

UNIT-17

MULTIPLICATION : BY URDVATIRYAK METHOD



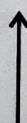
- Multiplication : by Urdvatiryak method

Introduction: “Vedic Ganita Sutra” are a part of mathematical calculation methods in our Ancient Vedas. At that time when we do not have calculators and other devices then these sutras were the tools to speedy calculations. We all know about multiplication of numbers; here we will learn to multiply two digit and three digit number by vedic sutras.

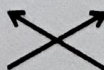
Urdvatiryak Sutra: Urdvatiryak Sutra is applicable to all type of multiplication. (It is also used in division of numbers.) This sutra is itself very consiced with only one word which means Urdva (i.e. vertical) and tiryak (i.e. diagonal).

Mathematical meaning

(i) Vertical Multiplication (Urdva)



(ii) Diagonal Multiplication (Tiryak)



(iii) Vertical and Horizontal Multiplication



Firstly we will see elementary uses

1.1 Vertical Multiplication of 3 and 5

$$\begin{array}{r} 3 \uparrow \\ 5 \downarrow \\ \hline 3 \times 5 \end{array}$$

1.2 Diagonal Multiplication of 35 and 67

$$\begin{array}{r} 3 \swarrow \quad \searrow 5 \\ 5 \swarrow \quad \searrow 7 \\ \hline (3 \times 5) + (6 \times 5) \end{array}$$

1.3 Vertical and Diagonal multiplication of 123 and 876

$$\begin{array}{r} 1 \swarrow \quad \uparrow 2 \quad \searrow 3 \\ 8 \swarrow \quad \uparrow 7 \quad \searrow 6 \\ \hline (1 \times 6) + (2 \times 7) + (3 \times 8) \end{array}$$

Note : In the process of multiplication number by whom we multiply is called multiplier and to whom we multiply is called multiplicand.

A simple example can explain this activity suppose we have to multiply by 13 to 12.

13 - Multiplier

12 - Multiplicant

Procedure :

- (i) We multiply right most digit of multiplier i.e. 3 to that of multiplicand i.e. 2 and product will be the right most digit of the product.

$$\begin{array}{r} 1 \quad 2 \uparrow \\ 1 \quad 3 \downarrow \\ \hline 6 \end{array}$$

- (ii) Now we will multiply 1 and 2 with 1 and 3 diagonally and add the products, will give middle digit of answer product.

$$\begin{array}{r} 1 \swarrow \quad \searrow 2 \\ 1 \swarrow \quad \searrow 3 \\ \hline (2+3) \end{array}$$

(iii) Now we multiply left most digits 1 and 1 vertically will give left most digit of the Product.

$$\begin{array}{r} 1 \uparrow 2 \\ 1 \uparrow 3 \\ \hline 1 \times 1 \end{array}$$

Comprehensively

$$\begin{array}{r} 1 \quad 2 \\ 1 \quad 3 \\ \hline 1/3 + 2/6 \end{array}$$

=156

Example

$$\begin{array}{r} 2 \quad \boxed{1} \uparrow \\ 1 \quad \boxed{4} \uparrow \\ \hline 2/8 + 1/4 \end{array}$$

= 294

Example

$$\begin{array}{r} 4 \quad 1 \\ 4 \quad 1 \\ \hline 16/4 + 4/1 \end{array}$$

= 1681

Remark : When ever product or result in any part is in two digits, write right digit and left one is added to the next part. Such carry patterns are explained in following examples,

Example

$$\begin{array}{r} 1 \quad 5 \\ 1 \quad 5 \\ \hline 1/5 + 5/25 \end{array}$$

= 225

For product, 25 digit 5 is at its place 2 is carried to 5+5 becomes 12 again is there and 1 is carried as (+)=2 another example of same procedure is given below.

Example

$$\begin{array}{r} 3 \quad 7 \\ 3 \quad 3 \\ \hline 9/2 \quad 0/2 \quad 1 \end{array}$$

$$= 1221$$

Example

$$\begin{array}{r} 4 \quad 9 \\ 4 \quad 9 \\ \hline 16/2 \quad 2/8 \quad 1 \end{array}$$

$$= 2401$$

Exercise X (a)

1. Solve the following
 - (i) Multiply ab and ef vertically.
 - (ii) Write all vertical multiple of 123 and 789.
 - (iii) Write all diagonal multiplier of 13 and 24.
2. Find product of following pair of numbers by "Urdvatiryakbhyam" i.e. "Vertically diagonal method".
 - (i) 16 and 11
 - (ii) 21 and 16
 - (iii) 23 and 21
3. Find product
 - (i) 32 and 32
 - (ii) 83 and 92
 - (iii) 46 and 35

Answer X (a)

1. (i) ac and bf
 - ii. $(1 \times 7), (2 \times 8), (3 \times 9)$
 - iii. $(1 \times 4), (3 \times 2)$
2. i. 176
 - ii. 336
 - iii. 483
3. i. 1024
 - ii. 7636
 - iii. 1610

