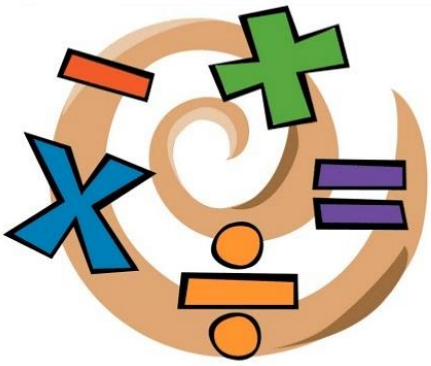
Operations on Large Numbers

Arithmetic Operations on Large Numbers

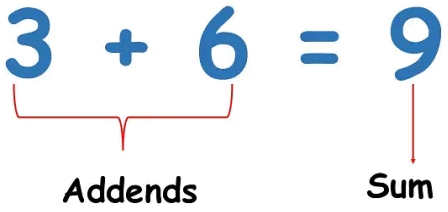
Large numbers are technically described as numbers bigger than what is used in daily life. As like normal numbers, it is possible to apply the arithmetic operations on the large numbers, such as:



- Addition of Large numbers
- Subtraction of Large Numbers
- Multiplication of Large Numbers
- Division of Large Numbers

Addition

Two or more numbers called the **addends** are added to give an answer called the **sum**.

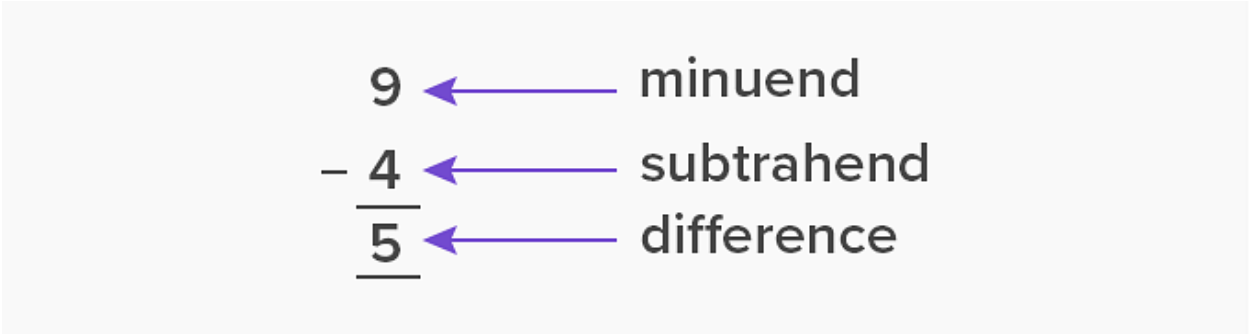


Example 1: The statistics on the Internet suggests that the estimated population of Russia and Mexico is 14,39,64,709 and 13,07,59,074 respectively. If the population of USA is 32,67,66,748, find out whether the population of Russia and Mexico taken together is more than that of USA or not.

	TC	C	TL	L	TTh	Th	H	T	O
			(1)	(1)	(1)			(1)	
	1	4	3	9	6	4	7	0	9
+	1	3	0	7	5	9	0	7	4
	2	7	4	7	2	3	7	8	3

Population of Russia and Mexico = 27,47,23,783
Population of USA = 32,67,66,748
Since, 3 ten crores > 2 ten crores, so the population of USA is more than the population of Russia and Mexico taken together.

Subtraction
When a number called **subtrahend** is subtracted from another number called **minuend**, the result is called their **difference**.



Example 1: The population of Greater Mumbai and Chennai as per 2011 census was 1,63,68,084 and 64,24,624 respectively. How much more is Greater Mumbai's population as compared to Chennai?

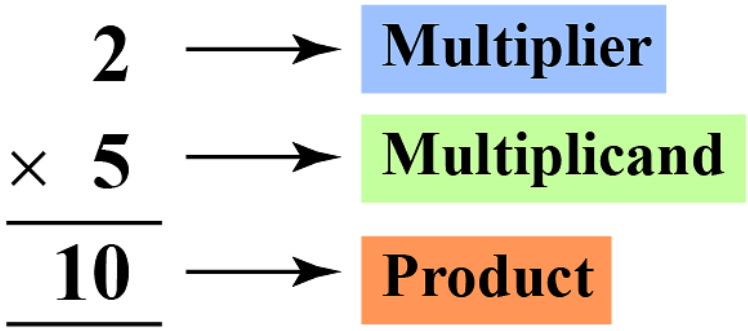
Population of Greater Mumbai = 1,63,68,084
Population of Chennai = 64,24,624
Population difference = 1,63,68,084 – 64,24,624
= 99,43,460

