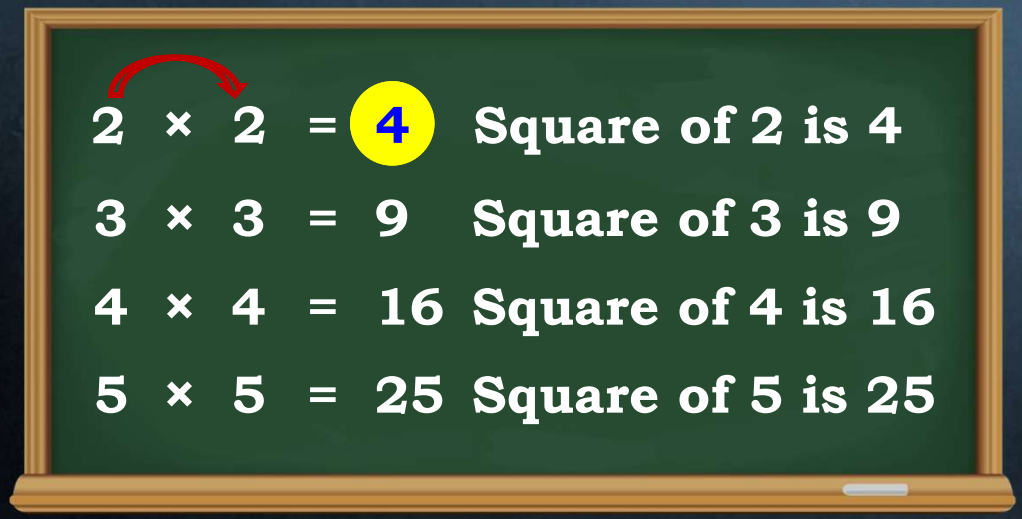
Squares and Square Roots

$\sqrt{25}$ 5 x 5 x 5

SQUARES AND SQUARE ROOT

Square of a Number

When a number is multiplied by itself, the product we get is the **SQUARE** of the number



NUMBER	SQUARE
1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100
11	121
12	144
13	169
14	196
15	225
16	256
17	289
18	324
19	361
20	400

PROPERTIES

Let us study the table showing the squares of numbers from 1 to 20

All these numbers end with 0, 1, 4, 5, 6, 9 at unit's place.

So all the square numbers end with 0, 1, 4, 5, 6 or 9 at unit's place

What do we observe?

None of these end with 2, 3, 7 or 8 at unit's place

All these numbers are also called as perfect squares.

NUMBER	SQUARE
1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100
11	121
12	144
13	169
14	196
15	225
16	256
17	289
18	324
19	361
20	400

PROPERTIES

Number Square

Now, observe the one's (unit's) place in both.

If a number has 1 or 9 in the unit's place, then it's square ends in 1

NUMBER	SQUARE
1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100
11	121
12	144
13	169
14	196
15	225
16	256
17	289
18	324
19	361
20	400

PROPERTIES

Number Square

If a number has 4 or 6 in the unit's place, then it's square ends in 6

Let's consider square numbers ending in 6.

NUMBER	SQUARE
1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100
11	121
12	144
13	169
14	196
15	225
16	256
17	289
18	324
19	361
20	400

PROPERTIES

Number Square

When a number ends in 5 or 0 in the unit's place, the square number also ends in 5 or 0.

NUMBER	SQUARE
1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100
11	121
12	144
13	169
14	196
15	225
16	256
17	289
18	324
19	361
20	400

PROPERTIES

Since the square of an odd natural number is odd

That of an even number is an even number.

Q. The square of which of the following would be odd number ?

(i) 431 (ii) 2826 (iii) 7779 (iv) 82004

Sol.

Since the square of an odd natural number is odd and that of an even number is an even number.

The square of 431 and 7729 are an odd number.
[∵ 431 and 7729 are an odd number.]

The square of 2826 and 82004 are an even number.
[∵ 2826 and 82004 are an even number.]

Q. What will be the unit digit of the squares of the following numbers?

(i) 81 $1 \times 1 = 1$

Sol. The square of unit's place digit 1 is 1.

$\therefore$ The unit's digit of square of 81 is 1.

(ii) 272 $2 \times 2 = 4$

Sol. The square of unit's place digit 2 is 4.

$\therefore$ The unit's digit of square of 272 is 4.

(iii) 799 $9 \times 9 = 81$

Sol. The square of unit's place digit 9 is 81.

$\therefore$ The unit's digit of square of 799 is 1.

Q. What will be the unit digit of the squares of the following numbers?

(iv) 3853 $3 \times 3 = 9$

Sol. The square of unit's place digit 3 is 9.

$\therefore$ The unit's digit of square of 3853 is 9.

(v) 1234 $4 \times 4 = 16$

Sol. The square of unit's place digit 4 is 16.

$\therefore$ The unit's digit of square of 1234 is 6.

Q. What will be the unit digit of the squares of the following numbers?

(vi) 26387 $7 \times 7 = 49$

Sol. The square of unit's place digit 7 is 49.

$\therefore$ The unit's digit of square of 26387 is 9.

(vii) 52698 $8 \times 8 = 64$

Sol. The square of unit's place digit 8 is 64.

$\therefore$ The unit's digit of square of 52698 is 4.

(viii) 99880 $0 \times 0 = 0$

Sol. The square of unit's place digit 0 is 0.

$\therefore$ The unit's digit of square of 99880 is 0.

Q. What will be the unit digit of the squares of the following numbers?

(ix) 12796 $6 \times 6 = 36$

Sol. The square of unit's place digit 6 is 36.

$\therefore$ The unit's digit of square of 12796 is 6.

(x) 55555 $5 \times 5 = 25$

Sol. The square of unit's place digit 5 is 25.

$\therefore$ The unit's digit of square of 55555 is 5.

Square of numbers which are multiples of 10

We have one zero

$10^2 = 100$

$20^2 = 400$

$80^2 = 6400$

But we have two zeros

Square numbers which are multiples of 10 only have even number of zeros at the end

Numbers 1, 4, 49, 81 are squares of 1, 2, 7, 9 respectively. But the squares of 1, 2, 7, 9 are respectively.

We have two zeros

$100^2 = 10000$

$200^2 = 40000$

$700^2 = 490000$

$900^2 = 810000$

But we have four zeros

Example

$1000^2 = 1000000$

$2000^2 = 4000000$

Q. The following numbers are obviously not perfect squares. Give reason?

(i) 1057

Sol. Since, the unit place digit is 7

$\therefore$ 1057 is not a perfect square.

Which is not one of (0, 1, 4, 5, 6 or 9).

(ii) 23453

Sol. Since, the unit place digit is 3.

$\therefore$ 23453 is not a perfect square.

Which is not one of (0, 1, 4, 5, 6 or 9).

(iii) 7928

Sol. Since, the unit place digit is 8

$\therefore$ 7928 is not a perfect square.

Which is not one of (0, 1, 4, 5, 6 or 9).

Q. The following numbers are obviously not perfect squares. Give reason?

(iv) 222222

Sol. Since, the units place digit is 2

∴ 222222 is not a perfect square.

Which is not one of (0, 1, 4, 5, 6 or 9).

(v) 64000

Sol. Since, the number of 0 is odd

∴ 64000 is not a perfect square.

Number of zeroes is 3

(vi) 89722

Sol. Since, the unit place digit is 2

∴ 89722 is not a perfect square.

Which is not one of (0, 1, 4, 5, 6 or 9).

Q. The following numbers are obviously not perfect squares. Give reason?

(vii) 222000

Sol. Since, the number of 0 is odd

$\therefore$ 222000 is not perfect square.

Number of zeroes is 3

(viii) 505050

Sol. Since, the number of 0 is odd

$\therefore$ 505050 can not be perfect square.

Number of zeroes is 1

(1) Find the square :

Trick: To find square of a number whose last digit is 5

For example : 3**5**

Method

(1) Not considering the last digit
Multiply the remaining number
With it's successive natural number

Next consecutive number

× 4 = 12

(2) Attach '25'
to the end of the number obtained in step 1

Example:

$(35)^2$

(3×4) $5^2 = 25$

1225

Example:

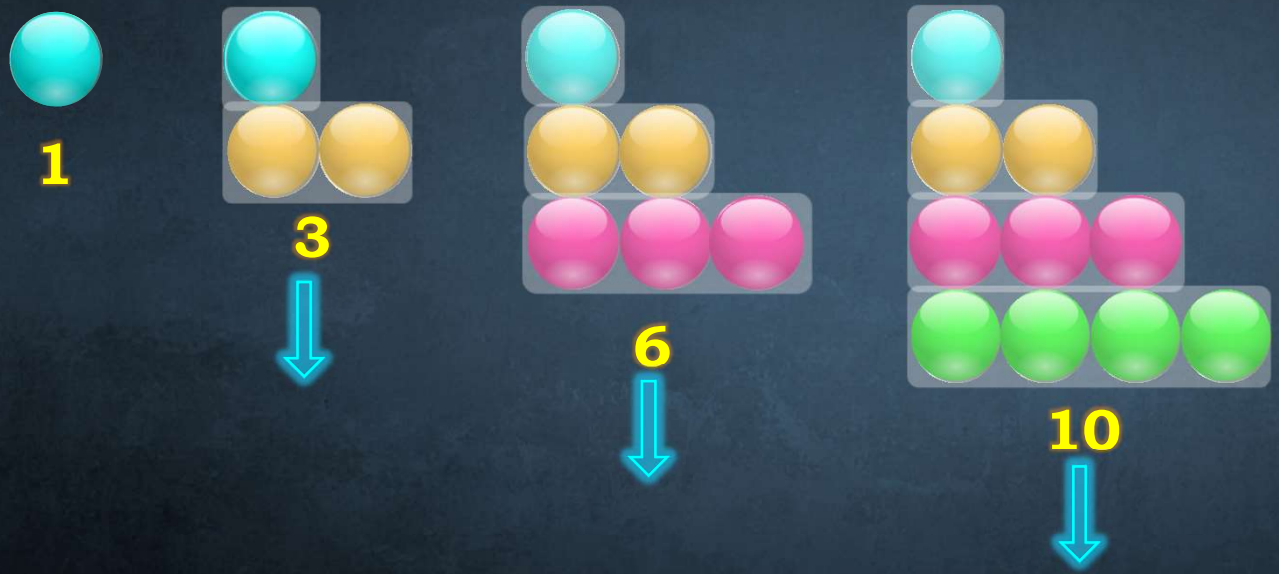
$(45)^2$

(4×5) $5^2 = 25$

2025

SOME MORE INTERESTING FACTS

1. Adding triangular numbers.



$1 + 3 = 4 = 2^2$

$3 + 6 = 9 = 3^2$

$6 + 10 = 16 = 4^2$

If we combine two consecutive triangular numbers we get square numbers

NUMBERS BETWEEN SQUARE NUMBERS

$(1)^2$ $(2)^2$ $(3)^2$ $(4)^2$ $(5)^2$

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

2 4 6 8

The numbers of terms between $(2)^2$ and $(3)^2$ are 2

The numbers of terms between $(3)^2$ and $(4)^2$ are 4

The numbers of terms between $(4)^2$ and $(5)^2$ are 6

The numbers of terms between $(5)^2$ and $(6)^2$ are 8

ADDING ODD NUMBERS

1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + 17, 19, 21, 23, 25, 27, 29, 31 . . .

$1 = 1^2$

$4 = 2^2$

$9 = 3^2$

$16 = 4^2$

$25 = 5^2$

$36 = 6^2$

$49 = 7^2$

$64 = 8^2$

$81 = 9^2$

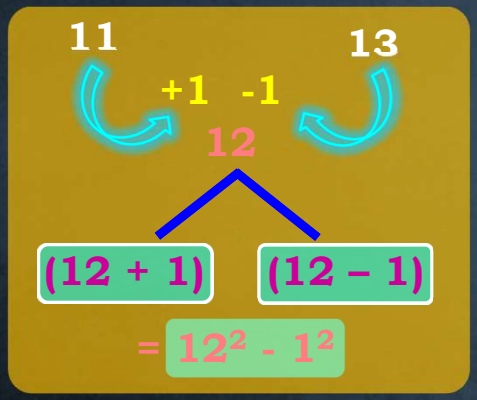
= .....

sum of first n odd numbers = n^2

one odd number for each oddness

Product of two consecutive even or odd numbers

Example



Lets us take 2 consecutive odd numbers 11 & 13.

Similarly,

$(a + 1) \times (a - 1)$
$= a^2 - 1$

$11 \times 13 = (12 - 1) \times (12 + 1) = 12^2 - 1$

$12 \times 14 = (13 - 1) \times (13 + 1) = 13^2 - 1$

$23 \times 25 = (24 - 1) \times (24 + 1) = 24^2 - 1$

$18 \times 20 = (19 - 1) \times (19 + 1) = 19^2 - 1$

Some more patterns in square numbers

$1^2 =$ 1

$11^2 =$ 1 2 1

$111^2 =$ 1 2 3 2 1

$1111^2 =$ 1 2 3 4 3 2 1

$11111^2 =$ 1 2 3 4 5 4 3 2 1

$111111^2 =$ 1 2 3 4 5 6 5 4 3 2 1

Observe the pattern

Some more patterns in square numbers

$7^2 = 49$

$67^2 = 4489$

$667^2 = 444889$

$6667^2 = 44448889$

$66667^2 = 4444488889$

$666667^2 = 444444888889$

Observe the pattern

Q. Observe the following pattern and find the missing digits.

$11^2 = 121$

$101^2 = 10201$

$1001^2 = 1002001$

$10001^2 = 1.....2.....1$

$10000001^2 = ...$

Have the same number of zeroes before and after the digit 2 as it was in original number.

Sol. Observing the above pattern, we have

(i) $100001^2 = 10000200001$

(ii) $10000001^2 = 100000020000001$

Q. Observe the following pattern and find the missing digits.

$11^2 = 121$

$101^2 = 10201$

$10101^2 = 102030201$

$1010101^2 =$ .....

$.....^2 = 10203040504030201$

by following the pattern which was in the original number.

Put zeros after every alternate number.

Sol. Observing the above, we have

(i) $(1010101)^2 = 1020304030201$

(ii) $10203040504030201 = (101010101)^2$

Q. Using the given pattern. Find the missing numbers.

$1^2 + 2^2 + 2^2 = 3^2$ (2 + 1)

$2^2 + 3^2 + 6^2 = 7^2$

$3^2 + 4^2 + 12^2 = 13^2$

$4^2 + 5^2 + \_\_^2 = 21^2$

$5^2 + \_\_^2 + 30^2 = 31^2$

$6^2 + 7^2 + \_\_^2 = \_\_^2$

To find pattern :

Third number is related to first and second number. How ?

Fourth number is related to third number. How ?

The third number is the product of first two numbers.

The fourth number can be obtained by adding one to the third number.

