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## SSC \& Railway

## Exams

Fast Calculation Using Vedic Maths

## Vedic Maths: Calculations Made Easy

## Base Method of Calculating squares

Generally, we can calculate the square of a number by the formula $\left(\mathbf{a}^{\mathbf{2}}+\mathbf{b}^{\mathbf{2}}+\mathbf{2 a b}\right)$. This formula applies by splitting a number into a and b. For eg. (49) ${ }^{\mathbf{2}}$ can be calculated using this formula by splitting into $\mathbf{4 0}$ and 9. But calculating with this method always is a lengthy process and not recommended to follow in the exam.
Base method of calculating squares is an easy method to square 2 and 3 digits numbers easily. The major thing is to find the Base here. The base is referred to $\mathbf{n} \times \mathbf{1 0}^{\mathbf{x}}$ $\mathbf{w h}^{2} \mathbf{n}$ is $\mathbf{1}, \mathbf{2}, \mathbf{3}$, and so on. You have to take the value of base i.e, $\mathbf{1 0}^{\mathbf{x}}$ which is nearer to the number.
Let us see the steps to find the square of a number using Base Method.
Step 1: Find Base i.e, $\mathbf{n} \times 10^{\times}$.
Step 2: Case 1: Square the (Number - Base) if Number > Base.
Case 2: Square the (Base - Number) if Base > Number.
Make sure the number of digits in this part = number of zeroes in the base, add zeroes if it is of fewer digits or carry forward extra digits in case of more than the required digits.
Step 3: Case 1: Add (Number - Base) to Number if Number > Base and then multiply by $n$.
Case 2: Subtract (Base - Number) from Number if Base > Number and then multiply by n .
Step 4: Merge results of Step 2 and 3 . Keep Step 2 result on the right side.
Suppose you have to find the square of 104.
Step 1: Now, here the base is 100 or $10^{2}$.
Step 2: Here Number > Base or $104>100$ so, $(104-100)^{2}=16$
Step 3: $1 \times(104+4)=108$
Step 4: 10816
In this way, you have to calculate the square using the base method. Let us take more examples to have a clear understanding.
Find the square of 99.
Step 1: Here, the base is 100 or $10^{2}$.
Step 2: $100>99(100-99)^{2}=01$ (Here we added one zero to the left side of square number to make it a 2 digit number)
Step 3: $1 \times(99-1)=98$
Step 4: 9801
Find the square of 119.
Step 1: Base is 100 or $10^{2}$.
Step 2: $(119-100)^{2}=361$ (Here 3 will be carried forward as we need only 2 digits at this side)
Step 3: $1 \times(119+19)=138+3$ carry $=141$
Step 4: 14161
Find the square of 198
Step 1: Now, here the base is 200 or $2 \times 10^{2}$.
Step 2: $(200-198)^{2}=04$ (Here we added one zero to the left side of square number to
make it a 2 digit number)
Step 3: $2 \times(198-2)=392$
Step 4: 39204
Find the square of 482
Step 1: Now, here the base is 500 or $5 \times 10^{2}$.
Step 2: $(500-482)^{2}=324$ (Here 3 will be carried forward as we need only 2 digits on this side)


Step 3: $5 \times(482-18)=2320+3$ carry $=2323$ (Here we had multiplied it by 5 as the base was $5 \times 10^{2}$ )
Step 4: 232324
Find the square of 1012
Step 1: Now, here the base is 1000 or $1 \times 10^{3}$.
Step 2: $(1012-1000)^{2}=144$ (Here we will keep three digits as the number of zeroes in the base is 3)
Step 3: $(1012+12)=1024$
Step 4: 1024144
In the exam, you have don't have to write the individual steps. Just start calculating mentally and write the final value. After practicing, you will be able to solve this quickly. Calculate the following squares using the base method and answer in the comment section.
(A) $(93)^{2}$
(B) $(216)^{2}$
(C) $(1001)^{2}$
(D) $(3014)^{2}$

Base method is useful when numbers are nearer to the base as it will become more calculating when the difference between numbers and base becomes larger. To overcome such calculation, we are introducing one more method i.e., Duplex Method.

