

**Chapter- 4**

**Special Multiplication Methods**

Multiplication in considered as one of the most difficult of the four mathematical operations. Students are scared of multiplication as well as tables. Just by knowing tables up to 5 students can multiply bigger numbers easily by some special multiplication methods of Vedic Mathematics. We should learn and encourage children to look at the special properties of each problem in order to understand it and decide the best way to solve the problem. In this way we also enhance the analytical ability of a child. Various methods of solving the questions /problems keep away the monotonous and charge up student’s mind to try new ways and in turn sharpen their brains.

# Easy way for multiplication

**Sutra:Vertically and Cross wise** :

For speed and accuracy tables are considered to be very important. Also students think why to do lengthy calculations manually when we can do them faster by calculators. So friends/ teachers we have to take up this challenge and give our students something which is more interesting and also faster than a calculator. Of course it’s us (the teachers/parents) who do understand that more we use our brain, more alert and active we will be for, that is the only exercise we have for our brain.

**Example 1**: 7 x8

**Step 1**: Here base is 10,

7 – 3 (7 is 3 below 10) also called deficiencies

× 8 – 2 (8 is 2 below 10) also called deficiencies

**Step 2**: Cross subtract to get first figure (or digit) of the answer: 7 – 2 = 5 or 8 – 3 = 5 , the two difference are always same.

**Step 3** : Multiply vertically *i.e.* –3 × –2 = 6 which is second part of the answer. So, 7 – 3

8 – 2 *i.e.* 7 × 8 = 56

5 / 6

**Example 2**: To find 6 × 7

**Step 1** : Here base is 10,

1. – 4 (6 is 4 less than 10) *i.e.* deficiencies
2. – 3 (7 is 3 less than 10) *i.e.* deficiencies

**Step 2**: Cross subtraction : 6 – 3 = 3 or 7 – 4 = 3 (both same)

**Step 3**: – 3 × – 4 = + 12 , but 12 is 2 digit number so we carry this 1 over to 3 ( obtained in 2 step) 6– 4

7 – 3

3 / (1) 2 *i.e.* 6 × 7 = 42

**Try these** : (1) 9 × 7 (ii) 8 × 9 ( iii) 6 × 9 (iv) 8 × 6 (v) 7 × 7

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# Second Method:

**Same Base Method** :

When both the numbers are more than the same base. This method is extension of the above method i.e. we are going to use same sutra here and applying it to larger numbers.

**Example 1**: 12 × 14

**Step 1**: Here base is 10

12 + 2 [12 is 2 more than 10 also called surplus]

14 + 4 [14 is 4 more than 10also called surplus]

**Step 2**: Cross add: 12 + 4 =16 or 14 + 2 = 16,(both same) which gives first part of answer = 16

**Step 3**: Vertical multiplication: 2 × 4 = 8

So, 12 + 2

14 +4

16 / 8So, 12 × 14 = 168

(14 + 2 = 12 + 4)

**Example 2**:105x 107

**Step1:** Here base is 100

105 + 05 [105 is 5 more than 100 or 5 is surplus]

107 + 07 [107 is 7 more than 100 or 7 is surplus]

Base here is 100 so we will write 05 in place of 5and 07 in place of 7

**Step 2**: Cross add: 105 + 7 = 112 or 107 + 5 = 112 which gives first part of the answer = 112

**Step 3**: Vertical multiplication: 05 × 07 = 35 (two digits are allowed)

As the base in this problem is 100 so two digits are allowed in the second part. So, 105 × 107 = 11235

**Example 3**: 112 x 115

**Step 1**: Here base is 100

112 + 12 [2 more than 100 i.e. 12 is surplus]

115 + 15 [15 more than 100 i.e. 15 is surplus]

**Step 2**: Cross add: 112 + 15 = 127 = 115 + 12 to get first part of answer

*i.e.*127

**Step 3**: Vertical multiplication 12 × 15 = ? Oh, my god!It’s such a big number. How to get product of this? Again use the same method to get the product.

12 + 2

15 + 5

12 + 5 = 15 + 2 = 17/ (1) 0, 17 + 1 / 0 = 180 *i.e.* 12 × 15 = 180

But only two digits are allowed here, so 1 is added to 127 and we get (127 + 1) = 128 So, 112 × 115 = 128, 80

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**Try these**: (i)12 × 14 (ii) 14 × 17 (iii) 17 × 19 (iv) 19 × 11 (v) 11 × 16 (vi) 112 × 113 (vii) 113 × 117

(viii) 117 × 111 (ix) 105 × 109 (x) 109 × 102 (xi) 105 × 108 (xii) 108 × 102 (xiii) 102 × 112 (xiv ) 112

× 119 (xv) 102 × 115

# Both numbers less than the same base:

Same sutra applied to bigger numbers which are less than the same base.

