

Base Conversions

INTRODUCTION

This hand out will demonstrate how to convert between different bases. It will cover the following conversions:

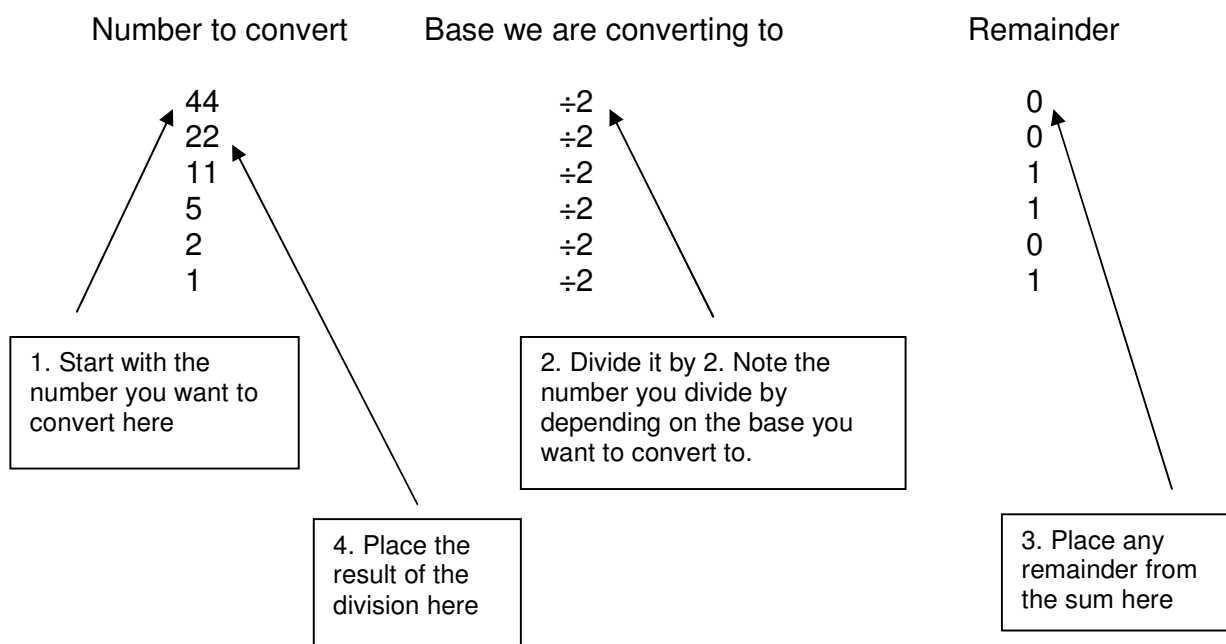
Denary	Base 10
Binary	Base 2
Hexadecimal	Base 16

Denary to Binary	Binary to Denary
Denary to Hexadecimal	Hexadecimal to Denary
Binary to Hexadecimal	Hexadecimal to Binary

DENARY to BINARY

This is converting base 10 whole numbers into Binary numbers, to do this carry out the following;

This example will convert the number 44 into binary.



Repeat these four steps until you have nothing left to divide. Once you have done this, the converted number can be read from the remainder column, **from bottom to top**.

Thus 44_{10} in Binary is 101100_2

BINARY to DENARY

To convert Binary into Denary, some background information first;

Denary or Base 10

10^3	10^2	10^1	10^0
Thousands	Hundreds	Tens	Units
1	3	4	5

The above would give us;

1 thousand or 1×10^3
3 hundreds or 3×10^2
4 tens or 4×10^1
5 units or 5×10^0

Which gives **one** thousand, **Three** hundred and **forty-five** (**1,345**)

It works the same for binary (and any other base) just change the 10 to a 2, so the table would look something like this;

2^3	2^2	2^1	2^0
Eights	Fours	Twos	Units
1	1	0	1

So in the above example **1101** would have

1 x eight or 1×2^3
1 x four or 0×2^2
0 x two or 1×2^1
1 unit or 1×2^0

So if we wanted to convert 1101 to Denary all we would have to do is add the above up like;

$$8 + 4 + 1 = 13$$

DENARY to HEXADECIMAL

The first thing you need to remember with Hex is when we count using this base we use letters for the numbers from 10 to 15;

Hex	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Denary	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

To convert 2314 to Hexadecimal do the following

Number to convert	Base we are converting to	Remainder
2314	$\div 16$	10 or A
144	$\div 16$	0
9	$\div 16$	9

You will notice that we have carried out the same operation as when we converted Denary into Binary the only difference is we have divided by 16 instead of 2.

So **2314** is **90A₁₆**

HEXADECIMAL to DENARY

To convert Hex into Denary we carry out the same operation as we did when we converted Binary into Denary the only difference is the table, which looks like this

16^3	16^2	16^1	16^0
4096s	256s	16s	Units
1	F	4	B

The above example gives us

1 x 4096 or 1 x 16^3
 F x 256 or 15 x 16^2
 4 x 16 or 4 x 16^1
 B units or 11 x 16^0

So we would have in Denary

(1x4096)	+	(15 x 256)	+	(4 x 16)	+	11
4096	+	3840	+	64	+	11

Which make **1F4B₁₆** in Hex, **8011₁₀** in Denary

BINARY to HEXADECIMAL

To convert Binary into Hex we take our Binary number and split into groups of four digits from the right so the. The reason we do this is because the most, one group of four numbers can total, is 15 This is the same as the total value that can go into any only column when counting in Hex.

It works something like this;

101 1101 1101 1101

Becomes

101	1101	1101	1101
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You then convert each of the groups into denary

101	1101	1101	1101
5	13	13	13

You then change any of the numbers that are above 9 into their corresponding Letters

101	1101	1101	1101
5	13	13	13
5	D	D	D

So 101110111011101_2 is $5DDD_{16}$

HEXADECIMAL to BINARY

To convert Hexadecimal into Binary you do the above but in reverse, however instead of grouping four hex digits you take one digits and convert it into a four digit binary number.

5	D	D	D
5	13	13	13
101	1101	1101	1101