Multiplication

Terms Related to Multiplication

We 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**.

Thus,

$$12 + 12 + 12 = \underbrace{3}_{\text{Multiplier}} \times \underbrace{12}_{\text{Multiplicand}}$$

Multiplier times multiplicand = **Product**

In ab, a is the multiplier and b is the multiplicand written as

$$\begin{array}{r} b \\ \times\ a \\ \hline ab \\ \hline \end{array}$$

Example:

H	T	O	
1	2	5	← Multiplicand
	×	6	← Multiplier
7	5	0	← Product

Multiplication is also used to find the number of objects in an array. (An array is a group of objects or symbols arranged in columns and rows.)

Multiplication fact for the given array:

$$\underbrace{4 \times 6}_{\text{Factors}} = \underbrace{24}_{\text{Product}}$$

Properties of Multiplication

There are five main properties of multiplication which are as follows:

1. Order Property
Two numbers can be multiplied in any order. The product remains the same.

Examples:

- $6 \times 5 = 5 \times 6 = 30$;
- $12 \times 3 = 3 \times 12 = 36$.

2. Grouping Property
The product of three or more numbers remains the same, even if we change the grouping of numbers.

Example:

- $(4 \times 6) \times 3 = 24 \times 3 = 72$;
- $4 \times (6 \times 3) = 4 \times 18 = 72$;
- $(4 \times 3) \times 6 = 4 \times (6 \times 3) = 72$.

3. Multiplication by 1
If we multiply a number by 1, the product is the number itself.

Examples:

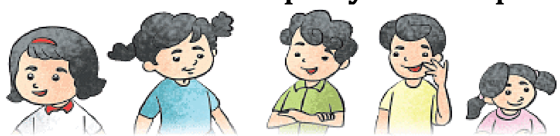
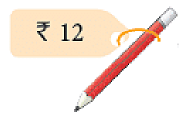
- $7 \times 1 = 7$;
- $6 \times 1 = 6$;
- $9 \times 1 = 9$;
- $18 \times 1 = 1 \times 18 = 18$.

4. Multiplication by 0
If we multiply a number by 0, the product is 0.

Examples:

- $0 \times 6 = 0$;
- $7 \times 0 = 0$;
- $0 \times 17 = 17 \times 0 = 0$.

5. Distributive Property of Multiplication over Addition

Each of the five children buys a pencil and an eraser. How much money did they spend altogether?
You might think that each child pays ₹ 17 or $(12 + 5)$ rupees. Then, you could express the problem as

$5 \times 17 = \boxed{}$ or $5 \times (12 + 5) = \boxed{}$

You might also think that each child pays 12 rupees for a pencil, so they spend 5×12 rupees for pencil. Each child pays 5 rupees for an eraser, so they spend 5×5 rupees for the erasers. The children spend $(5 \times 12) + (5 \times 5)$ rupees altogether.
Is the same amount of money spent in each case? (Yes)
$5 \times 17 = 5 \times (12 + 5) = (5 \times 12) + (5 \times 5) = 60 + 25 = 85$

This idea is called the **distributive property of multiplication over addition**. We say that multiplication distributes over addition.

Distributes

Over

$$5 \times 17 = 5 \times (10 + 7) = (5 \times 10) + (5 \times 7)$$
$$= 50 + 35$$
$$= 85$$

Tips: The term "distributive" conveys the same idea for which it is used in practical life. A wholesaler distributes goods to several retailers. Electricity is distributed from a generating plant to homes and factories. Books are distributed by a teacher to pupils and so on.

This idea is called the distributive property of multiplication over addition. We say that multiplication distributes over addition.

Multiplication Tables

To help you revise and understand the multiplication tables, the multiplication tables from 1 to 20 in the form of multiplication grid are given below.

×	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
4	4	8	12	16	20	24	28	32	36	40
5	5	10	15	20	25	30	35	40	45	50
6	6	12	18	24	30	36	42	48	54	60
7	7	14	21	28	35	42	49	56	63	70
8	8	16	24	32	40	48	56	64	72	80
9	9	18	27	36	45	54	63	72	81	90
10	10	20	30	40	50	60	70	80	90	100
11	11	22	33	44	55	66	77	88	99	110
12	12	24	36	48	60	72	84	96	108	120
13	13	26	39	52	65	78	91	104	117	130
14	14	28	42	56	70	84	98	112	126	140
15	15	30	45	60	75	90	105	120	135	150
16	16	32	48	64	80	96	112	128	144	160
17	17	34	51	68	85	102	119	136	153	170
18	18	36	54	72	90	108	126	144	162	180
19	19	38	57	76	95	114	133	152	171	190
20	20	40	60	80	100	120	140	160	180	200

You can read the table as shown by colour lines.