**Example1**: 99 × 98

**Step 1**: Check the base: Here base is 100 so we are allowed to have two digits on the right hand side.

 99 – 01 (1 less than 100 ) i.e. 01 deficiency

98 – 02 (2 less than 100) i.e. 0 2 deficiency

**Step 2**: Cross – subtract: 99 – 02 = 97 = 98 – 01 both same so first part of answer is 97

**Step3**: Multiply vertically – 01 × – 02 = 02 (As base is 100 so two digits are allowed in second part So, 99 × 98 = 9702

**Example 2** : 89 × 88

**Step1**: Here base is 100

So, 89 – 11 (i.e. deficiency = 11)

88 – 12 (i.e. deficiency = 12)

**Step2**: Cross subtract: 89 – 12 = 77 = 88 – 11(**both same)**

So, first part of answer can be 77

**Step 3:**Multiply vertically – 11 × – 12

Again to multiply 11 × 12 apply same rule 11 + 1 (10 + 1)

12 + 2 (10 + 2)

11 + 2 = 13 = 12 + 1 / 1 × 2 = 12 so, 11 × 12 = (1) 32 as only two digits are allowed on right hand side so add 1to L.H.S.

So, L.H.S. = 77 + 1 = 78

Hence 89 × 88 = 7832

**Example 3**: 988 × 999

**Step 1**: As the numbers are near 1000 so the base here is 1000 and hence three digits allowed on the right hand side

988 – 012 (012 less than 1000) i.e. deficiency = 0 12

999 – 001 (001 less than 1000) i.e. deficiency = 00 1

**Step 2**: Cross – subtraction: 988 – 001 = 987 = 999 – 012 = 987 So first part of answer can be 987

**Step 3**: Multiply vertically: –012 xs – 001 = 012 (three digits allowed)

 988 × 999 = 987012

How to check whether the solution is correct or not by 9 – check method.

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**Example 1**: 99 × 98 = 9702 Using 9 – check method.

As,

 0

98  8

99

Product (L.H.S.) = 0 × 8 = 0 [taking 9 = 0]

R.H.S. = 9702  7  2  9  0

9702  9

both are same

As both the sides are equal answer may be correct.

**Example 2**: 89 × 88 = 7832

89  8

88 = 8 + 8 = 16 = 1 + 6 = 7 (add the digits)

L.H.S. = 8 × 7 = 56 = 5 + 6 = 11 = 2 (1 + 1)

R.H.S. = 7832 = 8 + 3 = 11 = 1 + 1 = 2

As both the sides are equal, so answer is correct

**Example 3**: 988 × 999 = 987012

988 = 8 + 8 = 16 = 1 + 6 =7

= 0

999

As 0 × 7 =0 = LHS

987012 = 0 (As 7 + 2 = 9 = 0 , 8 + 1 = 9 = 0 also 9 = 0 )

 RHS = 0

As LHS = RHS So, answer is correct.

# Try These*:*

(i) 97 × 99 (ii) 89 × 89 (iii) 94 × 97 (iv) 89 × 92 (v) 93 × 95 (vi) 987 × 998 (vii) 997 × 988 (viii) 988

× 996 (ix) 983 × 998 (x) 877 × 996 (xi) 993 × 994 (xii) 789 × 993 (xiii) 9999 × 998 (xiv) 7897 × 9997

(xv) 8987 × 9996.

**Multiplying bigger numbers close to a base:** (number less than base)

**Example 1**: 87798 x 99995

**Step1**: Base here is 100000 so five digits are allowed in R.H.S.

87798 – 12202 (12202 less than 100000) deficiency is 12202

99995 – 00005 (00005 less than100000) deficiency is 5

**Step 2:** Cross – subtraction: 87798 -00005 =87793

Also 99995 – 12202 = 87793 (both same) So first part of answer can be 87793

**Step 2 : M**ultiply vertically: –12202 × – 00005 = + 61010

 87798 × 99995 = 8779361010

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# Checking:

87798 total 8 + 7 + 7 + 8 = 30 = 3 (single digit)

99995 total = 5

LHS = 3 x 5 =15 total = 1 + 5 = 6

RHS = product = 8779361010 total = 15 = 1 + 5 = 6

L.H.S = R.H.S. So, correct answer

**Example 2 :** 88777 × 99997

**Step 1**: Base have is 100000 so five digits are allowed in R.H.S.

88777 – 11223 i.e. deficiency is 11223

99997 – 00003 i.e. deficiency is 3

**Step 2**: Cross subtraction: 88777 – 00003 = 88774 = 99997 – 11223 So first part of answer is 88774

**Step 3**: Multiply vertically: – 11223 × – 00003 = + 33669

 88777 × 99997 = 8877433669

# Checking:

88777 total 8 + 8 + 7 + 7 + 7 = 37 = + 10 = 1

99997 total = 7

 LHS = 1 × 7 = 7

RHS = 8877433669 =8 + 8 + 7 + 7 + 4 = 34 = 3 + 4 = 7

i.e. LHS = RHS So, correct answer

# Try These:

(i) 999995 × 739984 (ii) 99837 × 99995 (iii) 99998 × 77338 (iv) 98456 × 99993 (v) 99994 × 84321