Sol. The missing number are

(i) $4^2 + 5^2 + 20^2 = 21^2$

(ii) $5^2 + 6^2 + 30^2 = 31^2$

(iii) $6^2 + 7^2 + 42^2 = 43^2$ (42 + 1)

Q. Without adding, find the sum.

(i) 1 + 3 + 5 + 7 + 9

(ii) 1 +3 + 5 + 7 + 9 + 11 + 13 + 15 + 17 + 19

(iii) 1 + 3 + 5 + 7 + 9 + 11 + 13 + 15+ 17+ 19 + 21 + 23

Sol.

(i) The sum of first 5 odd numbers $= 5^2$

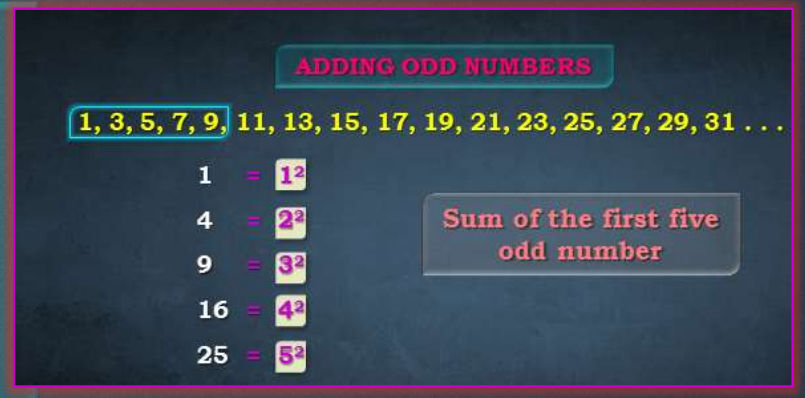
$= 25$

(ii) The sum of first 10 odd numbers $= 10^2$

$= 100$

(ii) The sum of first 12 odd numbers $= 12^2$

$= 144$



Q. (i) Express 49 as the sum of 7 odd numbers.
(ii) Express 121 as the sum of 11 odd numbers.

7 odd numbers

$49 = 7^2$

$= 1 + 3 + 5 + 7 + 9 + 11 + 13$

11 odd numbers

$121 = 11^2$

$= 1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + 17 + 19 + 21$

Q. How many numbers lie between squares of the following numbers ?

(i) 12 and 13 **(ii) 25 and 26** **(iii) 99 and 100**

Sol. (i) Between 12^2 and 13^2, there are

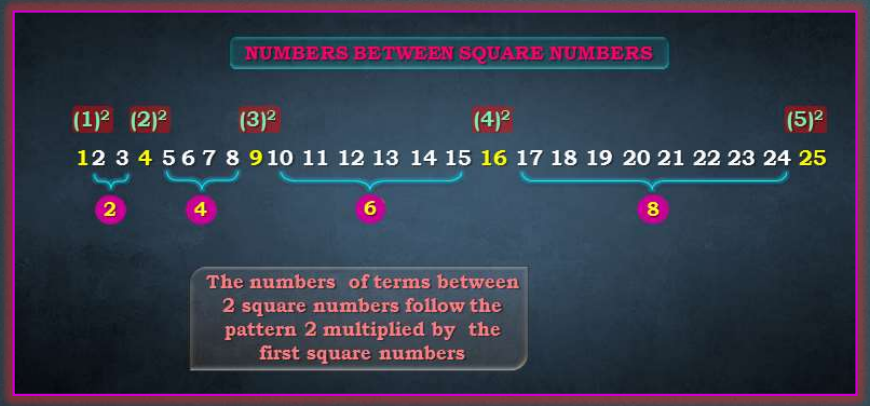
2×12 i.e., 24 numbers.

(ii) Between 25^2 and 26^2, there are

2×25 i.e., 50 numbers.

(iii) Between 99^2 and 100^2, there are

2×99 i.e., 198 numbers.



Finding the square of a number without actual multiplication

Example To find the square of number 39

1. $39^2 = (30 + 9)^2$

Sol. $(30 + 9)^2 = (30)^2 + 2 \times 30 \times 9 + (9)^2$

$= 900 + 540 + 81$

$= 1521$

What is b ?

What is a ?

30

Let us replace a with 30 & b with 9

Similarly, the formula

$(a + 1) \times (a - 1) = a^2 - 1$

2. $42^2 = (40 + 2)^2$

$= 40^2 + 2 \times 40 \times 2 + 2^2$

$= 1600 + 160 + 4$

$= 1764$

Q. Find the square of the following numbers.

(i) 32

Sol. $(32)^2 = (30 + 2)^2$

$= (30)^2 + 2\,(30)\,(2) + (2)^2$

$= 900 + 120 + 4$

$\therefore \quad (32)^2 = 1024$

$(a + b)^2 = a^2 + 2ab + b^2$

(ii) 35

Sol. $(35)^2 = (30 + 5)^2$

$= (30)^2 + 2\,(30)\,(5) + (5)^2$

$= 900 + 300 + 25$

$\therefore \quad (35)^2 = 1225$

Q. Find the square of the following numbers.

(iii) 86

Sol. $(86)^2 = (80 + 6)^2$

$= (80)^2 + 2(80)(6) + (6)^2$

$= 6400 + 960 + 36$

$\therefore \quad (86)^2 = 7396$

$(a + b)^2 = a^2 + 2ab + b^2$

(iv) 93

Sol. $(93)^2 = (90 + 3)^2$

$= (90)^2 + 2(90)(3) + (3)^2$

$= 8100 + 540 + 9$

$\therefore \quad (93)^2 = 8649$

Q. Find the square of the following numbers.

(v) 71

Sol. $(71)^2 = (70 + 1)^2$

$= (70)^2 + 2(70)(1) + (1)^2$

$= 4900 + 140 + 1$

$\therefore \quad (71)^2 = 5041$

$(a + b)^2 = a^2 + 2ab + b^2$

(vi) 46

Sol. $(46)^2 = (40 + 6)^2$

$= (40)^2 + 2(40)(6) + (6)^2$

$= 1600 + 480 + 36$

$\therefore \quad (46)^2 = 2116$

PYTHAGOREAN TRIPLET

If 3 numbers a, b, c are such that $a^2 + b^2 = c^2$ then they are called as **PYTHAGOREAN TRIPLET.**

Example

3, 4, 5 form a Pythagorean Triplet

[$\because 3^2 + 4^2 = 5^2$]

8, 15, 17 form a Pythagorean Triplet

[$\because 8^2 + 15^2 = 17^2$]

$8^2 + 15^2 = 17^2$

$64 + 225 = 289$

$289 = 289$

PYTHAGOREAN TRIPLET

NOTE : For any natural number $n, (n>1), (2n)^2 + (n^2 - 1)^2 = (n^2 + 1)^2$

Example Write a Pythagorean triplet whose one number is 15.

Sol : Since, a Pythagorean triplet is formed by $2n$, $n^2 - 1$ and $n^2 + 1$.

If $2n = 15$; $n = \frac{15}{2}$ is not a natural number.

$\because$ It is natural number. Pythagorean triplet is formed by

So, now let us assume that

$n^2 - 1 = 15$

$\therefore n^2 = 15 + 1$

$\therefore n^2 = 16$

$\therefore n = 4$

Taking square [roots on both]

Now, the required Pythagorean triplet is

$\therefore 2n = 2(4) = 8$

$n^2 - 1 = 4^2 - 1 = 15$

$n^2 + 1 = 4^2 + 1 = 17$

Note :
All the Pythagorean triplets may not be obtained using this form

Q. Write a Pythogorean triplet whose one member is

(i) 6

Sol. Let $2n = 6$ $\therefore\ n = \frac{6}{2} = 3$

Now, $n^2 - 1 = 3^2 - 1 = 9 - 1 = 8$

and, $n^2 + 1 = 3^2 + 1 = 9 + 1 = 10$

Thus, the required Pythagorean triplet is 6, 8, 10.

Now, the required Pythagorean triplet is $2n,\ n^2 - 1$ and $n^2 + 1$

(ii) 14

Sol. Let $2n = 14$ $\therefore\ n = \frac{14}{2} = 7$

Now, $n^2 - 1 = 7^2 - 1 = 49 - 1 = 48$

and, $n^2 + 1 = 7^2 + 1 = 49 + 1 = 50$

Thus, the required Pythagorean triplet is 14, 48, 50.

Q. Write a Pythogorean triplet whose one member is

(iii) 16

Sol. Let $2n = 16 \therefore n = \frac{16}{2} = 8$

Now, $n^2 - 1 = 8^2 - 1 = 64 - 1 = 63$

and, $n^2 + 1 = 8^2 + 1 = 64 + 1 = 65$

Thus, the required Pythagorean triplet is 16, 63, 65.

Now, the required Pythagorean triplet is $2n$, $n^2 - 1$ and $n^2 + 1$

(iv) 18

Sol. Let $2n = 18 \therefore n = \frac{18}{2} = 9$

Now, $n^2 - 1 = 9^2 - 1 = 81 - 1 = 80$

and, $n^2 + 1 = 9^2 + 1 = 81 + 1 = 82$

Thus, the required Pythagorean triplet is 18, 80, 82.

Q. What could be the possible 'ones' digit of the square root of each of the following numbers?

(i) 9801 **(ii) 99856** **(iii) 998001** **(iv) 65766025**

Sol. The possible digit at one's place of the square root of

(i) 9801 can be 1 or 9.

[∵ $1 \times 1 = 1$ and $9 \times 9 = 81$]

(ii) 99856 can be 4 or 6.

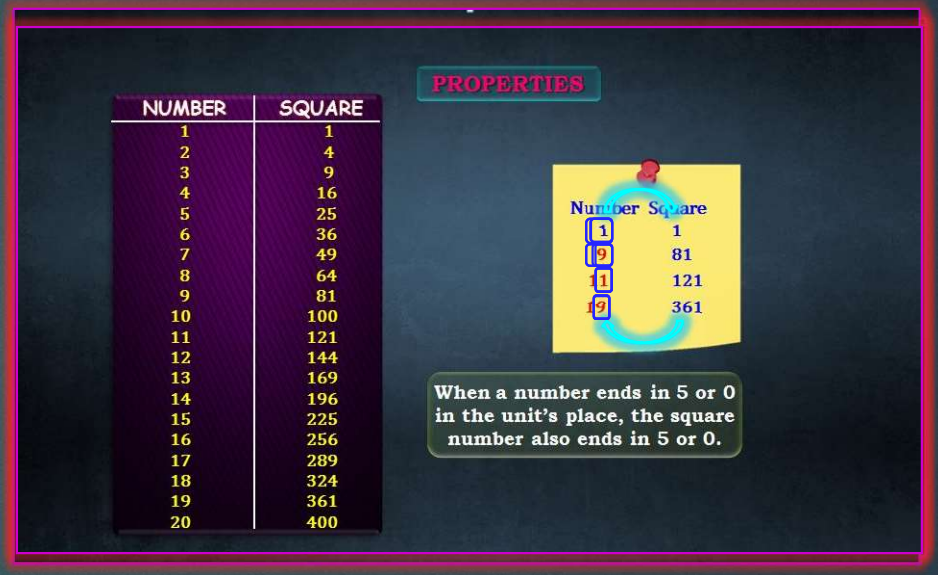
[∵ $4 \times 4 = 16$ and $6 \times 6 = 36$]

(iii) 998001 can be 1 or 9.

[∵ $1 \times 1 = 1$ and $9 \times 9 = 81$]

(iv) 65766025 can be 5.

[∵ $5 \times 5 = 25$]



Q. Without doing any calculation find the numbers which are surely not perfect squares.

(i) 153 (ii) 257 (iii) 408 (iv) 441

Sol. We know that the ending digit of perfect square is 0, 1, 4, 5, 6 and 9.

(i) 153, cannot be a perfect square.

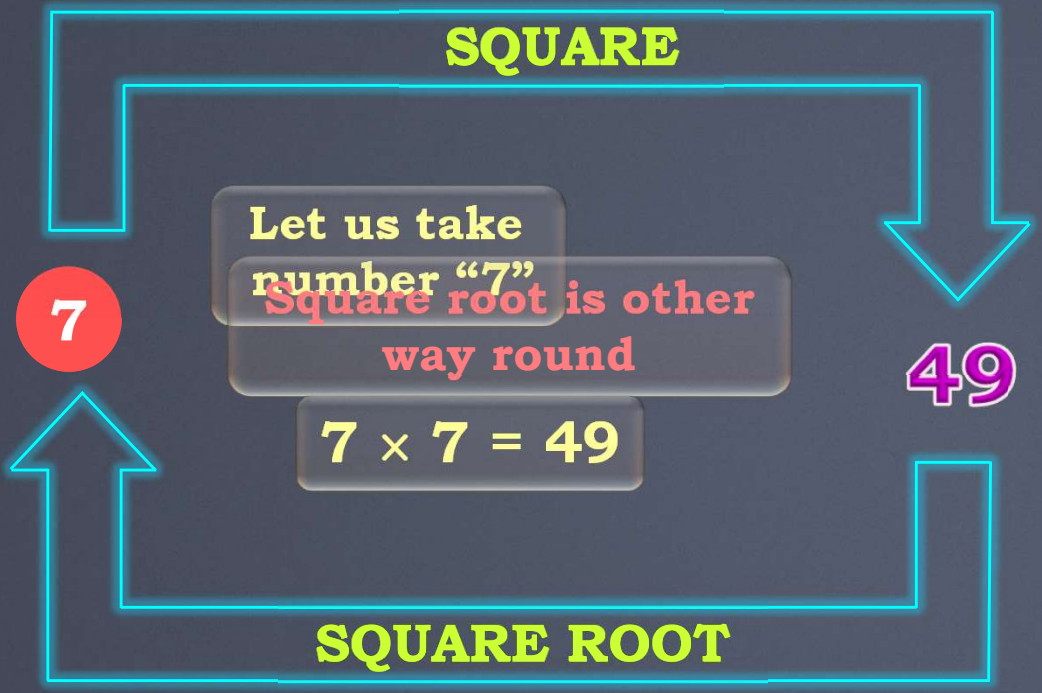
(ii) 257, cannot be a perfect square.

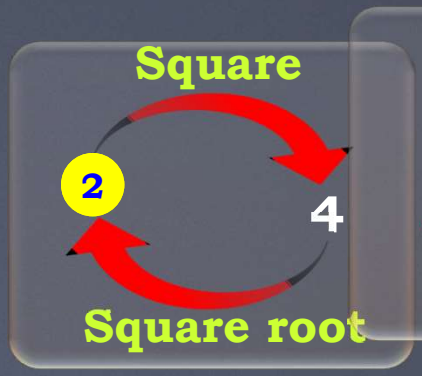
(iii) 408, cannot be a perfect square.

