Number System

Number System Defines a set of values used to represent Quantity.

Name	Base (r) (radix)	
Binary	2	0 to (2-1) = 0 & 1
Octal	8	0 to (8-1) = 0 to 7
Decimal	10	(0 to 10-1) = 0 to 9
Duodecimal	12	(0 to 12-1) = 0 to 11
Hexadecimal	16	(0 to 16-1) = 0 to 15

Decimal → 0 1 2 3 4 5 6 7 8 9

Binary → 0 1

Octal → 0 1 2 3 4 5 6 7

Duodecimal → 0, 1, 2, 3, 4, 5, 6, 7, 8, A, B

Hexadecimal → 0, 1, 2, 3, 4, ... 9, A, B, C, D, E, F

10 = A 12 = C 14 = E

11 = B 13 = D 15 = F

$7392 = 7000 + 300 + 90 + 2$

$r_1 < r_2$

$N_1 \geq N_2$

r_1 & r_2 } Base

N_1 & N_2 } Respective numbers

10^2 10^0 7392

7 3 9 2 $= 7000 + 300 + 90 + 2$

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

Number System & Codes

- Weighted
  - Ex. Decimal
    - Binary
    - Octal
    - BCD etc.
- Unweighted
  - Ex. Gray code, Excess-3 etc.

$(7392)_{10} \rightarrow (11100\ 11100000)_2$

$(7392)_{10} \rightarrow (16340)_8$

$(7392)_{10} \rightarrow (1CE0)_{16}$

Binary Number System

0 to $(r-1)$

$r = 2$

0 to $(2-1)$

0 and 1

Binary Digits (0 & 1) are called as 'bits'

2^3 2^1
1 0 1 0 1
2^4 2^2 2^0

10^3 10^1
7 3 9 2 .
10^2 10^0

$= 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$= 2^4 + 0 + 2^2 + 0 + 1$

$= 16 + 4 + 1$

$= 21$

$2^4 \times 2^2$ ✓
$\hookrightarrow 2^{4+2}$

$2^4 + 2^2$ ✗
$\hookrightarrow 2^{4+2}$

$(10101.11)_2$

$= 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1} + 1 \times 2^{-2}$

$= 2^4 + 0 + 2^2 + 0 + 1 + \frac{1}{2} + \frac{1}{2^2}$

$= 16 + 4 + 1 + 0.5 + 0.25$

$= (21.75)_{10}$

MSB & LSB

MSB: Most Significant Bit

LSB: Least Significant Bit

$b_4\ b_3\ b_2\ b_1\ b_0$

1 0 1 0 1 = 21

↑ MSB ↑ LSB

10101 = 21

10100 = 20

00101 = 5

10100

$2^4\ 0\ 2^2\ 1\ 0$ → 16 + 4 = 20

→ Bit is Smallest Unit of Data.

1 Nibble = 4 Bits BCD & Hexa decimal.

1 Byte = 8 bits

1 Word = 16 bits = 2 Byte

1 Double Word = 32 bits = 4 byte

Decimal to Binary Conversion

→ To convert decimal to any other base 'r', devide integer part by r and multiply fractional part by r.

