Convert Base 2 (Binary) to Base 10 (Decimal)

Converting a number in one base to another is easy if you have a plan. Follow along with the two examples below to review converting from base 2 to base 10. Then try the practice problems.

Example 1: Convert the binary number 1011 to its decimal equivalent.

1. Row 1 shows the powers of 2 from 2^3 down to 2^0.
2. Row 2 shows what each power equals and the place value it represents.
   (Remember, something like $2^3 = 2 \times 2 \times 2 = 8$).
3. In Row 3 we write the binary number that we want to convert.
4. In Row 4 we multiply the place value times the binary number.
   (Multiply Row 2 x Row 4 in each column).
5. Finally, we add up the numbers in the last row (8+0+2+1) to get the decimal number 11.

Powers of 2	2^3	2^2	2^1	2^0
Binary Place Value	8	4	2	1
Binary Number	**1**	**0**	**1**	**1**
Decimal Number	8	0	2	1

An easy way to show your work for this kind of calculation is as follows. Notice that we use the carat symbol ^ to represent the powers of 2. The ^ symbol is found on top of the 6 key on the keyboard.

1011 = (1*2^3)+(0*2^2)+(1*2^1)+(1*2^0)
= (1*8)+(0*4)+(1*2)+(1*1)
= 8 + 0 + 2 + 1
= 11

Example 2: Convert the binary number 00110010 to its decimal equivalent.

Notice that this is a bigger binary number and we have just added columns to the table to represent the higher powers of 2 (2^7 to 2^4) and their corresponding place values.

Powers of 2	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Binary Place Value	128	64	32	16	8	4	2	1
Binary Number	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**0**
Decimal Number	0	0	32	16	0	0	2	0

Adding up the numbers in the last row (0+0+32+16+0+0+2+0) = 50.

We can show our work as follows.

00110010 = (0*2^7)+(0*2^6)+(1*2^5)+(1*2^4)+(0*2^3)+(0*2^2)+(1*2^1)+(0*2^0)
= (0*128)+(0*64)+(1*32)+(1*16)+(0*8)+(0*4)+(1*2)+(0*1)
= 0 + 0 + 32 + 16 + 0 + 0 + 2 + 0
= 50

Use this technique and you will be able to convert base 2 (binary) to base 10 (decimal) with ease!

Test Yourself

Test yourself with some practice problems. Check your answers with the key at the bottom of the page.

1. Convert the binary number 10101010 to its decimal equivalent. Fill in the third and fourth row in the table and then show your work below.

Powers of 2	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Binary Place Value	128	64	32	16	8	4	2	1
Binary Number								
Decimal Number								

10101010=(__*2^7)+(__*2^6)+(__*2^5)+(__*2^4)+(__*2^3)+(__*2^2)+(__*2^1)+(__*2^0)
= (__*128)+(__*64)+(__*32)+(__*16)+(__*8)+(__*4)+(__*2)+(__*1)
= ____ + ____ + ____ + ____ + ____ + ____ + ____ + ____
= ____

2. Convert the binary number 01010101 to its decimal equivalent. Fill in the second, third and fourth row in the table and then show your work below.

Powers of 2	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Binary Place Value								
Binary Number								
Decimal Number								

0101010 =

3. Convert the binary number 1100111011 to its decimal equivalent. Fill in each row in the table and then show your work below. Notice that you have two additional place values in this number.

Powers of 2										
Binary Place Value										
Binary Number										
Decimal Number										

1100111011=

Answers:
The base 2 binary number 10101010 is equal to the base 10 decimal number 170.
The base 2 binary number 01010101 is equal to the base 10 decimal number 85.
The base 2 binary number 1100111011 is equal to the base 10 decimal number 827.