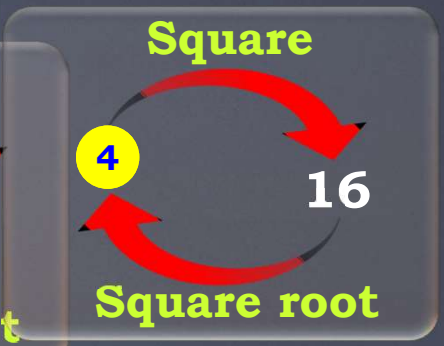
(iv) 441, can be a perfect square.

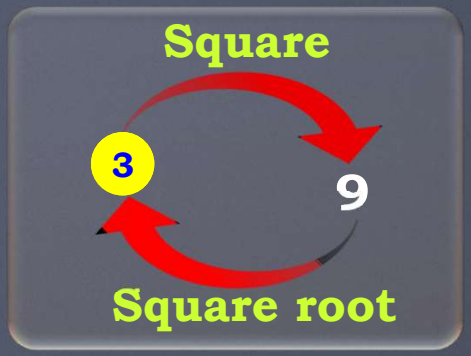
But here the ending digitsiare

$\sqrt{}$ (*Square Root*) of a Number









"$\sqrt{}$" is used to denote Square root of any number.

$7^2 = 49 \quad \sqrt{49} = 7$

Square Roots Of Positive Number

What are square roots of 64 ?

$64 = 8 \times 8$

$= 8^2$

Square root of 64 is 8

$\sqrt{64} = 8$

Let us take
1, 2, 3, 4
square root of 64

$64 = (-8) \times (-8)$

$= (-8)^2$

Square root of 64 is (– 8)

$\sqrt{64} = (-8)$

Thus, there are two sq
These are 8 and (- 8)

REMEMBER THIS :-

Every positive number
i.e. one positive and th
ots.

Ex :

$\sqrt{4} = 2$ and -2

$\sqrt{9} = 3$ and -3

$\sqrt{16} = 4$ and -4

$\sqrt{25} = 5$ and -5

There are 3 methods to find square root of number.

- Repeated subtraction Method
- Factorisation Method
- Division Method

How to find out Square root of a number

Finding square roots through repeated subtraction.

$\therefore \sqrt{81} = 9$

1. $81 - 1 = 80$
2. $- 3 = 77$
3. $- 5 = 72$
4. $- 7 = 65$
5. $- 9 = 56$
6. $- 11 = 45$
7. $- 13 = 32$
8. $- 15 = 17$
9. $- 17 = 0$

The step at which we get zero is the square root of the number.

Subtract successive odd numbers till we reach zero

From 81 we have subtracted successive odd numbers starting from 1 and obtained 0 at the ninth step

Q. Find the square roots of 100 and 169 by the method of repeated subtraction.

Sol. $\therefore \sqrt{100} = 10$

From 100 we have
Subtract successive odd
numbers starting from 1 and
get zero at the tenth step

Now lets count
the steps
obtained 0 at the tenth step

1
100 – 1 = 99

2
– 3 = 96

3
– 5 = 91

4
– 7 = 84

5
– 9 = 75

6
– 11 = 64

7
– 13 = 51

8
– 15 = 36

9
– 17 = 19

10
– 19 = 0

Q. Find the square roots of 100 and 169 by the method of repeated subtraction.

Sol. $\therefore \sqrt{169} = 13$

From 169 we have subtracted successive odd numbers starting from 1 and stopped at the 13th step when we reached zero.

1
169 – 1 = 168

2
– 3 = 165

3
– 5 = 160

4
– 7 = 153

5
– 9 = 144

6
– 11 = 133

7
– 13 = 120

8
– 15 = 105

9
– 17 = 88

10
– 19 = 69

11
– 21 = 48

12
– 23 = 25

13
– 25 = 0

Q. Find the square roots of the following numbers by the Prime Factorisation Method.

(i) 729

Sol. $729 = 3 \times 3 \times 3 \times 3 \times 3 \times 3$

$\therefore \sqrt{729} = 3 \times 3 \times 3$

$\therefore \sqrt{729} = 27$

$\therefore$ Thus, the square root of 729 = 27

Let us do prime factorisation of 729

Let us make pairs of same number

Rough work

3	729
3	243
3	81
3	27
3	9
3	3
	1

Q. Find the square roots of the following numbers by the Prime Factorisation Method.

(ii) 400

Sol. $400 = 2 \times 2 \times 2 \times 2 \times 5 \times 5$

$\therefore \sqrt{400} = 2 \times 2 \times 5$

$\therefore \sqrt{400} = 20$

$\therefore$ Thus, the square root of 400 = 20

Let us do prime factorisation of 400

Let us make pairs of same number

Rough work

2	400
2	200
2	100
2	50
5	25
5	5
	1

Q. Find the square roots of the following numbers by the Prime Factorisation Method.

(iii) 1764

Sol. $1764 = 2 \times 2 \times 3 \times 3 \times 7 \times 7$

$\therefore \sqrt{1764} = 2 \times 3 \times 7$

$\therefore \sqrt{1764} = 42$

$\therefore$ Thus, the square root of 1764 = 42

Let us make pairs of same numbers in the factorisation of 1764

Rough work

2	1764
2	882
3	441
3	147
7	49
7	7
	1

Q. Find the square roots of the following numbers by Prime Factorisation Method.

(iv) 4096

Sol. $4096 = (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times (2 \times 2)$

$\therefore \sqrt{4096} = 2 \times 2 \times 2 \times 2 \times 2 \times 2$

$\therefore \sqrt{4096} = 64$

$\therefore$ Thus, the square root of 4096 = 64

Let us make pairs of same number

Let us do pri factorisation 4096

Rough work

2	4096
2	2048
2	1024
2	512
2	256
2	128
2	64
2	32
2	16
2	8
2	4
2	2
	1

Q. Find the square roots of the following numbers by the Prime Factorisation Method.

(v) 7744

Sol. $7744 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 11 \times 11$

$\therefore \sqrt{7744} = 2 \times 2 \times 2 \times 11$

$\therefore \sqrt{7744} = 88$

$\therefore$ Thus, the square root of 7744 = 88

Let us make pairs of same number

Let us do prime factorisation of 7744

Rough work

2	7744
2	3872
2	1936
2	968
2	484
2	242
11	121
11	11
	1

Q. Find the square roots of the following numbers by the Prime Factorisation Method.

(vi) 9604

Sol. $9604 = 2 \times 2 \times 7 \times 7 \times 7 \times 7$

$\therefore \sqrt{9604} = 2 \times 7 \times 7$

$\therefore \sqrt{9604} = 98$

$\therefore$ Thus, the square root of 9604 = 98

Let us make pairs of same number of factorisation of 9604

Rough work

2	9604
2	4802
7	2401
7	343
7	49
7	7
	1

Q. Find the square roots of the following numbers by the Prime Factorisation Method.

(vii) 5929

Sol. $5929 = 7 \times 7 \times 11 \times 11$

$\therefore \sqrt{5929} = 7 \times 11$

$\therefore \sqrt{5929} = 77$

$\therefore$ Thus, the square root of 9604

$= 77$

Let us make pairs of same number of prime factorisation of 5929

Rough work

7	5929
7	847
11	121
11	11
	1

Q. Find the square roots of the following numbers by Prime Factorisation Method.

(viii) 9216

Sol. $9216 = (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times (3 \times 3)$

$\therefore \sqrt{9216} = 2 \times 2 \times 2 \times 2 \times 2 \times 3$

$\therefore \sqrt{9216} = 96$

$\therefore$ Thus, the square root of 4096 = 96

Let us make pairs of same number

Let us do prime factorisation of 9216

Rough work

2	9216
2	4608
2	2304
2	1152
2	576
2	288
2	144
2	72
2	36
2	18
3	9
3	3
	1

Q. Find the square roots of the following numbers by the Prime Factorisation Method.

(ix) 529

Sol. $529 = 23 \times 23$

$\therefore \sqrt{529} = 23$

$\therefore$ Thus, the square root of 529 = 23

Let us do prime factorisation of 529

Let us make pairs of same numbers

Rough work

23	529
23	23
	1

Q. Find the square roots of the following numbers by the Prime Factorisation Method.

(x) 8100

Sol. $8100 = 2 \times 2 \times 3 \times 3 \times 3 \times 5 \times 5$

$\therefore \sqrt{8100} = 2 \times 3 \times 3 \times 5$

$\therefore \sqrt{8100} = 90$

$\therefore$ Thus, the square root of 8100 = 90

Let us do prime factorisation of 8100

Let us make pairs of same number

Rough work

2	8100
2	4050
3	2025
3	675
3	225
3	75
5	25
5	5
	1

Q. For each of the following numbers, find the smallest whole number by which it should be multiplied so as to get a perfect square number. Also find the square root of the square number so obtained.

(i) 252

Sol.

$252 \times 7 = 2 \times 2 \times 3 \times 3 \times 7 \times 7$

$1764 = 2 \times 2 \times 3 \times 3 \times 7 \times 7$

$\therefore \sqrt{1764} = 2 \times 3 \times 7$

$\sqrt{1764} = 42$

So, now the perfect square is 1764

Thus, the required whole number = 7.

Also, the square root of 1764 = 42.

Rough work

2	252
2	126
3	63
3	21
7	7
	1

Q. For each of the following numbers, find the smallest whole number by which it should be multiplied so as to get a perfect square number. Also find the square root of the square number so obtained.

(iii) 1008

Sol.

$1008 \times 7 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 7 \times 7$

$7056 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 7 \times 7$

$\therefore \sqrt{7056} = 2 \times 2 \times 3 \times 7$

Thus, the required smallest whole number = 7.

Also, the square root of 7056 = 84.

Let us do prime factorisation of 1008

So, now the perfect square is 7056

Rough work

2	1008
2	504
2	252
2	126
3	63
3	21
7	7
	1

Q. For each of the following numbers, find the smallest whole number by which it should be multiplied so as to get a perfect square number. Also find the square root of the square number so obtained.

(iv) 2028

Sol.

$2028 \times 3 = 2 \times 2 \times 13 \times 13 \times 3 \times 3$

$6084 = 2 \times 2 \times 13 \times 13 \times 3 \times 3$

$\therefore \sqrt{6084} = 2 \times 13 \times 3$

$\sqrt{6084} = 78$

Thus, the required smallest whole number = 3.

Also, the square root of 6084 = 78.

Let us do prime factorisation of 2028

So, now the perfect square is 6084

i.e. multiply by 3.

Rough work

2	2028
2	1014
3	507
13	169
13	13
	1

Q. For each of the following numbers, find the smallest whole number by which it should be multiplied so as to get a perfect square number. Also find the square root of the square number so obtained.

(v) 1458

Sol.

$1458 \times 2 = 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 2 \times 2$

$2916 = 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 2 \times 2$

$\therefore \sqrt{2916} = 3 \times 3 \times 3 \times 3 \times 2$

Thus, the required smallest whole number = 2

So, now the perfect square is 2916.

Also, the square root of $2916 = 54$.

Let us do prime factorisation of 1458 and multiply by 2.

Rough work

2	1458
3	729
3	243
3	81
3	27
3	9
3	3
	1

Q. For each of the following numbers, find the smallest whole number by which it should be multiplied so as to get a perfect square number. Also find the square root of the square number so obtained.

(vi) 768

Sol.

Let us do prime factorisation of 768

$768 = \boxed{2 \times 2} \times \boxed{2 \times 2} \times \boxed{2 \times 2} \times \boxed{2 \times 2} \times 3$

$768 \times 3 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3 \times 3$

$2304 = \boxed{2 \times 2} \times \boxed{2 \times 2} \times \boxed{2 \times 2} \times \boxed{2 \times 2} \times \boxed{3 \times 3}$

$\therefore \sqrt{2304} = 2 \times 2 \times 2 \times 2 \times 3$

$\sqrt{2304} = 48$

Thus, the required smallest whole number = 3.

Also, the square root of 2304 = 48.

Rough work

2	768
2	384
2	192
2	96
2	48
2	24
2	12
2	6
2	3
3	1

Q. For each of the following numbers, find the smallest whole number by which it should be divided so as to get a perfect square number. Also find the square root of the square number so obtained.

(i) 252

Sol.

$\therefore \quad 252 = 2 \times 2 \times 3 \times 3 \times 7$

$\therefore \quad \frac{252}{7} = \frac{2 \times 2 \times 3 \times 3 \times 7}{7}$ (36)

$36 = 2 \times 2 \times 3 \times 3$

$\sqrt{36} = 2 \times 3$

$\sqrt{36} = 6$

Thus, the required smallest whole number = 7.

Also, the square root of 36 = 6.

Let us do prime factorisation of 252

Rough work

2	252
2	126
3	63
3	21
7	7
	1

Q. For each of the following numbers, find the smallest whole number by which it should be divided so as to get a perfect square number. Also find the square root of the square number so obtained.

(ii) 2925

Sol.

$\therefore\ 2925 = 3 \times 3 \times 5 \times 5 \times 13$

$\therefore\ \frac{2925}{13} = \frac{3 \times 3 \times 5 \times 5 \times 13}{13}$ (225)

$225 = 3 \times 3 \times 5 \times 5$

$\sqrt{225} = 3 \times 5$

$\sqrt{225} = 15$

Let us do prime factorisation of 2925.

So now the perfect square is 225.

Thus, the required smallest whole number = 13.

Also, the square root of 225 = 15.

Rough work

3	2925
3	975
5	325
5	65
13	13
	1

Q. For each of the following numbers, find the smallest whole number by which it should be divided so as to get a perfect square number. Also find the square root of the square number so obtained.

(iii) 396

Sol.

$\therefore\ 396 = 2 \times 2 \times 3 \times 3 \times 11$

$\therefore\ \frac{396}{11} = \frac{2 \times 2 \times 3 \times 3 \times 11}{11}$

$36 = 2 \times 2 \times 3 \times 3$

$\sqrt{36} = 2 \times 3$

$\sqrt{36} = 6$

Since the prime factors of 396 cannot be paired, so, now the perfect square is 396 divide by 11.

Thus, the required smallest whole number = 11.

Also, the square root of 36 = 6.

Rough work

2	396
2	198
3	99
3	33
11	11
	1

Q. For each of the following numbers, find the smallest whole number by which it should be divided so as to get a perfect square number. Also find the square root of the square number so obtained.

(iv) 2645

Sol.

$\therefore\ 2645 = 5 \times 23 \times 23$

$\therefore\ \frac{2645}{5} = \frac{5 \times 23 \times 23}{5}$ (529)

$529 = 23 \times 23$

$\sqrt{529} = 23$

Since the prime factor 5 of 2645 has no pair.

Thus, the required smallest whole number = 5.

Also, the square root of 529 = 23.

Rough work

5	2645
23	529
23	23
	1

Q. For each of the following numbers, find the smallest whole number by which it should be divided so as to get a perfect square number. Also find the square root of the square number so obtained.

(v) 2800

Sol.