# Multiply bigger number close to base (numbers more than base)

**Example 1**: 10021 × 10003

**Step 1**: Here base is 10000 so four digits are allowed 10021 + 0021 (Surplus)

10003 + 0003 (Surplus)

**Step 2**: Cross – addition 10021 + 0003 = 10024 = 10003 + 0021 (both same)

 First part of the answer may be 10024

**Step 3**: Multiply vertically: 10021 × 0003 = 0063 which form second part of the answer

 10021 × 10002 = 100240063

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# Checking:

10021 = 1+ 2 + 1 + 1 = 4

10003 = 1 + 3 = 4

 LHS = 4 × 4 = 16 = 1 + 6 = 7

RHS = 100240063 = 1 + 2 + 4 = 7

As LHS = RHS So, answer is correct

**Example 2**: 11123 × 10003

**Step 1**: Here base is 10000 so four digits are allowed in RHS 11123 + 1123 (surplus)

10003 + 0003 (surplus)

**Step 2**: Cross – addition: 11123 + 0003 = 11126 = 10003 + 1123 (both equal)

 First part of answer is 11126

**Step 3**: Multiply vertically: 1123 × 0003 = 3369 which form second part of answer

 11123 × 10003 = 111263369

# Checking:

11123 = 1 + 1 + 1 + 2 + 3 = 8

10003 = 1 + 3 = 4 and 4 × 8 = 32 = 3 + 2 = 5

 LHS = 5

R.H.S = 111263369 = 1 + 1 + 1 + 2 = 5

As L.H.S = R.H.S So, answer is correct

# Try These:

(i) 10004 × 11113 (ii) 12345 × 111523 (iii) 11237 × 10002 (iv) 100002 × 111523 (v) 10233 × 10005

Numbers near different base: **(Both numbers below base)**

**Example 1**: 98 × 9

**Step 1**: 98 Here base is 100 deficiency = 02

9 Base is 10 deficiency = 1

 98 – 02 Numbers of digits permitted on R.H.S is 1 (digits in lower base )

**Step 2:** Cross subtraction: 98

-1

88

It is important to line the numbers as shown because 1 is not subtracted from 8 as usual but from 9 so as to get 88 as first part of answer.

**Step 3:** Vertical multiplication: (-02) x (-1) = 2 (one digits allowed )

 Second part = 2

 98 × 9 = 882

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# Checking:

(Through 9 – check method)

98 = 8 , 9 = 0, LHS = 98 × 9 = 8 × 0 = 0

RHS = 882 = 8 + 8 + 2 = 18 = 1 + 8 = 9 = 0

As LHS = RHS So, correct answer

**Example 2:** 993 × 97

**Step 1:** 993 base is 1000 and deficiency is 007

97 base is 100 and deficiency is 03

 993 – 007 (digits in lower base = 2 So, 2 digits are permitted on

× 97 – 03 RHS or second part of answer)

**Step 2:** Cross subtraction: 993

– 03

963

Again line the number as shown because 03 is subtracted from 99 and not from 93 so as to get 963 which from first part of the answer.

**Step 3:** Vertical multiplication: (–007) – (–03) = 21 only two digits are allowed in the second part of answer So, second part = 21

 993 × 97 = 96321

**Checking:** (through 9 – check method)

993 = 3 97 = 7

 L.H.S. = 3 × 7 = 21 = 2 + 1 = 3

R.H.S. = 96321 = 2 + 1 = 3

As LHS =RHS so, answer is correct

**Example 3 :** 9996 base is 10000 and deficiency is 0004

988 base is 1000 and deficiency is 012

 9996 – 0004 (digits in the lower base are 3 so,3digits

× 988 – 012 permitted on RHS or second part of answer)

**Step 2 :** Cross – subtraction: 9996

– 012

9876

Well, again take care to line the numbers while subtraction so as to get 9876 as the first part of the answer.

