③ Binary ↔ Octal, Hexadecimal.

Binary ↔ octal

$(10\,110\,001\,101\,011.\,111\,100\,000\,110)_2 = (26153.7406)_8$

2 6 1 5 3 7 4 0 6

Binary ↔ Hexadecimal

$(10\,1100\,0110\,1011.\,1111\,0010)_2 = (2C6B.F2)_{16}$

2 C 6 B F 2

Octal ↔ Binary

$(673.124)_8 = (110\,111\,011\,.\,001\,010\,100)_2$

6 7 3 1 2 4

Hexadecimal ↔ Binary

$(306.D)_{16} = (0011\,0000\,0110\,.\,1101)_2$

3 0 6 D

Hexadecimal to Octal ?

Hexadecimal → Binary → Octal

$(Base)_5$ to $(Base)_8$?

Base-5 → Decimal → Base-8

Addition of Binary Numbers :-

Rules of binary addition :-

0+0 = 0

0+1 = 1

1+0 = 1

1+1 = 0 (carry 1)

Q:-

(a)
```
    1
   10001
 + 11101
 -------
  101110
```

(b)
```
   10111
  110001
 -------
 1001000
```

Subtraction of Binary Numbers :-

0−0 = 0

0−1 = 1 (with a borrow of 1)

1−0 = 1

1−1 = 0

```
   110101 → 53
 − 100101 → 37
 ---------
   010000 → 16
```

1's complement :- (0 ↔ 1)

Q:- 110101 − 100101

= 110101 + (−100101)

−ve sign means take complement

```
        1
       110101
     + 011010
     --------
 1 carry 001111
  add       + 1
     --------
       010000   → answer
```

Q: 101011 − 111001

+ 000110 = 101011 + (−111001)

101011

No carry 110001

Take complement → 001110 → add −ve sign (− 001110)

↑ Answer

Rules of subtraction using 1's complement

① Make number and subtrahend equal digits

② Take complement of subtrahend

③ Add number and subtrahend.

Carry remained?

- Yes → Add carry to the answer → Answer
- No → Take complement → add −ve sign → answer

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

② 101011 − 111001

① 110101 − 100101

Sol^n

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

1's complement of 100101 is 011010

2's complement is

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

⇒ 2's complement of −100101 is 011011

⇒
```
  1 1 0 1 0 1
+ 0 1 1 0 1 1
-------------
1 0 1 0 0 0 0
```
Carry 1 — number is +ve

010000 ⇒ Correct answer

10 1011 − 111001 = 101011 + (−111001)

1's → 000110
     + 1
2's → 000111

```
  1 0 1 0 1 1
+ 0 0 0 1 1 1
-------------
  1 1 0 0 1 0
```
no carry — number is −ve

Take 2's complement again

110010

1's → 001101
     + 1

2's → 001110

answer is

⇒ −001110

Rules of subtraction using 2's complement

① Take 2's complement of subtrahend.

② Add to the number.

Carry remained?

Yes → Number is +ve → answer

No → Number is −ve → Take 2's complement again