011 0111 1101 1100 1111 0001 in hexadecimal is **D37DCF1**

5. (2 points) What is the *16-bit* hexadecimal representation of the following *signed decimal* integer? Show all the steps of conversion in details.

-90

	Quotient	Remainder
90/2	45	0
45/2	22	1
22/2	11	0
11/2	5	1
5/2	2	1
2/2	1	0
½	0	1

Now we have to read it from bottom to top, which gives us 101101, whose decimal number is 90

Since this is a 16 bit we can add 0's in the front to make it a 16 bit, 0000000001011010

Since it's a negative number we have to perform 2's complement

Step 1: flip the binary numbers

1111111110100101

Step 2: Add 1

1 1 1 1 1 1 1 1 1 0 1 0 0 1 0 1

+ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1

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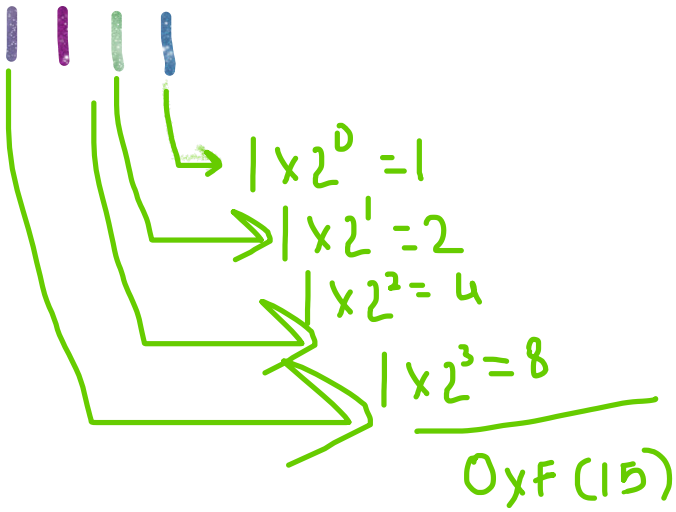
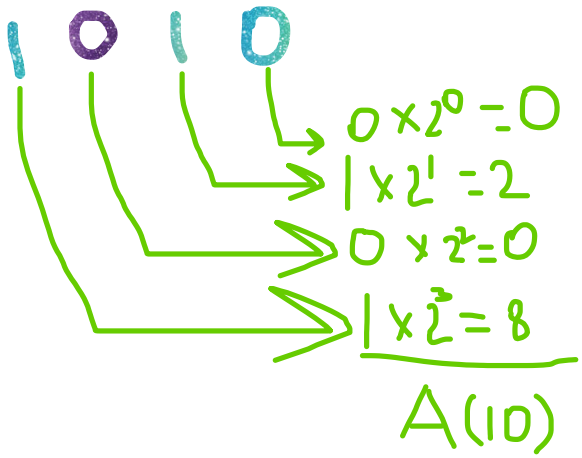
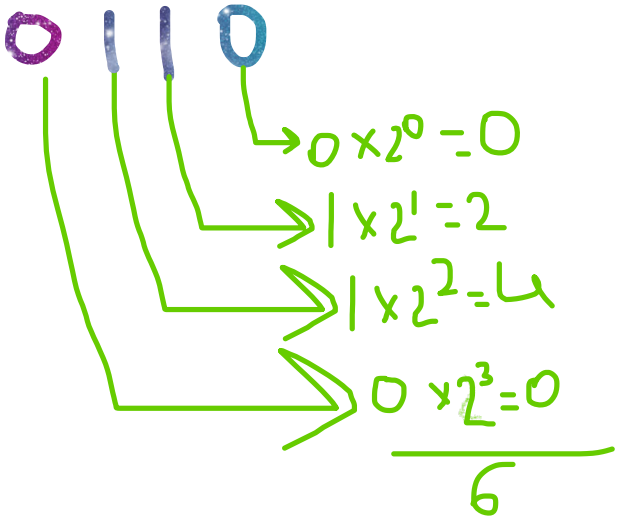
1 1 1 1 1 1 1 1 1 0 1 0 0 1 1 0

-90 in two's complement is 1111111110100110

Now we have to convert it into hexadecimal, by arranging the above binary number in groups of 4





