

EXERCISE 3.1

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1. Which of the following numbers are perfect squares?

(i) 484

(ii) 625

(iii) 576

(iv) 941

(v) 961

(vi) 2500

Solution:

(i) 484

First find the prime factors for 484

$$484 = 2 \times 2 \times 11 \times 11$$

By grouping the prime factors in equal pairs we get,

$$= (2 \times 2) \times (11 \times 11)$$

By observation, none of the prime factors are left out.

∴ 484 is a perfect square.

(ii) 625

First find the prime factors for 625

$$625 = 5 \times 5 \times 5 \times 5$$

By grouping the prime factors in equal pairs we get,

$$= (5 \times 5) \times (5 \times 5)$$

By observation, none of the prime factors are left out.

∴ 625 is a perfect square.

(iii) 576

First find the prime factors for 576

$$576 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3 \times 3$$

By grouping the prime factors in equal pairs we get,

$$= (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times (3 \times 3)$$

By observation, none of the prime factors are left out.

∴ 576 is a perfect square.

(iv) 941

First find the prime factors for 941

$$941 = 941 \times 1$$

We know that 941 itself is a prime factor.

∴ 941 is not a perfect square.

(v) 961

First find the prime factors for 961

$$961 = 31 \times 31$$

By grouping the prime factors in equal pairs we get,
 $= (31 \times 31)$

By observation, none of the prime factors are left out.

∴ 961 is a perfect square.

(vi) 2500

First find the prime factors for 2500

$$2500 = 2 \times 2 \times 5 \times 5 \times 5 \times 5$$

By grouping the prime factors in equal pairs we get,
 $= (2 \times 2) \times (5 \times 5) \times (5 \times 5)$

By observation, none of the prime factors are left out.

∴ 2500 is a perfect square.

2. Show that each of the following numbers is a perfect square. Also find the number whose square is the given number in each case:

(i) 1156

(ii) 2025

(iii) 14641

(iv) 4761

Solution:

(i) 1156

First find the prime factors for 1156

$$1156 = 2 \times 2 \times 17 \times 17$$

By grouping the prime factors in equal pairs we get,
 $= (2 \times 2) \times (17 \times 17)$

By observation, none of the prime factors are left out.

∴ 1156 is a perfect square.

To find the square of the given number

$$1156 = (2 \times 17) \times (2 \times 17)$$

$$= 34 \times 34$$

$$= (34)^2$$

∴ 1156 is a square of 34.

(ii) 2025

First find the prime factors for 2025

$$2025 = 3 \times 3 \times 3 \times 3 \times 5 \times 5$$

By grouping the prime factors in equal pairs we get,

$$= (3 \times 3) \times (3 \times 3) \times (5 \times 5)$$

By observation, none of the prime factors are left out.

\therefore 2025 is a perfect square.

To find the square of the given number

$$2025 = (3 \times 3 \times 5) \times (3 \times 3 \times 5)$$

$$= 45 \times 45$$

$$= (45)^2$$

\therefore 2025 is a square of 45.

(iii) 14641

First find the prime factors for 14641

$$14641 = 11 \times 11 \times 11 \times 11$$

By grouping the prime factors in equal pairs we get,

$$= (11 \times 11) \times (11 \times 11)$$

By observation, none of the prime factors are left out.

\therefore 14641 is a perfect square.

To find the square of the given number

$$14641 = (11 \times 11) \times (11 \times 11)$$

$$= 121 \times 121$$

$$= (121)^2$$

\therefore 14641 is a square of 121.

(iv) 4761

First find the prime factors for 4761

$$4761 = 3 \times 3 \times 23 \times 23$$

By grouping the prime factors in equal pairs we get,

$$= (3 \times 3) \times (23 \times 23)$$

By observation, none of the prime factors are left out.

\therefore 4761 is a perfect square.

To find the square of the given number

$$4761 = (3 \times 23) \times (3 \times 23)$$

$$= 69 \times 69$$

$$= (69)^2$$

\therefore 4761 is a square of 69.

3. Find the smallest number by which the given number must be multiplied so that the product is a perfect square:

(i) 23805

(ii) 12150

(iii) 7688

Solution:

(i) 23805

First find the prime factors for 23805

$$23805 = 3 \times 3 \times 23 \times 23 \times 5$$

By grouping the prime factors in equal pairs we get,

$$= (3 \times 3) \times (23 \times 23) \times 5$$

By observation, prime factor 5 is left out.

So, multiply by 5 we get,

$$23805 \times 5 = (3 \times 3) \times (23 \times 23) \times (5 \times 5)$$

$$= (3 \times 5 \times 23) \times (3 \times 5 \times 23)$$

$$= 345 \times 345$$

$$= (345)^2$$

\therefore Product is the square of 345.

(ii) 12150

First find the prime factors for 12150

$$12150 = 2 \times 3 \times 3 \times 3 \times 3 \times 3 \times 5 \times 5$$

By grouping the prime factors in equal pairs we get,

$$= 2 \times 3 \times (3 \times 3) \times (3 \times 3) \times (5 \times 5)$$

By observation, prime factor 2 and 3 are left out.

So, multiply by $2 \times 3 = 6$ we get,

$$12150 \times 6 = 2 \times 3 \times (3 \times 3) \times (3 \times 3) \times (5 \times 5) \times 2 \times 3$$

$$= (2 \times 3 \times 3 \times 3 \times 5) \times (2 \times 3 \times 3 \times 3 \times 5)$$

$$= 270 \times 270$$

$$= (270)^2$$

\therefore Product is the square of 270.

(iii) 7688

First find the prime factors for 7688

$$7688 = 2 \times 2 \times 31 \times 31 \times 2$$

By grouping the prime factors in equal pairs we get,

$$= (2 \times 2) \times (31 \times 31) \times 2$$

By observation, prime factor 2 is left out.

So, multiply by 2 we get,

$$\begin{aligned}7688 \times 2 &= (2 \times 2) \times (31 \times 31) \times (2 \times 2) \\ &= (2 \times 31 \times 2) \times (2 \times 31 \times 2) \\ &= 124 \times 124 \\ &= (124)^2\end{aligned}$$

∴ Product is the square of 124.

4. Find the smallest number by which the given number must be divided so that the resulting number is a perfect square:

(i) 14283

(ii) 1800

(iii) 2904

Solution:

(i) 14283

First find the prime factors for 14283

$$14283 = 3 \times 3 \times 3 \times 23 \times 23$$

By grouping the prime factors in equal pairs we get,

$$= (3 \times 3) \times (23 \times 23) \times 3$$

By observation, prime factor 3 is left out.

So, divide by 3 to eliminate 3 we get,

$$\begin{aligned}14283/3 &= (3 \times 3) \times (23 \times 23) \\ &= (3 \times 23) \times (3 \times 23) \\ &= 69 \times 69 \\ &= (69)^2\end{aligned}$$

∴ Resultant is the square of 69.

(ii) 1800

First find the prime factors for 1800

$$1800 = 2 \times 2 \times 5 \times 5 \times 3 \times 3 \times 2$$

By grouping the prime factors in equal pairs we get,

$$= (2 \times 2) \times (5 \times 5) \times (3 \times 3) \times 2$$

By observation, prime factor 2 is left out.

So, divide by 2 to eliminate 2 we get,

$$\begin{aligned}1800/2 &= (2 \times 2) \times (5 \times 5) \times (3 \times 3) \\ &= (2 \times 5 \times 3) \times (2 \times 5 \times 3) \\ &= 30 \times 30 \\ &= (30)^2\end{aligned}$$

∴ Resultant is the square of 30.

(iii) 2904

First find the prime factors for 2904

$$2904 = 2 \times 2 \times 11 \times 11 \times 2 \times 3$$

By grouping the prime factors in equal pairs we get,

$$= (2 \times 2) \times (11 \times 11) \times 2 \times 3$$

By observation, prime factor 2 and 3 are left out.

So, divide by 6 to eliminate 2 and 3 we get,

$$2904/6 = (2 \times 2) \times (11 \times 11)$$

$$= (2 \times 11) \times (2 \times 11)$$

$$= 22 \times 22$$

$$= (22)^2$$

∴ Resultant is the square of 22.

5. Which of the following numbers are perfect squares?

11, 12, 16, 32, 36, 50, 64, 79, 81, 111, 121

Solution:

11 it is a prime number by itself.

So it is not a perfect square.

12 is not a perfect square.

$$16 = (4)^2$$

16 is a perfect square.

32 is not a perfect square.

$$36 = (6)^2$$

36 is a perfect square.

50 is not a perfect square.

$$64 = (8)^2$$

64 is a perfect square.

79 it is a prime number.

So it is not a perfect square.

$$81 = (9)^2$$

81 is a perfect square.

111 it is a prime number.
So it is not a perfect square.

$121 = (11)^2$
121 is a perfect square.

6. Using prime factorization method, find which of the following numbers are perfect squares?

189, 225, 2048, 343, 441, 2961, 11025, 3549

Solution:

189 prime factors are

$$189 = 3^2 \times 3 \times 7$$

Since it does not have equal pair of factors 189 is not a perfect square.

225 prime factors are

$$225 = (5 \times 5) \times (3 \times 3)$$

Since 225 has equal pair of factors. \therefore It is a perfect square.

2048 prime factors are

$$2048 = (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times 2$$

Since it does not have equal pair of factors 2048 is not a perfect square.

343 prime factors are

$$343 = (7 \times 7) \times 7$$

Since it does not have equal pair of factors 2048 is not a perfect square.

441 prime factors are

$$441 = (7 \times 7) \times (3 \times 3)$$

Since 441 has equal pair of factors. \therefore It is a perfect square.

2961 prime factors are

$$2961 = (3 \times 3) \times (3 \times 3) \times (3 \times 3) \times (2 \times 2)$$

Since 2961 has equal pair of factors. \therefore It is a perfect square.

11025 prime factors are

$$11025 = (3 \times 3) \times (5 \times 5) \times (7 \times 7)$$

Since 11025 has equal pair of factors. \therefore It is a perfect square.

3549 prime factors are

$$3549 = (13 \times 13) \times 3 \times 7$$

Since it does not have equal pair of factors 3549 is not a perfect square.

7. By what number should each of the following numbers be multiplied to get a perfect square in each case? Also find the number whose square is the new number.

(i) 8820

(ii) 3675

(iii) 605

(iv) 2880

(v) 4056

(vi) 3468

(vii) 7776

Solution:

(i) 8820

First find the prime factors for 8820

$$8820 = 2 \times 2 \times 3 \times 3 \times 7 \times 7 \times 5$$

By grouping the prime factors in equal pairs we get,

$$= (2 \times 2) \times (3 \times 3) \times (7 \times 7) \times 5$$

By observation, prime factor 5 is left out.

So, multiply by 5 we get,

$$8820 \times 5 = (2 \times 2) \times (3 \times 3) \times (7 \times 7) \times (5 \times 5)$$

$$= (2 \times 3 \times 7 \times 5) \times (2 \times 3 \times 7 \times 5)$$

$$= 210 \times 210$$

$$= (210)^2$$

\therefore Product is the square of 210.

(ii) 3675

First find the prime factors for 3675

$$3675 = 5 \times 5 \times 7 \times 7 \times 3$$

By grouping the prime factors in equal pairs we get,

$$= (5 \times 5) \times (7 \times 7) \times 3$$

By observation, prime factor 3 is left out.

So, multiply by 3 we get,

$$3675 \times 3 = (5 \times 5) \times (7 \times 7) \times (3 \times 3)$$

$$= (5 \times 7 \times 3) \times (5 \times 7 \times 3)$$

$$= 105 \times 105$$

$$= (105)^2$$

\therefore Product is the square of 105.

(iii) 605

First find the prime factors for 605

$$605 = 5 \times 11 \times 11$$

By grouping the prime factors in equal pairs we get,

$$= (11 \times 11) \times 5$$

By observation, prime factor 5 is left out.

So, multiply by 5 we get,

$$\begin{aligned} 605 \times 5 &= (11 \times 11) \times (5 \times 5) \\ &= (11 \times 5) \times (11 \times 5) \\ &= 55 \times 55 \\ &= (55)^2 \end{aligned}$$

∴ Product is the square of 55.

(iv) 2880

First find the prime factors for 2880

$$2880 = 5 \times 3 \times 3 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$$

By grouping the prime factors in equal pairs we get,

$$= (3 \times 3) \times (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times 5$$

By observation, prime factor 5 is left out.

So, multiply by 5 we get,

$$\begin{aligned} 2880 \times 5 &= (3 \times 3) \times (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times (5 \times 5) \\ &= (3 \times 2 \times 2 \times 2 \times 5) \times (3 \times 2 \times 2 \times 2 \times 5) \\ &= 120 \times 120 \\ &= (120)^2 \end{aligned}$$

∴ Product is the square of 120.