## Duplex Method to calculate squares

To understand this method, at first, you must know how to calculate duplex of the numbers.
Dup (a) $=a^{2}$
Dup (ab) $=2 \times a \times b$
Dup (abc) $=2 \times a \times c+b^{2}$
Dup (abcd) $=2 \times a \times d+2 \times b \times c$
Now let`s start calculating squares using this method.
(A) Method of calculating the square of a number $\mathbf{a b}$.

It will be Dup a | Dup ab | Dup b
Calculate square of 42
Dup 4 | Dup 42 | Dup 2
$4^{2} \quad|2 \times 4 \times 2| \quad 2^{2}$

16 | 16 | 4 (Keep only one digit in each part except first one)
1764
(B) Method of calculating the square of a number abc.

Dup a | Dup ab | Dup abc | Dup bc | Dup c
Find the square of 145

| Dup $1 \mid$ Dup $14 \mid$ | Dup 145 | $\mid$ Dup 45 | Dup 5 |  |
| :---: | :---: | :---: | :---: | :---: |
| $1^{2}$ | $\|2 \times 1 \times 4\|$ | $2 \times 1 \times 5+4^{2}$ | $\|2 \times 4 \times 5\| c$ | $5^{2}$ |
| 1 | $\mid 8$ | 26 | $\mid 40$ | 25 |

(C) Method of calculating the square of a number abcd.

Dup a | Dup ab \| Dup abc | Dup abcd | Dup bcd | Dup cd | Dup d Find the square of 1234

| Dup 1 | Dup 12 \| | Dup 123 | Dup 1234 | Dup 234 | Dup $34 \mid$ Dup 4 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $1^{2}$ | $\|2 \times 1 \times 2\|$ | $2 \times 1 \times 3+2^{2}$ | $12 \times 1 \times 4+2 \times 2 \times 3$ | $2 \times 2 \times 4+3^{2}$ | $\|2 \times 3 \times 4\| 4^{2}$ |
| 1 | \| 4 | 10 | 20 | 25 | $24 \mid 16$ | 1522756

This is the way to solve squares using the duplex method. But in exams, don 't write steps. Just start calculating duplex from the right-hand side and write the final answer. Practice solving squares using this method without steps. You can calculate any number of digits from this method. The only need for this method is to know how to calculate duplex of the numbers.
Calculate the following squares using the duplex method and answer in the comment section.

(A) $(87)^{2}$
(B) $(529)^{2}$
(C) $(1991)^{2}$
(D) $(5018)^{2}$

Let us see some more tricks of solving squares of the numbers ending with digit $1,5,6$ and 9.

Trick to calculate squares of numbers ending with digit 5
Step 1: We all know $5^{2}$ is 25 . In the squares of numbers ending with 5 , just write 25 on the right-hand side of the answer.
Step 2: First digit of the number $x$ Successive digit of the first number.
Calculate $\mathbf{2 5}^{\mathbf{2}}=2 \times 3 \mid 25=\mathbf{6 2 5}$
Calculate $55^{2}=5 \times 6 \mid 25=\mathbf{3 0 2 5}$
Calculate $\mathbf{8 5}^{\mathbf{2}}=8 \times 9 \mid 25=7225$
Calculate $\mathbf{1 2 5}^{\mathbf{2}}=12 \times 13 \mid 25=15625$
Calculate $\mathbf{3 2 5}{ }^{\mathbf{2}}=32 \times 33 \mid 25=105625$
In the same way, you can calculate the square of other numbers ending with digit 5 . You just need to strengthen your multiplication skills.