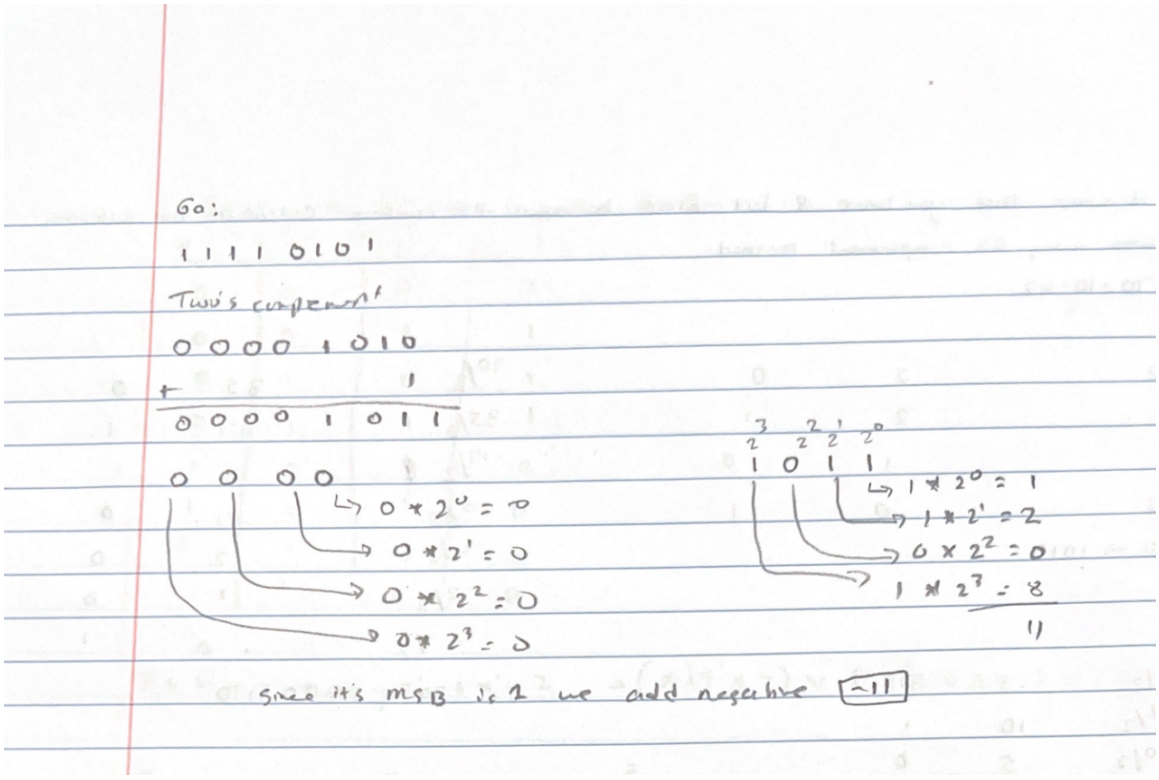


Therefore the hexadecimal representation of the signed decimal integer -90 is **FFA6**

6. (2 points) What is the decimal representation of each of the following *signed binary* numbers?

