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NRC 2359 - CMP 3004

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### TAREA #1

1. Transforme los siguientes números de una base a otra.

#### DECIMAL A BINARIO

• 10 :

$$\begin{array}{r} 10 \\ \hline 0 \quad 5 \quad 2 \\ 1 \quad 2 \quad 2 \\ \hline 0 \quad 1 \end{array} \Rightarrow R) (1010)_2,$$

menos significativo      más significativo

• 1369 :

$$\begin{array}{r} 1369 \\ \hline 16 \quad 684 \quad 2 \\ 09 \quad 08 \quad 342 \quad 2 \\ 1 \quad 04 \quad 14 \quad 171 \quad 2 \\ 0 \quad 02 \quad 11 \quad 85 \quad 2 \\ 0 \quad 1 \quad 05 \quad 42 \quad 2 \\ 1 \quad 02 \quad 21 \quad 2 \\ 0 \quad 1 \quad 10 \quad 2 \\ 0 \quad 5 \quad 2 \\ 1 \quad 2 \quad 2 \\ 0 \quad 1 \end{array}$$

R) (10101011001)<sub>2</sub>,

• 9234876 :

$$\begin{array}{r} 9234876 \\ \hline 12 \quad 4617438 \quad 2 \\ 03 \quad 06 \quad 2308719 \quad 2 \\ 14 \quad 017 \quad 03 \quad 1154359 \quad 2 \\ 08 \quad 14 \quad 10 \quad 15 \\ 07 \quad 03 \quad 08 \quad 14 \\ 16 \quad 18 \quad 11 \quad 03 \\ 0 \quad 0 \quad 19 \quad 15 \\ 1 \quad 1 \quad 1 \quad 1 \end{array}$$

288589      2  
08      144294  
08  
05  
18  
09  
1

144294		2		2		2		2		2		2	
04		72147	2										
02		12		36073	2								
09		014	76			18036	2						
14		07	007	13	(1)	003	16	9018	2				
0							10	018		4509	2		
										03	2		
										70			
										09			
										(1)	2254	2	
											02		
											05	35	2
											74	11	12
										0	0	0	2
											0	4	2
												0	2
												0	2

R)  $(100011001110100110111100)_2$ ,

• 49263749:

49263749		2		2		2		2		2		2	
09		24631874	2										
12		04		12315937	2								
06		06		03		6157968	2						
03		03		11		015							
17		11		15		17							
14		18		19		19							
09		07		13	(1)	16							
0		19				18							
						09							
						18							
						04							
						0							
							10						
							07						
							18						
							09						
							18						
							04						
							0						
								13					
								19					
								14					
								09					
								12					

769746		2		2		2		2		2		2	
16		384873	2										
09		18		192436	2								
17		04		12		96218	2						
14		08		04		10							
06		07		03		03							
0		13		16		11							
						15							
						11							
						375							
						17							
						15							
						187							
						07							
						187							
						07							
						93							
						13							
						46							
						0							
						23							
						07							
						11							
						1							
						5							
						2							
						1							
						2							
						2							

R)  $(1011101111011010010000101)_2$ ,

Decimal a binario con C2:

- 20:  $\begin{array}{r} 20 \\ \hline 00 \quad 10 \quad 2 \\ 0 \quad 5 \quad | \quad 2 \\ 1 \quad 2 \quad | \quad 2 \\ 0 \quad 1 \end{array}$

$20_{(10)} = 10100$   
 $\hookrightarrow 010100$

R) 2C:  $(101100)_{10}$

- 1025:

$$\begin{array}{r} 1025 \\ \hline 02 \quad 512 \quad 2 \\ 05 \quad 11 \quad 256 \quad | \quad 2 \\ 1 \quad 12 \quad 05 \quad 128 \quad | \quad 2 \\ 0 \quad 16 \quad 0 \quad 08 \quad | \quad 2 \\ 0 \quad 0 \quad 0 \quad 64 \quad | \quad 2 \\ 0 \quad 0 \quad 0 \quad 04 \quad | \quad 2 \\ 0 \quad 0 \quad 0 \quad 0 \quad 32 \quad | \quad 2 \\ 0 \quad 0 \quad 0 \quad 0 \quad 12 \quad | \quad 2 \\ 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 6 \quad | \quad 2 \\ 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 8 \quad | \quad 2 \\ 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 4 \quad | \quad 2 \\ 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 2 \quad | \quad 2 \\ 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 1 \end{array}$$