	C	TL	L	TTh	Th	H	T	O
	0	15	13		7	10		
		5						
	1	6	3	6	8	0	8	4
−		6	4	2	4	6	2	4
		9	9	4	3	4	6	0

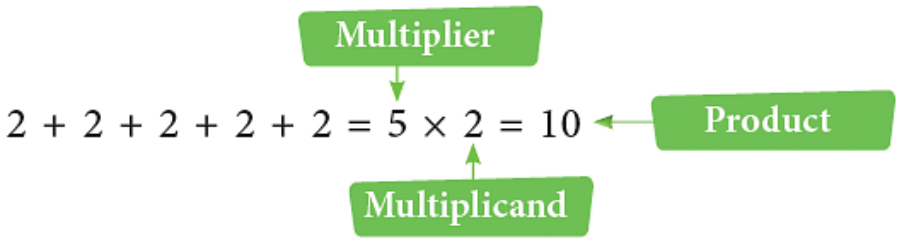
Thus, population of Greater Mumbai is 99,43,460 more than that of Chennai.
You can check subtraction by adding the subtrahend to the difference. If the sum is equal to the minuend, then the subtraction has been carried out correctly.

C	TL	L	TTh	Th	H	T	O	
	6	4	2	4	6	2	4	← Subtrahend
+	9	9	4	3	4	6	0	← Difference
1	6	3	6	8	0	8	4	← Minuend

Multiplication
You know that multiplication is **repeated addition**.
The number which is to be repeated or multiplied is called the **multiplicand.**
The number which expresses how often the multiplicand is repeated is called the **multiplier.**



Multiplier times the multiplicand = Product
For example:



2 added repeatedly five times.

5 times 2 is 10.
or 5 twos are 10.

Working form

$$\begin{array}{r} 2 \\ \times 5 \\ \hline 10 \end{array}$$

Tips: The multiplier and the multiplicand are also called the factors.

Properties of Multiplication

1. Changing the order of factors does not change the product.
   Example: $12 \times 7 = 7 \times 12 = 84$
2. The product of any number and 1 is the number itself.
   Example: $345 \times 1 = 1 \times 345 = 345$
3. Changing the grouping of factors does not change the product.
   Example: $2 \times (4 \times 9) = 2 \times 36 = 72$; $(2 \times 4) \times 9 = 8 \times 9 = 72$
   $\therefore 2 \times (4 \times 9) = (2 \times 4) \times 9 = 72.$
4. The product of any number and 0 is 0.
   Example: $79014 \times 0 = 0$

Multiplication by Multiples of 10

When one or both factors are multiples of 10, you can multiply mentally. Look at the following patterns to revise how

7 × 10 = 70	4 × 20 = 80
7 × 100 = 700	4 × 200 = 800
7 × 1000 = 7000	4 × 2000 = 8000
70 × 100 = 7000	40 × 20 = 800
700 × 100 = 70000	400 × 200 = 80000

- 7×1 ten $= 7$ tens $= 70$
  4×2 hundreds $= 8$ hundreds
  $= 800$
- To multiply by the multiples of 10, first find the product of the front non-zero digits. Then, write as many zeros after the product as there are zeros in both the factors.

Following the same pattern, we can mentally multiply a number by 10000 or 100000 and write the product.

$7156 \times 10000 = 7156 \times 1$ ten thousand $= 7156$ ten thousands $= 71560000$

4 zeros

Insert 4 zeros on the right.

$8614 \times 100000 = 8614 \times 1$ lakh $= 8614$ lakhs $= 861400000$

5 zeros

Insert 5 zeros on the right.

Example 1: Find the products.
(a) 5078 × 200
(b) 1294 × 7000
(c) 71950 × 40000

(a) 5078 × 200 $= 5078 \times (2 \times 100)$
$= (5078 \times 2) \times 100$
$= 10156 \times 100 = 1015600$

(b) 1294 × 7000 $= 1294 \times (7 \times 1000)$
$= (1294 \times 7) \times 1000$
$= 9058 \times 1000$
$= 9058000$

(c) 71950 × 40000 $= 71950 \times (4 \times 10000)$
$= (71950 \times 4) \times 10000$
$= 287800 \times 10000$
$= 2878000000$

Multiplying Large Numbers

Example 1: Multiply:
(a) 70935 by 36
(b) 32893 by 975

(a)

$$
\begin{array}{rr}
 & 70935 \\
 & \times\ 36 \\
\hline
 & 425610 \quad \leftarrow 70935 \times 6 \\
+ & 2128050 \quad \leftarrow 70935 \times 30 \\
\hline
 & 2553660
\end{array}
$$

$\therefore 70{,}935 \times 36 =$ **25,53,660**.