(v) 4056

First find the prime factors for 4056

$$4056 = 2 \times 2 \times 13 \times 13 \times 2 \times 3$$

By grouping the prime factors in equal pairs we get,

$$= (2 \times 2) \times (13 \times 13) \times 2 \times 3$$

By observation, prime factors 2 and 3 are left out.

So, multiply by 6 we get,

$$\begin{aligned} 4056 \times 6 &= (2 \times 2) \times (13 \times 13) \times (2 \times 2) \times (3 \times 3) \\ &= (2 \times 13 \times 2 \times 3) \times (2 \times 13 \times 2 \times 3) \\ &= 156 \times 156 \\ &= (156)^2 \end{aligned}$$

∴ Product is the square of 156.

(vi) 3468

First find the prime factors for 3468

$$3468 = 2 \times 2 \times 17 \times 17 \times 3$$

By grouping the prime factors in equal pairs we get,

$$= (2 \times 2) \times (17 \times 17) \times 3$$

By observation, prime factor 3 is left out.

So, multiply by 3 we get,

$$3468 \times 3 = (2 \times 2) \times (17 \times 17) \times (3 \times 3)$$

$$= (2 \times 17 \times 3) \times (2 \times 17 \times 3)$$

$$= 102 \times 102$$

$$= (102)^2$$

∴ Product is the square of 102.

(vii) 7776

First find the prime factors for 7776

$$7776 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3 \times 2 \times 3$$

By grouping the prime factors in equal pairs we get,

$$= (2 \times 2) \times (2 \times 2) \times (3 \times 3) \times (3 \times 3) \times 2 \times 3$$

By observation, prime factors 2 and 3 are left out.

So, multiply by 6 we get,

$$7776 \times 6 = (2 \times 2) \times (2 \times 2) \times (3 \times 3) \times (3 \times 3) \times (2 \times 2) \times (3 \times 3)$$

$$= (2 \times 2 \times 3 \times 3 \times 2 \times 3) \times (2 \times 2 \times 3 \times 3 \times 2 \times 3)$$

$$= 216 \times 216$$

$$= (216)^2$$

∴ Product is the square of 216.

8. By What numbers should each of the following be divided to get a perfect square in each case? Also, find the number whose square is the new number.

(i) 16562

(ii) 3698

(iii) 5103

(iv) 3174

(v) 1575

Solution:

(i) 16562

First find the prime factors for 16562

$$16562 = 7 \times 7 \times 13 \times 13 \times 2$$

By grouping the prime factors in equal pairs we get,

$$= (7 \times 7) \times (13 \times 13) \times 2$$

By observation, prime factor 2 is left out.

So, divide by 2 to eliminate 2 we get,

$$\begin{aligned}16562/2 &= (7 \times 7) \times (13 \times 13) \\ &= (7 \times 13) \times (7 \times 13) \\ &= 91 \times 91 \\ &= (91)^2\end{aligned}$$

∴ Resultant is the square of 91.

(ii) 3698

First find the prime factors for 3698

$$3698 = 2 \times 43 \times 43$$

By grouping the prime factors in equal pairs we get,

$$= (43 \times 43) \times 2$$

By observation, prime factor 2 is left out.

So, divide by 2 to eliminate 2 we get,

$$\begin{aligned}3698/2 &= (43 \times 43) \\ &= (43)^2\end{aligned}$$

∴ Resultant is the square of 43.

(iii) 5103

First find the prime factors for 5103

$$5103 = 3 \times 3 \times 3 \times 3 \times 3 \times 7$$

By grouping the prime factors in equal pairs we get,

$$= (3 \times 3) \times (3 \times 3) \times (3 \times 3) \times 7$$

By observation, prime factor 7 is left out.

So, divide by 7 to eliminate 7 we get,

$$\begin{aligned}5103/7 &= (3 \times 3) \times (3 \times 3) \times (3 \times 3) \\ &= (3 \times 3 \times 3) \times (3 \times 3 \times 3) \\ &= 27 \times 27 \\ &= (27)^2\end{aligned}$$

∴ Resultant is the square of 27.

(iv) 3174

First find the prime factors for 3174

$$3174 = 2 \times 3 \times 23 \times 23$$

By grouping the prime factors in equal pairs we get,

$$= (23 \times 23) \times 2 \times 3$$

By observation, prime factor 2 and 3 are left out.

So, divide by 6 to eliminate 2 and 3 we get,

$$3174/6 = (23 \times 23)$$

$$= (23)^2$$

∴ Resultant is the square of 23.

(v) 1575

First find the prime factors for 1575

$$1575 = 3 \times 3 \times 5 \times 5 \times 7$$

By grouping the prime factors in equal pairs we get,

$$= (3 \times 3) \times (5 \times 5) \times 7$$

By observation, prime factor 7 is left out.

So, divide by 7 to eliminate 7 we get,

$$1575/7 = (3 \times 3) \times (5 \times 5)$$

$$= (3 \times 5) \times (3 \times 5)$$

$$= 15 \times 15$$

$$= (15)^2$$

∴ Resultant is the square of 15.

9. Find the greatest number of two digits which is a perfect square.

Solution:

We know that the two digit greatest number is 99

$$\begin{array}{r} 9 \\ 9 \overline{) 99} \\ \underline{81} \\ 18 \end{array}$$

∴ Greatest two digit perfect square number is $99 - 18 = 81$

10. Find the least number of three digits which is perfect square.

Solution:

We know that the three digit greatest number is 100

To find the square root of 100

$$\begin{array}{r} 10 \\ 1 \overline{) 100} \\ \underline{1} \\ 20 \end{array}$$

∴ the least number of three digits which is a perfect square is 100 itself.

11. Find the smallest number by which 4851 must be multiplied so that the product becomes a perfect square.

Solution:

First find the prime factors for 4851

$$4851 = 3 \times 3 \times 7 \times 7 \times 11$$

By grouping the prime factors in equal pairs we get,

$$= (3 \times 3) \times (7 \times 7) \times 11$$

∴ The smallest number by which 4851 must be multiplied so that the product becomes a perfect square is 11.

12. Find the smallest number by which 28812 must be divided so that the quotient becomes a perfect square.

Solution:

First find the prime factors for 28812

$$28812 = 2 \times 2 \times 3 \times 7 \times 7 \times 7 \times 7$$

By grouping the prime factors in equal pairs we get,

$$= (2 \times 2) \times 3 \times (7 \times 7) \times (7 \times 7)$$

∴ The smallest number by which 28812 must be divided so that the quotient becomes a perfect square is 3.

13. Find the smallest number by which 1152 must be divided so that it becomes a perfect square. Also find the number whose square is the resulting number.

Solution:

First find the prime factors for 1152

$$1152 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3 \times 3$$

By grouping the prime factors in equal pairs we get,

$$= (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times (3 \times 3) \times 2$$

∴ The smallest number by which 1152 must be divided so that the quotient becomes a perfect square is 2.

The number after division, $1152/2 = 576$

prime factors for $576 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3 \times 3$

By grouping the prime factors in equal pairs we get,

$$= (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times (3 \times 3)$$

$$= 2^6 \times 3^2$$

$$= 24^2$$

∴ The resulting number is the square of 24.

EXERCISE 3.2

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1. The following numbers are not perfect squares. Give reason.

(i) 1547

(ii) 45743

(iii) 8948

(iv) 333333

Solution:

The numbers ending with 2, 3, 7 or 8 is not a perfect square.

So, (i) 1547

(ii) 45743

(iii) 8948

(iv) 333333

Are not perfect squares.

2. Show that the following numbers are not, perfect squares:

(i) 9327

(ii) 4058

(iii) 22453

(iv) 743522

Solution:

The numbers ending with 2, 3, 7 or 8 is not a perfect square.

So, (i) 9327

(ii) 4058

(iii) 22453

(iv) 743522

Are not perfect squares.

3. The square of which of the following numbers would be an odd number?

(i) 731

(ii) 3456

(iii) 5559

(iv) 42008

Solution:

We know that square of an even number is even number.

Square of an odd number is odd number.

(i) 731

Since 731 is an odd number, the square of the given number is also odd.

(ii) 3456

Since 3456 is an even number, the square of the given number is also even.

(iii) 5559

Since 5559 is an odd number, the square of the given number is also odd.

(iv) 42008

Since 42008 is an even number, the square of the given number is also even.

4. What will be the unit's digit of the squares of the following numbers?

(i) 52

(ii) 977

(iii) 4583

(iv) 78367

(v) 52698

(vi) 99880

(vii) 12796

(viii) 55555

(ix) 53924

Solution:

(i) 52

Unit digit of $(52)^2 = (2^2) = 4$

(ii) 977

Unit digit of $(977)^2 = (7^2) = 49 = 9$

(iii) 4583

Unit digit of $(4583)^2 = (3^2) = 9$

(iv) 78367

Unit digit of $(78367)^2 = (7^2) = 49 = 9$

(v) 52698

Unit digit of $(52698)^2 = (8^2) = 64 = 4$

(vi) 99880

Unit digit of $(99880)^2 = (0^2) = 0$

(vii) 12796

$$\text{Unit digit of } (12796)^2 = (6^2) = 36 = 6$$

(viii) 55555

$$\text{Unit digit of } (55555)^2 = (5^2) = 25 = 5$$

(ix) 53924

$$\text{Unit digit of } (53924)^2 = (4^2) = 16 = 6$$

5. Observe the following pattern

$$1+3 = 2^2$$

$$1+3+5 = 3^2$$

$$1+3+5+7 = 4^2$$

And write the value of $1+3+5+7+9+\dots$ up to n terms.

Solution:

We know that the pattern given is the square of the given number on the right hand side is equal to the sum of the given numbers on the left hand side.

\therefore The value of $1+3+5+7+9+\dots$ up to n terms = n^2 (as there are only n terms).

6. Observe the following pattern

$$2^2 - 1^2 = 2 + 1$$

$$3^2 - 2^2 = 3 + 2$$

$$4^2 - 3^2 = 4 + 3$$

$$5^2 - 4^2 = 5 + 4$$

And find the value of

(i) $100^2 - 99^2$

(ii) $111^2 - 109^2$

(iii) $99^2 - 96^2$

Solution:

(i) $100^2 - 99^2$

$$100 + 99 = 199$$

(ii) $111^2 - 109^2$

$$(111^2 - 110^2) + (110^2 - 109^2)$$

$$(111 + 110) + (100 + 109)$$

$$440$$

(iii) $99^2 - 96^2$

$$(99^2 - 98^2) + (98^2 - 97^2) + (97^2 - 96^2)$$

$$(99 + 98) + (98 + 97) + (97 + 96)$$

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7. Which of the following triplets are Pythagorean?**(i) (8, 15, 17)****(ii) (18, 80, 82)****(iii) (14, 48, 51)****(iv) (10, 24, 26)****(v) (16, 63, 65)****(vi) (12, 35, 38)****Solution:****(i) (8, 15, 17)**

$$\text{LHS} = 8^2 + 15^2$$

$$= 289$$

$$\text{RHS} = 17^2$$

$$= 289$$

$$\text{LHS} = \text{RHS}$$

 \therefore The given triplet is a Pythagorean.**(ii) (18, 80, 82)**

$$\text{LHS} = 18^2 + 80^2$$

$$= 6724$$

$$\text{RHS} = 82^2$$

$$= 6724$$

$$\text{LHS} = \text{RHS}$$

 \therefore The given triplet is a Pythagorean.**(iii) (14, 48, 51)**

$$\text{LHS} = 14^2 + 48^2$$

$$= 2500$$

$$\text{RHS} = 51^2$$

$$= 2601$$

$$\text{LHS} \neq \text{RHS}$$

 \therefore The given triplet is not a Pythagorean.**(iv) (10, 24, 26)**

$$\text{LHS} = 10^2 + 24^2$$

$$= 676$$

$$\text{RHS} = 26^2$$

$$= 676$$

$$\text{LHS} = \text{RHS}$$

∴ The given triplet is a Pythagorean.

(v) (16, 63, 65)

$$\text{LHS} = 16^2 + 63^2$$

$$= 4225$$

$$\text{RHS} = 65^2$$

$$= 4225$$

$$\text{LHS} = \text{RHS}$$

∴ The given triplet is a Pythagorean.

(vi) (12, 35, 38)

$$\text{LHS} = 12^2 + 35^2$$

$$= 1369$$

$$\text{RHS} = 38^2$$

$$= 1444$$

$$\text{LHS} \neq \text{RHS}$$

∴ The given triplet is not a Pythagorean.