Thus, $4 \times 5 = 20$, $7 \times 5 = 35$, $7 \times 7 = 49$, $18 \times 9 = 162$.

Multiplying by 10, 100, 1000, …

Study the following multiplication facts.

$3 \times 1 = 3$ $3 \times 10 = 30$ $3 \times 100 = 300$ $3 \times 1000 = 3000$	$10 \times 1 = 10$ $10 \times 10 = 100$ $10 \times 100 = 1000$ $10 \times 1000 = 10000$	$67 \times 1 = 67$ $67 \times 10 = 670$ $67 \times 100 = 6700$ $67 \times 1000 = 67000$

What do you observe?

We observe that,

1. to multiply a number by 10, put one zero on the right of the given number.
2. to multiply a number by 100, put two zeros on the right of the given number.
3. to multiply a number by 1000, put three zeros on the right of the given number.

4. to multiply a number by 10000, put four zeros on the right of the given number. Similarly, if you have to multiply by 10,0000, put 5 zeros on the right of the given number and so on.

Multiplying by a Multiple of 10, 100, 1000, ...

Observe the following:

- $387 \times 30 = 387 \times 3 \times 10 = (387 \times 3) \times 10 = 1161 \times 10 = 11610$
- $609 \times 50 = 609 \times 5 \times 10 = (609 \times 5) \times 10 = 3045 \times 10 = 30450$
- $1821 \times 800 = 1821 \times 8 \times 100 = (1821 \times 8) \times 100 = 14568 \times 100 = 1456800$
- $120 \times 900 = 12 \times 10 \times 9 \times 100 = (12 \times 9) \times (10 \times 100) = 108 \times 1000 = 108000$

What do you observe?
Multiply the non-zero factors. Put as many zeros at the end of the product as the number of zeros at the end of the factors.

Multiplication by a 1-Digit Multiplier

Example 1: Multiply 4872 by 4.

We proceed as per these steps:
Step 1: Arrange the multiplicand and multiplier, as shown.
Step 2: Multiply the ones.
Step 3: Multiply tens, regroup and carry.
Step 4: Multiply hundreds, regroup and carry.
Step 5: Multiply thousands.

$$\begin{array}{r} \scriptstyle 3\ 2 \\ 4\,8\,7\,2 \\ \times\ 4 \\ \hline 1\,9\,4\,8\,8 \\ \hline \end{array} \qquad \begin{array}{r} 4\,8\,7\,2 \\ \times\ 4 \\ \hline 1\,9\,4\,8\,8 \\ \hline \end{array}$$

You may carry mentally and write as above.

Multiplication by a 2-Digit Multiplier

Example 2: Multiply 137 by 23.

We have,

$137 \times 23 = 137 \times (20 + 3)$

$\quad = 137 \times 20 + 137 \times 3$

$\quad = 2740 + 411 =$ **3151.**

	1	3	7	
	×	2	3	
	4	1	1	← (137 × 3)
2	7	4	0	← (137 × 20)
3	1	5	1	

Example 3: Multiply 3598 by 67.

$3598 \times 67 = 3598 \times (60 + 7) = 3598 \times 60 + 3598 \times 7$

			3	5	9	8
			×		6	7
(3598 × 7) →		2	5	1	8	6
(3598 × 60) →	2	1	5	8	8	0
	2	4	1	0	6	6

You may omit this zero and write as shown on the right

		3	5	9	8	
		×		6	7	
	2	5	1	8	6	
2	1	5	8	8		← 0 is omitted
2	4	1	0	6	6	

Problems Based on Real Life Situations

Example 4: Ashok ordered 32 gross pencils for the school. How many pencils were ordered?

1 Gross = 144

So, 32 gross pencils = 144 × 32 = 4608

	1	4	4
	×	3	2
	2	8	8
4	3	2	0
4	6	0	8

So, Ashok ordered **4608** pencils.

Example 5: A cricket stadium has 456 rows with 20 seats in each row. How many seats are there in the stadium?

