Fast method converts numbers from base 10 to any other

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Engineers, programers, and others who have undergone the drudgery of converting numbers from the decimal system to systems with other bases will welcome this quick and simple conversion method. If a pocket calculator is available, no manual calculation or recording is needed other than jotting down the answer.

A chart is provided as reference for conversion to hexadecimal, octal, and binary numbering systems. The first column provides equal fractional parts of the numbering system to be used; e.g., hexadecimal notation the column is divided into 16 fractional parts 0/16, 1/16, 2/16, 3/16, . . . 15/16. In the other columns, each fractional part is assigned a digit; the digits are assigned consecutively, starting with the smallest fractional part of the numbering system.

The first step in conversion is to divide the decimal number by the base of the numbering system to which you are converting. If the number following the decimal point is greater than or equal to a fractional number in the chart, record the equivalent number as the least significant digit (LSD) in the new numbering system. Next divide the base number into the result of the first step. Look at the chart again and record the equivalent number as the second LSD. Repeat this process until the division produces a number smaller than 1.

As an example, let's convert the decimal number 321 to its hexadecimal equivalent:

1. Divide 321_{10} by 16 to get 20.0625.
2. From the chart, 0.0625 corresponds to 1, so record 1 as LSD.
3. Divide 20.0625 by 16, getting 1.2539.
4. From the chart, 0.2539 is greater than 0.25 but less than 0.3125, so record 4 as the second LSD.
5. Divide 1.2539 by 16, getting 0.0784.
6. From the chart, 0.0784 is greater than 0.0625 but less than 0.125, so jot down 1 as third LSD.
7. Since the result in step 5 is less than 1, conversion is complete. Answer is 141_{16}.

As you can see, the answer 141_{16} was reached in only seven steps, and nothing had to be written down except the answer itself.

As another example, using the larger digits in hexadecimal notation, convert 687_{10} to base 16:

1. 687/16 = 42.9375.
2. From chart, 0.9375 corresponds to F as the LSD.
3. 42.9375/16 = 2.6836.
4. From chart, 0.6836 corresponds to A as second LSD.

5. 2.6836/16 = 0.1677.
6. From chart, 0.1677 corresponds to 2.
7. The result in step 5 is less than 1, so conversion is complete. Answer is $2AF_{16}$.

The chart provided shows equivalent numbers in the hexadecimal, octal, and binary numbering systems. However, what makes this method unique is that the table need only be expanded to enable conversion to any number system; simply divide the numbering system into equal fractional parts; (e.g., base 5 would be 0/5, 1/5, 2/5, 3/5, and 4/5) and assign the digits within the numbering system to each fractional part: 0/5 corresponds to 0; 1/5 to 1; 2/5 to 2; 3/5 to 3; and 4/5 to 4.

Thus, to convert 28_{10} to base 5, jot down this table:

Decimal fraction	Base-5 digit
0.8	4
0.6	3
0.4	2
0.2	1
0	0

Then go through the conversion steps:

1. 28/5 = 5.6.
2. 0.6 corresponds to 3 as LSD.
3. 5.6/5 = 1.12.
4. 0.12 corresponds to 0 as second LSD.
5. 1.12/5 = 0.224.
6. 0.224 corresponds to 1.
7. Result in step 5 is less than 1, so conversion is complete. Answer is 103_5. □

CHART FOR CONVERTING DECIMAL NUMBERS TO HEXADECIMAL, OCTAL, OR BINARY NOTATIONS

Numbering System Fractional Parts	Equivalent Digits		
	Hexadecimal	Octal	Binary
0.9375 to 0.9999	F	7	1
0.8750	E		
0.8125	D	6	
0.75	C		
0.6875	B	5	
0.6250	A		
0.5625	9	4	
0.5	8		
0.4375	7	3	0
0.375	6		
0.3125	5	2	
0.25	4		
0.1875	3	1	
0.125	2		
0.0625	1	0	
0.0	0		

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