2.1 Convert these binary to decimal

Note Title 29/04/2010

Bit
11 10 9 8 7 6 5 4 3 2 1 0

(c) 100100001001

$= 2^{11} + 2^{8} + 2^{3} + 2^{0}$

$= 2048 + 256 + 8 + 1$

$= \mathbf{2313}$

Bit
7 6 5 4 3 2 1 0

(d) 01011011

$= 2^{6} + 2^{4} + 2^{3} + 2^{1} + 2^{0}$

$= 64 + 16 + 8 + 2 + 1$

$= \mathbf{91}$

(e) 11111111

(The binary number has maximum value when all bits are 1.)

8-bit gives $2^{8} = 256$ values, the max. value is 256-1 = **255**.

2.2 Convert the following decimal to binary

(c) 189

189 / 2	=	94	r. 1
94 / 2	=	47	r. 0
47 / 2	=	23	r. 1
23 / 2	=	11	r. 1
11 / 2	=	5	r. 1
5 / 2	=	2	r. 1
2 / 2	=	1	r. 0
1 / 2	=	0	r. 1

Answer: **10111101_2**

(d) 1024

1024 / 2	=	512	r. 0
512 / 2	=	256	r. 0
256 / 2	=	128	r. 0
128 / 2	=	64	r. 0
64 / 2	=	32	r. 0
32 / 2	=	16	r. 0
16 / 2	=	8	r. 0
8 / 2	=	4	r. 0
4 / 2	=	2	r. 0
2 / 2	=	1	r. 0
1 / 2	=	0	r. 1

Answer: **10000000000_2**

2.3 What is the largest decimal value that can be represented by an 8-bit binary number? A 16-bit number?

(The binary number has maximum value when all bits are 1.)

8-bit gives 2^8 = 256 values, the max. value is 256-1 = **255**.

16-bit gives 2^{16} = 65536 values, the max. value is 65536 -1 = **65535**.

2.6 Covert these Octal to binary

(c) 3777_8

= $011\ 111\ 111\ 111_2$

or **$11\ 111\ 111\ 111_2$**

(e) 165_8

= $001\ 110\ 101_2$

or **$1\ 110\ 101_2$**

Recap:
1 octal digit = 3-bit in binary.
Octal is used as shorthand for binary numbers.

Octal digit	Binary (3-bit)
0	0 0 0
1	0 0 1
2	0 1 0
3	0 1 1
4	1 0 0
5	1 0 1
6	1 1 0
7	1 1 1

2.7 Convert these binary to octal

(c) 100100001001_2

= 100 100 001 001 $_2$

= **4 4 1 1** $_8$

(d) 01011011_2

= 001 011 011 $_2$

= 1 3 3 $_8$

2.8 List octal sequence 165_8 to 200_8

165 , 166 , 167 , (No 168 !)
170 , 171 , 172 , 173 , 174 , 175 , 176 , 177 , (No 178 nor 180 !)
200

2.9 When a large decimal number is to be converted to binary, it is sometimes easier to convert it first to octal, and the from octal to binary. Try this procedure for 2313_{10} and compare it with the procedure used in 2.2e.

(decimal --> octal --> binary)

2313	/ 8 =	289.125	= 289	r. 1
289	/ 8 =	36.125	= 36	r. 1
36	/ 8 =	4.5	= 4	r. 4
4	/ 8 =	0	= 0	r. 4

In octal: 4 4 1 1 $_8$

In binary: **100 100 001 001** $_2$

(decimal --> binary)

2313 / 2 = 1156 r.1
1156 / 2 = 578 r. 0
578 / 2 = 289 r. 0
289 / 2 = 144 r. 1
144 / 2 = 72 r. 0
72 / 2 = 36 r. 0
36 / 2 = 18 r. 0
18 / 2 = 9 r. 0
9 / 2 = 4 r. 1
4 / 2 = 2 r. 0
2 / 2 = 1 r. 0
1 / 2 = 0 r. 1

In binary: **100100001001** $_2$

2.11 Covert these Hex to decimal

Bit
3 2 1 0

(c) $37FD_{16}$

$= 3 \times 16^3 + 7 \times 16^2 + F \times 16^1 + D \times 16^0$

$= 3 \times 4096 + 7 \times 256 + 15 \times 16 + 13 \times 1$

$= \mathbf{14333}_{10}$

Recall:
A, B, C, D, E, F in hex.
=10,11,12,13,14,15 in dec.

(d) $ABCD_{16}$

$= A \times 16^3 + B \times 16^2 + C \times 16^1 + D \times 16^0$

$= 10 \times 4096 + 11 \times 256 + 12 \times 16 + 13 \times 1$

$= \mathbf{43981}_{10}$

2.12 Covert these decimal to hex

(e) 7245

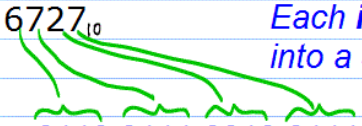
0.8125 x 16 = 13

7245	/ 16	=	452.8125	= 452	r. 13 --> D_{16}
452	/ 16	=	28.25	= 28	r. 4
28	/ 16	=	1.75	= 1	r. 12 --> C_{16}
1	/ 16			= 0	r. 1

Answer: **1 C 4 D** $_{16}$

2.19 Encode these decimal in BCD

(d) 6727_{10}



*Each **individual digit** in the decimal number is encoded into a **4-bit** binary number.*

$= 0110\ 0111\ 0010\ 0111_2$

(Note : this is different from converting 6727_{10} to binary.)