$\therefore$ $2800 = 2 \times 2 \times 2 \times 2 \times 5 \times 5 \times 7$

$\therefore$ $\frac{2800}{7} = \frac{2 \times 2 \times 2 \times 2 \times 5 \times 5 \times 7}{7}$

$400 = 2 \times 2 \times 2 \times 2 \times 5 \times 5$

$\therefore$ $\sqrt{400} = 2 \times 2 \times 5$

$\sqrt{400} = 20$

Thus, the required smallest whole number = 7.

Also, the square root of 400 = 20.

Since, the prime factorisation of 2800 is not in pair.

So, now the perfect square is 400.

So, we have to divide by 7.

Rough work

2	2800
2	1400
2	700
2	350
5	175
5	35
7	7
	1

Q. For each of the following numbers, find the smallest whole number by which it should be divided so as to get a perfect square number. Also find the square root of the square number so obtained.

(vi) 1620

Sol.

$1620 = 2 \times 2 \times 3 \times 3 \times 3 \times 3 \times 5$

$\frac{1620}{5} = \frac{2 \times 2 \times 3 \times 3 \times 3 \times 3 \times \cancel{5}}{\cancel{5}}$

$\therefore \quad 324 = 2 \times 3 \times 3$

$\sqrt{324} = 18$

Let us do prime factorisation of 1620

Since, 1620 is not divisible by 5.

Thus, the required smallest whole number = 5.

Also, the square root of 324 = 18.

Rough work

2	1620
2	810
3	405
3	135
3	45
3	15
5	5
	1

Q. The students of Class VIII of a school donated Rs. 2401 in all, for Prime Minister's National Relief Fund. Each student donated as many rupees as the number of student in the class. Find the number of students in the class.

Example

Sol. + = 4

Let the number of students = x

∴ Each student donated Rs x.

Taking number of students, suppose to find in the question?

Total amount donated by the class = Rs $x \times x$ = Rs x^2.

Thus, $x^2 = 2401$ [given]

$x = \sqrt{2401}$

$= \sqrt{7 \times 7 \times 7 \times 7}$

$= 7 \times 7$

$= 49$

∴ the total contribution is 20×20 = Rs 400

× = 4

∴ The number of students in the class = 49.

If the number of students are 20 then the contribution will also be Rs 20.

Rough work

7	2401
7	343
7	49
7	7
	1

Q. 2025 plants are to be planed in a garden in such a way that each row contain as many plants as the number of rows. Find the number of row and the number of plants in each row.

Sol.

Let the number of rows = x

$\therefore$ Number of plants is a row = x

So, the number of plants to be planted = $x \times x = x^2$

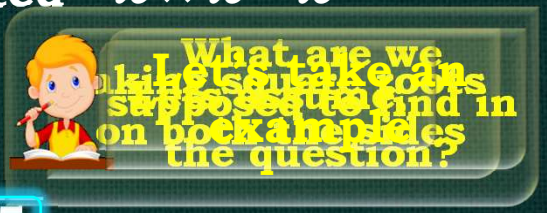
Thus, $x^2 = 2025$ [given]

$x = \sqrt{2025}$

$= \sqrt{3 \times 3 \times 3 \times 3 \times 5 \times 5}$

$= 3 \times 3 \times 5$

Thus, number of row = 45



$\therefore$ Also, number of plants in a row = 45.

Rough work

3	2025
3	675
3	225
3	75
5	25
5	5
	1

Q. Find the smallest square number that is divisible by each of the numbers 4, 9 and 10.

Example

Sol.

We know that LCM is the smallest number divisible by all its factors.

$\therefore$ LCM of 4, 9 and 10 $= 2 \times 2 \times 9 \times 5$

$= 180$

$\therefore$ 900 is a perfect square.

$\therefore$ Thus, the required number = 900.

Is it divisible by

$180 \times 5 = 2 \times 2$

$900 = 2 \times 2$

Rough work

2	4,9,10
2	2,9,5
5	1,9,5
9	1,9,1
	1,1,1

So, to make a square number 400

Q. Find the smallest square number that is divisible by each of the numbers 8, 15 and 20.

Sol.

The smallest number divisible by 8, 15, and 20 is their LCM.

Since, LCM of 8, 15, and 20
$= 2 \times 2 \times 2 \times 3 \times 5 = 120$

$\therefore$ 3600 is a perfect square.

$120 \times 2 \times 3 \times 5 = 2 \times 2 \times 2 \times 3 \times$

$3600 = 2 \times 2 \times 2 \times 2$

Rough work

2	8,15,20
2	4,15,10
5	2,15,6
	2,3,1

Square root by Division method

Exercise 6.4

Steps

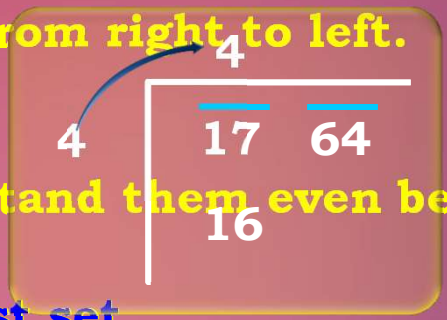
1. Make a set of 2 digits, Sets are always made from right to left.

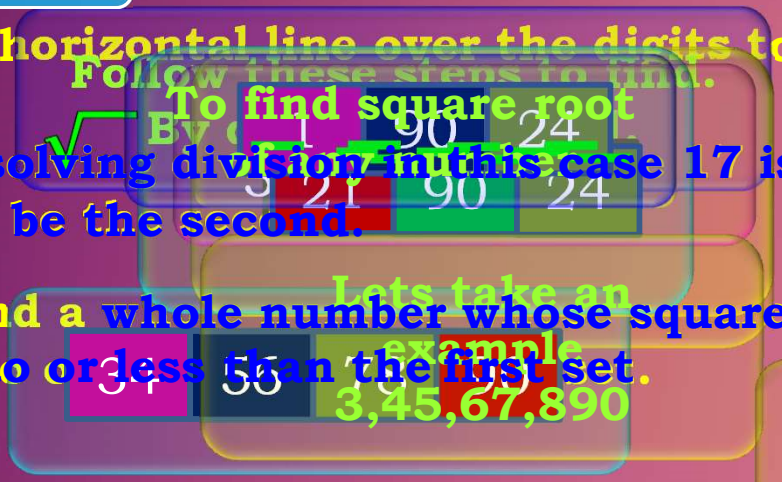
For Example

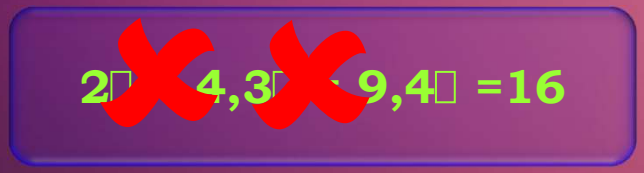
2. Put a horizontal line over the digits to understand them even better.

3. While solving division in this case 17 is the first set 64 will be the second.

4. Now find a whole number whose square is equal to or less than the first set.



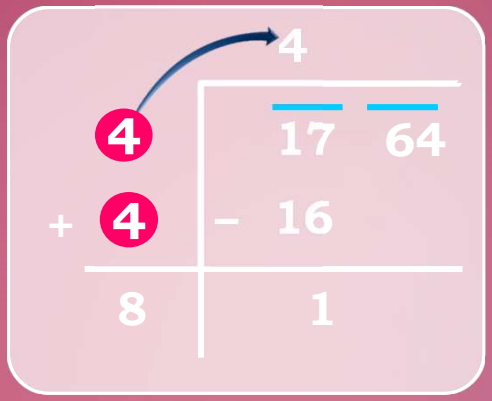




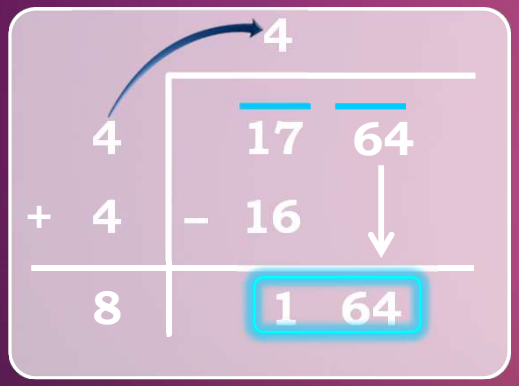
Steps

5.Subtract 16 from 17, so we get 1.

6. Now ,add the number to the left of the line i.e 4 add the same number to it, so we get 8.



7. Now, write down the second pair from the given number i.e 64 after the number 1. The new number so formed is 164.



Steps

8. Now, think of a digit that should be written besides 8, so that when we multiply the new number formed with the same digit, we should get a number equal to 164 or just less then164.

- So lets think of the digit.....

- Since we get zero as the remainder, 42 is the square root of 1764.

$(\therefore \sqrt{1764} = 42)$

0,1,2,3,4,5,.....

Rough Work

80	81	82
× 0	× 1	× 2
00	81	164

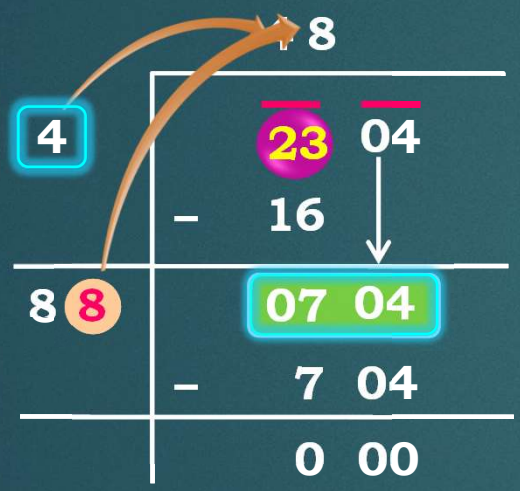
Follow these steps to find square root of any numbers

To find square root by division method

	4 2	
4		17 64
+ 4	− 16	
8 2		1 64
+ 2	− 1 64	
8 4		0 00

Q. Find the square root of each of the following numbers by division method.

(i) 2304



$\therefore \sqrt{2304} = 48$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

So, Find a square of a number less than or equal to first set

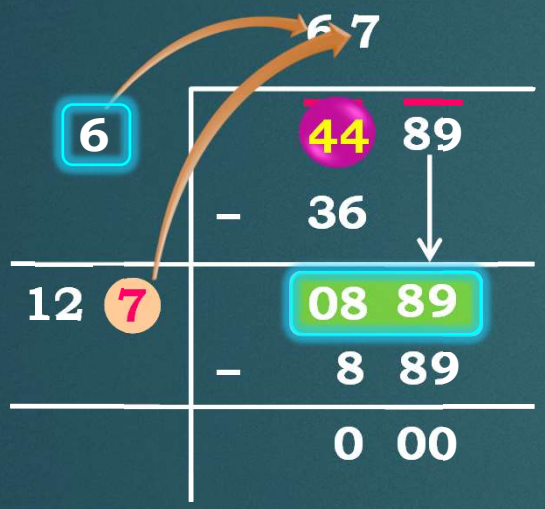
digit.

Rough Work

✗	8
8 7 × 7 = 60 9	8 8 × 8 = 70 4

Q. Find the square root of each of the following numbers by division method.

(ii) 4489



$\therefore \sqrt{4489} = 67$

Find a square of a number which is less than or equal to first set.

Rough Work

7

12 6 × 6 = 75 6

12 7 × 7 = 88 9

Q. Find the square root of each of the following numbers by division method.

(iii) 3481

```
          5 9
     ┌──────────
  5  │  34  81
     │ − 25
     ├──────────
 109 │   09 81
     │ −  9 81
     ├──────────
     │    0 00
```

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

Rough Work

8	9
$108 \times 8 = 864$	$109 \times 9 = 981$

$\therefore \sqrt{3481} = 59$

Q. Find the square root of each of the following numbers by division method.

(iv) 529

$$
\begin{array}{r|l}
 & 2\,3 \\
\hline
2 & 5\,29 \\
 & -\ 4 \\
\hline
4\ \ 3 & 01\,29 \\
 & -\ 1\,29 \\
\hline
 & 0\,00
\end{array}
$$

$\therefore \sqrt{529} = 23$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

Find a square of a number that is less than or equal to first set

Rough Work

✗	3
4 3 × 2 = 8 4	4 3 × 3 = 1 29

Q. Find the square root of each of the following numbers by division method.

(v) 3249

```
          5 7
     ┌──────────
  5  │ 32  49
     │-25
     ├──────────
 107 │ 07  49
     │- 7  49
     ├──────────
     │  0  00
```

$\therefore \sqrt{3249} = 57$

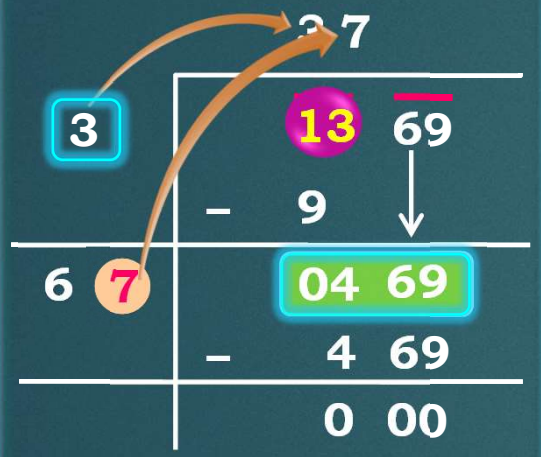
$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

Rough Work

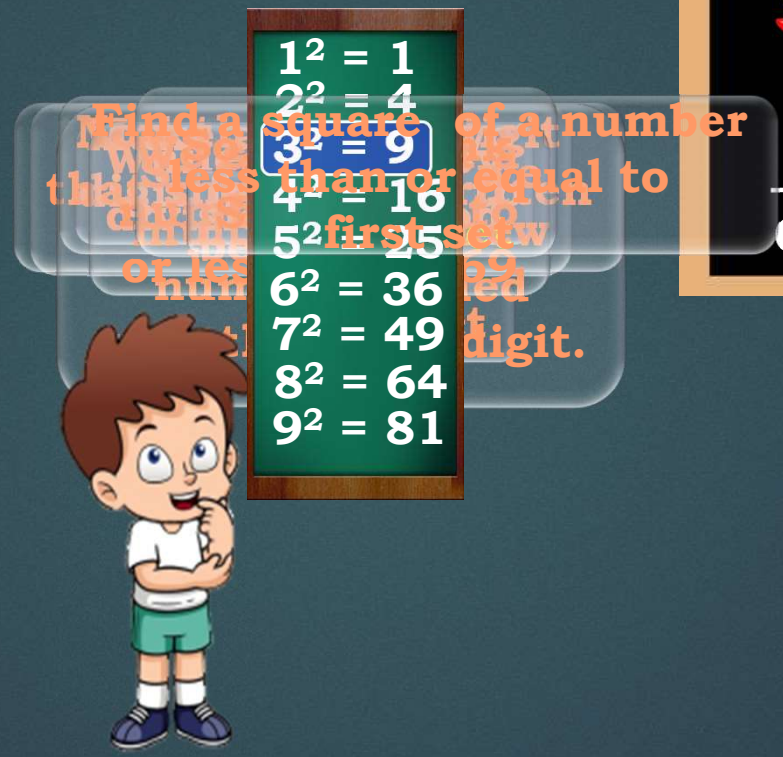
106 × 6 = 636 (✗)	107 × 7 = 749

Q. Find the square root of each of the following numbers by division method.

(vi) 1369



$\therefore \sqrt{1369} = 37$



Rough Work

✗	7
6 6	6 7
× 6	× 7
63 6	46 9

Q. Find the square root of each of the following numbers by division method.

(vii) 5776

		57 76
7		
	−	49
14 6		08 76
	−	8 76
		0 00

$\therefore \sqrt{5776} = 76$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

Find a square of a number which is less than or equal to the first set of digit.