**Step3** : Vertical multiplication: (–0004) × (–012) = 048

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(Remember, three digits are permitted in the second part i.e. second part of answer = 048

 9996 × 988 = 9876048

**Checking:**(9 – check method)

9996 = 6, 988 = 8 + 8 + = 16 = 1 + 6 = 7

 LHS = 6 × 7 = 42 = 4 + 2 = 6

RHS = 9876045 = 8 + 7 = 15 = 1 + 5 = 6

As, LHS =RHS so, answer is correct

# When both the numbers are above base

**Example 1:** 105 × 12

**Step 1:** 105 base is 100 and surplus is 5

12 base is 10 and surplus is 2

 105 + 05 (digits in the lower base is 1 so, 1 digit is permitted in the second part of answer ) 12 + 2

**Step 2:** Cross – addition: 105

+ 2

125 (again take care to line the numbers properly so as to get 125 )

 First part of answer may be 125

**Step 3:** Vertical multiplication : 05 × 2 = (1)0 but only 1 digit is permitted in the second part so 1 is shifted to first part and added to 125 so as to get 126

 105 × 12 = 1260

# Checking:

105 = 1 + 5 = 6 , 12 = 1 + 2 = 3

 LHS = 6 × 3 = 18 = 1 + 8 = 9 = 0

 RHS = 1260 = 1 + 2 + 6 = 9=0

**Example 2:** 1122 × 104

**Step1:** 1122 – base is 1000 and surplus is 122 104 – base is 100 and surplus is 4

 1122 + 122

104 + 04 (digits in lower base are 2 so, 2-digits are permitted in the second part of answer )

**Step 2:** Cross – addition 1122

+ 04 (again take care to line the nos. properly so as to get 1162) 1162

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 First part of answer may be 1162

**Step 3:** Vertical multiplication: 122 × 04 = 4, 88

But only 2 – digits are permitted in the second part, so, 4 is shifted to first part and added to 1162 to get 1166 ( 1162 + 4 = 1166 )

 1122 × 104 = 116688

Can be visualised as: 1122 + 122 104 + 04

1162 /  (4) 88 = 116688

+ 4 /

# Checking:

1122 = 1 + 1 + 2 + 2 + = 6, 104 = 1 + 4 =5

 LHS = 6 × 5 = 30 = 3

RHS = 116688 = 6 + 6 = 12 = 1 + 2 = 3

As LHS = RHS So, answer is correct

**Example 3:** 10007 × 1003

Now doing the question directly 10007 + 0007 base = 10000

× 1003 + 003 base = 1000

10037 / 021 (three digits per method in this part)

 10007 × 10003 = 10037021

**Checking :** 10007 = 1 + 7 = 8 , 1003 = 1 + 3 = 4

 LHS = 8 × 4 = 32 = 3 + 2 = 5

RHS = 10037 021 = 1 + 3 + 1 = 5

As LHS = RHS so, answer is correct

# Try These:

(i) 1015 × 103 (ii) 99888 × 91 (iii) 100034 × 102 (iv) 993 × 97 (v) 9988 × 98 (vi) 9995 × 96 (vii) 1005

× 103 (viii) 10025 × 1004 (ix) 102 × 10013 (x) 99994 × 95

**VINCULUM:** “Vinculum” is the minus sign put on top of a number e.g. 5, 41, 63 etc. which means (–5), (40 – 1) , (60 – 3) respectively

# Advantages of using vinculum:

1. It gives us flexibility, we use the vinculum when it suits us .
2. Large numbers like 6, 7, 8, 9 can be avoided.
3. Figures tend to cancel each other or can be made to cancel.
4. 0 and 1 occur twice as frequently as they otherwise would.

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**Converting from positive to negative form or from normal to vinculum form: Sutras:** All from 9 the last from 10 and one more than the previous one

9 = 1 1 (i.e. 10 – 1), 8 = 12, 7 = 13, 6 = 14, 19 = 2 1, 29 = 3 1

28 = 32, 36 = 44 (40 – 4), 38 = 42

# Steps to convert from positive to vinculum form:

1. Find out the digits that are to be converted i.e. 5 and above.
2. Apply “all from 9 and last from 10” on those digits.
3. To end the conversions “add one to the previous digit”.
4. Repeat this as many times in the same number as necessary.

# Numbers with several conversions:

159 = 241 (i.e. 200 – 41)

168 = 232 (i.e. 200 – 32 )

237 = 243 (i.e. 240 – 7 )

1286 = 1314 (i.e. 1300 – 14)

2387129 = 24 1313 1 ( here, only the large digits are be changed)

# From vinculum back to normal form:

**Sutras:** “All from 9 and last from ten” and “one less than then one before”.

1 1 = 09 (10 – 1), 13 = 07 (10 – 3) , 24 = 16 (20 – 4), 241 = 200 – 41 = 159, 162 = 160 – 2 = 158

222 = 200 – 22 = 178 1314 = 1300 – 14 = 1286, 2413131 = 2387129 can be done in part as

131 = 130 – 1 = 129 and 2413 = 2400 – 13 = 2387

 2413131 = 2387129.

