

③ Binary \leftrightarrow Octal, Hexadecimal.

Binary \leftrightarrow Octal

$$\left(\underbrace{10110}_2 \underbrace{00101011}_2 \cdot \underbrace{1110000110}_2 \right)_2 = (26153.7406)_8$$

2 6 1 5 3 7 4 0 6

Binary \leftrightarrow Hexadecimal

$$\left(\underbrace{10}_2 \underbrace{1100}_2 \underbrace{010}_2 \underbrace{1011}_2 \cdot \underbrace{1111}_2 \underbrace{0010}_2 \right)_2 = (2C6B.F2)_{16}$$

2 C 6 B F 2 2 16

Octal \leftrightarrow Binary

$$(678.124)_8 = \left(\underbrace{110}_2 \underbrace{111}_2 \underbrace{011}_2 \cdot \underbrace{001}_2 \underbrace{010}_2 \underbrace{100}_2 \right)_2$$

6 7 3 4

Hexadecimal \leftrightarrow Binary

Hexadecimal \leftrightarrow Binary

$$(306.D)_{16} = \left(\underbrace{0011}_2 \underbrace{0000}_2 \underbrace{0110}_2 \cdot \underbrace{1101}_2 \right)_2$$

3 0 6 D

Hexadecimal to Octal ?

Hexadecimal \rightarrow Binary \rightarrow Octal

(Base)₅ to (Base)₈ ?

Base-5 \rightarrow Decimal \rightarrow Base-8

Addition of Binary Numbers :-

Rules of binary addition :-

$$\begin{aligned}
 0+0 &= 0 \\
 0+1 &= 1 \\
 1+0 &= 1 \\
 1+1 &= 0 \text{ (carry 1)}
 \end{aligned}$$

Q:-

$$\begin{array}{r}
 1 \\
 10001 \\
 + 11101 \\
 \hline
 101110
 \end{array}$$

$$\begin{array}{r}
 10111 \\
 110001 \\
 \hline
 1001000
 \end{array}$$

Subtraction of Binary Numbers :-

$$\begin{aligned}
 0-0 &= 0 \\
 0-1 &= 1 \text{ (with a borrow of 1)} \\
 1-0 &= 1 \\
 1-1 &= 0
 \end{aligned}$$

$$\begin{array}{r}
 110101 \rightarrow 53 \\
 - 100101 \rightarrow 37 \\
 \hline
 010000 \rightarrow 16
 \end{array}$$

1's complement :- ($0 \leftrightarrow 1$)

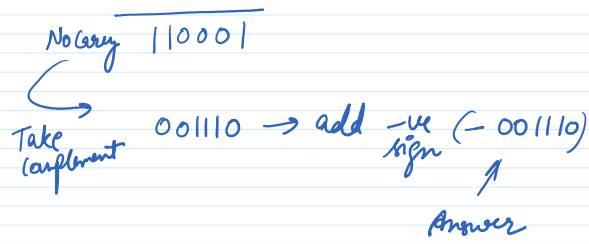
$$\begin{aligned}
 \underline{Q:-} \quad 110101 - 100101 \\
 = 110101 + (-100101)
 \end{aligned}$$

-ve sign means take complement

$$\begin{array}{r}
 1 \\
 110101 \\
 + 011010 \\
 \hline
 \text{Carry } 001111 \\
 1 \\
 \text{add } 1 \\
 \hline
 010000 \rightarrow \text{Answer}
 \end{array}$$

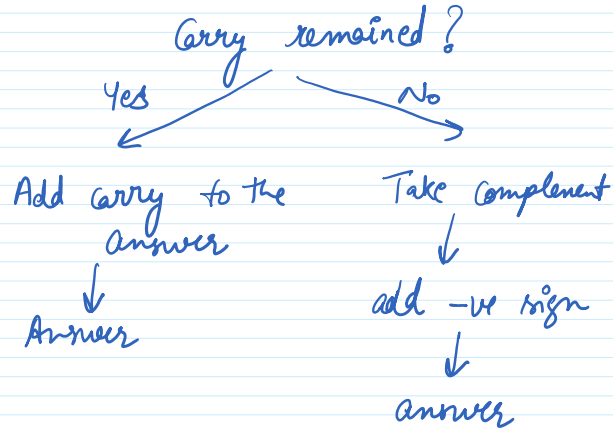
$$\begin{aligned}
 \underline{Q:-} \quad 101011 - 111001 \\
 + 000110 = 101011 + (-111001)
 \end{aligned}$$

101011



Rules of subtraction using 1's complement

- ① Make number and subtrahend equal digits
- ② Take complement of subtrahend
- ③ Add number and subtrahend.



2's Complement → Add 1 to 1's complement

② $110101 = 100101$

Solⁿ

$$110101 - 100101 = 110101 + (-100101)$$

1's complement of 100101 is 011010

2's complement is

$$\begin{array}{r} 011010 \\ + 1 \\ \hline 011011 \end{array}$$

\Rightarrow 2's complement of -100101 is 011011

$$\begin{array}{r} \Rightarrow \quad \begin{array}{cccc} 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 & 0 & 1 \\ + & 0 & 1 & 1 & 0 & 1 & 1 \\ \hline \end{array} \end{array}$$

Carry \leftarrow 010000
 number is +ve \Rightarrow correct answer

$$101011 - 111001 = 101011 + (-111001)$$

$$\begin{array}{r} \hookrightarrow 1's \quad 000110 \\ \hookrightarrow 2's \quad +1 \\ \quad \quad 000111 \end{array}$$

$$\begin{array}{r} \begin{array}{cccc} 1 & 1 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 & 1 \\ + & 0 & 0 & 0 & 1 & 1 & 1 \\ \hline \end{array} \end{array}$$

no carry
 number is -ve
 Take 2's complement again

$$\begin{array}{r} 110010 \\ 1's \rightarrow 001101 \\ \quad \quad +1 \\ 2's \rightarrow \hline 001110 \end{array}$$

\Rightarrow answer is -001110

Rules of subtraction using 2's complement

① Take 2's complement of subtrahend.

② Add to the number.

