إعداد

الطالبة :

بيان

شكري

الصغير

Problem 1. Solve the following short problems. (6 points)

a) Complete the following table to show the binary representation of the following number in signed-magnitude and 2's complement, assuming you have 7 bits.

Number	Signed Magnitude	2's Complement
-40		

b) Given a 6-bit signed 2's complement number system, the maximum positive number that can be represented is ______________________, while the minimum negative number is ______________________.

c) Consider the following operation of adding the following 5-bit 2's complement numbers:

$$(11100)_2 + (11001)_2 = (\qquad\qquad)_{10}$$

1. Fill in the decimal value of the result in the equation above.
2. Does an overflow occur for this operation? Justify your answer.

second exam :-

{ logic second spring 015 }

problem [1]

(A)

Number	signed magnitude	2's complement
-40	1101000	1011000.

64 32 16 8 4 2 1

(b) max positive number $\rightarrow 2^{n-1}-1 = 2^5-1 = 31.$

min negative number $\rightarrow -2^{n-1} = -2^5 = -32.$

(c) $(11100)_2 + (11001)_2 = (-11)_{10}$

[1]

$$
\begin{array}{r}
11000 \\
11100 \\
11001+ \\
\hline
(10101)_2 = (\cancel{21})_{10}
\end{array}
$$

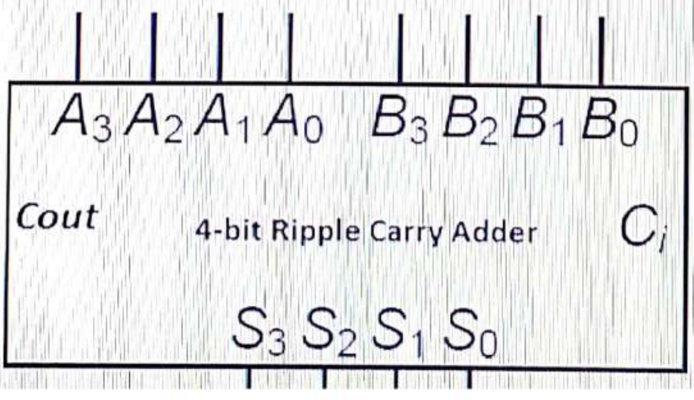
8 4 2 1

$(01011)_2 = (11)_{10}$

[2] No overflow / overflow = 0

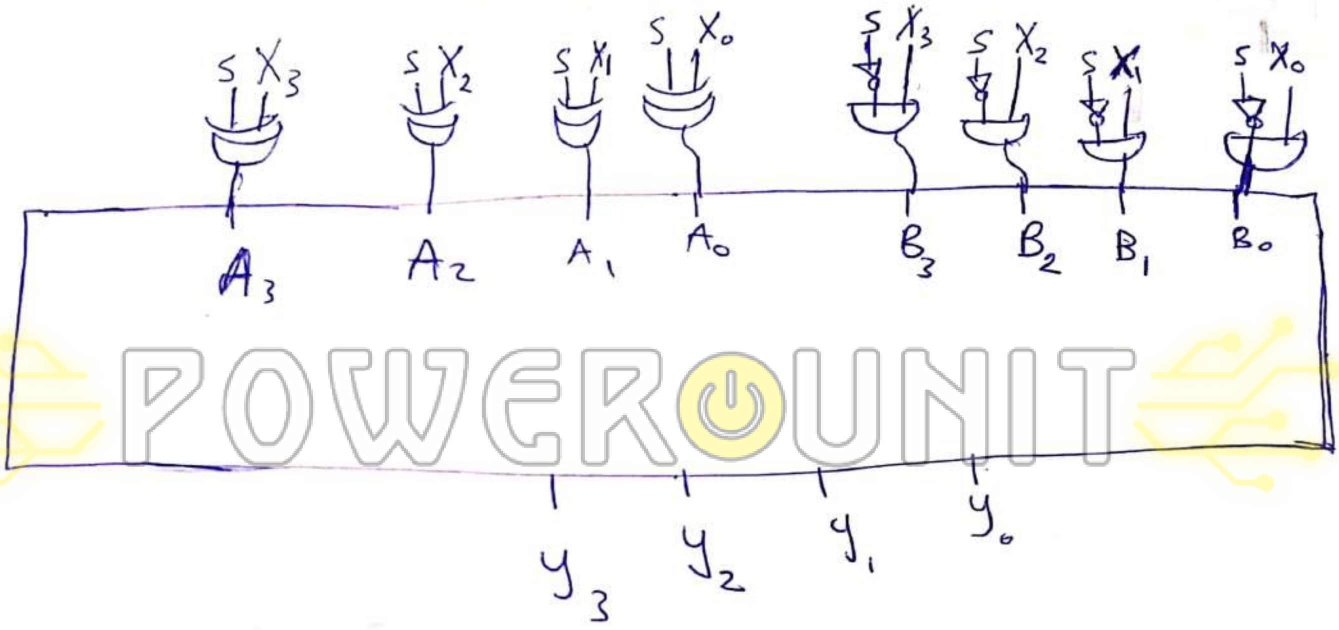
Problem 6. Assume **x** is a 4-bit 2's complement signed number. Given the following 4-bit ripple carry adder, design a circuit that outputs a 4 bit 2's complement signed number **y**. The circuit has a control bit S, when S=0 the output y=2x, when S=1 the output y=-x.