# Steps to convert from vinculum to positive form:

1. Find out the digits that are to be converted i.e. digits with a bar on top.
2. Apply “all from 9 and the last from 10” on those digits
3. To end the conversion apply “one less than the previous digit”
4. Repeat this as many times in the same number as necessary

**Try These:** Convert the following to their vinculum form:

(i) 91 (ii) 4427 (iii) 183 (iv) 19326 (v) 2745 (vi) 7648 (vii) 81513 (viii) 763468 (ix) 73655167 (x)

83252327

**Try These: From** vinculum back to normal form.

(i) 14 (i) 21 (iii) 23 (iv) 231 (v) 172 (vi) 1413 (vii) 2312132 (viii) 241231

(ix) 632233 1 (x) 14142323

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# When one number is above and the other below the base

**Example1:** 102 × 97

**Step 1:** Here, base is 100

102 + 02 (02 above base i.e. 2 surplus)

97 – 03 (03 below base i.e. 3 deficiency)

**Step 2:** Divide the answer in two parts as 102 / + 02

97 / – 03

**Step 3:** Right hand side of the answer is (+ 02) × (– 03) = – 06 = 06

**Step 4:** Left hand side of the answer is 102 – 3 = 99 = 97 + 02 (same both ways)

 102 × 97 = 9906 = 9894 (i.e. 9900 – 6 = 9894)

**Checking:** 102 = 1 + 2 = 3, 9 7 = 7

 L.H.S. = 3 × 7 = 21 = 1 + 2 = 3

 R.H.S = 9894 = 8 + 4 = 12 = 1 + 2 = 3

As L.H.S. = R.H.S. So, answer is correct

**Example 2 :** 1002 × 997

1002 + 002 (006 = 1000 – 6 = 994 and 1 carried from 999 to 999 reduces to 998)

997 – 003

999 006

 1002 × 997 = 998 994

# When base is not same:

**Example1:** 988 × 12

988 – 012 base is 1000 deficiency 12

12 + 2 base is 10 surplus is 2, 1 digit allowed in R.H.S.

1188 – 2 024

= 1186 = (2)4

 988 × 12 = 1186 4 = 11856 (because 4 = 10 – 4 = 6)

**Checking:** 9 88 = 8 + 8 = 16 = 1 + 6 = 7, 12 = 1 + 2 = 3

 LHS = 7 × 3 = 21 = 2 + 1 = 3

R.H.S = 11856 = 1 + 5 + 6 = 12 = 1 + 2 = 3

As LHS = RHS So, answer is correct

**Example 2:** 1012 × 98

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1012 |  | 1012 | + 012 | (base is 1000, 12 surplus (+ve sign) |
| – 02 |  | 98 | – 02 | (base is 100, 2 deficiency (–ve sign) |
|  |  |  |  |  |
| 992 |  | 992 | 24 | [As 012 × (– 02 ) = – 24 ] 2 digits allowed in RHS of |

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# Answer

 1012 × 98 = 99224 = 99176 [ As 992200 – 24 = 99176]

**Checking:**1012 = 1 + 1 + 2 = 4, 98 = 8

LHS = 4 × 8 = 32 = 3 + 2 = 5

RHS = 99176 = 1 + 7 + 6 = 14 = 1 + 4 = 5

As RHS = LHS so, answer is correct

# Try These:

(i) 1015 × 89 (ii) 103 × 97 (iii) 1005 × 96 (iv) 1234 × 92 (v) 1223 × 92 (vi) 1051 × 9 (vii) 9899 × 87

(viii) 9998 × 103 (ix) 998 × 96 (x) 1005 × 107

# Sub – base method:

Till now we have all the numbers which are either less than or more than base numbers. (i.e.10, 100, 1000, 10000 etc. , now we will consider the numbers which are nearer to the multiple of 10, 100, 10000 etc.

i.e. 50, 600, 7000 etc. these are called sub-base.

**Example:** 213 × 202

**Step1:** Here the sub base is 200 obtained by multiplying base 100 by 2

**Step 2:** R. H. S. and L.H.S. of answer is obtained using base- method.

213 + 13

202 + 02

215 13 × 02 = 26

**Step 3:** Multiply L.H.S. of answer by 2 to get 215 × 2 = 430

 213 × 202 = 43026



**Example 2:** 497 × 493

**Step1:** The Sub-base here is 500 obtained by multiplying base 100 by 5.

**Step2:** The right hand and left hand sides of the answer are obtained by using base method.

**Step3:** Multiplying the left hand side of the answer by 5.

|  |  |  |
| --- | --- | --- |
|  | 497 | –03 |
| 493 | –07 |
| Same | 497–07 = 490 | 21 |
|  | 493 – 03 = 490 |  |
|  | 490 × 5 |  |
|  | = 2450 |  |
|  | 497 × 493 = 245021 |  |