Multiplication of any three digit multiplier and three digit multiplicand-

Procedure – 111 and 111 multiplication

- (i) We will multiply right most digit of multiplier i.e. to that of multiplicand i.e.

$$\begin{array}{r} 1 \quad 1 \quad \boxed{1} \\ 1 \quad 1 \quad \boxed{1} \\ \hline 1 \end{array}$$

- (ii) Now we multiply diagonally to the right most two digits of multiplier and multiplicand and add.

$$\begin{array}{r} 1 \quad 1 \quad 1 \\ 1 \quad 1 \quad 1 \\ \hline (1+1) \end{array}$$

- (iii) Now we multiply diagonally and first and last digits of multiplier and multiplicand and middle digits vertically and add them

$$\begin{array}{r} 1 \quad 1 \quad 1 \\ 1 \quad 1 \quad 1 \\ \hline (1 \times 1) + (1 \times 1) + (1 \times 1) \end{array}$$

- (iv) Now we multiply left most two digits of multiplier and multiplicand diagonally

$$\begin{array}{r}
 1 \quad 1 \quad 1 \\
 \swarrow \quad \searrow \quad \swarrow \\
 1 \quad 1 \quad 1 \\
 \hline
 (1 \times 1)
 \end{array}$$

- (v) Multiplying left most digits of multiplier and multiplicand vertically

$$\begin{array}{r}
 1 \quad 1 \quad 1 \\
 \uparrow \quad \uparrow \quad \uparrow \\
 1 \quad 1 \quad 1 \\
 \hline
 1
 \end{array}$$

Comprehensively

$$\begin{array}{r}
 1 \quad 1 \quad 1 \\
 1 \quad 1 \quad 1 \\
 \hline
 1/2/2+1/2/1
 \end{array}$$

$$= 1231$$

Example: Multiplication of 102 and 104

i.

$$\begin{array}{r}
 1 \quad 0 \quad \boxed{2} \\
 1 \quad 0 \quad \boxed{4} \\
 \hline
 8
 \end{array}$$

ii.

$$\begin{array}{r}
 1 \quad 0 \quad 2 \\
 1 \quad 0 \quad 4 \\
 \hline
 0
 \end{array}$$

iii.

$$\begin{array}{r}
 1 \quad 0 \quad 2 \\
 \swarrow \quad \searrow \quad \swarrow \\
 1 \quad 0 \quad 4 \\
 \hline
 (4)+(2)+(0)
 \end{array}$$

iv.

$$\begin{array}{r}
 1 \quad 0 \quad 2 \\
 1 \quad 0 \quad 4 \\
 \hline
 0
 \end{array}$$

v.

$$\begin{array}{r}
 \boxed{1} \uparrow 0 \ 2 \\
 \boxed{1} \uparrow 0 \ 4 \\
 \hline
 1
 \end{array}$$

Comprehensive form

$$\begin{array}{r}
 1 \ 0 \ 2 \\
 \times 1 \ 0 \ 4 \\
 \hline
 1/0/6/0/8
 \end{array}$$

$$= 10608$$

Three Digit Multiplication with carry

Example: Multiplication of 109 and 111

i.

$$\begin{array}{r}
 1 \ 0 \ \boxed{9} \uparrow \\
 \times 1 \ 1 \ \boxed{1} \uparrow \\
 \hline
 9
 \end{array}$$

ii.

$$\begin{array}{r}
 1 \ 0 \ 9 \\
 1 \ 1 \ 1 \\
 \hline
 9
 \end{array}$$

iii.

$$\begin{array}{r}
 1 \ 0 \ 9 \\
 1 \ 1 \ 1 \\
 \hline
 (1)+(9)+(0)=10
 \end{array}$$

iv.

$$\begin{array}{r}
 1 \ 0 \ 9 \\
 1 \ 1 \ 1 \\
 \hline
 1
 \end{array}$$

v.

$$\begin{array}{r}
 \boxed{1} \uparrow 0 \ 9 \\
 \boxed{1} \uparrow 1 \ 1 \\
 \hline
 1
 \end{array}$$

Comprehensive form

$$\begin{array}{r}
 1 \ 0 \ 9 \\
 \times 1 \ 1 \ 1 \\
 \hline
 1/1/1/0/9/9
 \end{array}$$

$$= 12099$$

Exercise X (b)

1. Find product of following pair of numbers

(i) 101 and 102

(ii) 103 and 100

2. Find product

(i) 116 and 114

(ii) 582 and 231

(iii) 116 and 117

Answer X (b)

1 (i) 10302 (ii) 10300

2 (i) 13224 (ii) 134442 (iii) 13572

Multiplication by Aadhar method (Ancient Indian mathematical method)

Let us learn multiplication by simple and attractive vedic maths methods other than multiplication methods followed nowadays this method need only table upto 5.