(Hint: remember that 2x=x+x) (4 points)



problem $\boxed{6}$

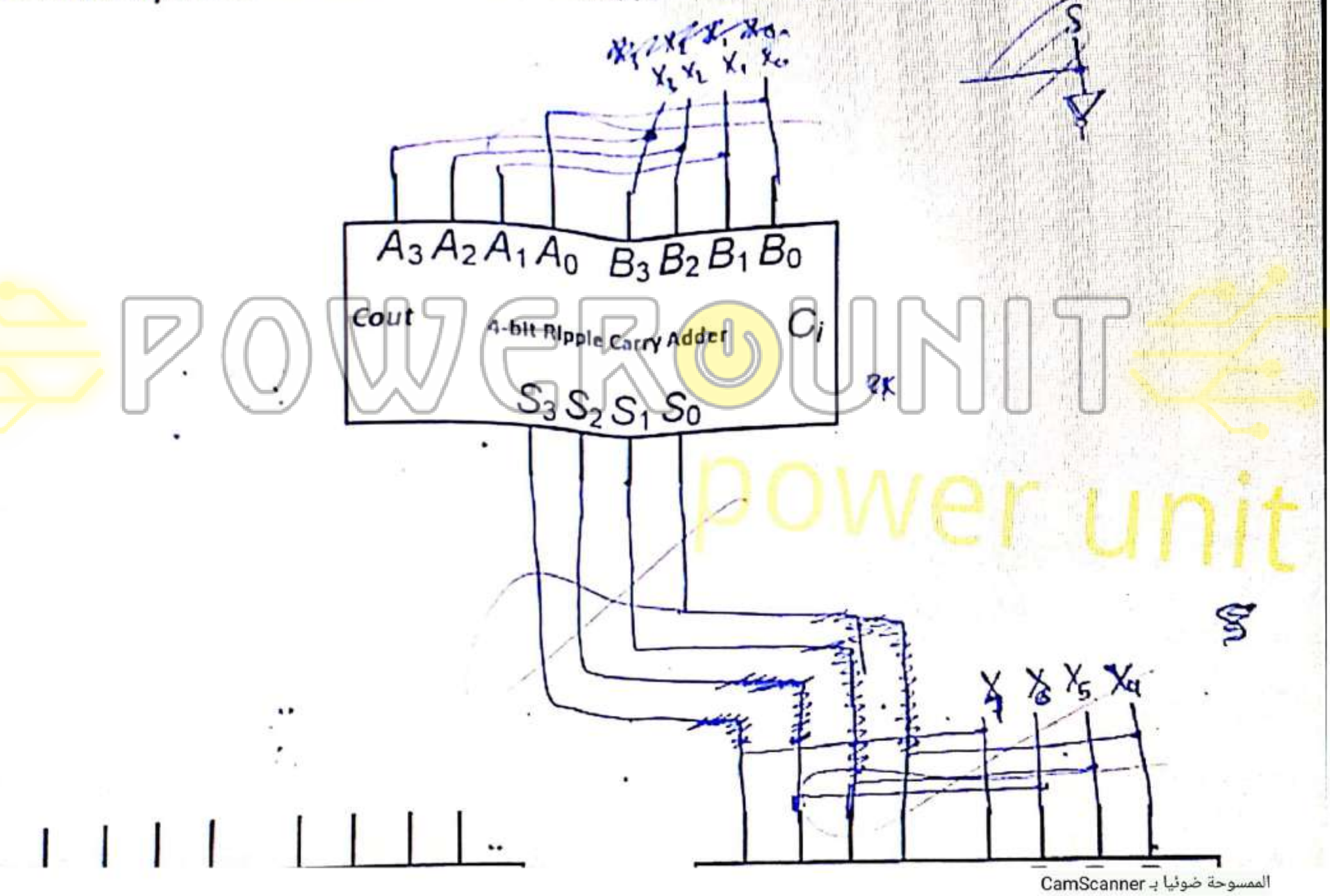
$\boxed{1}$



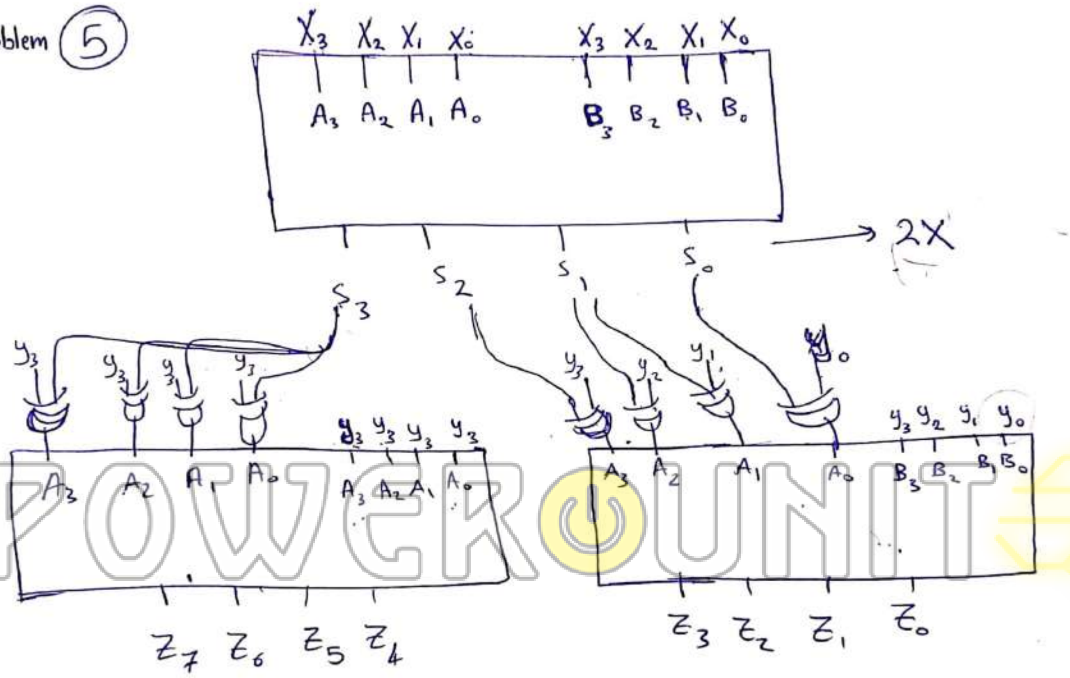
$y = 2\cancel{X}$

$y = -X$

Problem 5: Assume x and y are 4-bit ***2's complement signed numbers***. Using ***only*** the following three 4-bit ripple carry adders and any gates you need, design a circuit that outputs an 8-bit signed number z. The circuit has a control bit S, when S=0 the output **z=y+2x**, when S=1 the output **z=y-2x**. Your circuit should produce correct results for all possible input combinations of x and y. (Hint: remember that 2x=x+x) **(5 points)**



problem 5



$Z_7 - Z_0$

$y_3 y_2 y_1 y_0$

$X_3 X_2 X_1 X_0$

$$\begin{cases} y - 2X \rightarrow s = 1 \\ y + 2X \rightarrow s = 0 \end{cases}$$

d. Represent the number $(-14)_{10}$ as an 8-bit binary number using ***signed-magnitude*** representation?

1110

Answer = 10001110

e. Given two 8-bit ***2's complement signed numbers*** $A = (11010010)_2$ and $B = (00011101)_2$. In the given blank write the result of $A - B$?

