**Question 1:**

A is an 8- bit binary integer A = 01000011 and B is a 4-bit binary integer B = 1010

a-) If A and B are signed binary integers, perform the binary operations A+B and A-B and explain your answers using the related terms like carry, borrow, overflow.

Since B is 4-bit we need to convert it to 8-bit. Since it is signed integer B = 1010 = 11111010.

A = = 67

B = 11111010 -> 2’s complement method :

00000101

1

+

00000110 = 6 So B is equal to -6

***A + B:*** ***A - B:***

A = 01000011 : 67 A = 01000011 : 67

B = 11111010 : -6 -B = 00000110 : 6

+ +

A+B = 110111101 : 61 A+(-B) = 01001001 : 73

Carry bit, but it is ignored. NO overflow for both A+B and A – B.

b-) If A and B are unsigned binary integers, perform the binary operations A+B and A-B and explain your answers using the related terms like carry, borrow, overflow.

B is 4-bit we need to convert it to 8-bit. Since it is unsigned integer B = 1010 = 00001010.

A = = 67

B = = 10

-B = 11110101 + 1 = 11110110 = -10

***A + B:*** ***A - B:***

A = 01000011 : 67 A = 01000011 : 67

B = 00001010 : 10 -B = 11110110 : -10

+ +

A+B = 01001101 : 77 A+(-B) = 100111001 : 57

Since there is carry bit, there is no borrow and this can be calculated since A>B.

**Question 2:**

***a-)*** (𝑎𝑐(𝑐 + 𝑑) + 𝑎̅)𝑐

* (𝑎𝑐(𝑐 + 𝑑) + 𝑎̅)𝑐 = (ac +acd+ 𝑎̅)𝑐
* *---> Absorption Theorem states that a+ab = a so abc + abcd = abc*
* (ac +acd+ 𝑎̅)𝑐 = (ac + 𝑎̅)𝑐 (Absorption)
* (ac + 𝑎̅)𝑐 = ac + 𝑎̅𝑐
* ac + 𝑎̅𝑐 = c(a+𝑎̅) = c(1) = c (Annihilator)

***b-)*** 𝑎̅bc+𝑎𝑐̅+𝑎̅𝑐+𝑎𝑐+𝑎𝑏𝑐

* 𝑎̅bc+𝑎𝑐̅+𝑎̅𝑐+𝑎𝑐+𝑎𝑏𝑐 = 𝑎̅bc+𝑎𝑐̅+𝑎̅𝑐+𝑎𝑐+𝑎𝑏𝑐 + abc
* 𝑎̅bc+𝑎𝑐̅+𝑎̅𝑐+𝑎𝑐+𝑎𝑏𝑐 + abc = 𝑎̅bc+𝑎𝑐̅+𝑎̅𝑐+ ac + abc
* 𝑎̅bc+𝑎𝑐̅+𝑎̅𝑐+ ac + abc = bc+𝑎𝑐̅+𝑎̅𝑐+ ac

From the consensus theorem 🡪 𝑎𝑐̅+ ac = 𝑎𝑐̅+ ac + 𝑎

* bc+𝑎𝑐̅+𝑎̅𝑐+ ac = bc+𝑎𝑐̅+𝑎̅𝑐+ ac + 𝑎
* bc+𝑎𝑐̅+𝑎̅𝑐+ ac + 𝑎 = bc +𝑎̅𝑐+ ac + 𝑎 (Absorption)

From the consensus theorem 🡪 𝑎̅𝑐+ ac = 𝑎̅𝑐+ ac +

* bc +𝑎̅𝑐+ ac + 𝑎 = bc +𝑎̅𝑐+ ac + 𝑎 +
* bc +𝑎̅𝑐+ ac + 𝑎 + = bc + ac + 𝑎 + c (Absorption)
* bc + ac + 𝑎 + c = ac + 𝑎 + c (Since c(b+) = c.1 = c)
* ac + 𝑎 + c = 𝑎 + c (Absorption)

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