$$1025_{(10)} = 10000000001$$

R) 2C:  $(01111111111)_{10}$

-3925 : (1º) Binario de 3925

$$\begin{array}{r}
 3925 \\
 \hline
 1962 & 2 \\
 16 & 2 \\
 18 & 2 \\
 490 & 2 \\
 245 & 2 \\
 122 & 2 \\
 61 & 2 \\
 30 & 2 \\
 15 & 2 \\
 7 & 2 \\
 3 & 2 \\
 1 & 2 \\
 \end{array}$$

$3925 \rightarrow (11110101,0101)_2$

(2º) Complemento de 2 del binario:

$$\begin{array}{r}
 000010101010 \\
 + 1 \\
 \hline
 1000010101011
 \end{array}$$

↑ representa en negativo a -3925

R)  $(1000010101011)_2$

-104596 : (1º) Binario de 104596

$$\begin{array}{r}
 104596 \\
 \hline
 52298 & 2 \\
 26149 & 2 \\
 13074 & 2 \\
 6537 & 2 \\
 3268 & 2 \\
 1634 & 2 \\
 812 & 2 \\
 408 & 2 \\
 204 & 2 \\
 102 & 2 \\
 51 & 2 \\
 \end{array}$$

$104596 \rightarrow (11001100010010100)_2$

ESTILO

② Complemento de 2 del binario:

$$\begin{array}{r} \underline{11001100010010100} \\ (+) \\ \underline{00110011101101010} \\ + \\ \hline \text{2C: } \underline{100110011101101100} \end{array}$$

$$R) \underline{100110011101101100} \Rightarrow R) (100110011101101100)_2$$

Unsigned binary to hex

- Use the long & short methods:

$$\rightarrow (1100\ 0111\ 1010\ 1011\ 0011\ 0110\ 0000\ 101001)_2$$

Long Method:

① Transformar binario a decimal:

$$\begin{aligned} = & 1 \times 2^{39} + 1 \times 2^{38} + 1 \times 2^{35} + 1 \times 2^{34} + 1 \times 2^{33} + 1 \times 2^{32} + 1 \times 2^{30} + 1 \times 2^{28} + 1 \times 2^{26} \\ & + 1 \times 2^{25} + 1 \times 2^{22} + 1 \times 2^{21} + 1 \times 2^{19} + 1 \times 2^{18} + 1 \times 2^{17} + 1 \times 2^{15} + 1 \times 2^{14} \\ & + 1 \times 2^{12} + 1 \times 2^{11} + 1 \times 2^5 + 1 \times 2^3 + 1 \times 2^0 = (8.90508335145 \times 10^{11})_{10} \end{aligned}$$

② Transformar decimal a hexadecimal:

C) 1890508335145

## 20 Decimal to Hexadecimal

890508335145	16
90	111111
105	55656770946
090	764
108	125
123	136
113	0872
0151	077
074	130
105	029
09	1342
066	066
02	02

fin, numeros significativos

3317	16
0117	207
05	047
15	12

, mas significativo

= R) (CF566ED829)16 "

int 0

A	→ 10
B	→ 11
C	→ 12
D	→ 13
E	→ 14
F	→ 15

tabla hexadecimal

short method:

- Cada dígito hexadecimal se representa mediante un número binario de 4 dígitos.