ex (13)10 → ( )2

13 = 8 + 5

= 8 + 4 + 1

$= 2^3 + 2^2 + 2^0$

$2^0 = 1$

$2^1 = 2$

$2^2 = 4$

$2^3 = 8$

$2^4 = 16 > 13$

$b_3\ b_2\ b_1\ b_0$

$2^3\ \ 2^2\ \ 2^1\ \ 2^0$

$13 = 8 + 5$

$= 8 + 4 + 1$

$1\ \ 1\ \ 0\ \ 1$

$b^3\ b^2\ b^1\ b^0$

Divisor $= 2^3 + 2^2 + 2^0$

	Dividend	Remainder
2	13	1 ← LSB
2	6	0
2	3	1
2	1	1 ← MSB
2	0	0
	0	0

1101

$(25.625)_{10} \rightarrow (\ )_2$

2	25	1 ← LSB
2	12	0
2	6	0
2	3	1
2	1	1 ← MSB
	0	

11001

$0.625 \times 2 = 1.25$

$0.25 \times 2 = 0.50$

$0.50 \times 2 = 1.00$

$0.00 \times 2 = 0.00$

1010

$(11001.1010)_2$

$(25.625)_{10}$

$(67)_{10} \rightarrow (\quad)_2$

2	67	1
2	33	1
2	16	0
2	8	0
2	4	0
2	2	0
2	1	1
	0	

1000011

$(129.75)_{10} \rightarrow (\quad)_2$

2	129	1
2	64	0
2	32	0
2	16	0
2	8	0
2	4	0
2	2	0
2	1	1
	0	

10000001

$0.75 \times 2 = 1.5$

$0.5 \times 2 = 1.0$

$0.0 \times 2 = 0.0$

$0.75 \times 2 = 1.5$

$0.5 \times 2 = 1.0$

$0.0 \times 2 = 0.0$

$= 11$

$(10000001.110)_2$

Decimal to Octal Conversion

For decimal to Octal Conversion, divide integer part by 8 and Multiply fractional part by 8.

$r = 8$

1) $(112)_{10} \rightarrow (160)_8$

8	112	0	→ LSB
8	14	6	
2	1	1	→ MSB
	0		

2) $(25.625)_{10} \rightarrow (31.5)_8$

8	25	1	– LSB
8	3	3	– MSB
	0		

31.50

$0.625 \times 8 \rightarrow 5.000$ • 50

$0.000 \times 8 \rightarrow 0.000$

3) $(2048)_{10} \rightarrow (\ )_8$

8	2048	0
8	256	0
8	32	0
8	4	4
	0	

$(82.250)_{10} \rightarrow (122.2)_8$

8	82	2
8	10	2
8	1	1 ↑
	0	

122.2

$0.250 \times 8 = 2.000$

$0.000 \times 8 = 0.000$

Decimal to Hexadecimal Conversion

For Decimal to Hexadecimal Conversion, divide integer part by 16 and multiply fractional part by 16.

$r = 16$

1) $(254)_{10} \rightarrow (\ )_{16}$

16	254	14 ← LSB
16	15	15 ← MSB

14 → E

15 → F

$(FE)_{16}$

2) $(25.625)_{10} \rightarrow (\ )_{16}$

16	25	9
16	1	1 ↑
	0	

$(19.A)_{16}$

$0.625 \times 16 = 10.000$

$0.000 \times 16 = 0.000$

3) $(27.4)_{10} \rightarrow (\ )_4$

4	27	3
4	6	2
4	1	1
	0	

↑

$(123.1212)_4$

$0.4 \times 4 = 1.6$
$0.6 \times 4 = 2.4$
$0.4 \times 4 = 1.6$
$0.6 \times 4 = 2.4$
.
.
.

4) $(25.625)_{10} \rightarrow (\ )_4$

4	25	1
4	6	2
4	1	1
	0	

↑

$(121.22)_4$

$0.625 \times 4 = 2.5$
$0.5 \times 4 = 2.0$
$0.0 \times 4 = 0.0$

Note: Decimal to Any Base.

$XXX \cdot XX$

Divide ↑ ↑ Multiply.

Decimal to Binary

$(526)_{10} \Rightarrow (\quad)_2$

2	526

↑

Decimal to Octal $(526)_{10} \rightarrow (\quad)_8$

8	526

↑

Decimal to Hexadecimal $(526)_{10} \rightarrow (\quad)_{16}$

16	526

↑

$(526.24)_{10} \rightarrow (\quad)_2$

2	526

$0.24 \times 2 = 0.48$

$0.48 \times 2 = 0.96$

$0.96 \times 2 = 1.92$

$0.92 \times 2 = 1.84$

$0.84 \times 2 = \vdots$

Binary to Decimal Conversion

$a_3\ a_2\ a_1\ a_0 \cdot a_{-1}\ a_{-2}$

others to Decimal:

$$(a_3\ a_2\ a_1\ a_0 \cdot a_{-1}\ a_{-2})_r \rightarrow ( )_{10}$$

$$a_3 r^3 + a_2 r^2 + a_1 r^1 + a_0 r^0 + a_{-1} r^{-1} + a_{-2} r^{-2} = ( )_{10}$$

Ex.

