BINARY MULTIPLICATION

What is Binary Multiplication?

The binary multiplication operation is actually a process of addition and shifting operation. This process has to be continued until all the multiplier is done, and finally, the addition operation is made.

Similar to the decimal system, the multiplication of the binary numbers is done by multiplying the multiplicand with the multiplier. It is noted that the multiplication by zero makes all the bits zero, and this step may be ignored in the intermediate steps. The multiplication by 1 makes all the multiplicand value unchanged.

Binary Multiplication Table

The multiplication table for binary numbers is given below.

Binary Number	Multiplication Value
0 x 0	0
1 x 0	0
0 x 1	0
1 x 1	1

Binary Multiplication Rules

Binary multiplication, like other binary operations, is much easier, unlike the decimal multiplication when you remember the following multiplication rules. The rules of binary multiplication are:

- $0 \times 0 = 0$
- $0 \times 1 = 0$
- $1 \times 0 = 0$
- $1 \times 1 = 1$ [No borrow or carry method is applicable here]

As per these rules, it very clear, that if the binary multiplication includes 0, then it will result in zero itself. Hence,

Binary product of 0 and 0 is equal to 0

Binary product of 0 and 1 is equal to 0

Binary product of 1 and 0 is equal to 0

But,

Binary product of 1 and 1 is equal to 1.

Examples of Binary Multiplication

Some binary multiplication examples are given below for a better understanding of this concept.

Example 1: Solve 1010×101

Solution:

1010×101

1010

(×) 101

_____

1010

0000

_____

01010 ……. First Intermediate Sum

1010

_____

110010

Comparison with Decimal values:

$1010_2 = 10_{10}$

$1010_2 = 5_{10}$

$10 \times 5 = 50_{10}$

$(110010)_2 = 50_{10}$

What is Binary Division?

The binary division operation is similar to the base 10 decimal system, except the base 2. The division is probably one of the most challenging operations of the basic arithmetic operations. There are different ways to solve division problems using <u>binary operations</u>. Long division is one of them and the easiest and the most efficient way. This section has been designed to answer questions about binary division, including:

- What is Binary division?
- Procedure to add two binary numbers
- Examples to Solve Binary division

Binary Division Rules

The binary division is much easier than the decimal division when you remember the following division rules. The main rules of the binary division include:

- $1 \div 1 = 1$
- $1 \div 0 =$ Meaningless
- $0 \div 1 = 0$
- $0 \div 0 =$ Meaningless

Similar to the decimal number system, the binary division is similar, which follows the four-step process:

- Divide
- Multiply
- Subtract
- Bring down

Important Note: Binary division follows the long division method to find the resultant in an easy way.

Comparison with Decimal Value

$(01111100)_2 = (1111100)_2 = 124_{10}$

$(0010)_2 = (10)_2 = 2_{10}$

You will get the resultant value as 62 when you divide 124 by 2.

So the binary equivalent of 62 is $(111110)_2$

$(111110)_2 = 62_{10}$

Both the binary and the decimal system produce the same result.

Binary Division Examples

Example 1.

Question: Solve $01111100 \div 0010$

Solution:

Given

$01111100 \div 0010$

Here the dividend is 01111100, and the divisor is 0010

Remove the zero's in the **Most Significant Bit** in both the dividend and divisor, that doesn't change the value of the number.

So the dividend becomes 1111100, and the divisor becomes 10.

Now, use the long division method.

```
10 )  1 1 1 1 1 0 0        (1 1 1 1 1 0
      (-) 1 0
          ──────
          1 1
      (-)  1 0
          ──────
             1 1
          (-)  1 0
              ──────
                 1 1
              (-)  1 0
                  ──────
                     1 0
                  (-) 1 0
                      ──────
                        0 0
                        0 0
                      ──────
```

- **Step 1:** First, look at the first two numbers in the dividend and compare with the divisor. Add the number 1 in the quotient place. Then subtract the value, you get 1 as remainder.
- **Step 2:** Then bring down the next number from the dividend portion and do the step 1 process again
- **Step 3:** Repeat the process until the remainder becomes zero by comparing the dividend and the divisor value.
- **Step 4:** Now, in this case, after you get the remainder value as 0, you have zero left in the dividend portion, so bring that zero to the quotient portion.

Therefore, the resultant value is quotient value which is equal to 111110

So, $01111100 \div 0010 = 111110$

Example 2: Solve using the long division method: $101101 \div 101$

Solution:

```
101) 1 0 1 1 0 1          ( 1 0 0 1
     (-) 1 0 1
        ──────
           1 0 1
        (-) 1 0 1
           ──────
              0
```

So, when you bring down the fourth bit of the dividend, it does not match with the divisor. In order to bring down the 5th and 6th bit of the dividend, add two zeros in the quotient value.