1100 1111 0101 01100 1101 1101 1101 0110 0000 0010 1001

Hay 10 bloques de 4 dígitos

## Tabla de binarios - hexadecimal

<u>Bin.</u>	<u>Hex.</u>	
0000	0	• 1100 = C
0001	1	• 1111 = F
0010	2	• 0101 = 5
0011	3	• 0110 = 6
0100	4	• 1110 = E
0101	5	• 1101 = D
0110	6	• 1000 = 8
0111	7	• 0010 = 2
1000	8	• 1001 = 9
1001	9	
1010	A	
1011	B	
1100	C	
1101	D	
1110	E	
1111	F	

- 1100 = C
- 1111 = F
- 0101 = 5
- 0110 = 6
- 0110 = 6
- 1110 = E

}  $\Rightarrow R) (CF566ED829)_{16},$

long method :

(1º) Transformar binario a decimal:

$$\begin{aligned}
 &= 1 \times 2^{39} + 1 \times 2^{34} + 1 \times 2^{33} + 1 \times 2^{32} + 1 \times 2^{31} + 1 \times 2^{27} + 1 \times 2^{26} + 1 \times 2^{25} \\
 &\quad + 1 \times 2^{21} + 1 \times 2^{20} + 1 \times 2^{19} + 1 \times 2^{15} + 1 \times 2^{14} + 1 \times 2^{13} + 1 \times 2^9 + 1 \times 2^8 + 1 \times 2^7 \\
 &\quad + 1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^1 + 1 \times 2^0 = \boxed{5.82206678003 \times 10^{11}} \\
 &\quad (\Rightarrow (582206678003)_{10} \text{ Decimal})
 \end{aligned}$$

## ② Decimal & Hexadecima

$$\begin{array}{r}
 & 582206678003 \\
 \times & 102 \\
 \hline
 & 0622 \\
 & 140 \\
 & 726 \\
 \hline
 & 146 \\
 & 627 \\
 & 118 \\
 & 067 \\
 & 043 \\
 & 36387917375 \\
 \hline
 & 16 \\
 & 36387917375 \\
 & 039 \\
 & 077 \\
 & 1 \\
 & 055 \\
 & 095 \\
 & 1
 \end{array}$$

fin del numeros significativos

$$\begin{array}{r}
 & & 87 \\
 & \nearrow & \searrow \\
 16 & - & 16 \\
 \hline
 135 & - & 16 \\
 \hline
 9 & & 8
 \end{array}$$

= R

50

110

Scanned with CamScanner

Short method:

10000 1111 0000 1110 0001 1110 0000 1110 0000 1111 1110 0011

May 10 bloques de 4 dígitos

Tabla binarios - hexadecimales

Bin.	Hex.	
0000	0	• 1000 = 8
0001	1	• 0111 = 7
0010	2	• 1000 = 8
0011	3	• 1110 = E
0100	4	• 0011 = 3
0101	5	• 1000 = 8
0110	6	• 1110 = E
0111	7	• 0011 = 3
1000	8	• 1111 = F
1001	9	• 0011 = 3
1010	A	
1011	B	
1100	C	
1101	D	
1110	E	
1111	F	

• 1010 1101 0101 1100 0110 0101 0100 1010 1010 1010 1010

$$\Rightarrow 2^{39} + 2^{37} + 2^{35} + 2^{34} + 2^{32} + 2^{30} + 2^{28} + 2^{27} + 2^{26} + 2^{22}$$

$$+ 2^{21} + 2^{18} + 2^{16} + 2^{14} + 2^{11} + 2^9 + 2^7 + 2^5 + 2^3 + 2^1$$

$$= \overline{(744579484330)}_{10} \quad (1)$$

(2) A hexadecimal:

744579484330	16	46536217770	16	2908573610	16	181782100	16	11361381
104		145		130		21		
85		136		28		57		
57		82		125		98		
99		21		131		22		
34		57		33		61		
28		97		76		130		
124		17		0 (10)		20		
123						4		
113								
10								

11361381	16	710086	16	2773	16	173	16	10
16		70		117		13		
6138		60		53				
101		128		0 (6)				
5		0 (6)		5				

$$\Rightarrow R) (AD5CG54AAA)_{16},$$

Short Method :