$(10101.11)_2 \rightarrow ( )_{10}$

4 3 2 1 0 . -1 -2

$= 1\times2^4 + 0\times2^3 + 1\times2^2 + 0\times2^1 + 1\times2^0 + 1\times2^{-1} + 1\times2^{-2}$

$= 2^4 + 0 + 2^2 + 0 + 1 + 0.5 + \frac{1}{4}$

$= 16 + 4 + 1 + 0.75$

$= (21.75)_{10}$

$(1101100.101)_2 \rightarrow ( )_{10}$

6 5 4 3 2 1 0

$2\times2\times2\times2\times2\times2\times2$

$= 2^6 + 2^5 + 2^3 + 2^2 + 2^{-1} + 2^{-3}$

$= 64 + 32 + 8 + 4 + \frac{1}{2} + \frac{1}{8}$

$= 96 + 12 + \frac{5}{8}$

$= 108 + \frac{5}{8}$

$= (108.625)_{10}$

Octal to Decimal Conversion

$O_3\ O_2\ O_1\ O_0 . O_{-1}\ O_{-2}$

Integer Part | Fractional Part

$$O_3 \times 8^3 + O_2 \times 8^2 + O_1 \times 8^1 + O_0 \times 8^0 + O_{-1} \times 8^{-1} + O_{-2} \times 8^{-2} = (\quad)_{10}$$

i) $(57.4)_8 \rightarrow (\quad)_{10}$

$= 5 \times 8^1 + 7 \times 8^0 + 4 \times 8^{-1}$

$= 40 + 7 + \frac{1}{2}$

$= (47.5)_8$

ii) $(4507.44)_8 \rightarrow (\quad)_{10}$

3 2 1 0 -1 -2

$= 4 \times 8^3 + 5 \times 8^2 + 0 \times 8^1 + 7 \times 8^0 + 4 \times 8^{-1} + 4 \times 8^{-2}$

$= 4 \times 512 + 5 \times 64 + 0 + 7 + \frac{1}{2} + \frac{1}{64}$

$= 2048 + 320 + 7 + \frac{33}{64}$

$= 2375 + \frac{33}{64}$

$= 2375 + 0.5156$

$= (2375.5156)_{10}$

3> $(601)_8 \rightarrow = 6\times8^2 + 0\times8^1 + 1\times8^0$

$= 6\times64 + 0 + 1$

$= 384 + 1$

$= (385)_{10}$

4> $(1107.02)_8 \rightarrow (\quad)_{10}$

3 2 1 0

$= 1\times8^3 + 0\times8^2 + 7\times8^1 + 0\times8^0 + 0\times8^{-1} + 2\times8^{-2}$

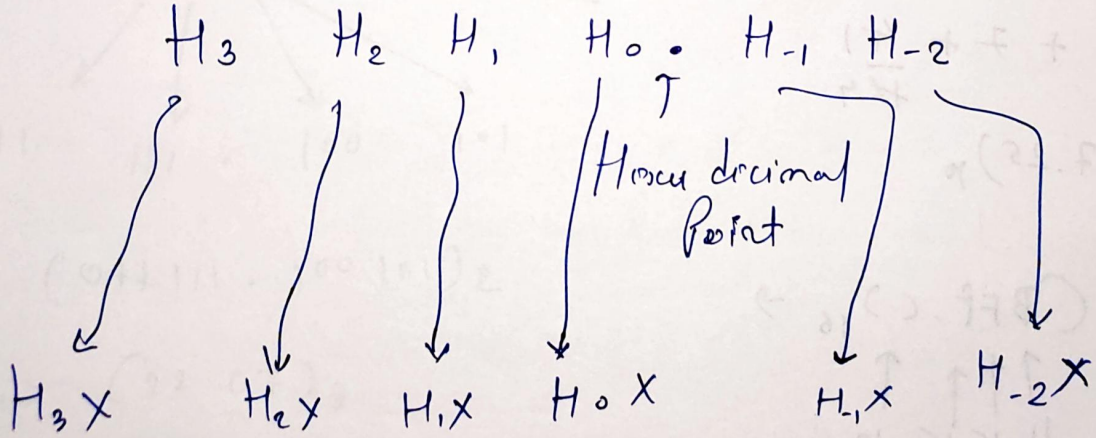
$= 8^3 + 0 + 56 + 0 + 0 + \frac{2}{64}$ (32)

$= 512 + 56 + \frac{1}{32}$

$= 568 + 1/32$

$= (568.03125)_{10}$

Hexadecimal to Decimal Conversion



$r = 16$

$$H_3 x \times 16^3 + H_2 x \times 16^2 + H_1 x \times 16^1 + H_0 x \times 16^0 + H_{-1} x \times 16^{-1} + H_{-2} x \times 16^{-2}$$