Rough Work

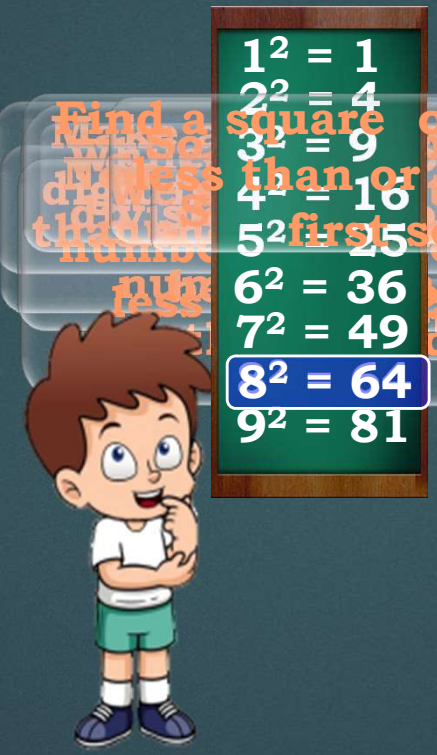
✗	6
14 5 × 5 = 72 5	14 6 × 6 = 87 6

Q. Find the square root of each of the following numbers by division method.

(viii) 7921

```
      8  9
    ---------
8 | 79  21
    -  64
    ---------
16  9  15 21
    -  15 21
    ---------
         0  00
```

$\therefore \sqrt{7921} = 89$



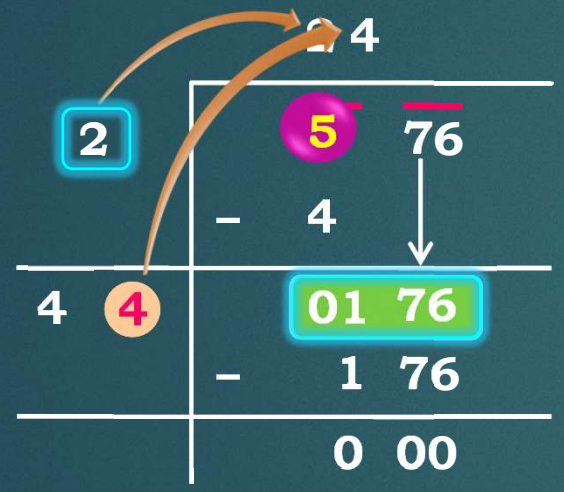
Find a square of a number less than or equal to first set digit.

Rough Work

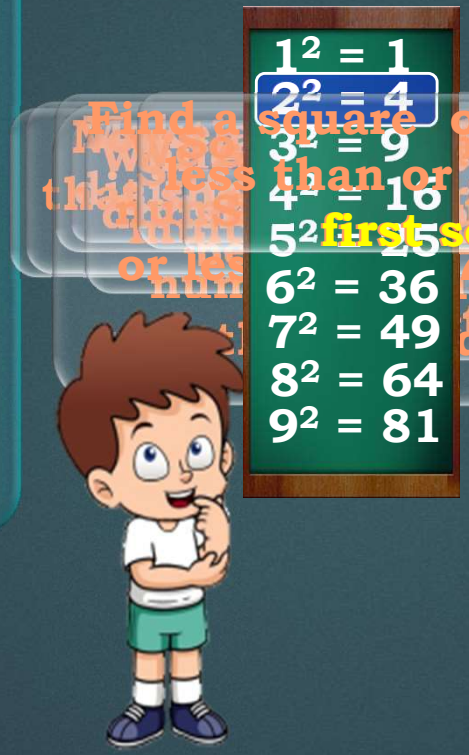
16 8	169
× 8	× 9
1344	1521

Q. Find the square root of each of the following numbers by division method.

(ix) 576



$\therefore \sqrt{576} = 24$



Find a square of a number less than or equal to first set

Rough Work

✗	4
4 3 × 3	4 4 × 4
12 9	17 6

Q. Find the square root of each of the following numbers by division method.

(x) 1024

	32
3	$\overline{10}\ \overline{24}$
	− 9
62	01 24
	− 1 24
	0 00

$\therefore \sqrt{1024} = 32$

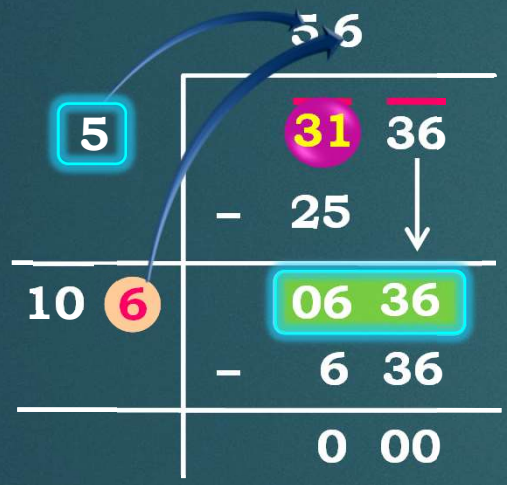
$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

Rough Work

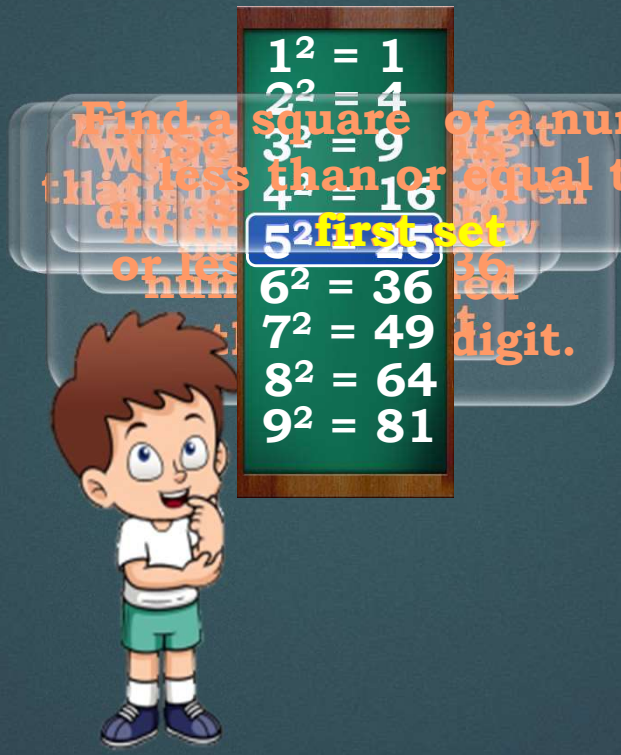
61	62
× 1	× 2
61	124

Q. Find the square root of each of the following numbers by division method.

(xi) 3136



$\therefore \sqrt{3136} = 56$

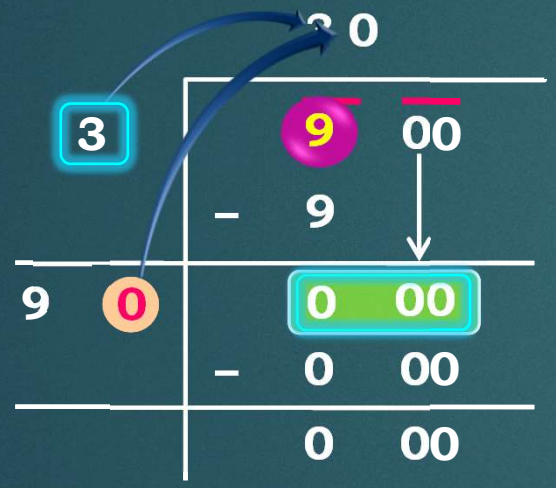


Rough Work

10 5 × 5 = 52 5	10 6 × 6 = 63 6

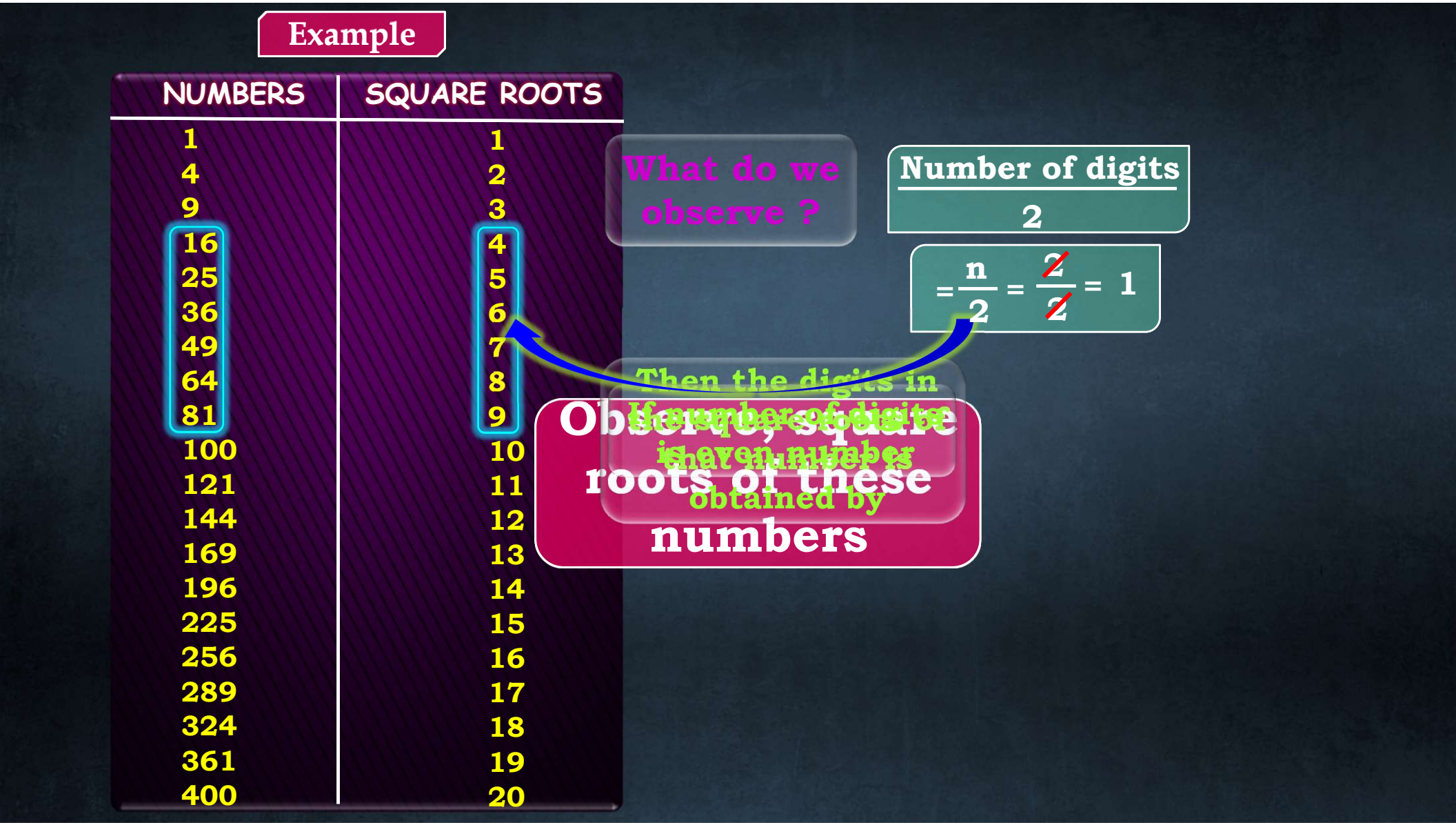
Q. Find the square root of each of the following numbers by division method.

(xii) 900



$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

$\therefore \sqrt{900} = 30$


Example
NUMBERS
SQUARE ROOTS
1 1
4 2
9 3
16 4
25 5
36 6
49 7
64 8
81 9
100 10
121 11
144 12
169 13
196 14
225 15
256 16
289 17
324 18
361 19
400 20
What do we observe ?
Number of digits
2
= n/2 = 2/2 = 1
Then the digits in
If number of digits
is even number
that number is
obtained by
Observe, square
roots of these
numbers

Example

NUMBERS	SQUARE ROOTS
1	1
4	2
9	3
16	4
25	5
36	6
49	7
64	8
81	9
100	10
121	11
144	12
169	13
196	14
225	15
256	16
289	17
324	18
361	19
400	20

$$\frac{n+1}{2} = \frac{1+1}{2} = \frac{2}{2} = 1$$

Number of digits +1

Then the digits in the square roots of that number is obtained by

If number of digits is odd number

Similarly

$$\frac{n+1}{2} = \frac{3+1}{2} = \frac{4}{2} = 2$$

Q. Find the number of digits in the square root of each of the following numbers (without any calculation).

(i) 64

Sol :

If 'n' stands for number of digits in the given number, then

For 64, $n = 2$ [even number]

$\therefore$ Number of digit is its square root $= \frac{n}{2} = \frac{\cancel{2}}{\cancel{2}} = 1$

(ii) 144

Sol :

If 'n' stands for number of digits in the given number, then For 144, $n = 3$ [odd number]

$\therefore$ Number of digit is its square root $= \frac{n+1}{2} = \frac{3+1}{2} = \frac{\cancel{4}}{\cancel{2}} = 2$

Q. Find the number of digits in the square root of each of the following numbers (without any calculation).

(iii) 4489

Sol :

If 'n' stands for number of digits in the given number, then

For 4489, n = 4 [even number]

$\therefore$ Number of digit is its square root $= \frac{n}{2} = \frac{\cancel{4}}{\cancel{2}} = 2$

(iv) 27225

Sol :

If 'n' stands for number of digits in the given number, then

For 27225, n = 5 [odd number]

$\therefore$ Number of digit is its square root $= \frac{n+1}{2} = \frac{5+1}{2} = \frac{\cancel{6}}{\cancel{2}} = 3$

Q. Find the number of digits in the square root of each of the following numbers (without any calculation).

(v) 390625

Sol :

If 'n' stands for number of digits in the given number, then

For 390625, n = 6 [even number]

$\therefore$ **Number of digit is its square root** $= \frac{n}{2} = \frac{6}{2}$

$= 3$

If 'n' stands for number of digits in the given number, then

Square root of a decimal fraction by the division method :

For example :

If the given number is 555.5449

Pairing of integral part is $\overline{5}\ \overline{55}$

Pairing of decimal part is $\overline{54}\ \overline{49}$

Thus, the group so formed is $\overline{5}\ \overline{55}.\overline{54}\ \overline{49}$

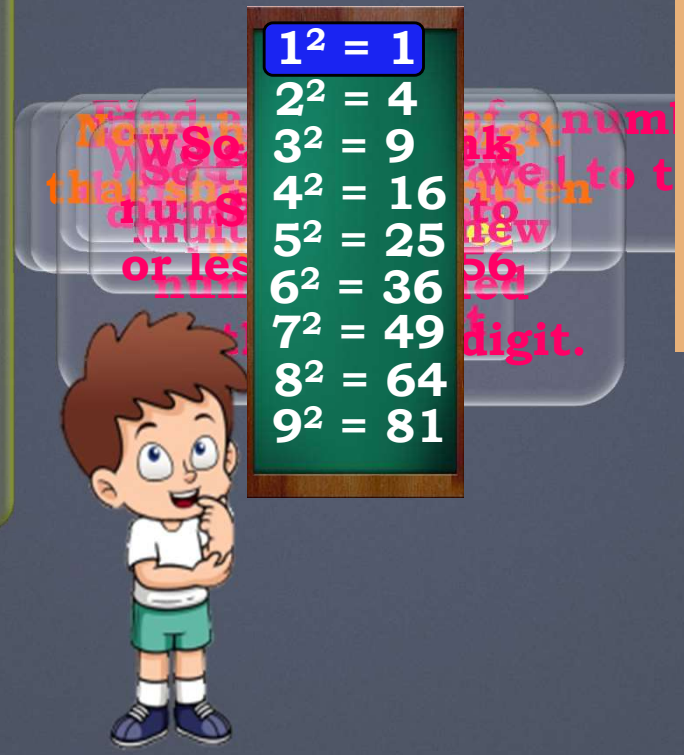
Make a set of two digit from left to right.