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**Example 3:** 206 × 197

Sub-base here is 200 so, multiply L.H.S. by 2

206

206 + 06

197 – 03

– 3 = 203 –18

06 = 203 × 2 = 18

= 406

197 +

 206 × 197 = 40618 = 40582

**Example 4:** 212 × 188

Sub – base here is 200

200 – 12

212 + 12

188 -12

= 200 (1)44

= 200

2

= 399

188 + 12

× 400 –1

 212 × 188 = 399 44 = 39856

**Checking:**(11 – check method)

+ – +

2 1 2 = 2 + 2 – 1 = 3

+ – +

1 8 8 = 1 – 8 + 8 = 1

L.H.S. = 3 × 1 = 3

+ – + – +

R.H.S. = 3 9 8 5 6 = 3

As L.H.S = R.H.S. So, answer is correct.

# Try these

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| (1) 42 × 43 | (2) 61 × 63 | (3) 8004 × 8012 | (4) | 397 × 398 (5) 583 × 593 |
| (6) 7005 × 6998 | (7) 499 × 502 | (8) 3012 × 3001 | (9) | 3122 × 2997 (10) 2999 × 2998 |

**Doubling and Making halves**

Sometimes while doing calculations we observe that we can calculate easily by multiplying the number by 2 than the larger number (which is again a multiple of 2). This procedure in called **doubling:**

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35 × 4 = 35 × 2 + 2 × 35 = 70 + 70 = 140

26 × 8 = 26 × 2 + 26 × 2 + 26 × 2 + 26 × 2 = 52 + 52 + 52 + 52

= 52 × 2 + 52 × 2 = 104 × 2 = 208

53 × 4 = 53 × 2 + 53 × 2 = 106 × 2 = 212

Sometimes situation is reverse and we observe that it is easier to find half of the number than calculating 5 times or multiples of 5. This process is called

# Making halves:

4. (1) 87 × 5 = 87 × 5 × 2/2 = 870/2 = 435

(2) 27 × 50 = 27 × 50 × 2/2 = 2700/2 = 1350

(3) 82 × 25 = 82 × 25 × 4/4 = 8200/4 = 2050

# Try These:

(1) 18 × 4

(2) 14 × 18

(3) 16 × 7

(4) 16 × 12

(5) 52 × 8

(6) 68 × 5

(7) 36 × 5

(8) 46 × 50

(9) 85 × 25

(10) 223 × 50

(11) 1235 × 20

(12) 256 × 125

(13) 85 × 4

(14) 102 × 8

(15) 521 × 25

# Multiplication of Complimentary numbers :

**Sutra: By one more than the previous one.**

This special type of multiplication is for multiplying numbers whose first digits(figure) are same and whose last digits(figures)add up to 10,100 etc.

**Example 1: 4**5 × 45

**Step I:** 5 × 5 = 25 which form R.H.S. part of answer

**Step II:** 4 × (next consecutive number)

**14**

i.e. 4 ×5 = 20, which form L.H.S. part of answer

 45 × 45 = 2025

**Example 2:** 95 × 95 = 9 × 10 = 90/25  (52)

i.e. 95 × 95 = 9025

**Example 3:** 42 × 48 = 4 × 5 = 20/16  (8 × 2)

 42 × 48 = 2016

**Example 4:** 304 × 306 = 30 × 31 = 930/24  (4 × 6)

 304 × 306 = 93024

# Try These:

(1) 63 × 67

(2) 52 × 58

(3) 237 × 233

(4) 65 × 65

(5) 124 × 126

(6) 51 × 59

(7) 762 × 768

(8) 633 × 637

(9) 334 × 336

(10) 95 × 95

# Multiplication by numbers consisting of all 9’s :

**Sutras:** ‘By one less than the previous one’ and ‘All from 9 and the last from 10’

# When number of 9’s in the multiplier is same as the number of digits in the multiplicand.

**Example** 1 : 765 × 999

**Step I** : The number being multiplied by 9’s is first reduced by 1

i.e. 765 – 1 = 764 This is first part of the answer

**Step II** : “All from 9 and the last from 10” is applied to 765 to get 235, which is the second part of the answer.

 765 × 999 = 764235

# When 9’s in the multiplier are more than multiplicand

**Example II :** 1863 × 99999

**Step I :** Here 1863 has 4 digits and 99999 have 5-digits, we suppose 1863 to be as 01863. Reduce this by one to get 1862 which form the first part of answer.