$= (\quad)_{10}$

Ex. $(BAD)_{16} \rightarrow (\quad)_{10}$

B A D

11 10 13

2 1 0

$= 11 \times 16^2 + 10 \times 16^1 + 13 \times 16^0$

$= 256 \times 11 + 160 + 13$

$= 2816 + 160 + 13$

$= (2989)_{10}$

Ex. $(57.4)_{16} \rightarrow (\quad)_{10}$

$= 5 \times 16^1 + 7 \times 16^0 + 4 \times 16^{-1}$

$= 80 + 7 + \frac{4}{16}$

$= (87.25)_{10}$

Ex. $(BFF.C)_{16} \rightarrow$

B F F C

11 15 15 12

2 1 0

$= 11 \times 16^2 + 15 \times 16^1 + 15 \times 16^0 + 12 \times 16^{-1}$

$=$

$= 11 \times 256 + 256 + 15 + \frac{12^3}{164}$

$= (3087.75)_{10}$

Octal to Binary & Binary to Octal Conversion

→ There are Eight different digits in Octal Number System.

0	000
1	001
2	010
3	011
4	100
5	101
6	110
7	111

$r = 8$

0 to (8-1)

0 to 7

Octal to Binary

i> $(37.45)_8 \rightarrow (\quad)_2$

011 111 . 100 101

→ $(011111.100101)_2$

ii> $(22.07)_8$

→ $(010010.000111)_2$

Binary to Octal

i> $(010110.110)_2 \rightarrow (\quad)_8$

2 6 6

$(26.6)_8$

ii> $(1001.100)_2 \rightarrow (\quad)_8$

1 1.4

$(11.4)_8$

H.W i> $(672.13)_8 \rightarrow (110111010.001011)_2$

2> $(010111011.100100) \rightarrow (\quad)_8$

2 7 3 4 4

$(273.44)_8$

Hexadecimal to Binary & Binary to Hexadecimal

↳ In hexadecimal number System we have 16 different digits.

→ Each one of them can be represented by a Equivalent 4 bit Binary number.

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

Hex to Binary

i> $(2598A)_{16} \rightarrow (\quad)_2$

$(0010\ 0101\ 1001\ 1000\ 1100)_2$

ii> $(CAFE.3D)_{16} \rightarrow (\quad)_2$

$(1100\ 1010\ 1111\ 1110.0011\ 1101)_2$

Binary to Hex

i> $(10001001.1100)_2 \rightarrow (\quad)_{16}$

8 9 . C

$(89.C)_{16}$

ii> $(0\ 10001001.1100)_2$

1 8 9 . 12

$(189.C)_{16}$

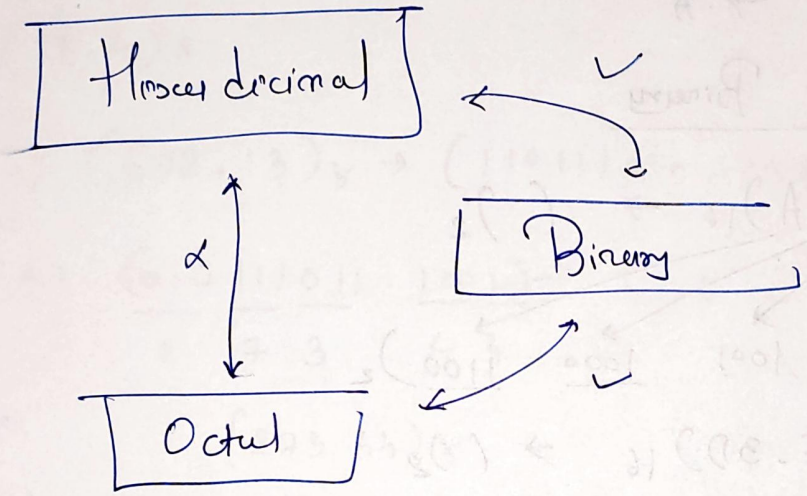
H.W. i) $(FACE)_{16} \rightarrow (\quad)_2$

ii) $(1101\ 1110\ 1010\ 1111)_2 \rightarrow (\quad)_{8\,16}$

Ans. 1) $(1111\ 1010\ 1100\ 1110)_2$

2) $(DEAF)_{8\,16}$

Hexa Decimal to Octal & Octal to Hexadecimal



4 Bit → 3 Bit data loss

Ex. $(CAD)_{16} \rightarrow (\quad)_8$

1100 1010 1101

$(6257)_8$

$(1100\ 1010\ 1101)$

6 2 5 5

Ex. $(652)_8 \rightarrow (\ )_{16}$

110 101 001

(110101001)