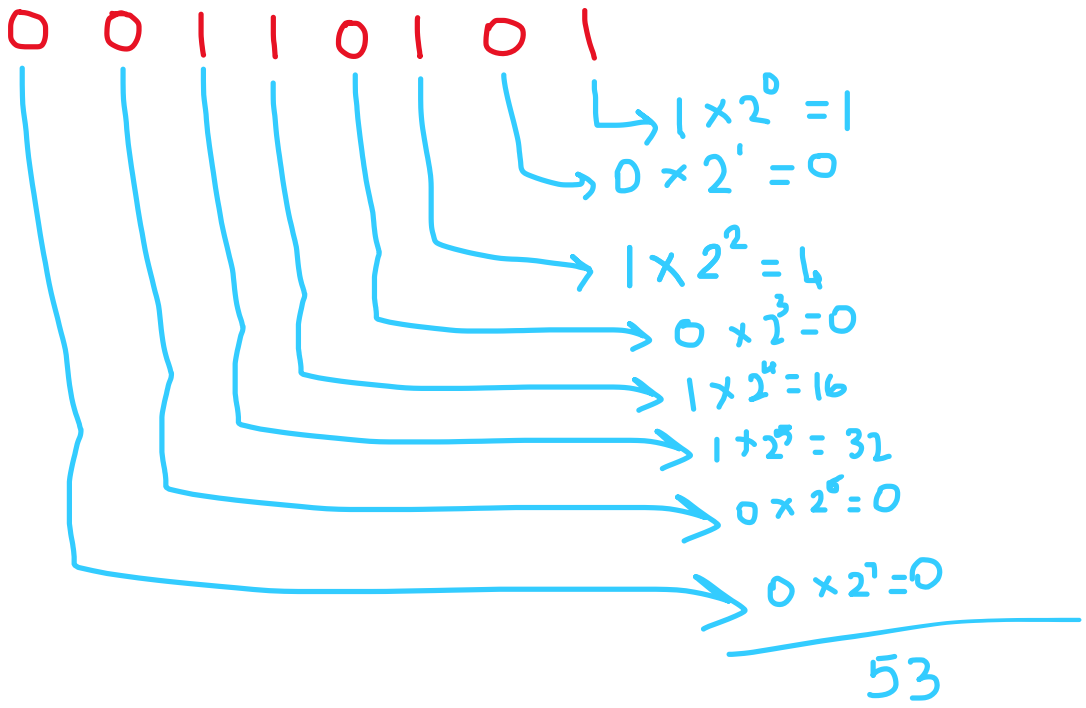
a. **(1 point)** 11110101

***since the MSB is 1 we can state that the decimal number is negative**



b. **(1 point)** 00110101

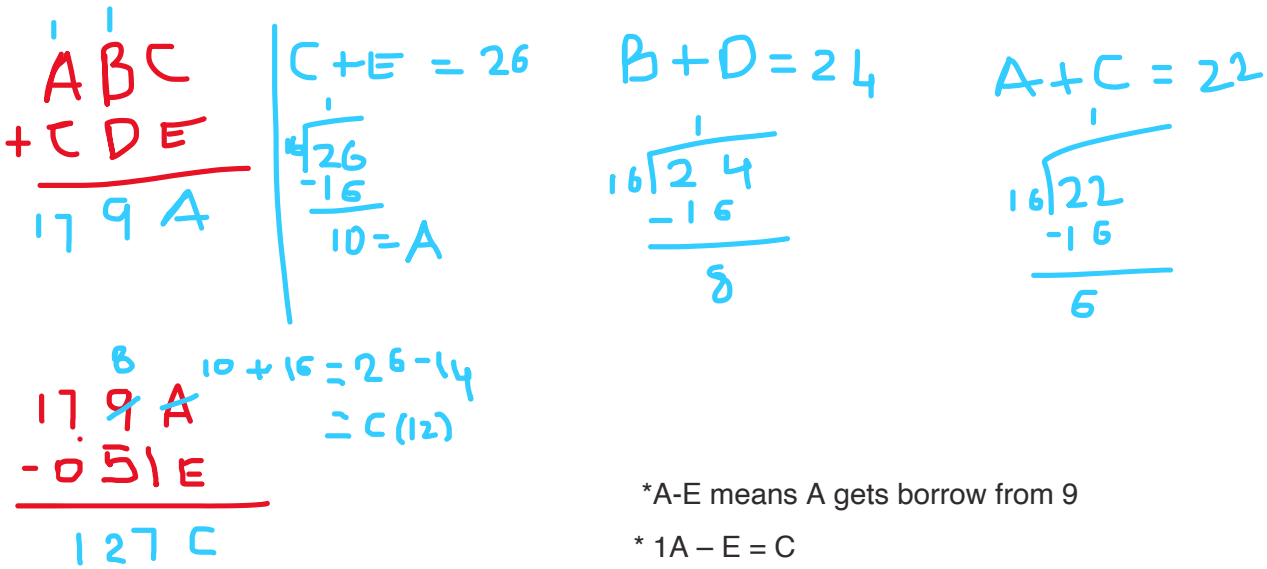
*since the MSB is 0, we can say that the decimal number would be positive



Therefore, the decimal representation of 00110101 is 53 and it will be 53 because the MSB is 0 which means the decimal number is positive

7. **(2 point)** Evaluate the following Hexadecimal expression. **All the numbers are hexadecimal**. Show all the steps of computation and the carries.