Trick to calculate squares of numbers ending with digit 6
Suppose you have to find the square of 76.
Step : (Number - 1) ${ }^{\mathbf{2}}+$ Number + (Number - 1)
$(76)^{2}=(75)^{2}+75+76=5625+151=5776$ (Calculate square of number ending with digit 5 using the above method.)
$(146)^{2}=(145)^{2}+145+146=21025+291=21316$
$(\mathbf{1 0 0 6})^{\mathbf{2}}=(1005)^{2}+1005+1006=1010025+2011=\mathbf{1 0 1 2 0 3 6}$
To calculate squares of numbers ending with digit 6, you must know how to calculate squares of numbers ending with digit 5 and fast multiplication skills as it is the foremost requirement.

Trick to calculate squares of numbers ending with digit 4
Suppose you have to find the square of 64.
Step : (Number + 1) ${ }^{\mathbf{2}}$ - Number - (Number + 1)
$(64)^{2}=(65)^{2}-65-64=4225-129=4096$ (Calculate square of number ending with digit 5 using the above method.)
$\mathbf{( 2 9 4 )}^{\mathbf{2}}=(295)^{2}-295-294=87025-589=\mathbf{8 6 4 3 6}$
$\mathbf{( 3 0 0 4})^{2}=(3005)^{2}-3005-3004=9030025-6009=\mathbf{9 0 2 4 0 1 6}$
Again, you must know how to calculate squares of numbers ending with digit 5 with strong multiplication skills to calculate squares of numbers ending with digit 4.

Trick to calculate squares of numbers ending with digit 1
Suppose you have to calculate the square of 91.
Step : (Number-1) ${ }^{\mathbf{2}}+$ Number + (Number + 1)
$(91)^{2}=(90)^{2}+90+91=8100+181=8281$
$\mathbf{( 1 6 1 )}^{2}=(160)^{2}+160+161=25600+321=25921$
$(921)^{2}=(920)^{2}+920+921=846400+1841=848241$ (Calculate $92^{2}$ mntally using base method)
$\mathbf{( 1 2 0 1}^{\mathbf{2}}=(1200)^{2}+1200+1201=1440000+2401=\mathbf{1 4 4 2 4 0 1}$
In the same way, you can calculate the square of other numbers ending with digit 1 . For this, you must remember squares up to 20 and strong addition calculation mentally.

## Trick to calculate squares of numbers ending with digit 9

Suppose you have to calculate the square of 79.
Step : (Number + 1) ${ }^{\mathbf{2}}$ - Number - (Number + 1)
$(79)^{2}=(80)^{2}-80-79=6400-159=6241$
$(159)^{2}=(160)^{2}-160-1659=25600-319=25281$
$(579)^{2}=(580)^{2}-580-579=336400-1159=335241$ (Calculate $92^{2}$ mntally using base method)
$(1239)^{2}=(1240)^{2}-1240-12039=1537600-2479=1535121$ (Calculate $124^{2}$ using duplex method)
For this also, you must possess strong multiplication skills.


Trick to calculate squares of numbers in the range of $\mathbf{5 1}$ to $\mathbf{7 0}$
Step : [25 + (Number-50)|(Number-50) ${ }^{2}$ ]
$(\mathbf{5 1})^{2}=25+1 \mid 01=\mathbf{2 6 0 1}$
$(57)^{2}=25+7 \mid 49=3249$
$(66)^{2}=25+16|256=41| 256=43 \mid 56=4356$ (Keep only 2 digit on right side)
$(69)^{2}=25+19|361=44| 361=47 \mid 61=4761$ (Keep only 2 digit on right side)
Trick to calculate squares of numbers in the range of $\mathbf{3 1}$ to $\mathbf{5 0}$
Step : [25-(50-Number) | (50-Number) ${ }^{2}$ ]
(49) ${ }^{2}=25-1 \mid 01=2401$
$(\mathbf{4 3})^{\mathbf{2}}=25-7 \mid 49=\mathbf{1 8 4 9}$
$(\mathbf{3 7})^{2}=25-13|169=12| 169=13 \mid 69=1369$ (Keep only 2 digit on right side)
$\left(\mathbf{3 1} \mathbf{)}^{\mathbf{2}}=25-19|361=6| 361=9 \mid 61=\mathbf{9 6 1}\right.$ (Keep only 2 digit on right side)
Another method: $(a+b)(a-b)+b^{2}$
(88) ${ }^{2}$ : it is $\mathbf{1 0 0 - 1 2}$ or $a=100$ and $b=12$