8. Observe the following pattern

$$(1 \times 2) + (2 \times 3) = (2 \times 3 \times 4) / 3$$

$$(1 \times 2) + (2 \times 3) + (3 \times 4) = (3 \times 4 \times 5) / 3$$

$$(1 \times 2) + (2 \times 3) + (3 \times 4) + (4 \times 5) = (4 \times 5 \times 6) / 3$$

And find the value of

$$(1 \times 2) + (2 \times 3) + (3 \times 4) + (4 \times 5) + (5 \times 6)$$

Solution:

$$(1 \times 2) + (2 \times 3) + (3 \times 4) + (4 \times 5) + (5 \times 6) = (5 \times 6 \times 7) / 3 = 70$$

9. Observe the following pattern

$$1 = 1/2 (1 \times (1+1))$$

$$1+2 = 1/2 (2 \times (2+1))$$

$$1+2+3 = 1/2 (3 \times (3+1))$$

$$1+2+3+4 = 1/2 (4 \times (4+1))$$

And find the values of each of the following:

(i) $1+2+3+4+5+\dots+50$

(ii) $31+32+\dots+50$

Solution:

We know that R.H.S = $\frac{1}{2}$ [No. of terms in L.H.S \times (No. of terms + 1)] (if only when L.H.S starts with 1)

$$(i) 1+2+3+4+5+\dots+50 = \frac{1}{2} (5 \times (5+1))$$

$$25 \times 51 = 1275$$

$$(ii) 31+32+\dots+50 = (1+2+3+4+5+\dots+50) - (1+2+3+\dots+30)$$

$$1275 - \frac{1}{2} (30 \times (30+1))$$

$$1275 - 465$$

$$810$$

10. Observe the following pattern

$$1^2 = \frac{1}{6} (1 \times (1+1) \times (2 \times 1 + 1))$$

$$1^2 + 2^2 = \frac{1}{6} (2 \times (2+1) \times (2 \times 2 + 1))$$

$$1^2 + 2^2 + 3^2 = \frac{1}{6} (3 \times (3+1) \times (2 \times 3 + 1))$$

$$1^2 + 2^2 + 3^2 + 4^2 = \frac{1}{6} (4 \times (4+1) \times (2 \times 4 + 1))$$

And find the values of each of the following:

$$(i) 1^2 + 2^2 + 3^2 + 4^2 + \dots + 10^2$$

$$(ii) 5^2 + 6^2 + 7^2 + 8^2 + 9^2 + 10^2 + 11^2 + 12^2$$

Solution:

$$RHS = \frac{1}{6} [(No. of terms in L.H.S) \times (No. of terms + 1) \times (2 \times No. of terms + 1)]$$

$$(i) 1^2 + 2^2 + 3^2 + 4^2 + \dots + 10^2 = \frac{1}{6} (10 \times (10+1) \times (2 \times 10 + 1))$$

$$= \frac{1}{6} (2310)$$

$$= 385$$

$$(ii) 5^2 + 6^2 + 7^2 + 8^2 + 9^2 + 10^2 + 11^2 + 12^2 = 1^2 + 2^2 + 3^2 + \dots + 12^2 - (1^2 + 2^2 + 3^2 + 4^2)$$

$$\frac{1}{6} (12 \times (12+1) \times (2 \times 12 + 1)) - \frac{1}{6} (4 \times (4+1) \times (2 \times 4 + 1))$$

$$650 - 30$$

$$620$$

11. Which of the following numbers are squares of even numbers?

121, 225, 256, 324, 1296, 6561, 5476, 4489, 373758

Solution:

We know that only even numbers be the squares of even numbers.

So, 256, 324, 1296, 5476, 373758 are even numbers, since 373758 is not a perfect square

\therefore 256, 324, 1296, 5476 are squares of even numbers.

12. By just examining the units digits, can you tell which of the following cannot be whole squares?

- (i) 1026
- (ii) 1028
- (iii) 1024
- (iv) 1022
- (v) 1023
- (vi) 1027

Solution:

We know that numbers ending with 2, 3, 7, 8 cannot be a perfect square.
∴ 1028, 1022, 1023, and 1027 cannot be whole squares.

13. Which of the numbers for which you cannot decide whether they are squares.

Solution:

We know that the natural numbers such as 0, 1, 4, 5, 6 or 9 cannot be decided surely whether they are squares or not.

14. Write five numbers which you cannot decide whether they are square just by looking at the unit's digit.

Solution:

We know that any natural number ending with 0, 1, 4, 5, 6 or 9 can be or cannot be a square number.

Here are the five examples which you cannot decide whether they are square or not just by looking at the units place:

(i) 2061

The unit digit is 1. So, it may or may not be a square number

(ii) 1069

The unit digit is 9. So, it may or may not be a square number

(iii) 1234

The unit digit is 4. So, it may or may not be a square number

(iv) 56790

The unit digit is 0. So, it may or may not be a square number

(v) 76555

The unit digit is 5. So, it may or may not be a square number

15. Write true (T) or false (F) for the following statements.

(i) The number of digits in a square number is even.

- (ii) The square of a prime number is prime.**
- (iii) The sum of two square numbers is a square number.**
- (iv) The difference of two square numbers is a square number.**
- (v) The product of two square numbers is a square number.**
- (vi) No square number is negative.**
- (vii) There is no square number between 50 and 60.**
- (viii) There are fourteen square number up to 200.**

Solution:

- (i)** False, because 169 is a square number with odd digit.
- (ii)** False, because square of 3(which is prime) is 9(which is not prime).
- (iii)** False, because sum of 2^2 and 3^2 is 13 which is not square number.
- (iv)** False, because difference of 3^2 and 2^2 is 5, which is not square number.
- (v)** True, because the square of 2^2 and 3^2 is 36 which is square of 6
- (vi)** True, because $(-2)^2$ is 4, which is not negative.
- (vii)** True, because as there is no square number between them.
- (viii)** True, because the fourteen numbers up to 200 are: 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196.

EXERCISE 3.3
PAGE NO: 3.32

1. Find the squares of the following numbers using column method. Verify the result by finding the square using the usual multiplication:

(i) 25

(ii) 37

(iii) 54

(iv) 71

(v) 96

Solution:

(i) 25

So here, $a = 2$ and $b = 5$

Column I	Column II	Column III
a^2	$2ab$	b^2
4	20	25
+2	+2	
6	22	
6	2	5

$$\therefore 25^2 = 625$$

Where, it can be expressed as

$$25^2 = 25 \times 25 = 625$$

(ii) 37

So here, $a = 3$ and $b = 7$

Column I	Column II	Column III
a^2	$2ab$	b^2
9	42	49
+4	+4	
13	46	
13	6	9

$$\therefore 37^2 = 1369$$

Where, it can be expressed as

$$37^2 = 37 \times 37 = 1369$$

(iii) 54

So here, $a = 5$ and $b = 4$

Column I	Column II	Column III
a^2	$2ab$	b^2
25	40	16
+4	+1	
29	41	
29	1	6

$$\therefore 54^2 = 2916$$

Where, it can be expressed as

$$54^2 = 54 \times 54 = 2916$$

(iv) 71

So here, $a = 7$ and $b = 1$

Column I	Column II	Column III
a^2	$2ab$	b^2
49	14	01
+1	+0	
50	14	
50	4	1

$$\therefore 71^2 = 5041$$

Where, it can be expressed as

$$71^2 = 71 \times 71 = 5041$$

(v) 96

So here, $a = 9$ and $b = 6$

Column I	Column II	Column III
a^2	$2ab$	b^2
81	108	36
+11	+3	
92	111	
92	1	6

$$\therefore 96^2 = 9216$$

Where, it can be expressed as
 $96^2 = 96 \times 96 = 9216$

2. Find the squares of the following numbers using diagonal method:

(i) 98

(ii) 273

(iii) 348

(iv) 295

(v) 171

Solution:

(i) 98

Step 1: Obtain the number and count the number of digits in it. Let there be n digits in the number to be squared.

Step 2: Draw square and divide it into n^2 sub-squares of the same size by drawing $(n - 1)$ horizontal and $(n - 1)$ vertical lines.

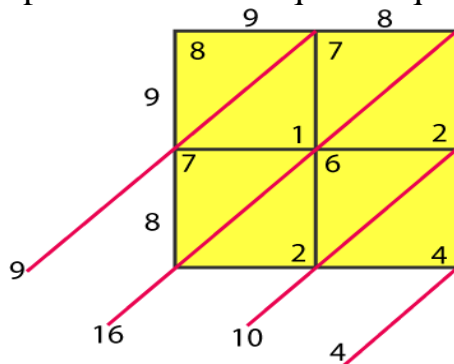
Step 3: Draw the diagonals of each sub-square.

Step 4: Write the digits of the number to be squared along left vertical side and top horizontal side of the squares.

Step 5: Multiply each digit on the left of the square with each digit on top of the column one-by-one. Write the units digit of the product below the diagonal and tens digit above the diagonal of the corresponding sub-square.

Step 6: Starting below the lowest diagonal sum the digits along the diagonals so obtained. Write the units digit of the sum and take carry, the tens digit (if any) to the diagonal above.

Step 7: Obtain the required square by writing the digits from the left-most side.



$$\therefore 98^2 = 9604$$

(ii) 273

Step 1: Obtain the number and count the number of digits in it. Let there be n digits in the number to be squared.

Step 2: Draw square and divide it into n^2 sub-squares of the same size by drawing $(n - 1)$ horizontal and $(n - 1)$ vertical lines.

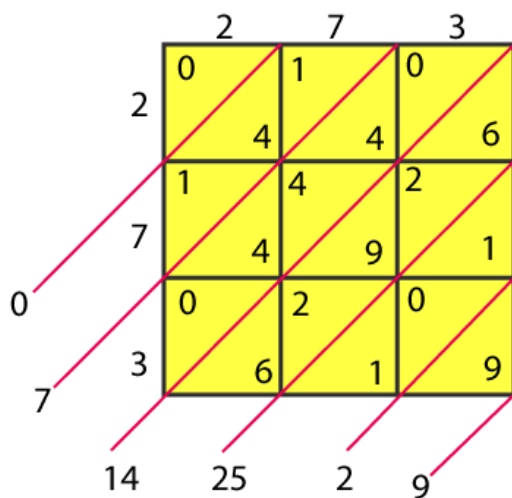
Step 3: Draw the diagonals of each sub-square.

Step 4: Write the digits of the number to be squared along left vertical side and top horizontal side of the squares.

Step 5: Multiply each digit on the left of the square with each digit on top of the column one-by-one. Write the units digit of the product below the diagonal and tens digit above the diagonal of the corresponding sub-square.

Step 6: Starting below the lowest diagonal sum the digits along the diagonals so obtained. Write the units digit of the sum and take carry, the tens digit (if any) to the diagonal above.

Step 7: Obtain the required square by writing the digits from the left-most side.



$$\therefore 273^2 = 74529$$

(iii) 348

Step 1: Obtain the number and count the number of digits in it. Let there be n digits in the number to be squared.

Step 2: Draw square and divide it into n^2 sub-squares of the same size by drawing $(n - 1)$ horizontal and $(n - 1)$ vertical lines.

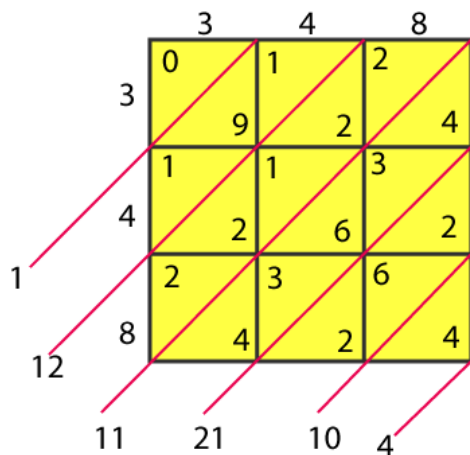
Step 3: Draw the diagonals of each sub-square.

Step 4: Write the digits of the number to be squared along left vertical side and top horizontal side of the squares.

Step 5: Multiply each digit on the left of the square with each digit on top of the column one-by-one. Write the units digit of the product below the diagonal and tens digit above the diagonal of the corresponding sub-square.

Step 6: Starting below the lowest diagonal sum the digits along the diagonals so obtained. Write the units digit of the sum and take carry, the tens digit (if any) to the diagonal above.

Step 7: Obtain the required square by writing the digits from the left-most side.



$$\therefore 348^2 = 121104$$

(iv) 295

Step 1: Obtain the number and count the number of digits in it. Let there be n digits in the number to be squared.

Step 2: Draw square and divide it into n^2 sub-squares of the same size by drawing $(n - 1)$ horizontal and $(n - 1)$ vertical lines.

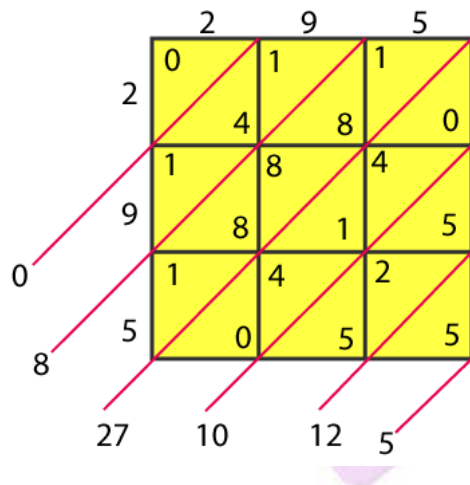
Step 3: Draw the diagonals of each sub-square.