1 10 9

$(1A9)_{16}$

H.W

1> $(CAFE)_{16} \rightarrow (\ )_8$

00 1100 1010 1111 1110

1 4 5 3 7 6

$(145376)_8$

2> $(707)_8 \rightarrow (\ )_{16}$

111 000 111

000 1110 0011 1

1 12 7

$(1C7)_{16}$

Binary Addition

$$\begin{array}{r} 547 \rightarrow \\ +\ 25 \rightarrow \\ \hline 572 \end{array}$$

$5 \times 10^2 + 4 \times 10^1 + 7 \times 10^0$

$2 \times 10^1 + 5 \times 10^0$

12×10^0

$12 = 10 + 2$

$(10+2) \times 10^0$

$10 \times 10^0 + 2 \times 10^0$

$1 \times 10^1 + 2 \times 10^0$

↑ Carry

base (r) = 10

0 + 9

$5\times10^2+$	$4\times10^1+$ $2\times10^1+$	7×10^0 5×10^0
$0+5$	$1+6$	2
5	7	

$12 > 9$

12×10^0

$12 = 10 + 2$

$(10+2)\times10^0$

$10\times10^0 + 2\times10^0$

$1\times10^1 + 2\times10^0$

Carry

$7 < 9$

$7 = (0+7)\times10^1$

$= 0\times10^1 + 7\times10^1$

Q) $110 + 101 = 1011$

$110 \rightarrow 1\times2^2 + 1\times2^1 + 0\times2^0$

$101 \rightarrow 1\times2^2 + 0\times2^1 + 1\times2^0$

$1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0$

base (r) = 2

0 and 1

$2\times2^2 : 2 = 2+0$

Sum ≤ 1 ← Condition for no Carry

$= 2\times2^2$

$2 = \frac{2}{r} + 0$

$= (2+0)\times2^2$

$= 1\times2^3 + 0\times2^2$

Carry

Summary of Binary Addition

	Sum	Carry
0 + 0 =	0	0
0 + 1 =	1	0
1 + 0 =	1	0
1 + 1 =	0	1

H.W

```
  1 1 1 1
  1 1 0 1 1
    1 1 1 1
-------------
1 0 1 0 1 0
```

Binary Subtraction

```
    0 1
  1 ✗ 0 1 1
  1 0 1 1 0
-------------
  0 0 1 0 1
```

Ans.

Borrow → (2)

$1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$

$-1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$

$0 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$2 - 1 = 1$

ii)

```
    2 2
  0 0 0 2
  1 ✗ ✗ 0
- 1 1 1
---------
  0 1 1 1
```

```
  1 1 0 1 1   → 27
  1 0 1 1 0   → -22
-------------   ----
  0 0 1 0 1     5
```

```
    2 2
  1 1 1 0   → 14
- 1 1 1     → 7
---------     ---
  0 1 1 1     7
```

```
  4 3 2 1 0
  1 0 1 0 1      →   21
-   1 1 1 1       -  15
-----------      ----
  0 0 1 1 0        6
```

Binary Multiplication

	Sum	Carry
0 + 0 =	0	0
1 + 0 or 0 + 1 =	1	0
1 + 1 =	0	1

Product

0 × 0 = 0

1 × 0 or 0 × 1 = 0

1 × 1 = 1

```
    2
   15
  x44
  ---
  600
   40
  ---
  660
```

```
   1010
 x  101
 ------
 101000
  00000
   1010
 ------
 110010
```

```
    166
  x 155
  -----
  16600
   5000
    500
  -----
  25730
```

$$
\begin{array}{r}
1010 \\
\times\ 101 \\
\hline
110010
\end{array}
\quad \rightarrow
$$