1010	blocks $\rightarrow$ octal
1101	
0101	
1100	
0110	
0101	
0100	
1010	

$$R) (AD5CG54AAA)_{16},$$

• 101000101010101010101010101011111111000000

Long Method:

$$\Rightarrow 2^{39} + 2^{37} + 2^{33} + 2^{31} + 2^{29} + 2^{27} + 2^{25} + 2^{23} + 2^{21} + 2^{19} \\ + 2^{17} + 2^{15} + 2^{13} + 2^{12} + 2^{11} + 2^{10} + 2^9 + 2^8 + 2^7 + 2^6 \\ = (69864801880)_{10}$$

69864801880	16			
58	43665501180	16		
106	116	2729093823	16	
104	46	112	720568363	16
88	145	090	105	10660522
80	150	109	96	
18	61	133	083	
28	131	58	36	
128	38	102	43	
00	60	63	11	
	12	15		

10660522	16			
106	666282	16		
100	26	41642	16	
45	102	96	2602	16
132	68	042	100	162
42	42	10	42	10
10	10		10	10

$\Rightarrow R) (A_2 A A A A B F C O)_{16} \text{ "}$

Short Method: 1010

0010

1010

1010

bloques

1010

1010

1011

1111

1100

0000



$R) (A_2 A A A A B F C O)_{16} \text{ "}$

# Signed binary to octal

• 111111 00000 11111 00000000 111 0101011

Long Method: (1) Binario a Decimal

$$2^{32} + 2^{31} + 2^{30} + 2^{29} + 2^{28} + 2^{27} + 2^{21} + 2^{20} + 2^{19} + 2^{18} + 2^{17}$$

$$+ 2^9 + 2^8 + 2^7 + 2^5 + 2^3 + 2^1 + 2^0 = (8459781035)_{10}$$

(2) Decimal a Octal:

8459781035	<u>8</u>	1057472629	<u>8</u>	132184078	<u>8</u>	16523009	<u>8</u>	258172
45		25		52		052		
37		17		41		43		
58		14		18		30		
21		67		24		60		
30		37		078		49		
23		062						
75	(3)	69	(5)					(7)

258172	<u>8</u>	32271	<u>8</u>	4033	<u>8</u>	504	<u>8</u>	24	<u>8</u>	63	<u>8</u>	0	<u>8</u>	7	<u>8</u>	7
18		027		033		24		0								
21		31	(7)	031	(1)	63		7								
57																
72	(4)															

$\Rightarrow R) (77017401653)_8$ ,

Short method:

bloques

111  
111  
000  
001  
111  
100  
000  
001  
110  
101  
011

R) (77017401653)<sub>8</sub>,

• 1110001110000001111111000000101010

(1) Complemento de 2:

Long Method

$$\begin{array}{r} 0001110001111110000000011111010101 \\ + \\ \hline 0001110001111110000000011111010101 \\ \hline 1 \\ 3024332326252232212012812161514131211109876543210 \end{array}$$

(2) A decimal:

$$2^1 + 2^2 + 2^4 + 2^6 + 2^7 + 2^8 + 2^9 + 2^{10} + 2^{11} + 2^{20} + 2^{21} + 2^{22} + 2^{23} + 2^{24} + 2^{28} + 2^{29} + 2^{30} = (1912080342)_{10}$$

(3) Decimal a octal:

1912080342	8
31	239010042
72	79
008	70
0034	61
22	50
6	20
fin	44
	42
	2
	8
	29878255
	58
	27
	36
	42
	25
	15
	7
	8
	3734531
	53
	54
	65
	13
	51
	3
	8
	466818
	66
	28
	11
	16
	0
58352	8

111111	8
58352	7294
23	09
75	14
32	6
0	11
911	8
31	113
7	33
1	14
8	8
6	14
1	1

⇒ R) (16176003726)<sub>8</sub>,

inicio

ESTILO

short method :

> Cada dígito octal se representa mediante un número binario de 3 dígitos.