Q. Find the square root of the following decimal numbers.

(i) 2. 56

$$\begin{array}{r|l} & 1.6 \\ \hline 1 & \overline{2.}\ \overline{56} \\ & -\ 1 \\ \hline 2\ 6 & 01\ 56 \\ & -\ 1\ 56 \\ \hline & 0\ 00 \end{array}$$

$\therefore \sqrt{2.56} = 1.6$



Rough Work

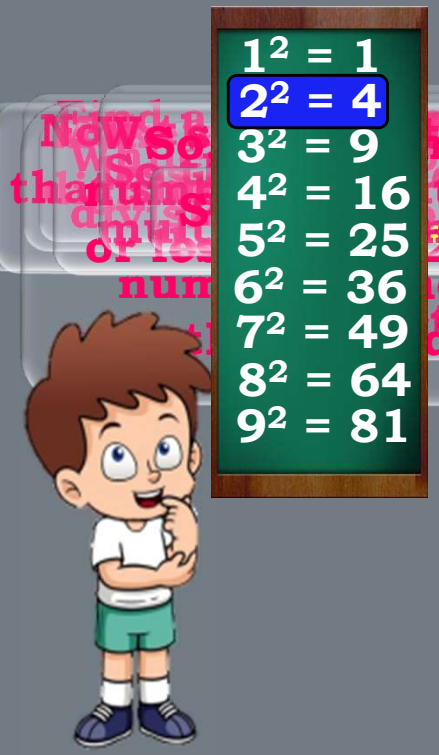
✗	6
2 5 × 5 = 12 5	2 6 × 6 = 15 6

Q. Find the square root of the following decimal numbers.

(ii) 7. 29

$$\begin{array}{r|l} & 2.7 \\ \hline 2 & \overline{7.}\ \overline{29} \\ & -\ 4 \\ \hline 4 \quad 7 & 03\ 29 \\ & -\ 3\ 29 \\ \hline & 0\ 00 \end{array}$$

$\therefore \sqrt{7.29} = 2.7$



Rough Work

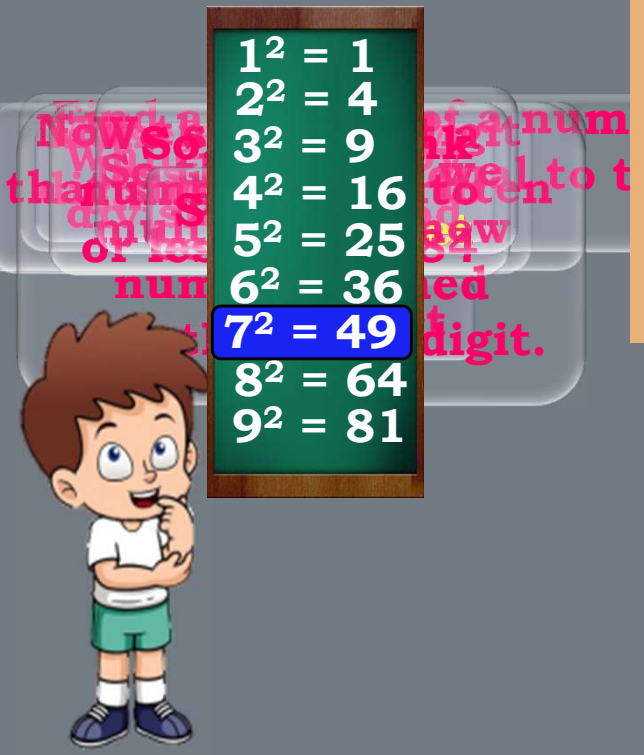
✗	7
4 6 × 6 = 27 6	4 7 × 7 = 32 9

Q. Find the square root of the following decimal numbers.

(iii) 51.84

```
      7.2
    ------
7 | 51.84
  -  49
    ------
14  2 | 02 84
  -     2 84
    ------
        0 00
```

$\therefore \sqrt{51.84} = 7.2$



Rough Work

✗	2
14 1 × 1 = 14 1	14 2 × 2 = 28 4

Q. Find the square root of the following decimal numbers.

(iv) 42.25

```
          6.5
     ┌──────────
  6  │ 42. 25
     │ -36
     ├──────────
 125 │  06 25
     │ - 6 25
     ├──────────
     │  0 00
```

$\therefore \sqrt{42.25} = 6.5$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

Rough Work

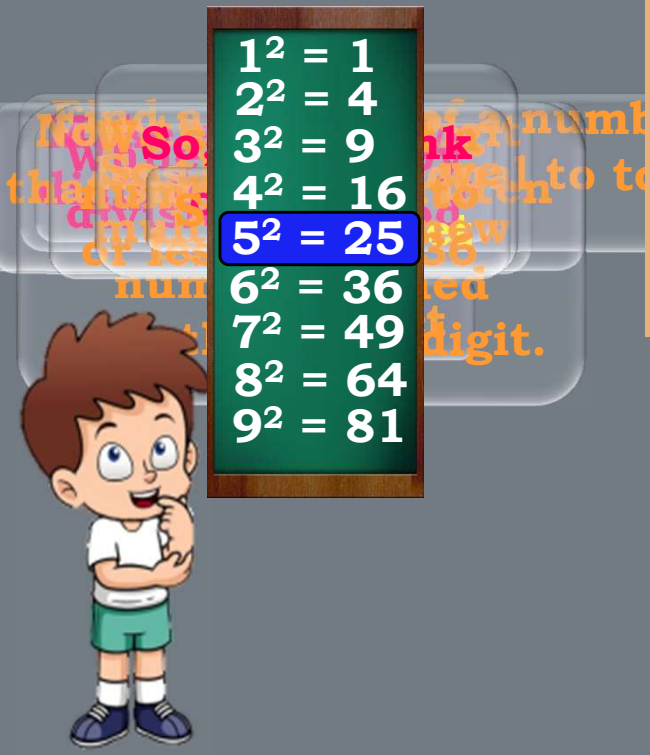
124	125
× 4	× 5
496	625

Q. Find the square root of the following decimal numbers.

(v) 31.36

$$\begin{array}{r|l} & 5.6 \\ \hline 5 & \overline{31.}\ \overline{36} \\ & -\ 25 \\ \hline 10\ 6 & 06\ 36 \\ & -\ 6\ 36 \\ \hline & 0\ 00 \end{array}$$

$\therefore \sqrt{31.36} = 5.6$



Rough Work

10 5 × 5 = 52 5	10 6 × 6 = 63 6

Q. Find the least number which must be subtracted from each of the following numbers so as to get a perfect square. Also find the square root of the perfect square so obtained.

(i) 402

$$\begin{array}{r|l} & 20 \\ \hline 2 & \overline{4}\ \overline{02} \\ - & 4 \\ \hline 4 & 0\ \ 02 \\ - & 0\ \ 00 \\ \hline & 0\ \ 02 \end{array}$$

Since, we get a remainder 2

∴ The least number to be subtracted from the given number = 2

∴ 402 – 2 = 400

∴ $\sqrt{400} = 20$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

So t… we l to to
mul… new
num… ed
with t… digit.
It is the
Perfect square

Q. Find the least number which must be subtracted from each of the following numbers so as to get a perfect square. Also find the square root of the perfect square so obtained.

(ii) 1989

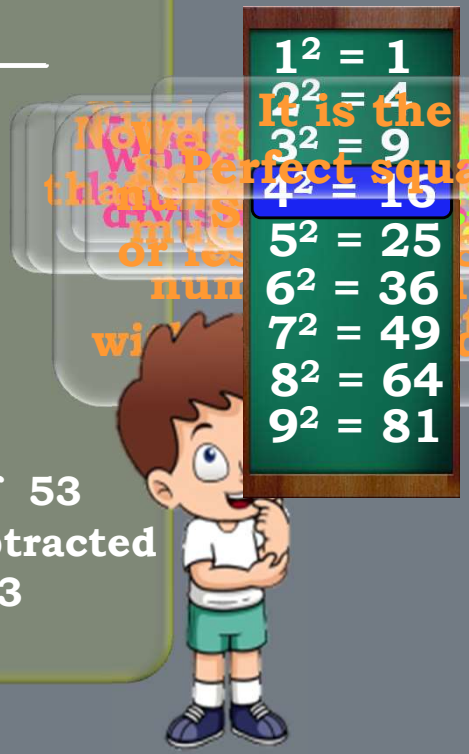
$$\begin{array}{r|l} & 4 \\ \hline 4 & 19\ 89 \\ & -\ 16 \\ \hline 8 \quad 4 & 03\ 89 \\ & -\ 3\ 36 \\ \hline & 0\ 53 \end{array}$$

Since, we get a remainder of 53

∴ The least number to be subtracted from the given number = 53

∴ 1989 – 53 = 1936

$\therefore \sqrt{1936} = 44$

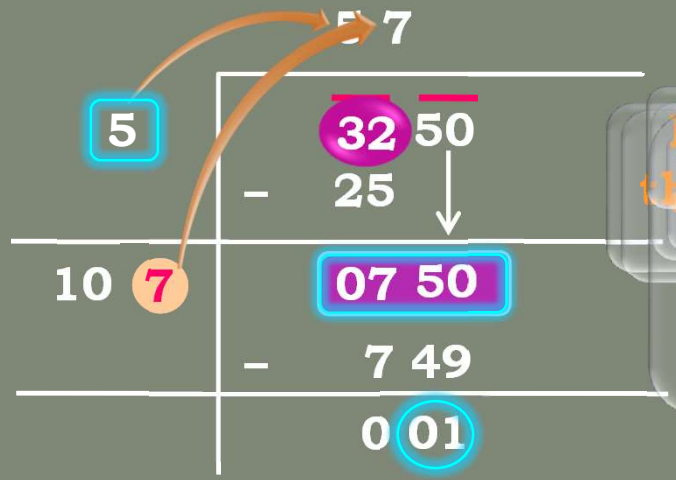


Rough Work

✗	4	✗
8 3 × 3	8 4 × 4	8 5 × 5
2 49	3 36	4 25

Q. Find the least number which must be subtracted from each of the following numbers so as to get a perfect square. Also find the square root of the perfect square so obtained.

(iii) 3250

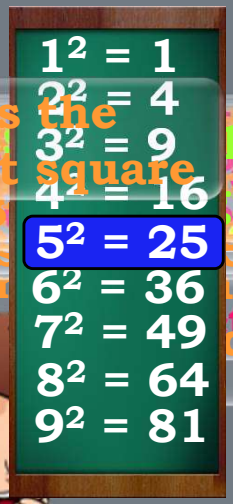


Since, we get a remainder of 01

∴ The least number to be subtracted from the given number = 1

∴ 3250 – 1 = 3249

$\therefore \sqrt{3249} = 57$

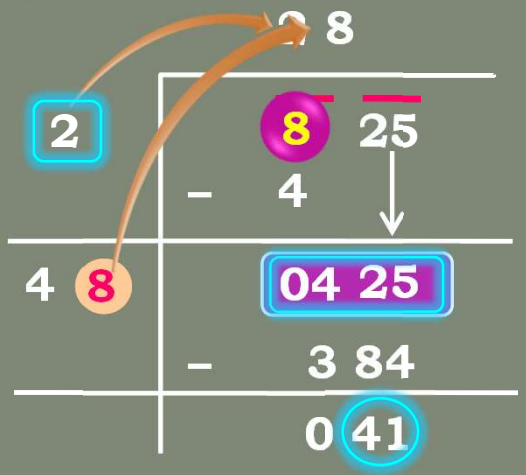


Rough Work

10 6	10 7	10 8
× 6	× 7	× 8
6 36	7 49	8 64

Q. Find the least number which must be subtracted from each of the following numbers so as to get a perfect square. Also find the square root of the perfect square so obtained.

(iv) 825

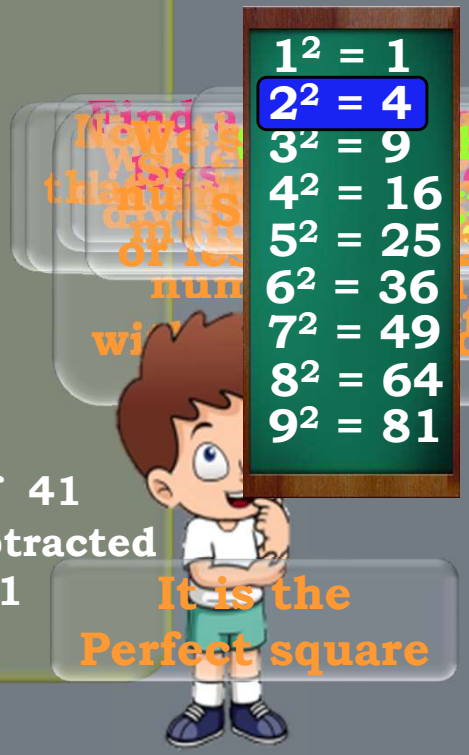


Since, we get a remainder of 41

∴ The least number to be subtracted from the given number = 41

∴ 825 – 41 = 784

$\therefore \sqrt{784} = 28$



Rough Work

4 7 × 7	4 8 × 8	4 9 × 9
3 29	3 84	4 41

Q. Find the least number which must be subtracted from each of the following numbers so as to get a perfect square. Also find the square root of the perfect square so obtained.