A − B = 10110101

11010010
+ 11100011
110110101

f. Given two 3-bit numbers $A = (011)_2$ and $B = (010)_2$. Determine the value of the overflow bit generated by the operation **A+B** if the numbers are treated as ***1) unsigned numbers*** and if they are treated as ***2) 2's complement signed numbers***?

011
010
101

Unsigned Overflow = 0

Signed Overflow = 1

logic second Fall015

problem $\boxed{1}$: (d) $(-14)_{10} \xrightarrow[\text{magnitude}]{\text{signed}} (10001110)_2$

unsigned number:

128 64 32 16 8 4 2 1 (8 bits)

$(0\ 0\ 0\ 0\ 1\ 1\ 1\ 0)_2 \longrightarrow (1\ 0001110)_2$

(e) $(11010010)_2 - (00011101)_2 = (10110101)_2$

$$\begin{array}{r} 11000010 \\ 11010010 \\ 11100011 + \\ \hline 10110101 \end{array}$$

(f)

$$\begin{array}{r} 010 \\ 011 \\ 010 + \\ \hline 101 \end{array}$$

unsigned overflow = 0

signed overflow = 1

Problem 1. Answer the following short questions. 9 **(14 points)**

a. What is the decimal value of the binary number $(10111)_2$ if it represents:

1. Sign-Magnitude number: 1 0111 = -7
2. 2's complement signed number: (10111) = -9

b. Does the following operation $(110001)_2 + (110111)_2$ result in an overflow or not when the number are: ***(You must Justify your answer)***

1. Unsigned numbers: 110001 + 110111 = 1101000 overflow because the curry is 1 and the result larger than the allowed bit
2. 2's complement signed numbers: 110001 + 110111 = 1101000 $C_{n-1} \oplus C_n = 0$ No over flow

c. Given two ***2's complement signed numbers*** $A = (1010)_2$ and $B = (01011100)_2$. In the given blank write the result of $A + B$ using an ***8-bit adder/subtractor***?

CamScanner المسوحة ضوئيا بـ

Logic second spring 016.

problem 1 A $(10111)_2$

sign magnitude number $\rightarrow (10111)_2 = (-7)_{10}$

2's complement signed number $\rightarrow (01001)_2 = (-9)_{10}$

b 1 $(110001)_2 + (110111)_2 = (101000)_2$

$$\begin{array}{r} 110111 \\ 110001 \\ + \; 110111 \\ \hline (101000)_2 \end{array}$$