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**Step II**: Apply ‘All from 9 and last from 10’ to 01863 gives 98137which form the last part of answer

 1863 x 99999 = 186298137

# When 9’s in the multiplier are less than multiplicand

**Example 3 :** 537 x 99

**Step I**: Mark off two figures on the right of 537 as 5/37, one

more than the L.H.S. of it i.e. (5+1) is to be subtracted from the whole number, 537 – 6 = 531this forms first part of the answer

**Step II:** Now applying “all from 9 last from 10” to R.H.S. part of 5/37 to get 63 (100 – 37 = 63)

 537 x 99 = 53163

# Try these

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| (1) | 254 × 999 | (2) | 7654 × 9999 | (3) 879 × 99 | (4) | 898 × 9999 |
| (5) | 423 × 9999 | (6) | 876 × 99 | (7) 1768 × 999 | (8) | 4263 × 9999 |
| (9) | 30421 × 999 | (10) | 123 × 99999 |  |  |  |

**Multiplication by 11**

**Example 1**: 23 × 11

**Step 1 :** Write the digit on L.H.S. of the number first. Here the number is 23 so, 2 is written first.

**Step 2 :** Add the two digits of the given number and write it in between. Here 2 + 3 = 5

**Step 3 :** Now write the second digit on extreme right. Here the digit is 3. So, 23 × 11 = 253

# OR

23 × 11 = 2 / 2+3 / 3 = 253

(Here base is 10 so only 2 digits can be added at a time)

**Example 2:** 243 × 11

**Step 1**: Mark the first, second and last digit of given number First digit = 2, second digit = 4, last digit = 3

Now first and last digits of the number 243 form the first and last digits of the answer.

**Step 2**: For second digit (from left) add first two digits of the number i.e. 2 + 4 = 6

**Step 3**: For third digit add second and last digits of the number i.e. 3 + 4 = 7 So, 243 × 11 = 2673

# OR

243 × 11 = 2 / 2 + 4 / 4 + 3 / 3 = 2673

Similarly we can multiply any bigger number by 11 easily.

**Example 3:** 42431 × 11

**16**

42431 × 11 = 4 / 4 + 2 / 2 + 4 / 4 + 3 / 3 + 1 / 1 = 466741

# If we have to multiply the given number by 111

**Example 1:** 189 × 111

**Step 1**: Mark the first, second and last digit of given number First digit = 1, second digit = 8, last digit = 9

Now first and last digits of the number 189 may form the first and last digits of the answer

**Step 2**: For second digit (from left) add first two digits of the number i.e. 1 + 8 = 9

**Step 3**: For third digit add first, second and last digits of the number to get 1 + 8 + 9 = 18 (multiplying by 111, so three digits are added at a time)

**Step 4**: For fourth digit from left add second and last digit to get, 8 + 9 = 17

As we cannot have two digits at one place so 1 is shifted and added to the next digit so as to get 189

× 111 = 20979

# OR



|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 1 + 8 = 9 | 1 + | 8 + 9 |  | 8 | + 9 | 9 |
|  | 9 + 1 = | = | 18 | = | 1 | 7 |  |
| 1 + 1 = 2 | = 1 0 | = | 18 + 1 |  | | | |
|  |  | = | 1 9 |  | | | |

189 × 111 = 20979

**Example 2** : 2891 × 111

2 2 + 8



2 + 8 + 9

8 + 9 + 1

9 + 1

10 + 2 = 19 + 1 18 + 1 = 1 0 1

= 1 2

= 2 0

= 1 9



2891 × 111 = 320901



# Try These:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| (1) | 107 × 11 | (2) | 15 × 11 | (3) | 16 × 111 | (4) | 112 × 111 |
| (5) | 72 × 11 | (6) | 69 × 111 | (7) | 12345 × 11 | (8) | 2345 × 111 |
| (9) | 272 × 11 | (10) | 6231 × 111. |  |  |  |  |

**Note:** This method can be extended to number of any size and to multiplying by 1111, 11111 etc. This multiplication is useful in percentage also. If we want to increase a member by 10% we multiply it by 1.1

**17**

# General Method of Multiplication.

**Sutra: Vertically and cross-wise.**

Till now we have learned various methods of multiplication but these are all special cases, wherenumbers should satisfy certain conditions like near base, or sub base, complimentary to each other etc. Now we are going to learn about a general method of multiplication, by which we can multiply any two numbers in a line. Vertically and cross-wise sutra can be used for multiplying any number.