Tabla binario - octal

Bin.	Oct.
000	0
001	1
010	2
011	3
100	4
101	5
110	6
111	7

> 111000111000000111111100000101010  
 => R) (16176003726)<sub>8</sub>

• 10101010101010000010101010101111000

Long method

(1) Complemento de 2:

$$\begin{array}{r}
 01010101010101111010101010100000111 \\
 + 0101010101011110101010101000001000 \\
 \hline
 0101010101011110101010101000001000
 \end{array}$$

32 30 28 26 24 22 20 18 16 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0

(2) A decimal:

$$\begin{aligned}
 & 2^3 + 2^8 + 2^{10} + 2^{14} + 2^{16} + 2^{18} + 2^{19} + 2^{20} + 2^{21} + 2^{22} + 2^{24} + 2^{26} + 2^{28} + 2^{30} \\
 & + 2^{32} = (5729244424)_{10}
 \end{aligned}$$

(3) Decimal a octal:

5729244424	8				
12	71615553	8			
49	76	89'5'1'9444	8		
12	41	09	11189930	8	
44	15	15	31	1398741	8
44	75	71	78	59	
44	35	79	69	38	
42	35	74	59	67	
24	33	24	33	34	
0	1	04	10	21	
<i>Fin</i>			2	5	

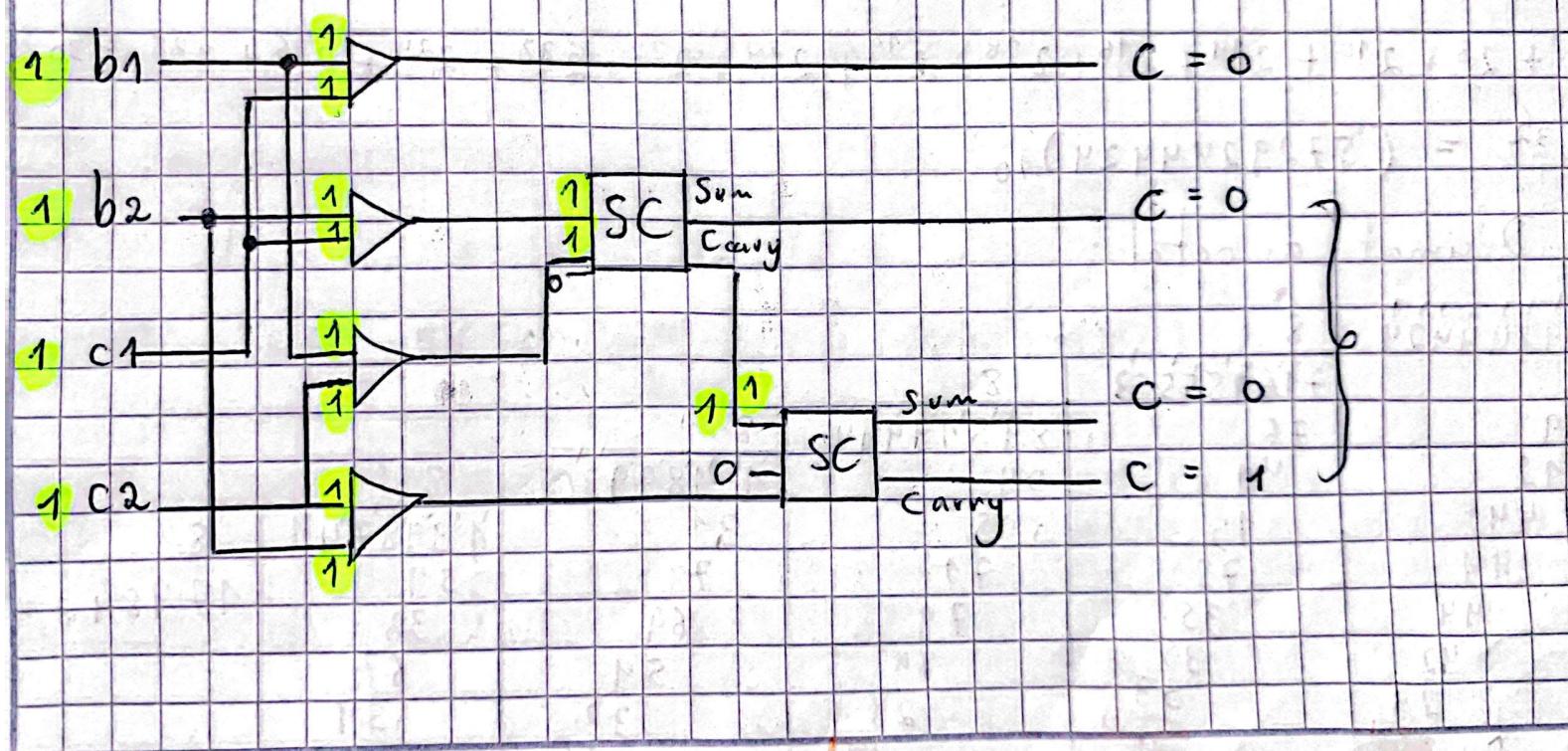
ESTILO



## 2. BOOLEAN CIRCUITS

- Multiplication of 2 binary numbers of length 2 bits.

$$10 \times 10 = 100$$