Step 4: Write the digits of the number to be squared along left vertical side and top horizontal side of the squares.

Step 5: Multiply each digit on the left of the square with each digit on top of the column one-by-one. Write the units digit of the product below the diagonal and tens digit above the diagonal of the corresponding sub-square.

Step 6: Starting below the lowest diagonal sum the digits along the diagonals so obtained. Write the units digit of the sum and take carry, the tens digit (if any) to the diagonal above.

Step 7: Obtain the required square by writing the digits from the left-most side.



$$\therefore 295^2 = 87025$$

(v) 171

Step 1: Obtain the number and count the number of digits in it. Let there be n digits in the number to be squared.

Step 2: Draw square and divide it into n^2 sub-squares of the same size by drawing $(n - 1)$ horizontal and $(n - 1)$ vertical lines.

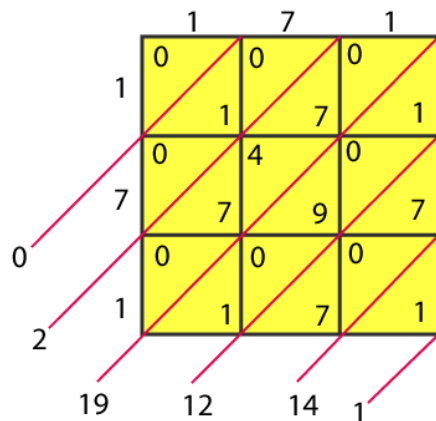
Step 3: Draw the diagonals of each sub-square.

Step 4: Write the digits of the number to be squared along left vertical side and top horizontal side of the squares.

Step 5: Multiply each digit on the left of the square with each digit on top of the column one-by-one. Write the units digit of the product below the diagonal and tens digit above the diagonal of the corresponding sub-square.

Step 6: Starting below the lowest diagonal sum the digits along the diagonals so obtained. Write the units digit of the sum and take carry, the tens digit (if any) to the diagonal above.

Step 7: Obtain the required square by writing the digits from the left-most side.



$$\therefore 171^2 = 29241$$

3. Find the squares of the following numbers:

(i) 127

(ii) 503

(iii) 450

(iv) 862

(v) 265

Solution:

(i) 127

$$127^2 = 127 \times 127 = 16129$$

(ii) 503

$$503^2 = 503 \times 503 = 253009$$

(iii) 450

$$450^2 = 450 \times 450 = 203401$$

(iv) 862

$$862^2 = 862 \times 862 = 743044$$

(v) 265

$$265^2 = 265 \times 265 = 70225$$

4. Find the squares of the following numbers:

(i) 425

(ii) 575

(iii) 405

(iv) 205

(v) 95

(vi) 745

(vii) 512

(viii) 995

Solution:

(i) 425

$$425^2 = 425 \times 425 = 180625$$

(ii) 575

$$575^2 = 575 \times 575 = 330625$$

(iii) 405

$$405^2 = 405 \times 405 = 164025$$

(iv) 205

$$205^2 = 205 \times 205 = 42025$$

(v) 95

$$95^2 = 95 \times 95 = 9025$$

(vi) 745

$$745^2 = 745 \times 745 = 555025$$

(vii) 512

$$512^2 = 512 \times 512 = 262144$$

(viii) 995

$$995^2 = 995 \times 995 = 990025$$

5. Find the squares of the following numbers using the identity $(a+b)^2 = a^2 + 2ab + b^2$:

(i) 405

(ii) 510

(iii) 1001

(iv) 209

(v) 605

Solution:

(i) 405

We know, $(a+b)^2 = a^2 + 2ab + b^2$

$$\begin{aligned} 405 &= (400+5)^2 \\ &= (400)^2 + 5^2 + 2(400)(5) \\ &= 160000 + 25 + 4000 \\ &= 164025 \end{aligned}$$

(ii) 510

We know, $(a+b)^2 = a^2 + 2ab + b^2$

$$\begin{aligned} 510 &= (500+10)^2 \\ &= (500)^2 + 10^2 + 2(500)(10) \\ &= 250000 + 100 + 10000 \\ &= 260100 \end{aligned}$$

(iii) 1001

We know, $(a+b)^2 = a^2 + 2ab + b^2$

$$\begin{aligned} 1001 &= (1000+1)^2 \\ &= (1000)^2 + 1^2 + 2(1000)(1) \\ &= 1000000 + 1 + 2000 \\ &= 1002001 \end{aligned}$$

(iv) 209

We know, $(a+b)^2 = a^2 + 2ab + b^2$

$$\begin{aligned} 209 &= (200+9)^2 \\ &= (200)^2 + 9^2 + 2(200)(9) \\ &= 40000 + 81 + 3600 \\ &= 43681 \end{aligned}$$

(v) 605

$$\begin{aligned}\text{We know, } (a+b)^2 &= a^2+2ab+b^2 \\ 605 &= (600+5)^2 \\ &= (600)^2 + 5^2 + 2 (600) (5) \\ &= 360000 + 25 + 6000 \\ &= 366025\end{aligned}$$

6. Find the squares of the following numbers using the identity $(a-b)^2 = a^2 - 2ab + b^2$

(i) 395

(ii) 995

(iii) 495

(iv) 498

(v) 99

(vi) 999

(vii) 599

Solution:

(i) 395

$$\begin{aligned}\text{We know, } (a-b)^2 &= a^2 - 2ab + b^2 \\ 395 &= (400-5)^2 \\ &= (400)^2 + 5^2 - 2 (400) (5) \\ &= 160000 + 25 - 4000 \\ &= 156025\end{aligned}$$

(ii) 995

$$\begin{aligned}\text{We know, } (a-b)^2 &= a^2 - 2ab + b^2 \\ 995 &= (1000-5)^2 \\ &= (1000)^2 + 5^2 - 2 (1000) (5) \\ &= 1000000 + 25 - 10000 \\ &= 990025\end{aligned}$$

(iii) 495

$$\begin{aligned}\text{We know, } (a-b)^2 &= a^2 - 2ab + b^2 \\ 495 &= (500-5)^2 \\ &= (500)^2 + 5^2 - 2 (500) (5) \\ &= 250000 + 25 - 5000 \\ &= 245025\end{aligned}$$

(iv) 498

$$\begin{aligned}\text{We know, } (a-b)^2 &= a^2 - 2ab + b^2 \\ 498 &= (500-2)^2\end{aligned}$$

$$\begin{aligned} &= (500)^2 + 2^2 - 2(500)(2) \\ &= 250000 + 4 - 2000 \\ &= 248004 \end{aligned}$$

(v) 99

We know, $(a-b)^2 = a^2 - 2ab + b^2$

$$\begin{aligned} 99 &= (100-1)^2 \\ &= (100)^2 + 1^2 - 2(100)(1) \\ &= 10000 + 1 - 200 \\ &= 9801 \end{aligned}$$

(vi) 999

We know, $(a-b)^2 = a^2 - 2ab + b^2$

$$\begin{aligned} 999 &= (1000-1)^2 \\ &= (1000)^2 + 1^2 - 2(1000)(1) \\ &= 1000000 + 1 - 2000 \\ &= 998001 \end{aligned}$$

(vii) 599

We know, $(a-b)^2 = a^2 - 2ab + b^2$

$$\begin{aligned} 599 &= (600-1)^2 \\ &= (600)^2 + 1^2 - 2(600)(1) \\ &= 360000 + 1 - 1200 \\ &= 358801 \end{aligned}$$

7. Find the squares of the following numbers by visual method:

(i) 52

(ii) 95

(iii) 505

(iv) 702

(v) 99

Solution:

(i) 52

We know, $(a+b)^2 = a^2 + 2ab + b^2$

$$\begin{aligned} 52 &= (50+2)^2 \\ &= (50)^2 + 2^2 + 2(50)(2) \\ &= 2500 + 4 + 200 \\ &= 2704 \end{aligned}$$

(ii) 95

We know, $(a-b)^2 = a^2 - 2ab + b^2$

$$\begin{aligned}95 &= (100-5)^2 \\ &= (100)^2 + 5^2 - 2(100)(5) \\ &= 10000 + 25 - 1000 \\ &= 9025\end{aligned}$$

(iii) 505

We know, $(a+b)^2 = a^2 + 2ab + b^2$

$$\begin{aligned}505 &= (500+5)^2 \\ &= (500)^2 + 5^2 + 2(500)(5) \\ &= 250000 + 25 + 5000 \\ &= 255025\end{aligned}$$

(iv) 702

We know, $(a+b)^2 = a^2 + 2ab + b^2$

$$\begin{aligned}702 &= (700+2)^2 \\ &= (700)^2 + 2^2 + 2(700)(2) \\ &= 490000 + 4 + 2800 \\ &= 492804\end{aligned}$$

(v) 99

We know, $(a-b)^2 = a^2 - 2ab + b^2$

$$\begin{aligned}99 &= (100-1)^2 \\ &= (100)^2 + 1^2 - 2(100)(1) \\ &= 10000 + 1 - 200 \\ &= 9801\end{aligned}$$

EXERCISE 3.4

PAGE NO: 3.38

1. Write the possible unit's digits of the square root of the following numbers. Which of these numbers are odd square roots?

(i) 9801

(ii) 99856

(iii) 998001

(iv) 657666025

Solution:

(i) 9801

We know that unit digit of 9801 is 1

Unit digit of square root = 1 or 9

Since the number is odd, square root is also odd

(ii) 99856

We know that unit digit of 99856 = 6

Unit digit of square root = 4 or 6

Since the number is even, square root is also even

(iii) 998001

We know that unit digit of 998001 = 1

Unit digit of square root = 1 or 9

Since the number is odd, square root is also odd

(iv) 657666025

We know that unit digit of 657666025 = 5

Unit digit of square root = 5

Since the number is odd, square root is also odd

2. Find the square root of each of the following by prime factorization.

(i) 441 (ii) 196

(iii) 529 (iv) 1764

(v) 1156 (vi) 4096

(vii) 7056 (viii) 8281

(ix) 11664 (x) 47089

(xi) 24336 (xii) 190969

(xiii) 586756 (xiv) 27225

(xv) 3013696

Solution:

(i) 441

Firstly let's find the prime factors for

$$441 = 3 \times 3 \times 7 \times 7$$
$$= 3^2 \times 7^2$$

$$\sqrt{441} = 3 \times 7$$
$$= 21$$

(ii) 196

Firstly let's find the prime factors for

$$196 = 2 \times 2 \times 7 \times 7$$
$$= 2^2 \times 7^2$$

$$\sqrt{196} = 2 \times 7$$
$$= 14$$

(iii) 529

Firstly let's find the prime factors for

$$529 = 23 \times 23$$
$$= 23^2$$

$$\sqrt{529} = 23$$

(iv) 1764

Firstly let's find the prime factors for

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

$$\sqrt{1764} = 2 \times 3 \times 7$$
$$= 42$$

(v) 1156

Firstly let's find the prime factors for

$$1156 = 2 \times 2 \times 17 \times 17$$
$$= 2^2 \times 17^2$$

$$\sqrt{1156} = 2 \times 17$$
$$= 34$$

(vi) 4096

Firstly let's find the prime factors for

$$4096 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$$
$$= 2^{12}$$

$$\sqrt{4096} = 2^6$$

$$= 64$$

(vii) 7056

Firstly let's find the prime factors for

$$\begin{aligned}7056 &= 2 \times 2 \times 2 \times 2 \times 21 \times 21 \\ &= 2^2 \times 2^2 \times 21^2\end{aligned}$$

$$\begin{aligned}\sqrt{7056} &= 2 \times 2 \times 21 \\ &= 84\end{aligned}$$

(viii) 8281

Firstly let's find the prime factors for

$$\begin{aligned}8281 &= 91 \times 91 \\ &= 91^2\end{aligned}$$

$$\sqrt{8281} = 91$$

(ix) 11664

Firstly let's find the prime factors for

$$\begin{aligned}11664 &= 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3 \times 3 \\ &= 2^2 \times 2^2 \times 3^2 \times 3^2 \times 3^2\end{aligned}$$

$$\begin{aligned}\sqrt{11664} &= 2 \times 2 \times 3 \times 3 \times 3 \\ &= 108\end{aligned}$$

(x) 47089

Firstly let's find the prime factors for

$$\begin{aligned}47089 &= 217 \times 217 \\ &= 217^2\end{aligned}$$

$$\sqrt{47089} = 217$$

(xi) 24336

Firstly let's find the prime factors for

$$\begin{aligned}24336 &= 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 13 \times 13 \\ &= 2^2 \times 2^2 \times 3^2 \times 13^2\end{aligned}$$

$$\begin{aligned}\sqrt{24336} &= 2 \times 2 \times 3 \times 13 \\ &= 156\end{aligned}$$

(xii) 190969

Firstly let's find the prime factors for

$$\begin{aligned}190969 &= 23 \times 23 \times 19 \times 19 \\ &= 23^2 \times 19^2\end{aligned}$$

$$\begin{aligned}\sqrt{190969} &= 23 \times 19 \\ &= 437\end{aligned}$$

(xiii) 586756

Firstly let's find the prime factors for

$$\begin{aligned}586756 &= 2 \times 2 \times 383 \times 383 \\ &= 2^2 \times 383^2\end{aligned}$$

$$\begin{aligned}\sqrt{586756} &= 2 \times 383 \\ &= 766\end{aligned}$$

(xiv) 27225

Firstly let's find the prime factors for

$$\begin{aligned}27225 &= 5 \times 5 \times 3 \times 3 \times 11 \times 11 \\ &= 5^2 \times 3^2 \times 11^2\end{aligned}$$

$$\begin{aligned}\sqrt{27225} &= 5 \times 3 \times 11 \\ &= 165\end{aligned}$$

(xv) 3013696

Firstly let's find the prime factors for

$$\begin{aligned}3013696 &= 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 217 \times 217 \\ &= 2^6 \times 217^2\end{aligned}$$

$$\begin{aligned}\sqrt{3013696} &= 2^3 \times 217 \\ &= 1736\end{aligned}$$

3. Find the smallest number by which 180 must be multiplied so that it becomes a perfect square. Also, find the square root of the perfect square so obtained.

