Basics

$1729 = 1 \cdot 1000 + 7 \cdot 100 + 2 \cdot 10 + 9$

$= 1 \cdot 10^3 + 7 \cdot 10^2 + 2 \cdot 10^1 + 9 \cdot 10^0$

$135_6 = 1 \cdot 6^2 + 3 \cdot 6^1 + 5 \cdot 6^0$

$42_{10} = 4 \cdot 10^1 + 2 \cdot 10^0$

$110_6 = 1 \cdot 6^2 + 1 \cdot 6^1 + 0 \cdot 6^0 = 42_{10}$

1_6	1_{10}
2_6	2_{10}
3_6	3_{10}
4_6	4_{10}
5_6	5_{10}
10_6	6_{10}
11_6	7_{10}
12_6	8_{10}
13_6	9_{10}
14_6	10_{10}
15_6	11_{10}
20_6	12_{10}

Convert 125_7 to base 10:

$125_7 = 1 \cdot 7^2 + 2 \cdot 7^1 + 5 \cdot 7^0$

$= 49 + 14 + 5 = 58_{10}$

Convert 56_{10} to base 3

$56 = a \cdot 3^3 + b \cdot 3^2 + c \cdot 3^1 + d$

$56 = 3(\underbrace{a \cdot 3^2 + b \cdot 3 + c}_{18}) + \underbrace{d}_{2}$

$18 = a \cdot 3^2 + b \cdot 3 + c$

$18 = 3(\underbrace{3a + b}_{6}) + \underbrace{c}_{0}$

$6 = \underbrace{3a}_{2} + \underbrace{b}_{0}$

$56_{10} = 2002_3$

$3\overline{)56}$ R 2

$3\overline{)18}$ R 2

$3\overline{)6}$ R 0

2 R 0

Convert 66_{10} to base 4

$4\overline{)66}$ R 2

$4\overline{)16}$ R 2

$4\overline{)4}$ R 0

1 R 0

$66_{10} = 1002_4$

Arithmetic in other bases:

$21_6 + 14_6$

$$\begin{array}{r} 21_6 \\ +\ 14_6 \\ \hline 35_6 \end{array}$$

$$\begin{array}{r} 1 \\ 23_6 \\ +\ 14_6 \\ \hline 41_6 \end{array}$$

$514_6 - 433_6$

$$\begin{array}{r} 514_6 \\ -\ 433_6 \\ \hline 41_6 \end{array}$$

Base 2: binary, computers $9_{10} = 1001_2$

Base 20, 60

Base 16: hexadecimal 0, 1, ... 9, A, B, C, D, E, F