- Two's complement for a binary number of length 3 bits.

(1) 2's Complement: bit #  $\Rightarrow b_1, b_2, b_3$

$$\begin{array}{r} b_1' \ b_2' \ b_3' \\ + \qquad \qquad \qquad 1 \\ \hline b_1'' \ b_2'' \ b_3'' \end{array}$$

(2) Truth table: NOT  $\Rightarrow$

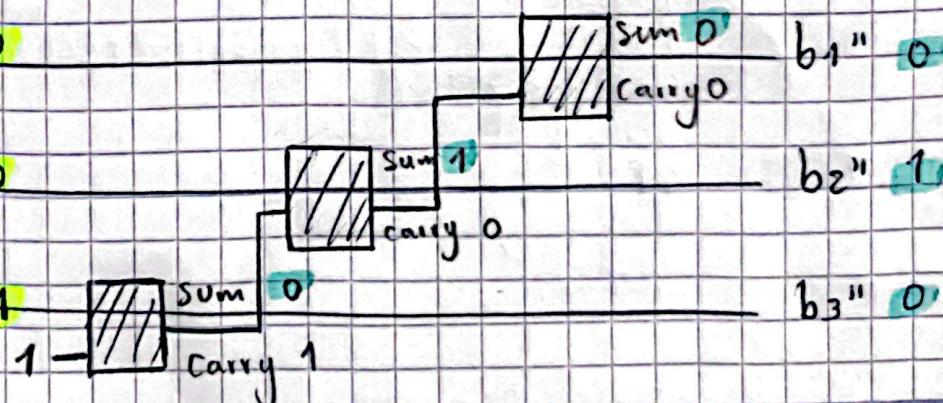
bits		
b	b'	
1	0	true / false
0	1	false / true

$$\begin{array}{r} 110 \rightarrow 001 \\ + \qquad \qquad \qquad 1 \\ \hline 010 \end{array}$$

$$b_1 \ 1 \rightarrow 0$$

$$b_2 \ 1 \rightarrow 0$$

$$b_3 \ 0 \rightarrow 1$$



ESTILO

3. Do the following multiplications in binary

• Usar mínimo de bits  $\rightarrow$  Algoritmo Booth

•  $-5 \times 8 = -40$  en bin = 101000 ~ Se deberá obtener este resultado

5 en bin = 101      2's C : 011 → 000011  $\Rightarrow$  MD

8 en bin = 1000      2's C : 1000 → 001000  $\Rightarrow$  MR

(1)

MD	MR	MX
000011	001000	0
PD	CK	
000000	000110	

(2)

MD	MR	MX
000011	000100	0
PD	CK	
000000	000101	

(3)

MD	MR	MX
000011	000010	0
PD	CK	
000000	000100	

(4)

MD	MR	MX
000011	000001	0
PD	CK	
000000	000011	

ESTILO

(5°)