Solution:

Firstly let's find the prime factors for

$$\begin{aligned}180 &= (2 \times 2) \times (3 \times 3) \times 5 \\ &= 2^2 \times 3^2 \times 5\end{aligned}$$

To make the unpaired 5 into paired, multiply the number with 5

$$180 \times 5 = 2^2 \times 3^2 \times 5^2$$

$$\begin{aligned}\therefore \text{Square root of } \sqrt{(180 \times 5)} &= 2 \times 3 \times 5 \\ &= 30\end{aligned}$$

4. Find the smallest number by which 147 must be multiplied so that it becomes a perfect square. Also, find the square root of the number so obtained.

Solution:

Firstly let's find the prime factors for

$$147 = (7 \times 7) \times 3 \\ = 7^2 \times 3$$

To make the unpaired 3 into paired, multiply the number with 3

$$147 \times 3 = 7^2 \times 3^2$$

$$\therefore \text{Square root of } \sqrt{(147 \times 3)} = 7 \times 3 \\ = 21$$

5. Find the smallest number by which 3645 must be divided so that it becomes a perfect square. Also, find the square root of the resulting number.

Solution:

Firstly let's find the prime factors for

$$3645 = (3 \times 3) \times (3 \times 3) \times (3 \times 3) \times 5 \\ = 3^2 \times 3^2 \times 3^2 \times 5$$

To make the unpaired 5 into paired, the number 3645 has to be divided by 5

$$3645 \div 5 = 3^2 \times 3^2 \times 3^2$$

$$\therefore \text{Square root of } \sqrt{(3645 \div 5)} = 3 \times 3 \times 3 \\ = 27$$

6. Find the smallest number by which 1152 must be divided so that it becomes a square. Also, find the square root of the number so obtained.

Solution:

Firstly let's find the prime factors for

$$1152 = (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times 2 \times (3 \times 3) \\ = 2^2 \times 2^2 \times 2^2 \times 2 \times 3^2$$

To make the unpaired 2 into paired, the number 1152 has to be divided by 2

$$1152 \div 2 = 2^2 \times 2^2 \times 2^2 \times 3^2$$

$$\therefore \text{Square root of } \sqrt{(1152 \div 2)} = 2 \times 2 \times 2 \times 3 \\ = 24$$

7. The product of two numbers is 1296. If one number is 16 times the other, find the numbers.

Solution:

Let us consider two numbers a and b

So we know that one of the number, $a = 16b$

$$a \times b = 1296$$

$$16b \times b = 1296$$

$$16b^2 = 1296$$

$$b^2 = 1296/16 = 81$$

$$b = 9$$

$$\begin{aligned}a &= 16b \\ &= 16(9) \\ &= 144 \\ \therefore a &= 144 \text{ and } b = 9\end{aligned}$$

8. A welfare association collected Rs 202500 as donation from the residents. If each paid as many rupees as there were residents, find the number of residents.

Solution:

Let us consider total residents as a
So, each paid Rs. a

$$\begin{aligned}\text{Total collection} &= a(a) = a^2 \\ \text{We know that the total Collection} &= 202500 \\ a &= \sqrt{202500} \\ a &= \sqrt{2 \times 2 \times 3 \times 3 \times 3 \times 3 \times 5 \times 5 \times 5 \times 5} \\ &= 2 \times 3 \times 3 \times 5 \times 5 \\ &= 450 \\ \therefore \text{Total residents} &= 450\end{aligned}$$

9. A society collected Rs 92.16. Each member collected as many paise as there were members. How many members were there and how much did each contribute?

Solution:

Let us consider there were few members, each attributed a paise a (a), i.e. total cost collected = 9216 paise

$$\begin{aligned}a^2 &= 9216 \\ a &= \sqrt{9216} \\ &= 2 \times 2 \times 2 \times 12 \\ &= 96 \\ \therefore \text{There were 96 members in the society and each contributed 96 paise}\end{aligned}$$

10. A society collected Rs 2304 as fees from its students. If each student paid as many paise as there were students in the school, how many students were there in the school?

Solution:

Let us consider number of school students as a
each student contributed a paise
Total money obtained = a^2 paise

$$\begin{aligned}&= 2304 \text{ paise} \\ a &= \sqrt{2304}\end{aligned}$$

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

$$a = 2 \times 2 \times 2 \times 2 \times 3$$

$$a = 48$$

∴ There were 48 students in the school

11. The area of a square field is 5184 m^2 . A rectangular field, whose length is twice its breadth has its perimeter equal to the perimeter of the square field. Find the area of the rectangular field.

Solution:

Let us consider the side of square field as a

$$a^2 = 5184 \text{ m}^2$$

$$a = \sqrt{5184} \text{ m}$$

$$a = 2 \times 2 \times 2 \times 9$$

$$= 72 \text{ m}$$

$$\text{Perimeter of square} = 4a$$

$$= 4(72)$$

$$= 288 \text{ m}$$

$$\text{Perimeter of rectangle} = 2(l + b) = \text{perimeter of the square field}$$

$$= 288 \text{ m}$$

$$2(2b + b) = 288$$

$$b = 48 \text{ and } l = 96$$

$$\text{Area of rectangle} = 96 \times 48 \text{ m}^2$$

$$= 4608 \text{ m}^2$$

12. Find the least square number, exactly divisible by each one of the numbers: (i) 6, 9, 15 and 20 (ii) 8, 12, 15 and 20

Solution:

(i) 6, 9, 15 and 20

Firstly take L.C.M for 6, 9, 15, 20 which is 180

So the prime factors of $180 = 2^2 \times 3^2 \times 5$

To make it a perfect square, we have to multiply the number with 5

$$180 \times 5 = 2^2 \times 3^2 \times 5^2$$

∴ 900 is the least square number divisible by 6, 9, 15 and 20

(ii) 8, 2, 15 and 20

Firstly take L.C.M for 8, 2, 15, 20 which is 360

So the prime factors of $360 = 2^2 \times 3^2 \times 2 \times 5$

To make it a perfect square, we have to multiply the number with $2 \times 5 = 10$

$$360 \times 10 = 2^2 \times 3^2 \times 5^2 \times 2^2$$

∴ 3600 is the least square number divisible by 8, 12, 15 and 20

13. Find the square roots of 121 and 169 by the method of repeated subtraction.

Solution:

Let us find the square roots of 121 and 169 by the method of repeated subtraction

$$121 - 1 = 120$$

$$120 - 3 = 117$$

$$117 - 5 = 112$$

$$112 - 7 = 105$$

$$105 - 9 = 96$$

$$96 - 11 = 85$$

$$85 - 13 = 72$$

$$72 - 15 = 57$$

$$57 - 17 = 40$$

$$40 - 19 = 21$$

$$21 - 21 = 0$$

Clearly, we have performed operation 11 times

$$\therefore \sqrt{121} = 11$$

$$169 - 1 = 168$$

$$168 - 3 = 165$$

$$165 - 5 = 160$$

$$160 - 7 = 153$$

$$153 - 9 = 144$$

$$144 - 11 = 133$$

$$133 - 13 = 120$$

$$120 - 15 = 105$$

$$105 - 17 = 88$$

$$88 - 19 = 69$$

$$69 - 21 = 48$$

$$48 - 23 = 25$$

$$25 - 25 = 0$$

Clearly, we have performed subtraction 13 times

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

14. Write the prime factorization of the following numbers and hence find their square roots.

(i) 7744

(ii) 9604

(iii) 5929

(iv) 7056

Solution:

(i) 7744

Prime factors of 7744 is

$$7744 = 2^2 \times 2^2 \times 2^2 \times 11^2$$

∴ The square root of 7744 is

$$\begin{aligned}\sqrt{7744} &= 2 \times 2 \times 2 \times 11 \\ &= 88\end{aligned}$$

(ii) 9604

Prime factors of 9604 is

$$9604 = 2^2 \times 7^2 \times 7^2$$

∴ The square root of 9604 is

$$\begin{aligned}\sqrt{9604} &= 2 \times 7 \times 7 \\ &= 98\end{aligned}$$

(iii) 5929

Prime factors of 5929 is

$$5929 = 11^2 \times 7^2$$

∴ The square root of 5929 is

$$\begin{aligned}\sqrt{5929} &= 11 \times 7 \\ &= 77\end{aligned}$$

(iv) 7056

Prime factors of 7056 is

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

∴ The square root of 7056 is

$$\begin{aligned}\sqrt{7056} &= 2 \times 2 \times 7 \times 3 \\ &= 84\end{aligned}$$

15. The students of class VIII of a school donated Rs 2401 for PM's National Relief Fund. Each student donated as many rupees as the number of students in the class, Find the number of students in the class.

Solution:

Let us consider number of students as a

Each student denoted a rupee

So, total amount collected is $a \times a$ rupees = 2401

$$a^2 = 2401$$

$$a = \sqrt{2401}$$

$$a = 49$$

∴ There are 49 students in the class.

16. A PT teacher wants to arrange maximum possible number of 6000 students in a field such that the number of rows is equal to the number of columns. Find the number of rows if 71 were left out after arrangement.

Solution:

Let us consider number of rows as a

No. of columns = a

Total number of students who sat in the field = a^2

Total students $a^2 + 71 = 6000$

$$a^2 = 5929$$

$$a = \sqrt{5929}$$

$$a = 77$$

∴ total number of rows are 77.