Number of seats in each row = 20
Number of rows = 456
Total number of seats = $456 \times 20 = 9120$

$$\begin{array}{r} 456 \\ \times\ 20 \\ \hline 9120 \end{array}$$

Then, there are 9120 seats in the stadium.

Multiplication by a 3-Digit Multiplier

Example 6: Multiply 256 by 248.

$256 \times 248 = 256 \times (200 + 40 + 8)$

Step 1: Multiply 256 by 8.

$$\begin{array}{r} 256 \\ \times\ \ \ 8 \\ \hline 2048 \end{array}$$

Step 2: Multiply 256 by 40.

$$\begin{array}{r} 256 \\ \times\ 40 \\ \hline 10240 \end{array}$$

Step 3: Multiply 256 by 200.

$$\begin{array}{r} 256 \\ \times\ 200 \\ \hline 51200 \end{array}$$

Step 4: Add the above three products.

2048 + 10240 + 51200 = **63488.**

Short Method:

		2	5	6	← Multiplicand
	×	2	4	8	← Multiplier
	2	0	4	8	← (256 × 8)
1	0	2	4	0	← (256 × 40)
5	1	2	0	0	← (256 × 200)
6	3	4	8	8	← Product

Example 7: Multiply 656 by 203.

			6	5	6	
		×	2	0	3	
		1	9	6	8	← Multiply by 3 ones
		0	0	0		← Multiply by 0 tens
1	3	1	2			← Multiply by 2 hundreds
1	3	3	1	6	8	

Short Method

			6	5	6	
		×	2	0	3	
		1	9	6	8	
1	3	1	2	0		Write ‘0’ to indicate multiplication by 0 tens.
1	3	3	1	6	8	

Example 8: Multiply 432 by 350.

		4	3	2	
	×	3	5	0	
2	1	6	0	0	← Write ‘0’ to indicate multiplication by ‘0’ ones.
1	2	9	6		← Multiplication by 3 hundreds. Zeros omitted at the ones and tens place.
1	5	1	2	0	0

∴ 432 × 350 = **151200.**

Example 9: Multiply 1038 × 809.

		1	0	3	8
		×	8	0	9
		9	3	4	2
8	3	0	4	0	
8	3	9	7	4	2

Write 0 to indicate multiplication by '0' tens.

∴ 1038 × 809 = **839742.**

Problems Based on Real Life Situations

Example 10: A baker bakes 765 cakes in a day. How many cakes does he bake in a normal year?

Number of cakes baked in a day = 765
Number of cakes baked in a year = (765 × 365)
1 year = 365 days
= 279225

			7	6	5
		×	3	6	5
		3	8	2	5
	4	5	9	0	0
2	2	9	5	0	0
2	7	9	2	2	5

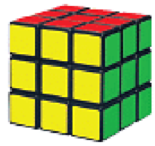
∴ Thus, the baker bakes **2,79,225** cakes in a year.

Estimating Products

Mr Das wants to buy the toys shown below for his daughter Kiran. He would like to know approximately how much the toys will cost him.

Here, he wants to know the approximate cost.

₹ 86



₹ 86

₹ 86

When we give an approximate answer close to the exact answer, we are **estimating.**

We round off the numbers and then estimate the product. Here, the cost of the three toys is 3 × ₹ 86.
Rounding up 86 to 90, the estimated cost = 3 × ₹ 90 = ₹ 270.

Example 11: Estimate the product 38 × 44.

38	→	40	Rounded up to the nearest ten
× 44	→	× 40	Rounded down to the nearest ten
		1600	Estimated product

Actual product = 38 × 44 = **1672**

Example 12: Estimate the product 516 × 393 to the nearest
(a) tens
(b) hundreds.

(a) 516	→	520	Rounded up to the nearest ten
× 393	→	× 390	Rounded down to the nearest ten
		202800	Estimated product

(b) 516	→	500	Rounded down to the nearest hundred
× 393	→	× 400	Rounded up to the nearest hundred
		200000	Estimated product

Actual product = 516 × 393 = 202788

From the above results, we see that rounding off to the nearest ten produces a closer approximate of the exact product than rounding off to the nearest hundred. However, 520×390 involves more calculations than 500×400.

Tips: To estimate a product, we round off the multiplier and the multiplicand to the nearest ten, hundred or thousand, whichever is more convenient. Then, multiply the rounded numbers to get the estimated product.