For different figure numbers the sutra works as follows:

# Two digit – multiplication

**Example:** Multiply 21 and 23

**Step1**: Vertical (one at a time) 2 [1]

2 [3]

 1 × 3 = 3



3

 

|  |  |  |  |
| --- | --- | --- | --- |
| **Step2:** Cross –wise (two at a time) | 2 | 1 | (2 × 3 + 2 × 1) = 8 |
|  | 2 | 3 | 8 3 |

**Step3:** Vertical (one at a time)

 [2] 1 2 × 2 = 4



 [2] 3 4 8 3

 21 × 23 = 483

Multiplication with carry:

**Example:** Multiply 42 and 26

12

**Step1:** Vertical 42 



26 

2 × 6 = 12

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Step2:** Cross-wise | 4 | 2 | 4 × 6 + 2 × 2 | 28 | 12 |
|  | 2 | 6 | 24 + 4 = 28 |  |  |

**Step3**: Vertical

 42 4 × 2 = 8 8 8 2





 26 + 2 1

= 10 = 2 9



 42 × 26 = 1092

# Three digit multiplication:

**Example**: 212 × 112

**18**

**Step1:** Vertical (one at a time) 212 



112 

2 × 2

= 4

4

**Step2:** Cross-wise 2 1 2 2 × 1 + 2 × 1

4 4

(two at a time) 1 1 2 = 2 + 2 = 4

**Step3:** Vertical and cross-wise 2 2

1

1

(three at a time) 1 2

2 × 2 + 2 × 1 + 1 × 1 = 4 + 2 + 1 = 7 7 4 4

**Step4:** cross wise 2 1 2 2 × 1 + 1 × 1

3 7 4 4

(Two at a time) 1 1 2 = 2 + 1 = 3

**Step 5**: vertical (one at a time)

 2 1 2 2 × 1 = 2



2 3 7 4 4

 1 1 2

 212 × 112 = 23744

# Three digits Multiplication with carry:

**Example:** 816 × 223

 8 1

6











 8 × 2 8 × 2 + 2 × 1 8 × 3 + 6 × 2 + 1 × 2 3 × 1 + 2 × 6 6 × 3 = 18

 = 16 + 2 = 18 = 24 + 12 + 2 3 + 12 = 15





 =38

 2 2 3 16

16 + 2 18 + 3 38 + 1 15 + 1 1 8

= 2 1 = 3 9 = 1 6

 816 × 223 = 181968

Checking by 11 – check method

+ – + – +

8 1 6 = 14 – 1 = 1 3 = 3 – 1 = 2

+ - +

2 2 3 =3

 L.H.S. = 3 × 2 = 6

**19**

- + - + - + - +

1 8 1 9 6 8 = 1 7 = 7 – 1 = 6

As L.H.S. = R.H.S.

 Answer is correct

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Try These:** |  | | | |
| (1) 342 × 514 (2) 1412 × 4235 | (3) | 321 × 53 | (4) 2121 × 2112 | (5) 302 × 415 |
| (6) 1312 × 3112 (7) 5123 × 5012 | (8) | 20354 × 131 | (9) 7232 × 125 | (10) 3434 × 4321 |

# Number Split Method

As you have earlier used this method for addition and subtraction, the same may be done for multiplication also.

# For example :

|  |  |  |  |
| --- | --- | --- | --- |
| 263  × 2 | 26  × 2 | 3  ×2 | ***Note :*** The split allows us to add 36 + 24  and 42 + 39 both of which can be done |
|  | 52 | 6 | mentally |

**Multiplication of algebraic expressions:**

**Sutra:** Vertically and cross-wise

**Example1** : (*x* + 3) (*x* + 4)

*x* + 3

*x* × *x*

4*x* + 3*x*

4 × 3

*x*2

= 7*x*

= 12

*x*2

7 × 12

 

 

 

 

 

*x* + 4

*x*2 + 7*x* + 12

**Example2**: (2*x* + 5) (3*x* + 2)

2*x* + 5

  (2*x*) × (3*x*) 4*x* + 15*x* 10

  

 

 

 

3*x* + 2

=6*x*2 = 19*x*



6*x*2 +19*x* + 10

**20**

**Example3**: (*x*2 + 2*x* + 5) (*x*2 – 3*x* + 1)

 *x*2 + 2*x* – 5 

*x*4

–3*x*3 +2*x*3 *x2* + 5*x2* –6*x2* 2*x* –15*x*

5 × 1

= –*x*3

= 0

= – 13*x*

= 5

*x*4

–*x*3

0

–13*x*

5

 

 *x*2 – 3*x* + 1 

*x*4 – *x*3 – 13*x* + 5

# Try These:

(1) (2*x* – 1) (3*x* + 2)

(2) (2*x* + 1) (*x*2 + 3*x* – 5)

(3) (5*x*+ 5) (7*x* – 6)

(4) (*x* + 5) (*x*2– 2*x* + 3)

(5) (*x* – 4) (*x*2 + 2*x* + 3)

(6) (*x*2 + 4*x* – 5) (*x* + 5)

(7) (*x*3 – 5) (*x*2 + 3)

(8) (*x*2 – 2*x* + 8) (*x*4 – 2)

(9) (*x*2 – 7*x* + 4) (*x*3 – 1)

(10) (*x*3 – 5*x*2 + 2) (*x*2 + 1)

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