(b)

$$
\begin{array}{rr}
 & 32893 \\
 & \times\ 975 \\
\hline
 & 164465 \quad \leftarrow 32893 \times 5 \text{ ones } (5) \\
 & 2302510 \quad \leftarrow 32893 \times 7 \text{ tens } (70) \\
+ & 29603700 \quad \leftarrow 32893 \times 9 \text{ hundreds } (900) \\
\hline
 & 32070675
\end{array}
$$

$\therefore 32{,}893 \times 975 =$ **3,20,70,675**.

Example 2: Multiply 2892 by 9760.

$$
\begin{array}{rr}
 & 2892 \\
 & \times\ 9760 \\
\hline
 & 0000 \quad \leftarrow 2892 \times 0 \\
 & 173520 \quad \leftarrow 2892 \times 60 \\
 & 2024400 \quad \leftarrow 2892 \times 700 \\
+ & 26028000 \quad \leftarrow 2892 \times 9000 \\
\hline
 & 28225920
\end{array}
$$

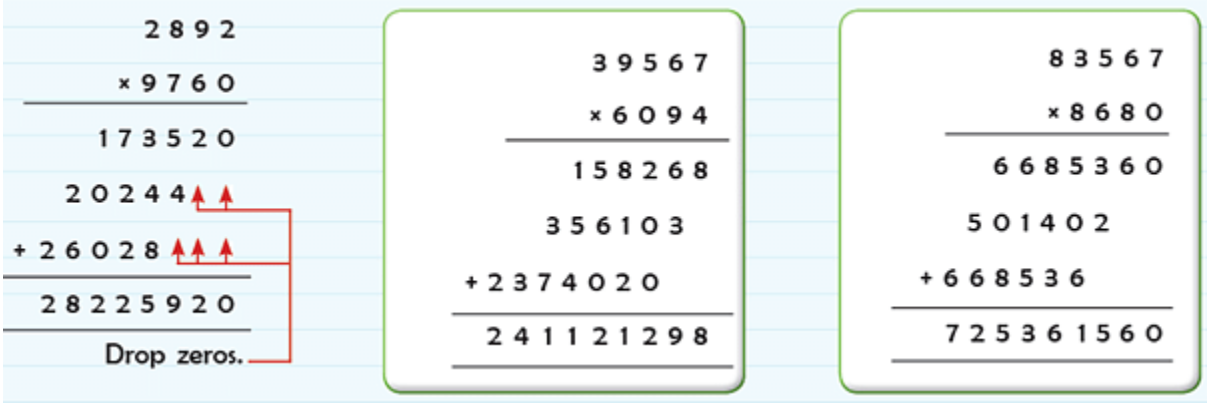
Short Method

$$
\begin{array}{r}
2892 \\
\times\ 9760 \\
\hline
173520 \\
2024400 \\
+\ 26028000 \\
\hline
28225920
\end{array}
$$

Write '0' to indicate multiplication by 0 ones.

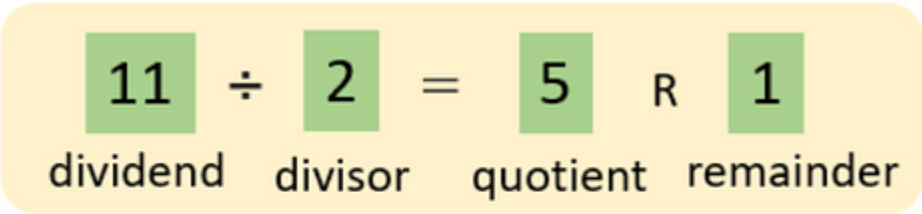
∴ 2892 × 9760 = **2,82,25,920.**

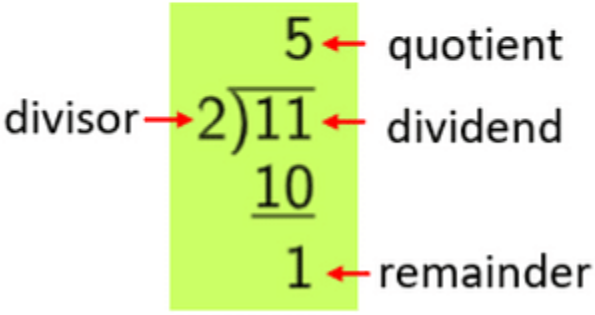
Tips: As shown below, if care is taken in placing the numerals, the zeros may be dropped without changing the product.



