Number conversion (base conversion)

Some basic exponential rules

(any number to the power of 0 is equal to 1)

(any number to the power of 1 is equal to the number itself)

(for any other power, just multiply the number for itself as many times as indicated by the exponent)

**Notation**

d(1111) – decimal number

b(1111) – binary number (base 2)

o(1111) – octal number (base 8)

h(1111) – hexadecimal number (base 16)

**What symbols we use to represent numbers in a given base**

In general, the highest number will be the base minus 1 so:

* **Binary** – highest number is 1 the other is 0
* **Octal** – highest number is 7, we use all the other ones down to 0
* **Hexadecimal** – highest number is 15, we use numbers from 0 to 9 then A = 10, B = 11, C = 12, D = 13, E = 14, F = 15

How to convert from a given base to decimal

b(1111)

starting from the rightmost digit write numbers above it from 0 and increase by 1 moving towards the leftmost digit:

in our case we want to convert binary 1111, so we will have (the number to convert is in the bottom row):

|  |  |  |  |
| --- | --- | --- | --- |
| 3 | 2 | 1 | 0 |
| 1 | 1 | 1 | 1 |

Now the conversion is easy, we know the base is 2 so the numbers in the first row are the exponent we need to give the base when multiplying the corresponding digits of the number we want to convert, so the result we want is the sum of these products:

b(1111) = d () = d(8 + 4 + 2 + 1) = d(15)

another example from binary to decimal:

b(11001)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 4 | 3 | 2 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 |



b(11001) = d () = d(16 + 8 + 0 + 0 +1) = d(25)



Conversions from other bases work in the exact same way, the only difference is the base.

Conversion of o(1111):

|  |  |  |  |
| --- | --- | --- | --- |
| 3 | 2 | 1 | 0 |
| 1 | 1 | 1 | 1 |

o(1111) = d () = d(512 + 64 + 8 + 1) = d(585)

Another example from base 8:

o(1576):

|  |  |  |  |
| --- | --- | --- | --- |
| 3 | 2 | 1 | 0 |
| 1 | 5 | 7 | 6 |

o(1111) = d () = d(512 + 320 + 56 + 6) = d(894)

Last example is for hexadecimals:

h(1111)

|  |  |  |  |
| --- | --- | --- | --- |
| 3 | 2 | 1 | 0 |
| 1 | 1 | 1 | 1 |

Now the base is 16 so:

h(1111) = d () = d(4096 + 256 + 16 + 1) = d(4369)

another example:

|  |  |  |  |
| --- | --- | --- | --- |
| 3 | 2 | 1 | 0 |
| A | 4 | F | 8 |

h(A4F8) = d () = d(40960 + 1024 + 240 + 8) = d(42232)