EXERCISE 3.5
PAGE NO: 3.43
1. Find the square root of each of the following by long division method:

- (i) 12544 (ii) 97344**
(iii) 286225 (iv) 390625
(v) 363609 (vi) 974169
(vii) 120409 (viii) 1471369
(ix) 291600 (x) 9653449
(xi) 1745041 (xii) 4008004
(xiii) 20657025 (xiv) 152547201
(xv) 20421361 (xvi) 62504836
(xvii) 82264900 (xviii) 3226694416
(xix) 6407522209 (xx) 3915380329

Solution:
(i) 12544

By using long division method

$$\begin{array}{r}
 112 \\
 1 \overline{) 12544} \\
 \underline{1} \\
 25 \\
 \underline{21} \\
 444 \\
 \underline{444} \\
 0
 \end{array}$$

 \therefore the square root of 12544

$$\sqrt{12544} = 112$$

(ii) 97344

By using long division method

$$\begin{array}{r}
 312 \\
 3 \overline{) 97344} \\
 \underline{9} \\
 61 \\
 \underline{61} \\
 622 \\
 \underline{622} \\
 0
 \end{array}$$

 \therefore the square root of 97344

$$\sqrt{97344} = 312$$

(iii) 286225

By using long division method

$$\begin{array}{r}
 535 \\
 5 \overline{) 286225} \\
 \underline{25} \\
 103 \\
 \underline{362} \\
 309 \\
 1065 \\
 \underline{5325} \\
 5325 \\
 \underline{0}
 \end{array}$$

\therefore the square root of 286225
 $\sqrt{286225} = 535$

(iv) 390625

By using long division method

$$\begin{array}{r}
 625 \\
 6 \overline{) 390625} \\
 \underline{36} \\
 122 \\
 \underline{306} \\
 244 \\
 1245 \\
 \underline{6225} \\
 6225 \\
 \underline{0}
 \end{array}$$

\therefore the square root of 390625
 $\sqrt{390625} = 625$

(v) 363609

By using long division method

$$\begin{array}{r}
 603 \\
 6 \overline{) 363609} \\
 \underline{36} \\
 1203 \\
 \underline{3609} \\
 3609 \\
 \underline{0}
 \end{array}$$

\therefore the square root of 363609
 $\sqrt{36369} = 603$

(vi) 974169

By using long division method

$$\begin{array}{r}
 987 \\
 9 \overline{) 974169} \\
 \underline{81} \\
 1641 \\
 \underline{1504} \\
 13769 \\
 \underline{13769} \\
 0
 \end{array}$$

∴ the square root of 974169

$$\sqrt{974169} = 987$$

(vii) 120409

By using long division method

$$\begin{array}{r}
 347 \\
 3 \overline{) 120409} \\
 \underline{9} \\
 304 \\
 \underline{256} \\
 4809 \\
 \underline{4809} \\
 0
 \end{array}$$

∴ the square root of 120409

$$\sqrt{120409} = 347$$

(viii) 1471369

By using long division method

$$\begin{array}{r}
 1213 \\
 1 \overline{) 1471369} \\
 \underline{1} \\
 47 \\
 \underline{44} \\
 313 \\
 \underline{241} \\
 7269 \\
 \underline{7269} \\
 0
 \end{array}$$

∴ the square root of 1471369

$$\sqrt{1471369} = 1213$$

(ix) 291600

By using long division method

$$\begin{array}{r}
 540 \\
 5 \overline{) 291600} \\
 \underline{25} \\
 416 \\
 \underline{416} \\
 00 \\
 \underline{00} \\
 0
 \end{array}$$

∴ the square root of 291600
 $\sqrt{291600} = 540$

(x) 9653449

By using long division method

$$\begin{array}{r}
 3107 \\
 3 \overline{) 9653449} \\
 \underline{9} \\
 65 \\
 \underline{61} \\
 43449 \\
 \underline{43449} \\
 0
 \end{array}$$

∴ the square root of 9653449
 $\sqrt{9653449} = 3107$

(xi) 1745041

By using long division method

$$\begin{array}{r}
 1321 \\
 1 \overline{) 1745041} \\
 \underline{1} \\
 74 \\
 \underline{69} \\
 550 \\
 \underline{524} \\
 2641 \\
 \underline{2641} \\
 0
 \end{array}$$

∴ the square root of 1745041
 $\sqrt{1745041} = 1321$

(xii) 4008004

By using long division method

$$\begin{array}{r}
 2002 \\
 2 \overline{) 4008004} \\
 \underline{4} \\
 40 \\
 \underline{000} \\
 400 \\
 \underline{080} \\
 0 \\
 4002 \\
 \underline{8004} \\
 8004 \\
 \underline{0}
 \end{array}$$

∴ the square root of 4008004
 $\sqrt{4008004} = 2002$

(xiii) 20657025

By using long division method

$$\begin{array}{r}
 4545 \\
 4 \overline{) 20657025} \\
 \underline{16} \\
 85 \\
 \underline{465} \\
 425 \\
 904 \\
 \underline{4070} \\
 3616 \\
 9085 \\
 \underline{45425} \\
 45425 \\
 \underline{0}
 \end{array}$$

∴ the square root of 20657025
 $\sqrt{20657025} = 4545$

(xiv) 152547201

By using long division method

$$\begin{array}{r}
 12351 \\
 1 \overline{) 152547201} \\
 \underline{1} \\
 22 \\
 \underline{52} \\
 44 \\
 243 \\
 \underline{854} \\
 729 \\
 2465 \\
 \underline{12572} \\
 12325 \\
 27701 \\
 \underline{24701} \\
 24701 \\
 \underline{0}
 \end{array}$$

∴ the square root of 152547201
 $\sqrt{152547201} = 12351$

(xv) 20421361

By using long division method

$$\begin{array}{r}
 4519 \\
 4 \overline{) 20421361} \\
 \underline{16} \\
 85 \overline{) 442} \\
 \underline{425} \\
 901 \overline{) 1713} \\
 \underline{901} \\
 9029 \overline{) 81261} \\
 \underline{81261} \\
 0
 \end{array}$$

\therefore the square root of 20421361

$$\sqrt{20421361} = 4519$$

(xvi) 62504836

By using long division method

$$\begin{array}{r}
 7906 \\
 7 \overline{) 62504836} \\
 \underline{49} \\
 149 \overline{) 1350} \\
 \underline{1341} \\
 1580 \overline{) 948} \\
 \underline{948} \\
 15806 \overline{) 94836} \\
 \underline{94836} \\
 0
 \end{array}$$

\therefore the square root of 62504836

$$\sqrt{62504836} = 7906$$

(xvii) 82264900

By using long division method

$$\begin{array}{r}
 9070 \\
 9 \overline{) 82264900} \\
 \underline{81} \\
 180 \\
 \underline{1807} \\
 12649 \\
 \underline{12649} \\
 14140 \\
 00 \\
 0 \\
 \times
 \end{array}$$

∴ the square root of 82264900
 $\sqrt{82264900} = 9070$

(xviii) 3226694416

By using long division method

$$\begin{array}{r}
 56804 \\
 5 \overline{) 3226694416} \\
 \underline{25} \\
 106 \\
 \underline{726} \\
 1128 \\
 \underline{9069} \\
 11360 \\
 4544 \\
 0 \\
 113604 \\
 454416 \\
 454416 \\
 \times
 \end{array}$$

∴ the square root of 3226694416
 $\sqrt{3226694416} = 56804$

(xix) 6407522209

By using long division method

$$\begin{array}{r}
 80047 \\
 8 \overline{) 6407522209} \\
 \underline{64} \\
 160 \\
 \underline{1600} \\
 16004 \\
 \underline{16004} \\
 160087 \\
 \underline{160087} \\
 \times
 \end{array}$$

∴ the square root of 6407522209
 $\sqrt{6407522209} = 80047$

(xx) 3915380329

By using long division method

$$\begin{array}{r}
 62573 \\
 6 \overline{) 3915380329} \\
 \underline{36} \\
 122 \\
 \underline{1245} \\
 12507 \\
 \underline{125143} \\
 \times
 \end{array}$$

∴ the square root of 3915380329
 $\sqrt{3915380329} = 62573$

2. Find the least number which must be subtracted from the following numbers to make them a perfect square:

(i) 2361

(ii) 194491

(iii) 26535

(iv) 161605

(v) 4401624

Solution:

(i) 2361

By using long division method

$$\begin{array}{r}
 48 \\
 4 \overline{) 2361} \\
 \underline{16} \\
 88 \\
 \underline{761} \\
 704 \\
 \underline{57}
 \end{array}$$

\therefore 57 has to be subtracted from 2361 to get a perfect square.

(ii) 194491

By using long division method

$$\begin{array}{r}
 441 \\
 4 \overline{) 194491} \\
 \underline{16} \\
 84 \\
 \underline{344} \\
 336 \\
 881 \\
 \underline{891} \\
 881 \\
 \underline{10}
 \end{array}$$

\therefore 10 has to be subtracted from 194491 to get a perfect square.

(iii) 26535

By using long division method

$$\begin{array}{r}
 162 \\
 1 \overline{) 26535} \\
 \underline{1} \\
 26 \\
 \underline{165} \\
 156 \\
 322 \\
 \underline{935} \\
 644 \\
 \underline{291}
 \end{array}$$

\therefore 291 has to be subtracted from 26535 to get a perfect square.

(iv) 161605

By using long division method

$$\begin{array}{r}
 402 \\
 9 \overline{) 161605} \\
 \underline{16} \\
 802 \\
 \underline{1605} \\
 1604 \\
 \underline{1604} \\
 1
 \end{array}$$

\therefore 1 has to be subtracted from 161605 to get a perfect square.

(v) 4401624

By using long division method

$$\begin{array}{r}
 2098 \\
 2 \overline{) 4401624} \\
 \underline{4} \\
 40 \\
 \underline{40} \\
 0 \\
 409 \\
 \underline{4016} \\
 3681 \\
 4188 \\
 \underline{33524} \\
 33504 \\
 \underline{33504} \\
 20
 \end{array}$$

\therefore 20 has to be subtracted from 4401624 to get a perfect square.

3. Find the least number which must be added to the following numbers to make them a perfect square:

(i) 5607

(ii) 4931

(iii) 4515600

(iv) 37460

(v) 506900

Solution:

(i) 5607

By using long division method

$$\begin{array}{r}
 74 \\
 7 \overline{) 5607} \\
 \underline{49} \\
 144 \\
 \underline{140} \\
 707 \\
 \underline{576} \\
 131
 \end{array}$$

The remainder is 131

Since, $(74)^2 < 5607$

We take, the next perfect square number i.e., $(75)^2$

$(75)^2 = 5625 > 5607$

So, the number to be added = $5625 - 5607 = 18$

(ii) 4931

By using long division method

$$\begin{array}{r}
 70 \\
 7 \overline{) 4931} \\
 \underline{49} \\
 140 \\
 \underline{140} \\
 31 \\
 \underline{0} \\
 31
 \end{array}$$

The remainder is 31

Since, $(70)^2 < 4931$

We take, the next perfect square number i.e., $(71)^2$

$(71)^2 = 5041 > 4931$

So, the number to be added = $5041 - 4931 = 110$

(iii) 4515600

By using long division method

$$\begin{array}{r}
 2124 \\
 2 \overline{) 4515600} \\
 \underline{4} \\
 41 \\
 \underline{41} \\
 422 \\
 \underline{422} \\
 4244 \\
 \underline{4244} \\
 1056 \\
 \underline{844} \\
 21200 \\
 \underline{16976} \\
 4224
 \end{array}$$

The remainder is 4224

Since, $(2124)^2 < 4515600$

We take, the next perfect square number i.e., $(2125)^2$

$(2125)^2 = 4515625 > 4515600$

So, the number to be added = $4515625 - 4515600 = 25$

(iv) 37460

By using long division method

$$\begin{array}{r}
 193 \\
 1 \overline{) 37460} \\
 \underline{1} \\
 29 \\
 \underline{261} \\
 383 \\
 \underline{1360} \\
 1149 \\
 \underline{1149} \\
 211
 \end{array}$$

The remainder is 211

Since, $(193)^2 < 37460$

We take, the next perfect square number i.e., $(194)^2$

$(194)^2 = 37636 > 37460$

So, the number to be added = $37636 - 37460 = 176$

(v) 506900

By using long division method

$$\begin{array}{r}
 711 \\
 7 \overline{) 506900} \\
 \underline{49} \\
 141 \\
 \underline{141} \\
 1421 \\
 \underline{1421} \\
 1379
 \end{array}$$

The remainder is 1379

Since, $(711)^2 < 506900$

We take, the next perfect square number i.e., $(712)^2$

$(712)^2 = 506944 > 506900$

So, the number to be added = $506944 - 506900 = 44$

4. Find the greatest number of 5 digits which is a perfect square.
Solution:

We know that the greatest 5 digit number is 99999

By using long division method

$$\begin{array}{r}
 316 \\
 3 \overline{) 99999} \\
 \underline{9} \\
 61 \\
 \underline{61} \\
 626 \\
 \underline{3899} \\
 3766 \\
 \underline{143}
 \end{array}$$

The remainder is 143

So, the greatest 5 digit perfect square number is:

$$99999 - 143 = 99856$$

\therefore 99856 is the required greatest 5 digit perfect square number.

5. Find the least number of 4 digits which is a perfect square.
Solution:

We know that the least 4 digit number is 1000

By using long division method

$$\begin{array}{r}
 31 \\
 3 \overline{) 1000} \\
 \underline{9} \\
 61 \\
 \underline{61} \\
 39
 \end{array}$$

The remainder is 39

Since, $(31)^2 < 1000$

We take, the next perfect square number i.e., $(32)^2$

$$(32)^2 = 1024 > 1000$$

\therefore 1024 is the required least number 4 digit number which is a perfect square.

6. Find the least number of six digits which is a perfect square.
Solution:

We know that the least 6 digit number is 100000

By using long division method

$$\begin{array}{r}
 316 \\
 3 \overline{) 100000} \\
 \underline{9} \\
 61 \\
 \underline{61} \\
 626 \\
 \underline{3900} \\
 \underline{3756} \\
 144
 \end{array}$$

The remainder is 144

Since, $(316)^2 < 100000$

We take, the next perfect square number i.e., $(317)^2$

$(317)^2 = 100489 > 100000$

$\therefore 100489$ is the required least number 6 digit number which is a perfect square.