Division

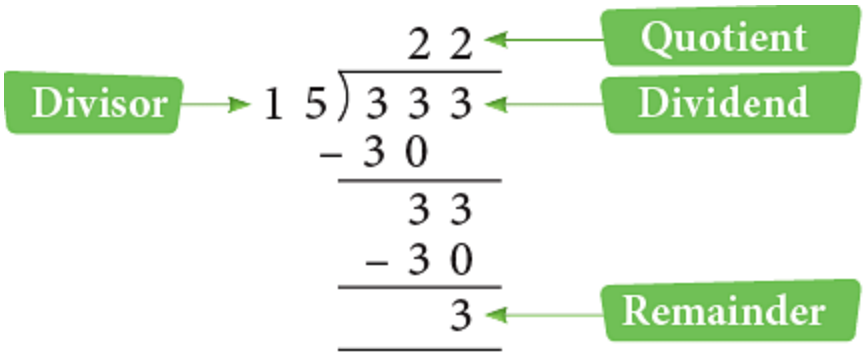
You know that division is the opposite of multiplication. The number to be divided is called the **dividend**. The number which divides is called the **divisor** and the result obtained is called the quotient. The number remaining, in the end, is called the **remainder**.





Parts of a Division

Example 1: Divide 333 by 15.

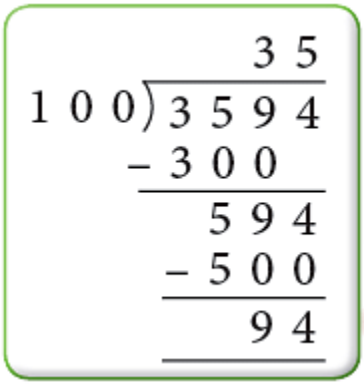


∴ 333 ÷ 15 = **22 R 3**
So, we can check division as under:
15 × 22 + 3 = 330 + 3 = 333

Properties of Division

1. Dividing a number by itself is equal to 1.
   Example: 7876 ÷ 7876 = 1
2. Dividing zero by any number is equal to 0.
   Example: 0 ÷ 38765 = 0
3. Dividing a number by 1 is equal to the number itself.
   Example: 76208 ÷ 1 = 76208
4. Dividing any number by zero is not defined.
   Example: 3893 ÷ 0 (not defined)

Division by Multiples of 10
You have studied about division by multiples of 10 in class 4 in detail. Let us revise the same here.
376 ÷ 10 ⇒ Quotient = 37; Remainder = 6
3594 ÷ 100 ⇒ Quotient = 35; Remainder = 94
7894 ÷ 1000 ⇒ Quotient = 7; Remainder = 894



Thus, we have,

Division	Quotient	Remainder
Any number ÷ 10	All the digits except digit at ones place	Digit at ones place
Any number ÷ 100	All the digits except digits at tens and ones place	Digits at tens and ones place
Any number ÷ 1000	All the digits except digits at hundreds, tens and ones place	Digits at hundreds, tens and ones place

Similarly,

$86963 \div 10000 \Rightarrow$ Quotient = 8; Remainder = 6963

$212095 \div 10000 \Rightarrow$ Quotient = 21; Remainder = 2095

$505940 \div 100000 \Rightarrow$ Quotient = 5; Remainder = 5940

$2386723 \div 100000 \Rightarrow$ Quotient = 23; Remainder = 86723

Separate

Division by a 2-Digit Divisor

Example 1: Divide 6590898 by 95.

```
          6 9 3 7 7
      ┌──────────────
9 5 ) 6 5 9 0 8 9 8
    – 5 7 0          ← Subtract 6 × 95
      ─────
        8 9 0        ← Bring down 0
      – 8 5 5        ← Subtract 9 × 95
      ───────
          3 5 8      ← Bring down 8
        – 2 8 5      ← Subtract 3 × 95
        ─────────
            7 3 9    ← Bring down 9
          – 6 6 5    ← Subtract 7 × 95
          ─────────
              7 4 8  ← Bring down 8
            – 6 6 5  ← Subtract 7 × 95
            ─────────
                8 3
```

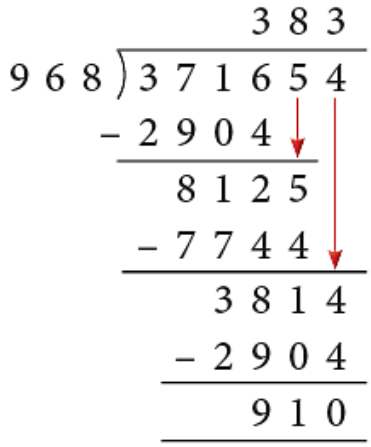
∴ 6590898 ÷ 95 = **69377 R 83.**

Take the first digit 9 of the divisor and divide 65 by 9. 9 sevens are 63 but 7 × 95 = 665, which is greater than 659. So, we take 6 in the quotient and subtract 6 ×

95 = 570 from 659. Now, bring down 0. Take the first two digits of 890, i.e., 89. Divide by 9. 9 nines are 81 and 9 × 95 = 855. Subtract 855 from 890. Bring down 8. Now, proceed further in a similar manner till the remainder is less than 95.