unsigned number ⇒ 1

overflow

2's complement signed numbers ⇒ 0

(c) $A = (1010)_2$

$B = (01011100)_2$

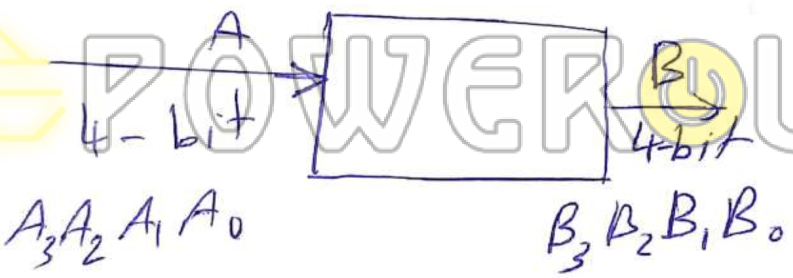
$A - B = A + 2's\ B$

$$\begin{array}{r} 1\,1\,1\,0\,0\,0\,0\,0 \\ 1111\ 1010 \\ +\ 1010\ 0100 \\ \hline 1001\ 1110 \end{array}$$

$A - B = (10011110)_2$

h. Draw the logic diagram of a combinational circuit that has a ***4-bit unsigned*** number (A) as an input and produces a ***4-bit unsigned*** number (B) as an output such that B equals the ***quotient*** of (A ÷ 8).

h



$$B = \frac{A}{8}$$

c. Variables A and B are 8-bit unsigned numbers with the following values: **A** = $(1000\ 1001)_2$ and **B** = $(1001\ 1010)_2$. An 8-bit adder/subtractor is used to perform the operation:**A – B. Determine** the 8-bit result of the adder/subtractor and Borrow bit.

$A - B =$ 1110 1111	Borrow bit = 1

1001 1010

1110 1111

+ 0110 0110

1110 1111

d. The 2's complement for $(0010111)_2$ is (1101001)

e. The 7's complement for $(735)_8$ is = 8's complement = (042)

Logic second spring 017

problem 1 c

$A = (1000\ 1001)_2$, $B = (1001\ 1010)_2$

$A - B = A + 2'\text{complement } B$

$$\begin{array}{r} 0\,0\,0\,0\,0\,0\,0\,0 \\ 1000\ 1001 \\ 0110\ 0110+ \\ \hline (1110\ 1111)_2 \end{array}$$

d $(00101111)_2 \xrightarrow{2's\ \text{complement}} (11010001)_2$

e $(735)_8 \xrightarrow{7's\ \text{complement}} (042)_8$

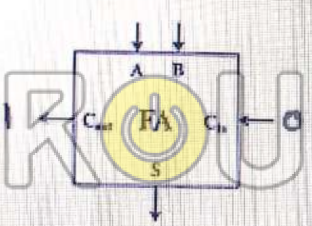
$(042)_8$

max(777)

e. Given the following full adder cell, if $C_{in} = 0$ and $C_{out} = 1$, then the values of A and B are:

A = A

B = B



X (6)

Problem 2. Show that the following circuit implements a 2-input XNOR gate (2 points)

Logic second summer 018.

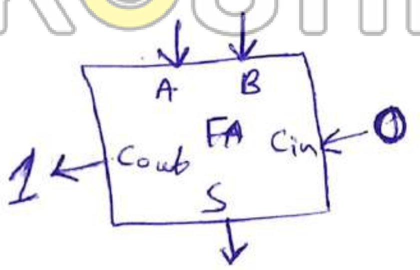
e $C_{in} = 0$, $C_{out} = 1$

1

$A = 1$

$B = 1$

$$\begin{array}{r} 1 \\ 1^{+} \\ \hline 0 \end{array}$$



c. Using **6-bits**, the minimum negative number using **Sign-Magnitude** format is $= (111111)_2$

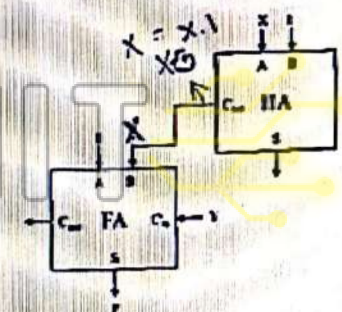
d. What is the **decimal** value of the **6-bits signed number** $(100111)_2$ if it is represented using **signed 2's complement** format? (~~-25~~ $)_{10}$

-011001

-25

e. What is the Boolean expression of **output F** in the figure below in terms of X and Y?

