

Number Systems

Table for Use in Simple Conversions

Decimal	Octal	Binary	Hexadecimal
0	0	0000	0
1	1	0001	1
2	2	0010	2
3	3	0011	3
4	4	0100	4
5	5	0101	5
6	6	0110	6
7	7	0111	7
8	10	1000	8
9	11	1001	9
10	12	1010	A
11	13	1011	B
12	14	1100	C
13	15	1101	D
14	16	1110	E
15	17	1111	F

Conversions between Octal, Binary & Hexadecimal Table Lookup

$765_8 == 111\ 110\ 101 == 0001\ 1111\ 0101 == 1F5_{16}$
111 110 101 0001 1111 0101
groups of three groups of four

Conversion of Base 10 to Any Other Base

Successive Division of the Base 10 Number by the Base Number of the Target Base
Collecting the Remainders in Reverse Order to Form the Target Base Number, e.g.,

$$768_{10} = \underline{\hspace{2cm}}_8$$

$$\begin{array}{r} 8 \overline{)768} \\ \underline{8 \mid 96} \\ 8 \overline{)12} \\ \underline{14} \end{array} \begin{array}{l} 0 \\ 0 \\ \end{array} \begin{array}{l} \uparrow \\ \\ \end{array}$$

$$768_{10} = 1400_8$$

Restatement: Conversion of Decimal Number to Any Base n, i.e.,
Successive Divisions of the Decimal Number by n, preserving the remainders

$$65_{10} = X_5$$

$$\begin{array}{r} 5 \overline{)65} \\ \underline{5 \mid 13} \\ 2 \\ \end{array} \begin{array}{l} 0 \\ 3 \\ \end{array} \begin{array}{l} \\ \\ \uparrow \end{array}$$

$$65_{10} = 230_5$$

Conversion of Any Base to Base 10

Polynomial Expansion of the Number, i.e., Multiply the Coefficient by the Base
Raised to the Power of the Exponent, e.g.,

$$1400_8 = \underline{\hspace{2cm}}_{10}$$

$$1400_8 = 1 \cdot 8^3 + 4 \cdot 8^2 + 0 \cdot 8^1 + 0 \cdot 8^0 = 8^3 + 4 \cdot 8^2 = 8^2 \cdot (8 + 4) = 64 \cdot 12 = 768_{10}$$

3 2 1 0 ← Indexes Base == 8

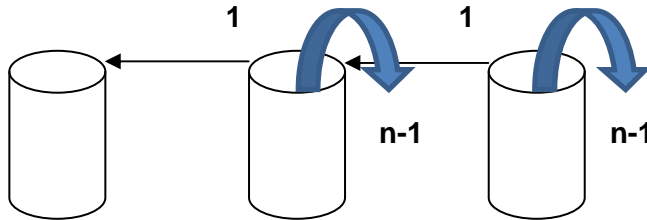
Conversion of Any Base n Number to a Decimal (Base 10) Number
Polynomial Expansion

$$\begin{array}{c} 230_5 \\ 2 \ 1 \ 0 \end{array} = 2 \cdot 5^2 + 3 \cdot 5^1 + 0 \cdot 5^0 = 50 + 15 + 0 = 65_{10}$$

$$\text{Coefficient} * \text{Base}^{\text{Index}} + \text{Coefficient} * \text{Base}^{\text{Index}} + \text{Coefficient} * \text{Base}^{\text{Index}} + \dots$$

Addition

- Base n**
- (1) dump the bucket when it has n stones in it;
 - (2) add one stone to the bucket on the left

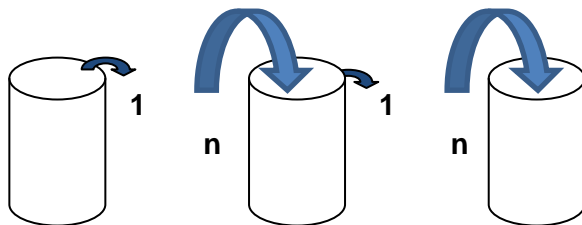


Subtraction

“Take Away”

When bucket is empty for Base n

- (1) remove one stone from the bucket on the left
- (2) place n stones in the bucket that was empty



Primitive Symbols

1, 2, 3, ... , A, B, C, ... , etc.

Composite Symbols

143, AC9, 1011, 75, etc.