Division by a 3-Digit Divisor

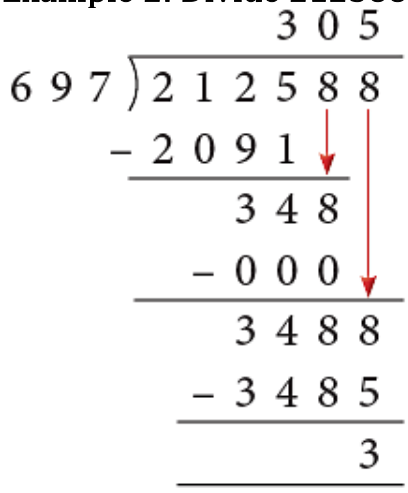
Example 1: Divide 371654 by 968.



∴ 371654 ÷ 968 = **383 R 910.**

The divisor contains 3 digits, so we should consider 3 digits of the dividend, that is, 371. But since 371 is smaller than 968, we have to consider 4 digits, that is, 3716. Take the first digit 9 of the divisor and divide 37 by 9. The trial quotient is 4. But 4 × 968 gives 3872 which is greater than 3716, so take 3 as the quotient, 3 × 968 = 2904. Subtract 2904 from 3716 and bring down the next digit 5. Now, complete the division as shown.

Example 2: Divide 212588 by 697.



∴ 212588 ÷ 697 = **305 R 3.**

Short Method

$$
\begin{array}{r}
305 \\
697\overline{)212588} \\
-2091\downarrow\downarrow \\
\hline
3488 \\
-3485 \\
\hline
3 \\
\hline
\end{array}
$$

We bring down 8 but the divisor 697 cannot divide 348 even once, so we put 0 after 3 in the quotient and bring down 8. Complete as shown.

Operations on Numbers using Estimation

- An estimate is a number close to an exact number which may be obtained by rounding off the exact number.
- We have already learned rounding off numbers in Chapter 3. It helps us to get to a number that is near the actual number.
- We can make use of rounding off the numbers to estimate the sums, differences, products, and quotients.

Estimating Sums

Example: The population of town X is 616817 and that of town Y is 293402. Estimate the total population of both towns to the nearest thousand.

Rounding off the numbers to the nearest thousand, we get,

$616817 \rightarrow 617000$ and $293402 \rightarrow 293000$

$\therefore$ Estimated sum $= 617000 + 293000 =$ **910000**

Estimating Differences

Example: There were 67853 spectators in the stadium, out of which 15229 were children. Estimate the number of adults in the stadium to the nearest thousand.

Total number of spectators in the stadium = 68000 (Rounded off to the nearest thousand)

Total number of children in the stadium = 15000

$\therefore$ Number of adults in the stadium $= 68000 - 15000 = 53000$

So, there were about 53000 adults in the stadium.

Estimating Products

Example: A factory produces 19272 bulbs every month. About how many bulbs will be produced in a year? Also, find the actual answer.
Here, we need to find the product of number of bulbs produced in a month and the number of months.

Actual Product

$$\begin{array}{r} 19272 \\ \times\ 12 \\ \hline 38544 \\ +\ 192720 \\ \hline \mathbf{231264} \end{array}$$

Estimated Product

$$\begin{array}{r} 20000 \\ \times\ 10 \\ \hline \mathbf{200000} \end{array}$$

Rounding off to the nearest 10000

Rounding off to the nearest 10

Tips: While estimating an operation with two numbers with different number of digits, always round off the numbers to the highest place value.

Estimating Quotients

To estimate the quotient, we find the compatible numbers (a multiple of divisor).
For example, to estimate the quotient of 72 and 432.
We round off $72 \rightarrow 70$ and $432 \rightarrow 420$.
$\therefore 7 \times 6 = 42$.
So, the estimated quotient is 6.

Example: The cost of 28 jackets is ₹ 41,580. Find the estimated cost of one jacket.
28 is rounded off to 30 and ₹ 41581 is rounded off to ₹ 42000 as 30 and 42000 are compatible numbers.
$\therefore$ Estimated quotient $= 42000 \div 30 = 1400$.
So, the estimated cost of one jacket is ₹ 1400.