Aadhar (base) method – Aadhar is always in the power of 10 or 10 itself. In this ways aadhar are 10, 100, 1000, 10000, etc. If we multiply any two numbers nearer to these aadhar, first by using Nikilam sutra we find puraka of these number from aadhar. If number is smaller than aadhar the purak will be negative and if larger purak will be positive.

Number	Aadhar (base)	Purak
8	10	$8 - 10 \cdot -2$
15	10	$15 - 10 \cdot \pm 5$
95	100	$95 - 100 \cdot -5$
102	100	$102 - 100 \cdot \pm 2$
112	100	$112 - 100 \cdot \pm 12$
1009	1000	$1009 - 1000 \cdot \pm 9$

Multiplication procedure by Aadhar method.

- Step 1 – To find Aadhar and purak of given number.
 Step 2 – Two sides of multiplication
 Left hand side – puraks (+ve, -ve) with sign
 Right hand side – Number
 Step 3 – Multiply purak numbers and add carry to left digit of Right hand side number.
 Step 4 – Left hand side number is added or subtracted to purak, as per sign.

Example – Multiply 9 and 7.

Step 1-

Numbers	Purak
9	$9 - 10 = -1$
7	$7 - 10 = -3$

Step 2-

Left Hand Side	Right Hand Side
9	-1
7	-3

Step 3- R.H.S. purak product $1 \times 3 = 3$

Therefore

$$\begin{array}{r}
 9 \quad -1 \\
 7 \quad -3 \\
 \hline
 6 \quad / \quad 0 \\
 \quad 3 \\
 \hline
 6 \quad / \quad 3
 \end{array}$$

Ans. -63

Example – Multiply 6 and 7.

L.H.S	R.H.S
6	4
7	3
3	0
	12
3+1	2
4	2

Ans. - 42

Example – Multiply 95 and 99.

L.H.S.	R.H.S.
95	5
99	1
94	00
	+ 5
94	05

Ans. - 9405

Example – Multiply 102 and 107.

L.H.S.	R.H.S
102	2
107	7
109	00
	+ 14
109	14

Ans. - 10914

Note – With the help above procedure try to solve problem with aadhar 1000, 10000 etc.

Exercise X (c)

1. Solve following by aadhar method

(i) Multiply 9 and 8

(ii) Multiply 11 and 12

(iii) Multiply 7 and 6

(iv) Multiply 99 and 92

2. Ravi wants to plant mangoes in 96 rows with 97 plant in each row in his school playground. How many mango plants are required in all?
3. Multiply
 - (i) 998 by 997
 - (ii) 1012 by 1007
 - (iii) 107 by 102

Upto this we have puraks either both positive or both negative. Now we will learn to multiply numbers where one of purak is positive and other is negative.

Positive purak	×	Positive purak	=	Results positive purak
Negative purak	×	Negative purak	=	Results positive purak
Positive purak	×	Negative purak	=	Results Negative purak
Negative purak	×	Positive purak	=	Results Negative purak

Example – Multiply 12 and 9.

L.H.S.		R.H.S.
12	$\swarrow \quad \nearrow$	+ 2
9	$\nearrow \quad \swarrow$	- 1
11	/	0
		- 2
10	/	10
		- 2
10	/	8

Ans. - 108

Example – Multiply 15 and 6.

L.H.S.	R.H.S.
$\begin{array}{r} 15 \\ 6 \end{array}$	$\begin{array}{r} +5 \\ -4 \end{array}$
$\begin{array}{r} 11 \end{array}$	$\begin{array}{r} 0 \end{array}$
	-20
$\begin{array}{r} 11-2 \end{array}$	$\begin{array}{r} 0 \end{array}$
$\begin{array}{r} 9 \end{array}$	$\begin{array}{r} 0 \end{array}$

Ans. - 90

Example – Multiply 105 and 967.

L.H.S.		R.H.S.
105	$\swarrow \quad \searrow$	± 5
96		$- 4$
101	/	00
		- 20
100	/	100
		- 20
100	/	80

Ans. - 10080

Exercise X (d)

1. Solve following problems by Aadhar method

(i) Multiply 11 by 9

(ii) Multiply 12 by 8

(iii) Multiply 15 by 6

2. Multiply

(i) 107 by 95

(ii) 102 by 99

(iii) 109 by 91

3. Multiply

(i) 992 by 1003

(ii) 998 by 1009

Answers X (c)

1. (i) 72

(ii) 132

(iii) 42

(iv) 9108

2. 9312

3. (i) 995006

(ii) 1019084

(iii) 10914

Answers X (d)

1. (i) 99

(ii) 96

(iii) 90

2. (i) 10165

(ii) 10098

(iii) 9919

3. (i) 994976

(ii) 1006982

We learn

- ◆ Students got awarded about aadhar method of vedic maths.
- ◆ Students are able to multiply with one purak positive and other purak negative. Type multiplication of numbers.
- ◆ Students are able to multiply different numbers below aadhar (negative puraks)
- ◆ Students are able to multiply different numbers above aadhar (positive puraks)