(v) 4000

	6 3
6	40 00
	− 36
12 3	04 00
	− 3 69
	0 31

Since, we get a remainder of 31

∴ The least number to be subtracted from the given number = 31

∴ 4000 − 31 = 3969

$\therefore \sqrt{3969} = 63$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

It is the Perfect square

Rough Work

2	3	4
12 2	12 3	12 4
× 2	× 3	× 4
2 44	3 69	4 96

Q. Find the least number which must be subtracted from each of the following numbers so as to get a perfect square. Also find the square root of the perfect square so obtained.

(i) 525

$$\begin{array}{r|l} & 2\ 2 \\ \hline 2 & \overline{5}\ \overline{25} \\ & -\ 4 \\ \hline 4\ 2 & 01\ 25 \\ & -\ 84 \\ \hline & 0\ 41 \end{array}$$

$\therefore$ we get a remainder of 41

$22^2 < 525$

Next perfect square number,

$23^2 = 529$

$\therefore$ The least number to be added from the given number = $529 - 525 = 4$

$\therefore$ $525 + 4 = 529$

$\therefore \sqrt{529} = 23$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

Rough Work

✗	2	✗
4 1 × 1 = 41	4 2 × 2 = 84	4 3 × 3 = 1 29

Q. Find the least number which must be subtracted from each of the following numbers so as to get a perfect square. Also find the square root of the perfect square so obtained.

(ii) 1750

$$\begin{array}{r|l} & 41 \\ \hline 4 & \overline{17}\ \overline{50} \\ - & 16 \\ \hline 81 & 01\ 50 \\ - & 81 \\ \hline & 0\ 69 \end{array}$$

Since, we get a remainder of 69

$41^2 < 1750$

Next perfect square number,

$42^2 = 1764$

∴ The least number to be added from the given number = 1764 – 1750 =14

∴ 1750 + 14 = 1764 $\therefore \sqrt{1764} = 42$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

It is the Perfect square

Rough Work

80	81	82
× 0	× 1	× 2
00	81	164

Q. Find the least number which must be subtracted from each of the following numbers so as to get a perfect square. Also find the square root of the perfect square so obtained.

(iii) 252

$$\begin{array}{r|l} & 15 \\ \hline 1 & 2\,52 \\ - & 1 \\ \hline 25 & 01\,52 \\ - & 1\,25 \\ \hline & 0\,27 \end{array}$$

Since, we get a remainder of 27

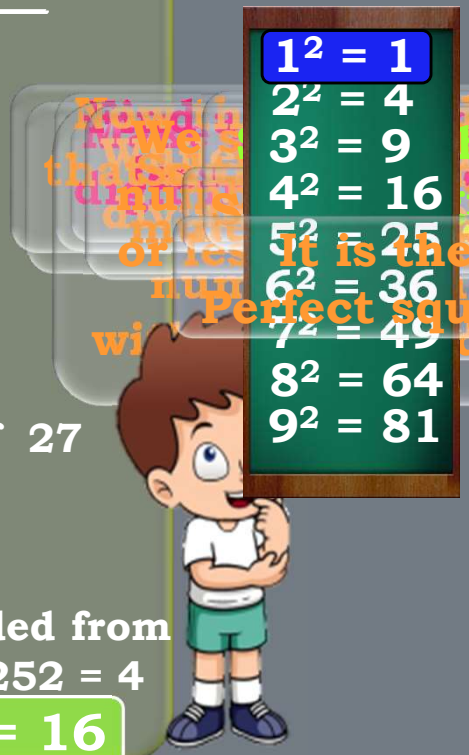
$15^2 < 252$

Next perfect square number,

$16^2 = 256$

∴ The least number to be added from the given number = 256 – 252 = 4

∴ 252 + 4 = 256 $\therefore \sqrt{256} = 16$



Rough Work

✗	5	✗
24 × 4 = 96	25 × 5 = 125	26 × 6 = 156

Q. Find the least number which must be subtracted from each of the following numbers so as to get a perfect square. Also find the square root of the perfect square so obtained.

(iv) 1825

4	18 25	
	− 16	
8 2	02 25	
	− 1 64	
	0 61	

Since, we get a remainder of 61

$42^2 < 1825$

Next perfect square number,

$43^2 = 1849$

∴ The least number to be added from the given number = 1849 − 1825 = 24

∴ 1825 + 24 = 1849 $\therefore \sqrt{1849} = 43$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

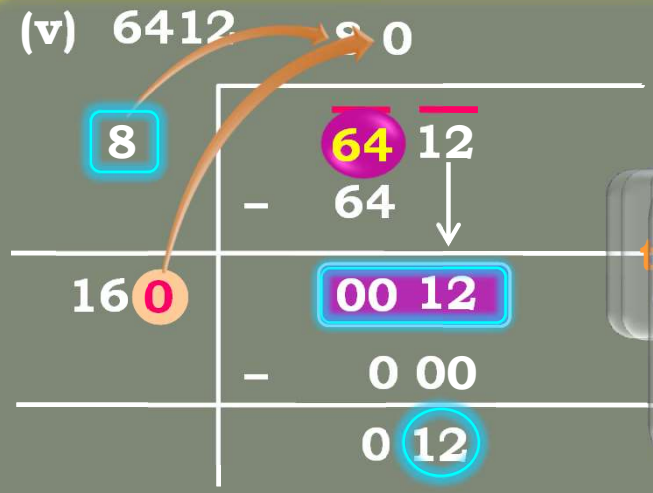
It is the Perfect square

Rough Work

8 1	8 2	8 3
× 1	× 2	× 3
81	1 64	2 49

Q. Find the least number which must be subtracted from each of the following numbers so as to get a perfect square. Also find the square root of the perfect square so obtained.

(v) 6412



Since, we get a remainder of 12

$80^2 < 6412$

Next perfect square number,

$81^2 = 6561$

∴ The least number to be added from the given number = 6561 - 6412 =149

∴ 6412 + 149 = 6561 $\therefore \sqrt{6561} = 81$

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

It is the Perfect square

Q. Find the length of the side of a square whose area is $441\ m^2$

Sol :

Let the length of side of the square = x meter

$\therefore$ Area = side $\times$ side

$= x \times x = x^2$

$x^2 = 441 m^2$ [given]

$\therefore$ $x = 21$ [Taking square root]

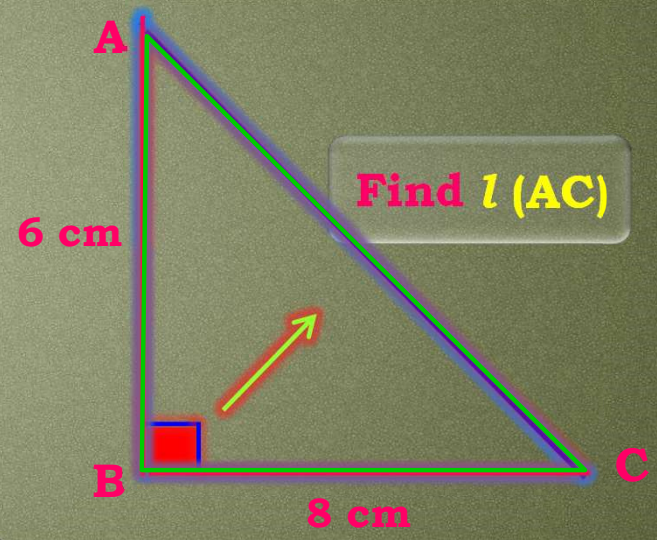
Thus, The required side is 21 m.

			2 1
	2		4 41
+	2	–	4
	4 1		0 41
+	1	–	0 41
	42		00

Lets assume,
We know,
Area of Square = side × side

Q. In a right triangle ABC, $\angle B = 90°$

(a) If AB = 6 cm, BC = 8 cm, find AC



Sol. In Δ ABC,

$m\angle B = 90°$

l (AB) = 6cm

l (AB) = 8cm

By Pythagoras theorem,

(HYPOTENUSE)^2 = (ONE SIDE)^2 + (OTHER SIDE)^2

What we have to find ?

l (AC)^2 = l (AB)^2 + l (BC)^2

l (AC)^2 = (6)^2 + (8)^2

l (AC)^2 = 36 + 64

l (AC)^2 = 100

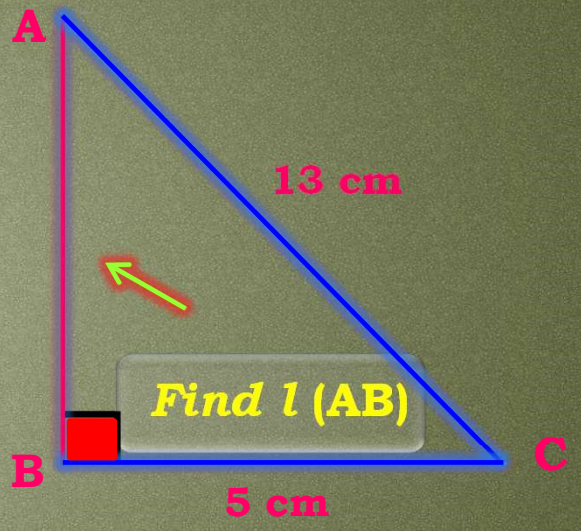
l (AC) = $\sqrt{100}$ cm (Taking square root)

AC = 10 cm

The length of AC is 10 cm.

Q. In a right triangle ABC, $\angle B = 90°$

(b) If AC = 13 cm, BC = 5 cm, find AB



Sol. In ΔABC,

$m\angle B = 90°$

l (AC) = 13cm

l (BC) = 5cm

What we have to find ?

By Pythagoras theorem,

(HYPOTENUSE)^2 = (ONE SIDE)^2 + (OTHER SIDE)^2

$l(AC)^2 = l(AB)^2 + l(BC)^2$

$l(13)^2 = (AB)^2 + (5)^2$

$l(AB)^2 = (13)^2 - (5)^2$

$l(AB)^2 = (169) - (25)$

$l(AB)^2 = 144$

$\sqrt{AB^2} = \sqrt{144}$ (Taking square root)

$AB = 12$ cm

The length of AB is 12 cm.

Q. A gardener has 1000 plants. He wants to plant these in such a way that the number of rows and the number of columns remain same. Find the minimum number of plants he needs more for this.a right triangle ABC, ∠B = 90°

Sol.

The number of plants in a row and the number of columns are the same.

Let Number of rows = number of columns = x

∴ Their product must be a square number.

∴ 1000 is not a perfect square.

Since, we get a remainder 39

$1000 > 31^2$

and next square number is 32

$32^2 = 1024$

∴ $1000 + 24 = 1024$

The minimum number of plants required to be added is 24.

	3 1	
	3	10 00
+	3	− 9
	6 1	1 00
+	1	− 0 61
	6 2	39

Q. There are 500 children in a school. For a P.T. drill they have to stand in such a manner that the number of rows is equal to the number of columns. How many children would be left out in this arrangement.

Sol.

The number of rows and the number of columns are same.

∴ Total number (i.e. their product) must be a square number, we have

But 500 is not a perfect square.

Since, we get a remainder 16

∴ 500 − 16 = 484

484

Example

Similarly, there are 5 students in a school.

Thus, the required number of children to be left out is 16

Rough Work

$$\begin{array}{r} 2 \\ 2\overline{)\,5} \\ -\,4 \\ \hline 1 \end{array}$$

Exercise

Q. In a right triangle ABC, $\angle B = 90°$

(a) If AB = 6 cm, BC = 8 cm, find AC

Sol. In Δ ABC,

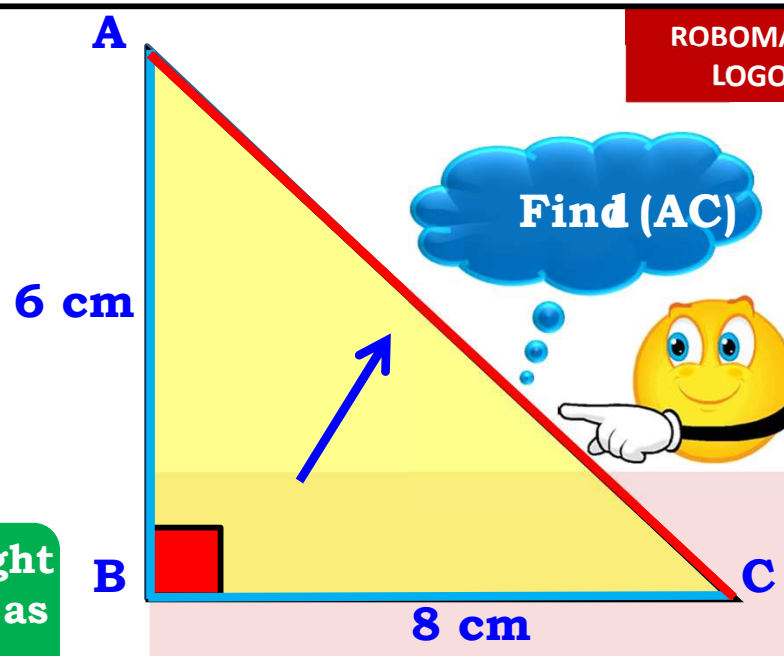
$m\angle B = 90^0$

l (AB) = 6 cm

l (BC) = 8 cm

First let us find what is **GIVEN** in the question

The side opposite to right angle (i.e.90^0) is called as the hypotenuse.



ROBOMATE LOGO

TEACHER

Exercise

ROBOMATE LOGO

Q. In a right triangle ABC, $\angle B = 90°$

(b) If AC = 13 cm, BC = 5 cm, find AB

Sol. In ΔABC,

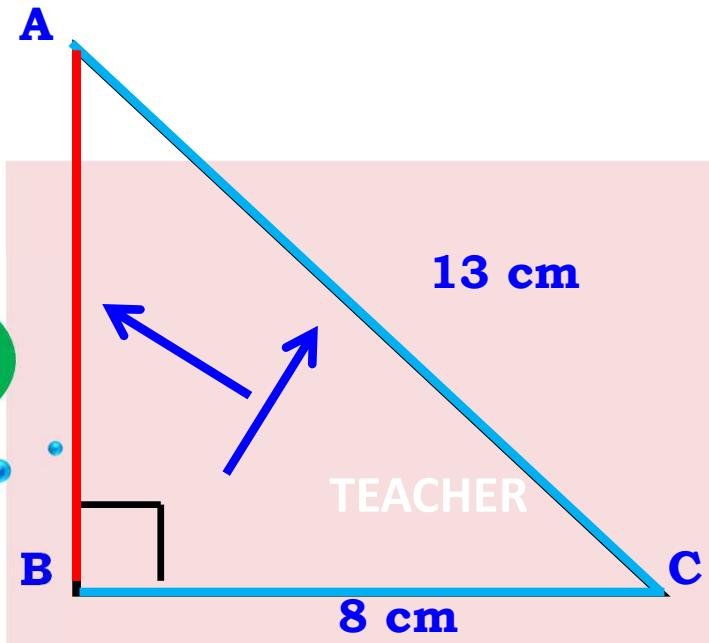
$m\angle B = 90^0$

l (AC) = 13 cm

l (BC) = 5 cm

The side opposite to right angle (90^0) is called as the hypotenuse.

