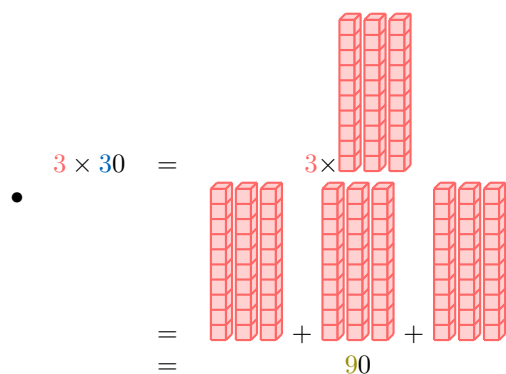
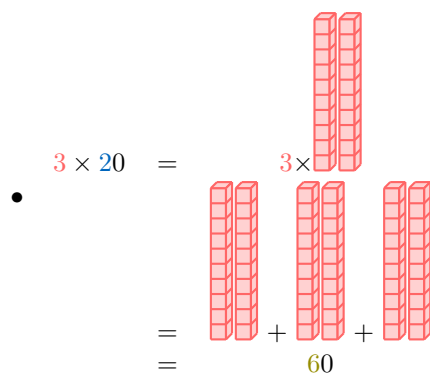
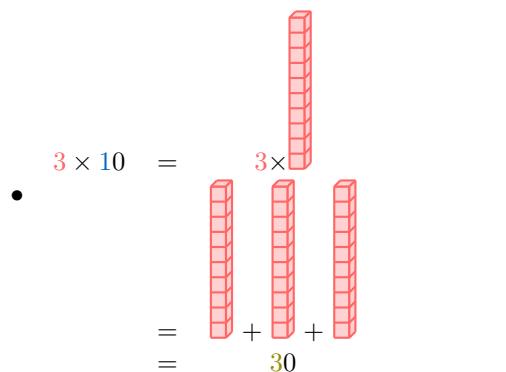


LONG MULTIPLICATION

Long multiplication is a method used for multiplying larger numbers. It requires knowledge of the multiplication table for single digits.

A MULTIPLICATION TABLES FOR MULTIPLES OF 10

Discover: Imagine starting with a simple one-digit number, such as 3. What happens when we multiply by multiples of 10? Let's explore step by step:



• $3 \times 40 = 120$

• $3 \times 50 = 150$

• $3 \times 60 = 180$

• $3 \times 70 = 210$

• $3 \times 80 = 240$

• $3 \times 90 = 270$

Notice that the multiplication table for multiples of 10 looks similar to the regular table, but you just add a zero at the end.

Proposition Multiplication Table for Multiple of 10

To multiply by multiples of 10, use the regular multiplication table and add the zeros from the factors to the result:

$3 \times 1 = 3$	$300 \times 10 = 3000$
$3 \times 2 = 6$	$300 \times 20 = 6000$
$3 \times 3 = 9$	$300 \times 30 = 9000$
$3 \times 4 = 12$	$300 \times 40 = 12000$
$3 \times 5 = 15$	$300 \times 50 = 15000$
$3 \times 6 = 18$	$300 \times 60 = 18000$
$3 \times 7 = 21$	$300 \times 70 = 21000$
$3 \times 8 = 24$	$300 \times 80 = 24000$
$3 \times 9 = 27$	$300 \times 90 = 27000$

B LONG MULTIPLICATION BY ONE-DIGIT NUMBERS

Discover: When multiplying a large number by a single-digit number, it can be tedious and time-consuming to handle each step separately. For example:

$$\begin{array}{r}
 764 \\
 \times 2 \\
 \hline
 8 \quad 4 \times 2 = 8 \\
 + 120 \quad 60 \times 2 = 120 \\
 + 1400 \quad 700 \times 2 = 1400 \\
 \hline
 1528 \quad 8 + 120 + 1400 = 1528
 \end{array}$$

To simplify, you can perform the additions step by step using the carry-over method, similar to column addition.

Method Column Multiplication

To calculate 23×7 , follow these steps:

1. Step 1: Write the multiplication in columns

Write the numbers in columns, aligning the digits based on their place value (units, tens, hundreds).

$$\begin{array}{r}
 23 \\
 \times 7 \\
 \hline
 \end{array}$$

2. Step 2: Multiply the ones

$$3 \text{ ones} \times 7 \text{ ones} = 21 \text{ ones} = 2 \text{ tens} + 1 \text{ one}$$

Write the carry-over (2) above the tens column.

$$\begin{array}{r}
 2 \\
 23 \\
 \times 7 \\
 \hline
 1
 \end{array}$$

3. Step 3: Multiply the tens

$$2 \text{ tens} \times 7 \text{ ones} + 2 \text{ tens (carry-over)} = 16 \text{ tens}$$

Write 16 in the tens and hundreds columns.

$$\begin{array}{r}
 2 \\
 23 \\
 \times 7 \\
 \hline
 161
 \end{array}$$

4. Result: $23 \times 7 = 161$.

C LONG MULTIPLICATION BY MULTI-DIGIT NUMBERS

Discover: To calculate 23×37 , we can use the distributive property:

$$\begin{aligned} 23 \times 37 &= 23 \times 7 + 23 \times 30 && \text{(by distributivity: } 37 = 7 + 30) \\ &= 161 + 690 && \text{(intermediate products)} \\ &= 851 && \text{(add the intermediate results)} \end{aligned}$$

This approach forms the basis of column multiplication for multi-digit numbers. The process organizes the steps efficiently:

$$\begin{array}{r} 23 \\ \times 37 \\ \hline 161 \\ 690 \\ \hline 851 \end{array} \quad \begin{array}{l} 23 \times 7 = 161 \\ 23 \times 30 = 690 \\ 161 + 690 = 851 \end{array}$$

Method Column Multiplication for Multi-Digit Numbers

To calculate 23×37 , follow these steps:

1. Step 1: Write the multiplication in columns

$$\begin{array}{r} 23 \\ \times 37 \\ \hline \end{array}$$

2. Step 2: Multiply the ones digit (7)

(a) Multiply the ones: $3 \times 7 = 21$

$$\begin{array}{r} 2 \\ 23 \\ \times 37 \\ \hline 1 \end{array}$$

(b) Multiply the tens: $2 \times 7 + 2_{\text{(carried)}} = 14 + 2 = 16$

$$\begin{array}{r} 2 \\ 23 \\ \times 37 \\ \hline 161 \end{array}$$

3. Step 3: Multiply the tens digit (3)

(a) Add a placeholder . (or 0) as a for the multiplication with a tens digit

$$\begin{array}{r} 23 \\ \times 37 \\ \hline 161 \\ . \end{array}$$

(b) Multiply the ones: $3 \times 3 = 9$

$$\begin{array}{r} 23 \\ \times 37 \\ \hline 161 \\ 9. \end{array}$$

(c) Multiply the tens: $2 \times 3 = 6$

$$\begin{array}{r} 23 \\ \times 37 \\ \hline 161 \\ 69. \end{array}$$

4. Step 4: Add the intermediate results $161 + 690 = 851$

$$\begin{array}{r}
 23 \\
 \times 37 \\
 \hline
 161 \\
 69 \\
 \hline
 851
 \end{array}$$

5. **Result:** $23 \times 37 = 851$.