$1\times2^3 + 0\times2^2 + 1\times2^1 + 0\times2^0$			
	1×2^2	$+\ 0\times2^1$	$+\ 1\times2^0$
1×2^3	0×2^2	1×2^1	0×2^0
0×2^4 0×2^4	0×2^3 1×2^3	0×2^2 0×2^2	0×2^1 $\times$
1×2^5		$\times$	$\times$
1×2^5	1×2^4	0×2^3	0×2^2	1×2^1	0×2^0

$$
\begin{array}{r}
1010 \\
\times\ \ 11 \\
\hline
10100 \\
\ \ 1010 \\
\hline
11110
\end{array}
$$

$0\times2^0\times2^0$

$0\times1\times1$

0×1

0×2^0

$1\times2^0\times2^1$

1×2^1

$0\times2^1\times2^0$

0×2^1

$0\times2^2\times2^0$

0×2^2

H.W.

$$
\begin{array}{r}
1101 \\
\times\ \ 11 \\
\hline
11010 \\
\ \ 1101 \\
\hline
100111
\end{array}
$$

Binary Division

Simple trick → Convert Binary to Decimal then do division.

```
   16
8 | 128
  - 8
  ----
    48
    48
  ----
    00
```

```
   1
110 | 101010
    - 110
    -----
      1001
       110
      ----
       0110
        110
       ----
        000
```

```
   016
8 | 128
  -0↓
  ----
   12
  - 8
  ----
    48
   -48
  ----
    60
```

```
        000111
110 | 101010
    - 0↓
    -----
      10
    - 0
    -----
      101
    -   0
    -----
      0010
    -  110
    -------
      0001
       110
    -------
      0000
    -  110
    -------
      0006
```

H.W>

i> $1001 \div 11 = 9 \div 3 = 3 = 11$

ii> $111000 \div 111 = 56 \div 7 = 8$

111000 (5, 4, 3, 2, 1, 0)

$= 2^5 + 2^4 + 2^3$

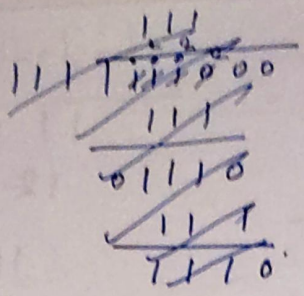
$= 32 + 16 + 8$

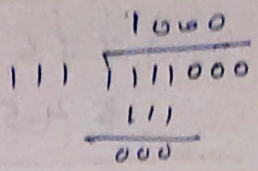
$= 24 + 32$

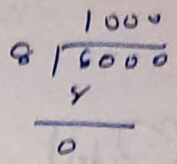
$= 56$

$= 1000$

```
   1
11 | 1000
     11
    ----
     011
      11
    ----
      00
```







Octal Addition

$$\begin{array}{r} {\scriptstyle 1} \\ A_1\ A_0\ 5 \\ +\ B_1\ B_0\ 4 \\ \hline \end{array}$$

base $(r) = 8 \Rightarrow 0 + 0 \; 7$

$C_0 \leq 7$

$Sum = C_0$

$Carry = 0$

$a > 7$

$9 = 1 \times 8 + 1$

$= (8 + 1) \times 8^0$

$= 8 \times 8^0 + 1 \times 8^0$

$= (1) \times 8^1 + 1 \times 8^0$

Carry

$$\begin{array}{r} 7 \\ +\ 7 \\ \hline 14 \end{array}$$

$1 \times 8 + 6$

↓ Carry

$C_0 > 7$

$C_0 = C \times 8 + S$

↓ Carry ↓ Base ↓ Sum

$$\begin{array}{r} 243 \\ +\ 212 \\ \hline 455 \end{array}$$

$$\begin{array}{r} {\scriptstyle 1\ 1} \\ 567 \\ +\ 243 \\ \hline 1032 \end{array}$$

$7 + 3 = 10$

$= 8 + 2$

$6 + 4 + 1 = 11$

$8 + 3$

$5 + 2 + 1 = 8$

$8 + 0$

H.W

$$\begin{array}{r} {}^{1}\cancel{1}\cancel{7}\cancel{7}6 \\ 3\,4\,5 \\ \hline 2\,3\,4\,3 \end{array}$$

$11 = 8 + 3$

$12 = 8 + 4$

$11 = 8 + 3$

Octal Subtraction

Ex.