X	Y	F
0	0	0
0	1	1
1	0	1
1	1	0



$F(X,Y) = \sum m(1,2) = \bar{X}y + X\bar{y}$

$F = X \oplus y \oplus 0$

Logic second spring 019

problem 1

c

6 bits ,, the minimum negative number using Sign-magnitude $\rightarrow -(2^{n-1}-1)$

$= -(2^5-1)$

$= \boxed{-31}$

$(111111)_2$

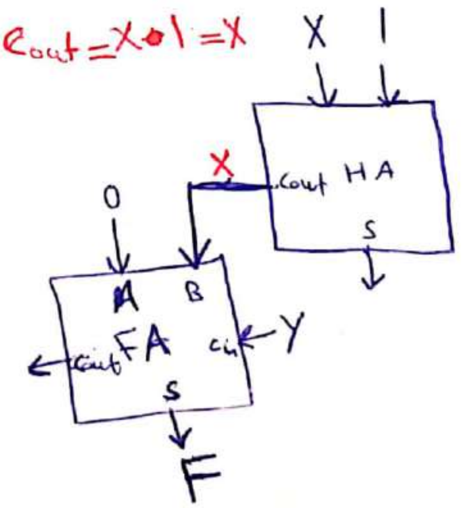
d

$(100111)_2 \xrightarrow[\text{complement}]{2\text{'s}} -(011001)_2 = -(25)_{10}$

e

X	Y	A	F = (sum)
0	0	0	0
0	1	0	1
1	0	0	1
1	1	0	0

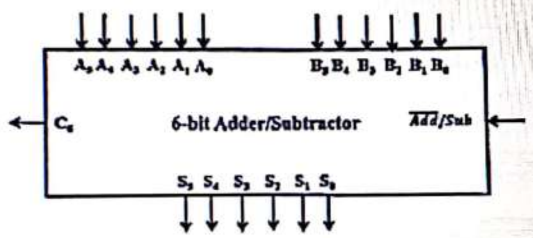
$C_{out} = X \cdot 1 = X$



$F = \bar{X}Y + X\bar{Y}$

* Sum $= X \oplus Y$

Problem 8. Given the following 6-bit adder/subtractor, answer the two questions below: **(3 points)**



3

I. Assume that inputs A and B are **unsigned numbers** set to the following values: A= $(011010)_2$ and B = $(001100)_2$. The $\overline{Add}/Sub$ control is set to 0. Accordingly, compute the sum bits S[5:0] and determine if there is an overflow or not.

```
 11
 011010
+001100
-------
 100110
```

$S_5S_4S_3S_2S_1S_0$ = 100 110

Is there an overflow? No.

II. Assume that inputs A and B are **signed numbers** in 2's complement format set to the following values: A = $(110111)_2$ and B = $(111001)_2$. The $\overline{Add}/Sub$ control is set to 1. Accordingly, compute the sum bits S[5:0] and determine if there is an overflow or not.

```
  1111
  110111
+ 000111
--------
  111110
```

$S_5S_4S_3S_2S_1S_0$ = 111110

Is there an overflow? No.

problem 8 ① $A = (011010)_2$, $B = (001100)_2$

set to 0 → s = 0 → Adder:

$$A+B \Rightarrow \begin{array}{r} \boxed{0}11000 \\ 011010 \\ 001100 + \\ \hline (100110)_2 \end{array} \Rightarrow (100110)_2$$

No overflow

② $A = (110111)_2$, $B = (111001)_2$

set to 1 → s = 1 → subtraction.