ABC + CDE – 51E



*A-E means A gets borrow from 9

* 1A – E = C

*8 – 1 = 7

* 7 – 5 = 2

* 1-0 = 1

Therefore, the hexadecimal expression of the following operation is **127C**

8. **(1 point)** Is it possible to store **-19** in a 5-bit storage. If your answer is YES, then show how to store **-19** in 5-bit register. If your Answer is No, Explain why.
    a. **No, because we cannot store a -19 in the 5- bit because it shows it is signed number and we need to look at the MSB reserved for the sign. Because in the signed representation, if the binary number starts with 1 then it indicates that the decimal number is negative and if starts with 0 then the decimal is positive. Since the starting binary number for -19 is 10011 and the MSB is 1, which means the decimal number is negative, so therefore we need 6 bit to represent the decimal -19.**
9. **(1 point)** What is the smallest decimal value you can represent, using a **145-bit signed integer?** You can write the number in exponent form.

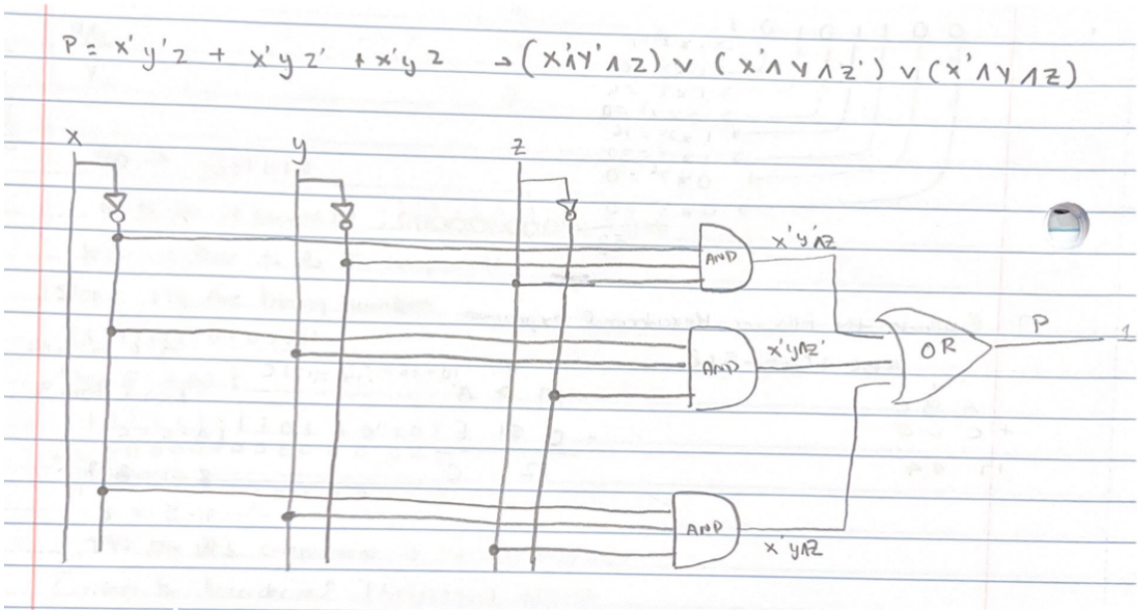
    -2^144

10. (2 points) What is the Boolean expression for P?

x	y	z	P
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

Design a circuit that can produce output P for inputs x, y, and z as expressed in the table above.

P = (X'Y'Z) V (X'YZ')V(X'YZ)



Note:

- **Make sure to justify all answers – show all work.**
- The Assignment **must be submitted electronically** through ICollege.
- You can do your work in a text editor (Microsoft word, open office, etc.)
- Or you can do it in a piece of paper, then scan or take a picture of the paper.
- Upload the answers in a **pdf file** to iCollege in the respective assignment dropbox.
- All work must be neat and legible. Illegible work will receive no credit. This includes work where the print contrast or darkness are too faint.
- The work that you turn in must be your own --- copying is not allowed for any assignments.
- Using another student's work as your own, allowing another student to use your work as their own, is academic misconduct.