$$\begin{array}{r} {}^{6}\cancel{7}\ {}^{3}\cancel{4}\ 3 \\ -\ 5\ 6\ 4 \\ \hline 1\ 5\ 7 \end{array}$$

$$7 \times 8^2 + 4 \times 8^1 + 3 \times 8^0$$

$$5 \times 8^2 + 6 \times 8^1 + 4 \times 8^0$$

$$1 \times 8^2 + 5 \times 8^1 + 7 \times 8^0$$

$$\begin{array}{r} {}^{5}\cancel{6}\ {}^{1}\cancel{2}\ 4 \\ 2\ 6\ 5 \\ \hline 3\ 3\ 7 \end{array}$$

$12 - 5 = 7$

$9 - 6 = 3$

$5 - 2 = 3$

H.W)

$$\begin{array}{r} {}^{4}\cancel{5}\ {}^{1}\cancel{0}\ 8 \\ -\ \ 3\ 3 \\ \hline 4\ 5\ 5 \end{array}$$

$9 - 3 = 6$

$8 - 3 = 5$

$$\begin{array}{r} {}^{5}\cancel{6}\ {}^{7}\cancel{0}\ {}^{7}\cancel{0}\ 8 \\ -\ \ 7\ 7\ 7 \\ \hline 5\ 0\ 0\ 1 \end{array}$$

Octal Multiplication

```
   72
 x 12
-----
  720
   64
-----
 1104
```

1104 <- Ans.

```
    1 1
    3 5 7
    1 2 3
  + 1 1 2
-------
  7 3 6 0
    1 7 5
-------
1 0 6 7 5
```

14 = 8 + 6

11 = 8 + 3

91 = 8 × 2 + 5

15 = 8 + 7

9 = 8 + 1

6 + 7 + 2 = 15

15 = 8 + 7

3 + 1 + 1 + 1 = 6

H.W

```
   63
 x 24
-----
 1460
+  04
-----
 1774
```

12 = 8 + 4

24 = 8 × 3 + 0

```
   23
  835
 x 55
-----
 4210
  671
-----
44237
```

23 = 8 × 3 + 1

18 = 8 × 2 + 2

30 = 8 × 3 + 6

15 = 8 + 7

30 = 8 × 3 + 6

Hexa decimal Addition

```
  5689
+ 4574
------
 9BFD
```

```
    1 1
    A D D
+   D A D
---------
  1 8 8 A
```

D + D = 26

D + A = 23

A + D = 23

Base → 16

0 to (16-1)

0 to 15

A D D

A^{12} D^{13} D^{16^0}

```
  A D D
+ D A D
-------
1 8 8 A
```

$24 = 1 \times 16 + 8$

$13 \times 16^0 + 13 \times 16^0$

26×16^0

$(16+10) \times 16^0$

$16 \times 16^0 + 10 \times 16^0$

$(1) \times 16^1 + 10 \times 16^0$

Carry

$1 + 13 + 10 = 24$

$24 = 16^1 \times 1 + (8)$

H.W

```
  1 1
  8 9 9
    1 8 9
-------
  A 2 2
```

```
  1 1
  D A F
  B A F
-------
1 9 5 E
```

$F + F = 30$

$16 + 14$

$10 + 10 = 20$

$13 + 11 = 24$

$30 \rightarrow 16 \times 1 + 14$

$25 \rightarrow 16 \times 1 + 9$

$21 \rightarrow 16 \times 1 + 5$

Hexa decimal subtraction

1) 9 B 5 4
- 5 3 2 1
4 3 3 3

2) 16 16 16
8 6 3 16
9 7 4 B
5 8 7 C
3 E C F

16+11-12
27-12
= 15
19-7=12
22-8=14

Kiran 16
3) E 1 16
F A B
A E F
4 B C

16+11-15
27-15=12
16+9-14
= 11

16 16
4) 6 5 7 16
7 7 8 8
D E F
6 9 9 9

24-15 = 9
16+7-14 = 7
22-13 = 9
23-14 = 9

Hexa decimal multiplication

9 4
x 1 2
9 4 0
2 8
+
A 6 8
Hex.

A B C

	1	2	3	
		8	2	
1	4	7	8	0
		E	1	4
Ans →	1	7	7	B	4

$22 = 16 \times 1 + 6 + 1$

$20 = 16 \times 1 + 4$

$12 \times 3 = 36$

$36 = 16 \times 2 + 4$

$33 = 16 \times 2 + 1$

$30 = 16 \times 1 + 14$

E

$23 = 16 \times 1 + 7$