$A - B = A + 2'sB = (111110)_2$

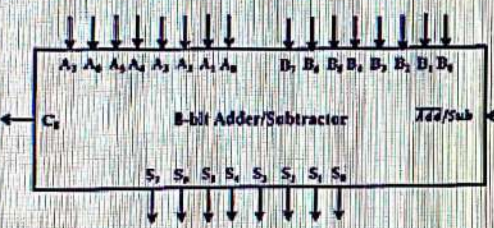
$$\begin{array}{r} \boxed{00}0111 \\ 110111 \\ 000111 + \\ \hline (111110)_2 \end{array}$$

No overflow

Problem 8. Given the following 8-bit adder/subtractor, answer the two questions below: **(3 points)**

1

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



I. Assume that inputs A and B are ***unsigned numbers*** set to the following values: $A = (10101101)_2$ and $B = (00111111)_2$. The $\overline{Add}/Sub$ control is set to 0. Accordingly, compute the sum bits S[7:0] and determine if there is an overflow or not.

$S_7S_6S_5S_4S_3S_2S_1S_0$ =	11101011 ✗

Is there an overflow?	No ✓

no carry

II. Assume that inputs A and B are ***signed numbers*** in 2's complement format set to the following values: $A = (01011001)_2$ and $B = (11001011)_2$. Use the 8-bit adder/subtractor above to compute $A - B$ and specify the value of sum bits S[7:0] and determine if there is an overflow or not.

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

$S_7S_6S_5S_4S_3S_2S_1S_0$ =	10001101 ✗

Is there an overflow?	yes ✓

(8) [1] $A = (10101101)_2$, $B = (00111111)_2$

S = 0 → Adder

0 0 1 1 1 1 1 1 1

1 0 1 0 1 1 0 1 +

0 0 1 1 1 1 1 1

$(11101100)_2$ → $S_7 S_6 S_5 S_4 S_3 S_2 S_1 S_0$

overflow = 0

No overflow

(2) $A = (01011001)_2$, $B = (11001011)_2$

A − B ??

0 1 1 1 0 0 0 1

0 1 0 1 1 0 0 1

0 0 1 1 0 1 0 1 +

$(10001110)_2$

overflow = 1

Problem 5: Assume m and n are 4-bit ***unsigned*** numbers. Using ***only*** the following three 4-bit ripple carry adders and ***any logic gates*** you need, design a circuit that outputs an 8-bit ***unsigned*** number **k** such that: **(5 points)**

$$k = (6 \times m) - n$$

$m_3 \; m_2 \; m_1 \; m_0$

أول خطوة (6m).

1 بحول الضرب إلى جمع.

$K = 6m - n$

$m \rightarrow m_3\ m_2\ m_1\ m_0$

$n \rightarrow n_3\ n_2\ n_1\ n_0$

$K \rightarrow K_7\ K_6\ K_5\ K_4 \dots K_0$

$$
\begin{array}{cccccccc}
 & & & m_3 & m_2 & m_1 & m_0 & \\
 & & & & 1 & 1 & 0 & \times \\
\hline
 & 0 & 0 & 0 & 0 & 0 & 0 & \\
 & 0 & m_3 & m_2 & m_1 & m_0 & 0 & + \\
 & m_3 & m_2 & m_1 & m_0 & 0 & 0 & \\
\hline
 & S_3 & S_2 & S_1 & S_0 & m_0 & 0 &
\end{array}
$$

بعطوا (S). إذاً هم حاصل جمعهم بالـadder.

رح اطرحهم مع n فأول adder بوضع 4bits ($S_1 S_0 m_0$ 0) وبطرحهم مع 4bit [N] ($N_3 \dots N_0$)
وثاني adder بوضع 4bits (التكملة $S_3 S_3 S_3 S_2$ { S_3 بكبرها بتكرارها 2 عشان أطرحهم مع 4-bits
[N]) N فقط 4bits يعني $N_3 \dots N_0$ فقط فكبرها وبكررها 3) ← $\boxed{6m-n}$.