Find l (AB)



Exercise

ROBOMATE LOGO

By Pythagoras theorem,

(HYPOTENUSE)² = (ONE SIDE)² + (OTHER SIDE)²

$l\,(AC)^2 = l\,(AB)^2 + l\,(BC)^2$

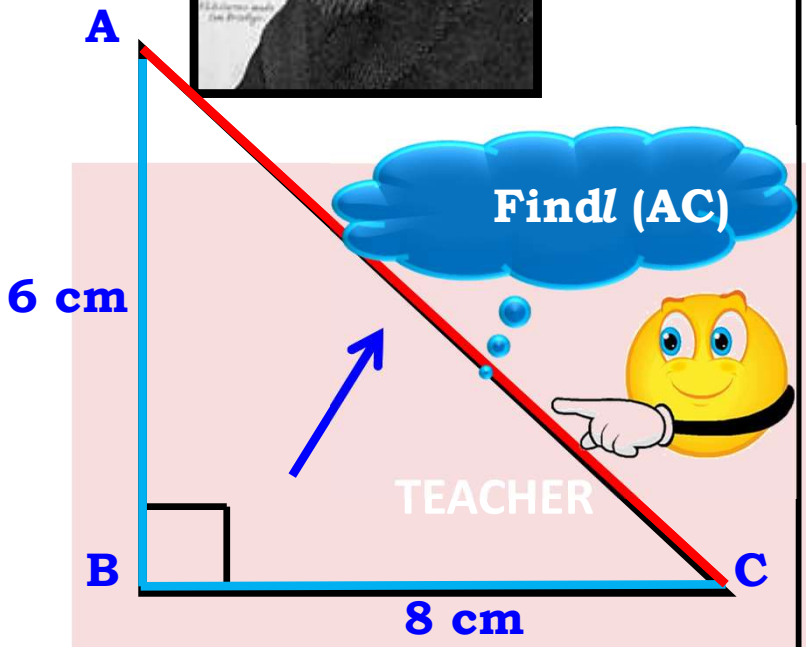
$l\,(AC)^2 = (6)^2 + (8)^2$

$l\,(AC)^2 = 36 + 64$

$\sqrt{AC}^2 = \sqrt{100}$ **(Taking square root)**

$AC = 10$ cm

The length of AC is 10 cm.



Exercise

ROBOMATE LOGO

By Pythagoras theorem

(HYPOTENUSE)² = (ONE SIDE)² + (OTHER SIDE)²

$l\,(AC)^2 = l\,(AB)^2 + l\,(BC)^2$

$(13)^2 = (AB)^2 + (5)^2$

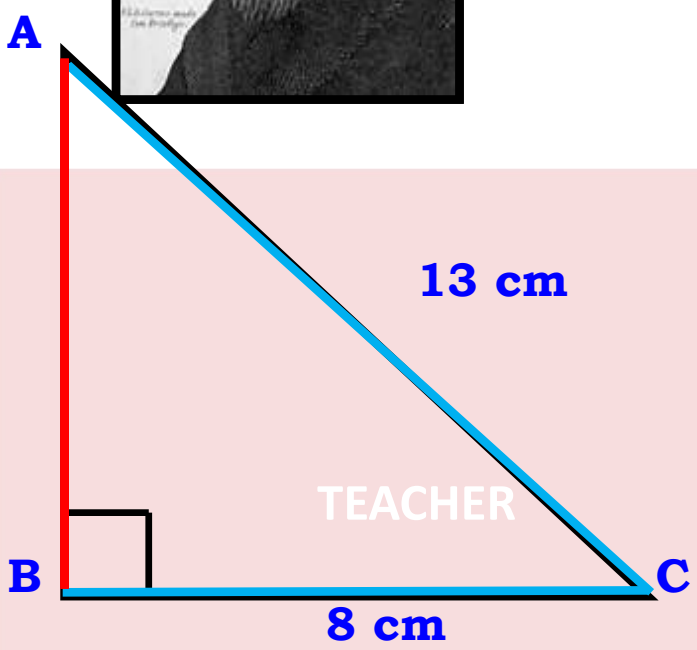
$(AB)^2 = (13)^2 - (5)^2$

$(AB)^2 = 169 - 25$

$(AB)^2 = 144$

$\sqrt{AB^2} = \sqrt{144}$ (Taking square root)

$AB = 12$ cm



The length of AB is 12 cm.

THANK YOU

Q. 5929 students are sitting in an auditorium in such a manner that there are as many students in a row as there are rows in the auditorium. How many rows are there in the auditorium?

Example

Row 1  = 3 students

Row 2  = 3 students

Row 3  = 3 students

Total = 9 students

i.e, total number of student =

total number of rows $\times$ Total number of students in each row = $3 \times 3 = 3^2$

Q. 5929 students are sitting in an auditorium in such a manner that there are as many students in a row as there are rows in the auditorium. How many rows are there in the auditorium?

To find square root of 5929 Let us do prime factorisation of 5929 We need to factorize

Sol.

Let the number of rows in a auditorium be x

Since the number of students in each row is equal to the number of rows

$\therefore$ The number of students in each row = x

$\therefore$ total number of students =

total number of rows $\times$ total number of students in each row

i.e, $x \times x = 5929$

$x^2 = 5929$

$x^2 = 7 \times 7 \times 11 \times 11$

Rough work

7	5929
7	847
11	121
11	11
	1

Q. 5929 students are sitting in an auditorium in such a manner that there are as many students in a row as there are rows in the auditorium. How many rows are there in the auditorium?

Sol.

$$x = \sqrt{(7 \times 7) \times (11 \times 11)} \text{ cm}$$

$$x = 7 \times 11$$

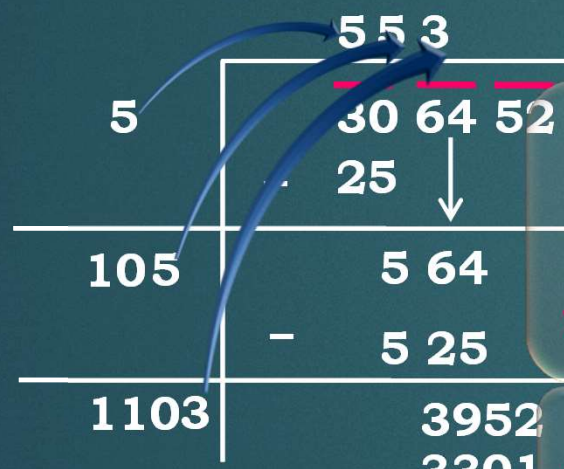
$$x = 77$$

Hence, there are 77 rows in the auditorium

Taking one factor from each pair

Q. Find the least number which must be added to 306452 to make it a perfect square.

Sol. Let us first work out the process of finding the square root by the division method :



We should get a number equal to or less than 364

Now think of a digit that should be written besides 10 so that the product of this digit with the same digit is the largest number formed

Now think of a digit that should be written besides 10

Rough Work

3

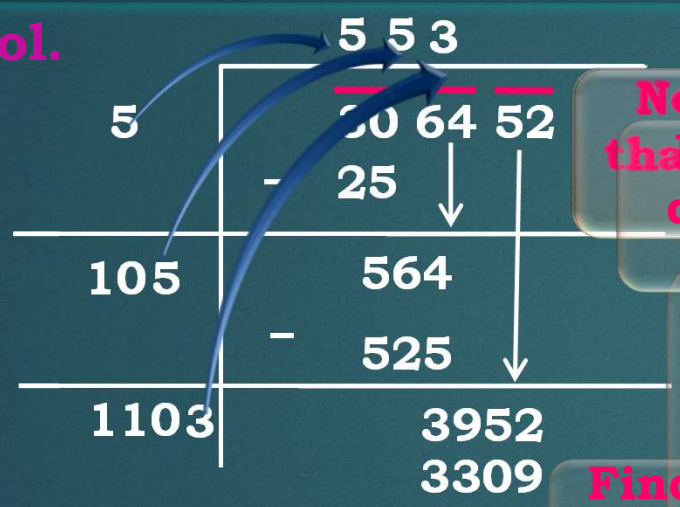
1103 × 3 = 3309

1104 × 4 = 4416

$1^2 = 1$
$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

Q. Find the least number which must be added to 306452 to make it a perfect square.

Sol.



Now think of a digit

Make a set of two digits from right to left.

Subtract

So that when we multiply the new number formed with the same digit.

Find a square of a number less than or equal to to first set

We should get a number equal to or less than 3952

It is evident from the above working that
$(553)^2 < 306452 < (554)^2$.

Rough Work

1102	1103	1104
× 2	× 3	× 4
2204	3309	4416

$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

Q. Find the least number which must be added to 306452 to make it a perfect square.

Sol.

Also 306452 is (4416 – 3952) = 464 less than $(554)^2$.
Thus, if we add 464 to 306452, it will be a perfect square.
Hence, the required least number is 464.

Q. Find the greatest number of six digits which is a perfect square.

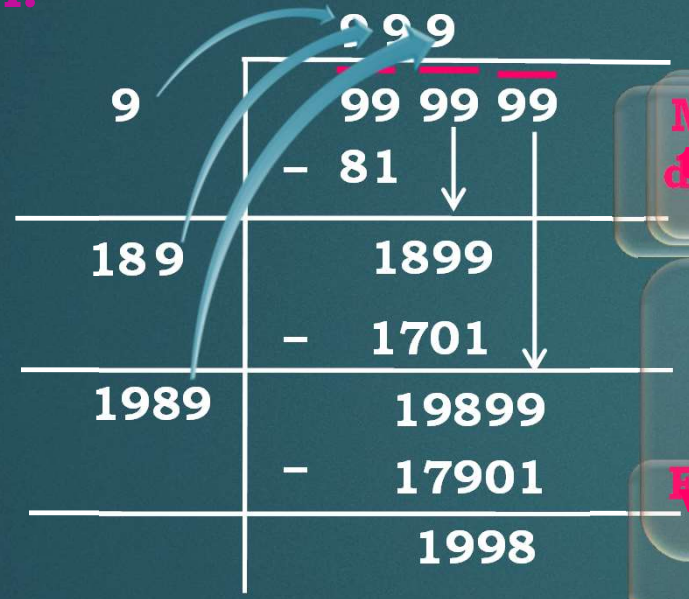
Sol. We know that the greatest number of six digits is 999999.

In order to find greatest number of six digits which is perfect square, we must first find the smallest number that must be subtracted from 999999 to make it a perfect square.

For this, we work out the process of finding the square root of 999999 by long division method as given below.

Q. Find the greatest number of six digits which is a perfect square.

Sol.



Make a set of two digit from right to left.

Now think of a digit that should be written besides 198

Subtract

So that when we multiply the new number formed with the same digit.

Find a square of a number less than or equal to to first set

We should get a number equal to or less than 19899

Rough Work

1988 × 8	1989 × 9
15904	17901

$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

Q. Find the greatest number of six digits which is a perfect square.

Sol.

It follows from this, that we must subtract 1998 from 999999 to make it a perfect square.

$\therefore$ Required number = 999999 – 1998

= 998001

Q. Find the square root of 0.00008281.

Sol. Here, the number of decimal places is even. So, we place the bars and find the square root as shown below.

```
      0.0091
    ---------------------
0   | 0.00 00 82 81
    - 0
    ---------------------
9   |    00 00 82
    -       81
    ---------------------
181 |          181
    -       181
    ---------------------
    |          0
```

Now think of a digit that should be written besides 18

Make a set of two digits from right to left

Subtract

So that when we multiply the new number formed with the same digit.

Find a square of a number less than or equal to first set

We should get a number equal to or less than 181

Rough Work

1	✗
18 1	182
× 1	× 2
181	364

$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

Thus, $\sqrt{310.00008281} = 0.0091$

Q. Find the value of $\sqrt{15625}$ and the use it to find the value of $\sqrt{156.25} + \sqrt{1.5625}$

Sol. We first find the value of $\sqrt{15625}$ by long division method as given below :

	1 2 5
1	1 56 25
	− 1
22	56
	− 44
245	1225
	− 1225
	0

We should get a number equal to or less than 1225

first set

Rough Work

	5	
244	245	246
× 4	× 5	× 6
976	1225	1476

$2^2 = 4$
$3^2 = 9$
$4^2 = 16$
$5^2 = 25$
$6^2 = 36$
$7^2 = 49$
$8^2 = 64$
$9^2 = 81$

Q. Find the value of $\sqrt{15625}$ and the use it to find the value of $\sqrt{156.25} + \sqrt{1.5625}$

Sol. $\therefore \quad \sqrt{15625} = 125$

Now,

$$\sqrt{156.25} + \sqrt{1.5625}$$

$$= \sqrt{\frac{15625}{100}} + \sqrt{\frac{15625}{10000}}$$

$$= \frac{125}{10} + \frac{125}{100}$$

$$= 12.5 + 12.5$$

$$= 13.75$$

Q. Given that $\sqrt{2} = 1.414$ and $\sqrt{5} = 2.236$, evaluate each of the following:

(i) $\sqrt{\frac{36}{5}}$ (ii) $\sqrt{\frac{625}{98}}$

Sol.

(i) $\sqrt{\frac{36}{5}} = \frac{6}{\sqrt{5}}$

$= \frac{6}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$

$= \frac{6\sqrt{5}}{\sqrt{5}}$

$\Rightarrow \sqrt{\frac{36}{5}} = \frac{6 \times 2.236}{5}$

$= \frac{13.416}{5} = 2.6832$

Q. Given that $\sqrt{2} = 1.414$ and $\sqrt{5} = 2.236$, evaluate each of the following:

(i) $\sqrt{\frac{36}{5}}$ (ii) $\sqrt{\frac{625}{98}}$

Sol. (ii) $\sqrt{\frac{625}{98}} = \frac{\sqrt{25 \times 25}}{\sqrt{49 \times 2}} = \frac{25}{7\sqrt{2}}$

$= \frac{25}{7\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$

$= \frac{25\sqrt{2}}{7 \times 2}$

$= \frac{25\sqrt{2}}{14}$

$\Rightarrow \sqrt{\frac{625}{98}} = \frac{25 \times 1.414}{14}$

$= \frac{35.35}{14} = 2.525$