MD  
0000 11

PD 111101	MR 000001	MX 0
	CK 000011	

(6°)

MD  
000011

PD 111110	MR 100000	MX 1
	CK 000010	

(7°)

MD  
000011

PD 000001	MR 100000	MX 10
	CK 000010	23

(8°)

MD  
000011

PD 000000	MR 110000	MX 0
	CK 000001	00

(9°)

MD  
000011

PD 000000	MR 011000	MX 0
	CK 000000	

Resultado en (9°)  $\Rightarrow$  PD + MR = 101000  
 $\Leftrightarrow -40$  en bin.

$$11 \times (-10) \Rightarrow 110 \text{ en}$$

11 en bin: 1011 } 2,5 C: 0001011  $\Rightarrow$  MD  
 10 en bin: 1010 } 0000110  $\Rightarrow$  MR

(1)

MD  
0001011

PD 0000000	MR 0000110	MX 0
CK 00001111		

(2)

MD  
0001011

PD 0000000	MR 0000011	MX 0
CK 0001110		

(3)

MD  
0001011

PD 1110101	MR 0000011	MX 0
CK 0001110		

(4)

MD  
0001011

PD 1111010	MR 1000001	MX 1
CK 0001011		

(5°)

**MD**  
0001011

**PD**  
1111101

<b>MR</b>	<b>MX</b>
0100000	1
<b>CK</b>	
0000100	

(6°)

**MD**  
0001011

**PD**  
0001000

<b>MR</b>	<b>MX</b>
0100000	1
<b>CK</b>	
0000100	

(7°)

**PD**  
0000100

<b>MD</b>	<b>MR</b>	<b>MX</b>
0001011	0010000	0
<b>CK</b>		
0000011		

(8)

**PD**  
0000010

<b>MD</b>	<b>MR</b>	<b>MX</b>
0001011	0001000	0
<b>CK</b>		
0000010		

(9°)

**PD**  
0000001

<b>MD</b>	<b>MR</b>	<b>MX</b>
0001011	0000100	0
<b>CK</b>		
0000001		

10°

MD

0001011

MR

1000010

PD

0000000

CK

0000000

MX

0

Resultado en  $10^{\circ} \Rightarrow PD + MR = 10010010$ , "

•  $2 \times 3 \Rightarrow 6$

2 en bin = 10 positivos  $\Rightarrow 010 \Rightarrow 2's C: 110$

3 en bin = 11

011

10

MD

010

PD

000

MR

011

MX

0

20

MD

010

PD

110

MR

011

MX

0

30

CK

011

MD

010

PD

111

MR

001

MX

1

CK

010

ESTILO

④

PD 111	MD 010 MR 100	MX 1
	CK 001	

⑤

PD 001	MD 010 MR 100	MX 1
	CK 001	
	MD 010	GM
PD 000	MR 110	0
	CK 000	NO

⑥

Resultado en ⑥  $\Rightarrow$   $PD + MR = "000110" = 110$ ,

- $(-4) \times (-8) = 32$  en bin  $100000$ , resp.

4 en bin: 100      2's C: 000100  
 8 en bin: 1000

⑦

PD 000000	MD 000100 MR 001000	MX 0
	CK 000110	

(2º)

MD 000100  
PD 000000 MR 000100 MX 0  
CK 000101

(3º)

MD 000100  
PD 000000 MR 000100 MX 0  
CK 000100

(3º)

(4º)

MD 000100  
PD 000000 MR 000001 MX 0  
CK 000011

(5º)

MD 000100  
PD 111100 MR 000001 MX 0  
CK 000011

(6º)

MD 000100  
PD 111110 MR 000000 MX 1  
CK 000010

7º

MD  
000100

PD

000010

MR

000000

MX

1

CK

000010

8º

MD  
000100

PD

000001

MR

000000

MX

0

CK  
000001

9º

MD  
000100

PD  
000000

MR  
100000

MX  
0

CK  
000000

Resultado en 9º  $\Rightarrow$  PD + MR = 100000 //