So, (88) $\mathbf{I}^{\mathbf{2}}=(88+12)(88-12)+12^{2}=76 \times 100+144=7744$
$(\mathbf{1 0 4})^{2}=(104+4)(104-4)+4^{2}=108 \times 100+146=\mathbf{1 0 8 1 6}$
$(438)^{2}=(438+38)(438-38)+38^{2}=476 \times 400+1444=191844$
Calculate the following squares using any of the above mentioned method:
(A) $(59)^{2}$
(B) $(876)^{2}$
(C) $(1441)^{2}$
(D) $(995)^{2}$
(E)
$(1441)^{2}$
(F) $(78)^{2}$

Cubes of the numbers ( 1 to 10)

| Numbers | Cubes |
| :---: | :---: |
| 1 | 1 |
| 2 | 8 |
| 3 | 27 |
| 4 | 64 |
| 5 | 125 |
| 6 | 216 |
| 7 | 343 |
| 8 | 512 |
| 9 | 729 |
| 10 | 1000 |

Now, do you analyze anything from the above table?

## Observation 1:

Unit digit of the numbers and their cubes is similar

| 1 | 1 |
| :---: | :---: |
| 4 | 64 |
| 5 | 125 |
| 6 | 216 |
| 9 | 729 |
| 10 | 1000 |

So, always remember that, if you find a number who is a definite cube and carries the above-mentioned unit digits, then their cube roots will also have same unit digits.
Observation 2:

Numbers having the unit digit 2 will have 8 as the unit digit in the cube and vice versa

Numbers having the unit digit 3 will have 7 as the unit digit in the cube and vice versa

2
8
3
27
8
512
7
343

Thus, keep in mind that if you find a number who is a definite cube and carries the unit digits as:
a. 2 , then cube root will have unit digit as 8 .
b. 8 , then cube root will have unit digit as 2 .

Remember the conclusions of the above observations. They will be used in the steps of calculating the cube roots.

Method to calculate cube roots of definite Cube numbers
Let us discuss through an example:
Find the cube root of a number 59319.
Step 1: Divide the number by taking 3 rightmost digits in one part and remaining digits in another part. Then, from the unit or last digit of the cube, find the unit digit of cube root number.
Here the last digit of the cube is 9 . Now, as per the above observation, the numbers having the unit digit 9 have the same unit digit in their cubes and vice versa. So, the unit digit of cube root will also be 9 .
Step 2: Now consider the remaining digits of the number. Then find the smaller cube number to the remaining digit and write its cube root number.
Here, remaining digits: 59.

## Smaller cube to 59 is 27.

Cube root of 27 is 3 .
So, cube root of 59319 is 39 .
So, with the help of just two simple steps, you can find the cube root of the number.
Cube root of 59319

59
27 or $(3)^{3}<59$
3

## 319

9
9
39
Let`s have some examples to understand it better.
Example 1: Find the cube root of 91125.
Cube root of 91125
64 or $(4)^{3}<91$
4
125
5
5

$$
5
$$

45
Example 2: Find the cube root of 175616
Cube root of 175616
175
125 or $(5)^{3}<175$
616

5

## 56

Example 3: Find the cube root of 300763

## Cube root of 300763

300
763
216 or $(6)^{3}<300$
6
6
6

Example 4: Find the cube root of 474552
Cube root of 474552

## 474 <br> 552

343 or $(7)^{3}<474$ 8
7
8
78
Example 5: Find the cube root of 778688
Cube root of 778688
778
688
729 or $(9)^{3}<778$
9
2
92

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