7. Find the greatest number of 4 digits which is a perfect square.

Solution:

We know that the greatest 4 digit number is 9999

By using long division method

$$\begin{array}{r}
 91 \\
 9 \overline{) 9999} \\
 \underline{81} \\
 89 \\
 \underline{1899} \\
 \underline{1701} \\
 198
 \end{array}$$

The remainder is 198

So, the greatest 4 digit perfect square number is:

$9999 - 198 = 9801$

$\therefore 9801$ is the required greatest 4 digit perfect square number.

8. A General arranges his soldiers in rows to form a perfect square. He finds that in doing so, 60 soldiers are left out. If the total number of soldiers be 8160, find the number of soldiers in each row

Solution:

We know that the total number of soldiers = 8160

Number of soldiers left out = 60

Number of soldiers arranged in rows to form a perfect square = $8160 - 60 = 8100$

$$\begin{aligned}\therefore \text{number of soldiers in each row} &= \sqrt{8100} \\ &= \sqrt{(9 \times 9 \times 10 \times 10)} \\ &= 9 \times 10 \\ &= 90\end{aligned}$$

9. The area of a square field is 60025m^2 . A man cycles along its boundary at 18 Km/hr. In how much time will he return at the starting point?

Solution:

We know that the area of square field = 60025 m^2

$$\begin{aligned}\text{Speed of cyclist} &= 18\text{ km/h} \\ &= 18 \times (1000/60 \times 60) \\ &= 5\text{ m/s}^2\end{aligned}$$

$$\text{Area} = 60025\text{ m}^2$$

$$\text{Side}^2 = 60025$$

$$\begin{aligned}\text{Side} &= \sqrt{60025} \\ &= 245\end{aligned}$$

$$\begin{aligned}\text{We know, Total length of boundary} &= 4 \times \text{Side} \\ &= 4 \times 245 \\ &= 980\text{ m}\end{aligned}$$

$$\begin{aligned}\therefore \text{Time taken to return to the starting point} &= 980/5 \\ &= 196\text{ seconds} \\ &= 3\text{ minutes } 16\text{ seconds}\end{aligned}$$

10. The cost of levelling and turning a square lawn at Rs 2.50 per m^2 is Rs13322.50 Find the cost of fencing it at Rs 5 per metre.

Solution:

We know that the cost of levelling and turning a square lawn = 2.50 per m^2

Total cost of levelling and turning = Rs. 13322.50

$$\begin{aligned}\text{Total area of square lawn} &= 13322.50/2.50 \\ &= 5329\text{ m}^2\end{aligned}$$

$$\text{Side}^2 = 5329$$

$$\begin{aligned}\text{Side of square lawn} &= \sqrt{5329} \\ &= 73\text{ m}\end{aligned}$$

$$\begin{aligned}\text{So, total length of lawn} &= 4 \times 73 \\ &= 292\text{ m}\end{aligned}$$

$$\begin{aligned}\therefore \text{Cost of fencing the lawn at Rs 5 per metre} &= 292 \times 5 \\ &= \text{Rs. } 1460\end{aligned}$$

11. Find the greatest number of three digits which is a perfect square.

Solution:

We know that the greatest 3 digit number is 999

By using long division method

$$\begin{array}{r}
 31 \\
 3 \overline{) 999} \\
 \underline{9} \\
 61 \\
 \underline{61} \\
 38
 \end{array}$$

The remainder is 38

So, the greatest 3 digit perfect square number is:

$$999 - 38 = 961$$

\therefore 961 is the required greatest 3 digit perfect square number.

12. Find the smallest number which must be added to 2300 so that it becomes a perfect square.

Solution:

By using long division method let's find the square root of 2300

$$\begin{array}{r}
 47 \\
 4 \overline{) 2300} \\
 \underline{16} \\
 87 \\
 \underline{700} \\
 700 \\
 \underline{91}
 \end{array}$$

The remainder is 91

Since, $(47)^2 < 2300$

We take, the next perfect square number i.e., $(48)^2$

$$(48)^2 = 2304 > 2300$$

\therefore The smallest number required to be added to 2300 to get a perfect square is

$$2304 - 2300 = 4$$

EXERCISE 3.6

PAGE NO: 3.48

1. Find the square root of:

(i) $441/961$

(ii) $324/841$

(iii) $4 \frac{29}{29}$

(iv) $2 \frac{14}{25}$

(v) $2 \frac{137}{196}$

(vi) $23 \frac{26}{121}$

(vii) $25 \frac{544}{729}$

(viii) $75 \frac{46}{49}$

(ix) $3 \frac{942}{2209}$

(x) $3 \frac{334}{3025}$

(xi) $21 \frac{2797}{3364}$

(xii) $38 \frac{11}{25}$

(xiii) $23 \frac{394}{729}$

(xiv) $21 \frac{51}{169}$

(xv) $10 \frac{151}{225}$

Solution:

(i) $441/961$

The square root of
 $\sqrt{441/961} = 21/31$

(ii) $324/841$

The square root of
 $\sqrt{324/841} = 18/29$

(iii) $4 \frac{29}{29}$

The square root of

$$\sqrt{4 \frac{29}{29}} = \sqrt{(225/49)} = 15/7$$

(iv) $2 \frac{14}{25}$

The square root of

$$\sqrt{2 \frac{14}{25}} = \sqrt{(64/25)} = 8/5$$

(v) $2\frac{137}{196}$

The square root of

$$\sqrt{2\frac{137}{196}} = \sqrt{\frac{529}{196}} = \frac{23}{14}$$

(vi) $23\frac{26}{121}$

The square root of

$$\sqrt{23\frac{26}{121}} = \sqrt{\frac{2809}{121}} = \frac{53}{11}$$

(vii) $25\frac{544}{729}$

The square root of

$$\sqrt{25\frac{544}{729}} = \sqrt{\frac{18769}{729}} = \frac{137}{27}$$

(viii) $75\frac{46}{49}$

The square root of

$$\sqrt{75\frac{46}{49}} = \sqrt{\frac{3721}{49}} = \frac{61}{7}$$

(ix) $3\frac{942}{2209}$

The square root of

$$\sqrt{3\frac{942}{2209}} = \sqrt{\frac{7569}{2209}} = \frac{87}{47}$$

(x) $3\frac{334}{3025}$

The square root of

$$\sqrt{3\frac{334}{3025}} = \sqrt{\frac{9409}{3025}} = \frac{97}{55}$$

(xi) $21\frac{2797}{3364}$

The square root of

$$\sqrt{21\frac{2797}{3364}} = \sqrt{\frac{73441}{3364}} = \frac{271}{58}$$

(xii) $38\frac{11}{25}$

The square root of

$$\sqrt{38\frac{11}{25}} = \sqrt{\frac{961}{25}} = \frac{31}{5}$$

(xiii) $23\frac{394}{729}$

The square root of

$$\sqrt{(23\ 394/729)} = \sqrt{(17161/729)} = 131/27 = 4\ 23/27$$

(xiv) $21\ 51/169$

The square root of

$$\sqrt{(21\ 51/169)} = \sqrt{(3600/169)} = 60/13 = 4\ 8/13$$

(xv) $10\ 151/225$

The square root of

$$\sqrt{(10\ 151/225)} = \sqrt{(2401/225)} = 49/15 = 3\ 4/15$$

2. Find the value of:

(i) $\sqrt{80}/\sqrt{405}$

(ii) $\sqrt{441}/\sqrt{625}$

(iii) $\sqrt{1587}/\sqrt{1728}$

(iv) $\sqrt{72} \times \sqrt{338}$

(v) $\sqrt{45} \times \sqrt{20}$

Solution:

(i) $\sqrt{80}/\sqrt{405}$

$$\sqrt{80}/\sqrt{405} = \sqrt{16}/\sqrt{81} = 4/9$$

(ii) $\sqrt{441}/\sqrt{625}$

$$\sqrt{441}/\sqrt{625} = 21/25$$

(iii) $\sqrt{1587}/\sqrt{1728}$

$$\sqrt{1587}/\sqrt{1728} = \sqrt{529}/\sqrt{576} = 23/24$$

(iv) $\sqrt{72} \times \sqrt{338}$

$$\sqrt{72} \times \sqrt{338} = \sqrt{(2 \times 2 \times 2 \times 3 \times 3)} \times \sqrt{(2 \times 13 \times 13)}$$

By using the formula $\sqrt{a} \times \sqrt{b} = \sqrt{(a \times b)}$

$$= \sqrt{(2 \times 2 \times 2 \times 3 \times 3 \times 2 \times 13 \times 13)}$$

$$= 2^2 \times 3 \times 13$$

$$= 156$$

(v) $\sqrt{45} \times \sqrt{20}$

$$\sqrt{45} \times \sqrt{20} = \sqrt{(5 \times 3 \times 3)} \times \sqrt{(5 \times 2 \times 2)}$$

By using the formula $\sqrt{a} \times \sqrt{b} = \sqrt{(a \times b)}$

$$= \sqrt{(5 \times 3 \times 3 \times 5 \times 2 \times 2)}$$

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

$$= 30$$

3. The area of a square field is $80\frac{244}{729}$ square metres. Find the length of each side of the field.

Solution:

$$\begin{aligned}\text{We know that the given area} &= 80\frac{244}{729} \text{ m}^2 \\ &= \frac{58564}{729} \text{ m}^2\end{aligned}$$

If L is length of each side

$$L^2 = \frac{58564}{729}$$

$$\begin{aligned}L &= \sqrt{\frac{58564}{729}} = \frac{\sqrt{58564}}{\sqrt{729}} \\ &= \frac{242}{27} \\ &= 8\frac{26}{27}\end{aligned}$$

\therefore Length is $8\frac{26}{27}$

4. The area of a square field is $30\frac{1}{4}\text{m}^2$. Calculate the length of the side of the square.

Solution:

$$\begin{aligned}\text{We know that the given area} &= 30\frac{1}{4} \text{ m}^2 \\ &= \frac{121}{4} \text{ m}^2\end{aligned}$$

If L is length of each side then,

$$L^2 = \frac{121}{4}$$

$$\begin{aligned}L &= \sqrt{\frac{121}{4}} = \frac{\sqrt{121}}{\sqrt{4}} \\ &= \frac{11}{2}\end{aligned}$$

\therefore Length is $\frac{11}{2}$

5. Find the length of a side of a square playground whose area is equal to the area of a rectangular field of dimensions 72m and 338 m.

Solution:

By using the formula

$$\begin{aligned}\text{Area of rectangular field} &= l \times b \\ &= 72 \times 338 \text{ m}^2 \\ &= 24336 \text{ m}^2\end{aligned}$$

$$\text{Area of square, } L^2 = 24336 \text{ m}^2$$

$$\begin{aligned}L &= \sqrt{24336} \\ &= 156 \text{ m}\end{aligned}$$

\therefore Length of side of square playground is 156 m.

EXERCISE 3.7

PAGE NO: 3.52

Find the square root of the following numbers in decimal form:

1. 84.8241

Solution:

By using long division method

$$\begin{array}{r} 9.21 \\ 9 \overline{) 84.8241} \\ \underline{81} \\ 182 \\ \underline{182} \\ 1841 \\ \underline{1841} \\ 0 \end{array}$$

\therefore the square root of 84.8241

$$\sqrt{84.8241} = 9.21$$

2. 0.7225

Solution:

By using long division method

$$\begin{array}{r} 0.85 \\ 0 \overline{) 0.7225} \\ \underline{0} \\ 8 \\ \underline{72} \\ 165 \\ \underline{165} \\ 0 \end{array}$$

\therefore the square root of 0.7225

$$\sqrt{0.7225} = 0.85$$

3. 0.813604

Solution:

By using long division method

$$\begin{array}{r}
 0.902 \\
 0 \overline{) 0.813604} \\
 \underline{0} \\
 9 \\
 \underline{81} \\
 180 \\
 \underline{36} \\
 1802 \\
 \underline{3604} \\
 0
 \end{array}$$

∴ the square root of 0.813604
 $\sqrt{0.813604} = 0.902$

4. 0.00002025

Solution:

By using long division method

$$\begin{array}{r}
 0.0045 \\
 0 \overline{) 0.00002025} \\
 \underline{0 \ 0 \ 0} \\
 4 \\
 \underline{20} \\
 85 \\
 \underline{425} \\
 425 \\
 \underline{0}
 \end{array}$$

∴ the square root of 0.00002025
 $\sqrt{0.00002025} = 0.0045$

5. 150.0625

Solution:

By using long division method

$$\begin{array}{r}
 12.25 \\
 1 \overline{) 150.0625} \\
 \underline{1} \\
 22 \\
 \underline{050} \\
 242 \\
 \underline{606} \\
 2445 \\
 \underline{484} \\
 12225 \\
 \underline{12225} \\
 0
 \end{array}$$

∴ the square root of 150.0625
 $\sqrt{150.0625} = 12.25$

6. 225.6004
Solution:

By using long division method

$$\begin{array}{r}
 15.02 \\
 1 \overline{) 225.6004} \\
 \underline{1} \\
 125 \\
 \underline{125} \\
 060 \\
 \underline{0} \\
 6004 \\
 \underline{6004} \\
 0
 \end{array}$$

∴ the square root of 225.6004
 $\sqrt{225.6004} = 15.02$

7. 3600.720036
Solution:

By using long division method

$$\begin{array}{r}
 60.006 \\
 6 \overline{) 3600.720036} \\
 \underline{36} \\
 000 \\
 \underline{0} \\
 7200 \\
 \underline{0000} \\
 720036 \\
 \underline{720036} \\
 0
 \end{array}$$

∴ the square root of 3600.720036
 $\sqrt{3600.720036} = 60.006$

8. 236.144689
Solution:

By using long division method

$$\begin{array}{r}
 15.367 \\
 1 \overline{) 236.144689} \\
 \underline{1} \\
 25 \\
 \underline{136} \\
 125 \\
 \underline{1114} \\
 909 \\
 \underline{3066} \\
 20546 \\
 \underline{18396} \\
 30727 \\
 \underline{215089} \\
 215089 \\
 \underline{0} \\
 0
 \end{array}$$

\therefore the square root of 236.144689
 $\sqrt{236.144689} = 15.367$

9. 0.00059049

Solution:

By using long division method

$$\begin{array}{r}
 0.0243 \\
 0 \overline{) 0.00059049} \\
 \underline{0} \\
 0 \\
 \underline{0} \\
 2 \\
 \underline{05} \\
 4 \\
 \underline{44} \\
 190 \\
 \underline{176} \\
 483 \\
 \underline{1449} \\
 1449 \\
 \underline{0} \\
 0
 \end{array}$$

\therefore the square root of 0.00059049
 $\sqrt{0.00059049} = 0.0243$

10. 176.252176

Solution:

By using long division method

$$\begin{array}{r}
 13.276 \\
 1 \overline{) 176.252176} \\
 \underline{1} \\
 13 \underline{076} \\
 \underline{69} \\
 262 \underline{725} \\
 \underline{524} \\
 2647 \underline{20121} \\
 \underline{18529} \\
 26546 \underline{159276} \\
 \underline{159276} \\
 0
 \end{array}$$

\therefore the square root of 176.252176
 $\sqrt{176.252176} = 13.276$

11. 9998.0001

Solution:

By using long division method

$$\begin{array}{r}
 99.99 \\
 9 \overline{) 9998.0001} \\
 \underline{81} \\
 189 \underline{1898} \\
 \underline{1701} \\
 1989 \underline{19700} \\
 \underline{17901} \\
 19989 \underline{179901} \\
 \underline{179901} \\
 0
 \end{array}$$

\therefore the square root of 9998.0001
 $\sqrt{9998.0001} = 99.99$

12. 0.00038809

Solution:

By using long division method

$$\begin{array}{r}
 0.0197 \\
 \hline
 0 \quad 0.00038809 \\
 \quad 0 \\
 \hline
 0 \quad 000 \\
 \quad 0 \\
 \hline
 1 \quad 03 \\
 \quad 1 \\
 \hline
 29 \quad 288 \\
 \quad 261 \\
 \hline
 387 \quad 2709 \\
 \quad 2709 \\
 \hline
 \quad 0
 \end{array}$$

∴ the square root of 0.00038809
 $\sqrt{0.00038809} = 0.0197$

13. What is that fraction which when multiplied by itself gives 227.798649?

Solution:

Let us consider a number a

$$\begin{aligned}
 \text{Where, } a &= \sqrt{227.798649} \\
 &= 15.093
 \end{aligned}$$

By using long division method let us verify

$$\begin{array}{r}
 15.093 \\
 \hline
 1 \quad 227.798649 \\
 \quad 1 \\
 \hline
 25 \quad 127 \\
 \quad 125 \\
 \hline
 300 \quad 279 \\
 \quad 0 \\
 \hline
 3009 \quad 27986 \\
 \quad 27081 \\
 \hline
 30183 \quad 90549 \\
 \quad 90549 \\
 \hline
 \quad 0
 \end{array}$$

∴ 15.093 is the fraction which when multiplied by itself gives 227.798649.

14. The area of a square playground is 256.6404 square meter. Find the length of one side of the playground.

Solution:

We know that the given area of a square playground = 256.6404

$$\text{i.e., } L^2 = 256.6404 \text{ m}^2$$

$$L = \sqrt{256.6404}$$

$$= 16.02\text{m}$$

By using long division method let us verify

$$\begin{array}{r}
 16.02 \\
 1 \overline{) 256.6404} \\
 \underline{1} \\
 156 \\
 \underline{156} \\
 064 \\
 \underline{0} \\
 6404 \\
 \underline{6404} \\
 0
 \end{array}$$

\therefore length of one side of the playground is 16.02m.

15. What is the fraction which when multiplied by itself gives 0.00053361?

Solution:

Let us consider a number a

$$\text{Where, } a = \sqrt{0.00053361}$$

$$= 0.0231$$

By using long division method let us verify

$$\begin{array}{r}
 0.0231 \\
 0 \overline{) 0.00053361} \\
 \underline{0} \\
 000 \\
 \underline{0} \\
 005 \\
 \underline{4} \\
 133 \\
 \underline{129} \\
 461 \\
 \underline{461} \\
 0
 \end{array}$$

\therefore 0.0231 is the fraction which when multiplied by itself gives 0.00053361.

16. Simplify:

(i) $(\sqrt{59.29} - \sqrt{5.29}) / (\sqrt{59.29} + \sqrt{5.29})$

(ii) $(\sqrt{0.2304} + \sqrt{0.1764}) / (\sqrt{0.2304} - \sqrt{0.1764})$

Solution:

(i) $(\sqrt{59.29} - \sqrt{5.29}) / (\sqrt{59.29} + \sqrt{5.29})$

Firstly let us find the square root $\sqrt{59.29}$ and $\sqrt{5.29}$

$$\begin{aligned}\sqrt{59.29} &= \sqrt{5929} / \sqrt{100} \\ &= 77/10 \\ &= 7.7\end{aligned}$$

$$\begin{aligned}\sqrt{5.29} &= \sqrt{529} / \sqrt{100} \\ &= 23/10 \\ &= 2.3\end{aligned}$$

$$\begin{aligned}\text{So, } (7.7 - 2.3) / (7.7 + 2.3) & \\ &= 54/10 \\ &= 0.54\end{aligned}$$

(ii) $(\sqrt{0.2304} + \sqrt{0.1764}) / (\sqrt{0.2304} - \sqrt{0.1764})$

Firstly let us find the square root $\sqrt{0.2304}$ and $\sqrt{0.1764}$

$$\begin{aligned}\sqrt{0.2304} &= \sqrt{2304} / \sqrt{10000} \\ &= 48/100 \\ &= 0.48\end{aligned}$$

$$\begin{aligned}\sqrt{0.1764} &= \sqrt{1764} / \sqrt{10000} \\ &= 42/100 \\ &= 0.42\end{aligned}$$

$$\begin{aligned}\text{So, } (0.48 + 0.42) / (0.48 - 0.42) & \\ &= 0.9/0.06 \\ &= 15\end{aligned}$$

17. Evaluate $\sqrt{50625}$ and hence find the value of $\sqrt{506.25} + \sqrt{5.0625}$

Solution:

By using long division method let us find the $\sqrt{50625}$

	225
2	50625
	4
42	106
	84
445	2225
	2225
	0

$$\begin{aligned}\text{So now, } \sqrt{506.25} &= \sqrt{50625} / \sqrt{100} \\ &= 225/10 \\ &= 22.5\end{aligned}$$

$$\begin{aligned}\sqrt{5.0625} &= \sqrt{50625} / \sqrt{10000} \\ &= 225/100 \\ &= 2.25\end{aligned}$$

So equating in the above equation we get,

$$\begin{aligned}\sqrt{506.25} + \sqrt{5.0625} &= 22.5 + 2.25 \\ &= 24.75\end{aligned}$$

18. Find the value of $\sqrt{103.0225}$ and hence find the value of

(i) $\sqrt{10302.25}$

(ii) $\sqrt{1.030225}$

Solution:

By using long division method let us find the

$$\sqrt{103.0225} = \sqrt{(1030225/10000)} = \sqrt{1030225}/\sqrt{10000}$$

	1015	
1	1 03 02 25	
	1	
201	0302	
	201	
2025	10125	
	10125	
	0	

So now, (i) $\sqrt{10302.25} = \sqrt{(1030225/ 100)}$
 $= 1015/ 10$
 $= 101.5$

(ii) $\sqrt{1.030225} = \sqrt{1030225/ \sqrt{1000000}}$
 $= 1015/1000$
 $= 1.015$

EXERCISE 3.8

PAGE NO: 3.56

1. Find the square root of each of the following correct to three places of decimal.

- (i) 5 (ii) 7
- (iii) 17 (iv) 20
- (v) 66 (vi) 427
- (vii) 1.7 (viii) 23.1
- (ix) 2.5 (x) 237.615
- (xi) 15.3215 (xii) 0.9
- (xiii) 0.1 (xiv) 0.016
- (xv) 0.00064 (xvi) 0.019
- (xvii) $7/8$ (xviii) $5/12$
- (xix) $2\frac{1}{2}$ (xx) $287\frac{5}{8}$

Solution:

(i) 5

By using long division method

	2.2360	
2		5.000000
		4
42		100
		84
443		1600
		1329
4466		27100
		26796
44720		30400

∴ the square root of 5 is 2.236

(ii) 7

By using long division method

$$\begin{array}{r}
 2.6457 \\
 2 \overline{) 7.000000} \\
 \underline{4} \\
 46 \\
 \underline{300} \\
 276 \\
 524 \\
 \underline{2400} \\
 2096 \\
 5285 \\
 \underline{30400} \\
 26425 \\
 52927 \\
 \underline{397500} \\
 370489 \\
 \underline{27011}
 \end{array}$$

\therefore the square root of 7 is 2.646

(iii) 17

By using long division method

$$\begin{array}{r}
 4.123 \\
 4 \overline{) 17.000000} \\
 \underline{16} \\
 81 \\
 \underline{1.00} \\
 81 \\
 822 \\
 \underline{1900} \\
 1644 \\
 8243 \\
 \underline{25600} \\
 24729 \\
 82431 \\
 \underline{87100} \\
 82431 \\
 \underline{4669}
 \end{array}$$

\therefore the square root of 17 is 4.123

(iv) 20

By using long division method

$$\begin{array}{r}
 4.4721 \\
 4 \overline{) 20.000000} \\
 \underline{16} \\
 84 \\
 \underline{400} \\
 336 \\
 887 \\
 \underline{6400} \\
 6209 \\
 8942 \\
 \underline{19100} \\
 17884 \\
 89441 \\
 \underline{121600} \\
 89441 \\
 \underline{32159}
 \end{array}$$

\therefore the square root of 20 is 4.472

(v) 66

By using long division method

$$\begin{array}{r}
 8.1240 \\
 8 \overline{) 66.000000} \\
 \underline{64} \\
 161 \\
 \underline{161} \\
 1622 \\
 \underline{3900} \\
 16244 \\
 \underline{65600} \\
 162480 \\
 \underline{64976} \\
 162480 \\
 \underline{62400}
 \end{array}$$

\therefore the square root of 66 is 8.124

(vi) 427

By using long division method

$$\begin{array}{r}
 20.6639 \\
 2 \overline{) 427.000000} \\
 \underline{4} \\
 40 \\
 \underline{027} \\
 406 \\
 \underline{0} \\
 406 \\
 \underline{2700} \\
 4126 \\
 \underline{2436} \\
 4126 \\
 \underline{26400} \\
 41323 \\
 \underline{24756} \\
 41323 \\
 \underline{164400} \\
 413269 \\
 \underline{123969} \\
 413269 \\
 \underline{4043100} \\
 413269 \\
 \underline{3719421} \\
 413269 \\
 \underline{323679}
 \end{array}$$

\therefore the square root of 427 is 20.664

(vii) 1.7

By using long division method

$$\begin{array}{r}
 1.3038 \\
 1 \overline{) 1.700000} \\
 \underline{1} \\
 23 \\
 \underline{0.70} \\
 69 \\
 \underline{100} \\
 260 \\
 \underline{0} \\
 2603 \\
 \underline{10000} \\
 7809 \\
 \underline{219100} \\
 26068 \\
 \underline{208544} \\
 10556
 \end{array}$$

∴ the square root of 1.7 is 1.304

(viii) 23.1

By using long division method

$$\begin{array}{r}
 4.8062 \\
 4 \overline{) 23100000} \\
 \underline{16} \\
 88 \\
 \underline{710} \\
 960 \\
 \underline{600} \\
 9606 \\
 \underline{57636} \\
 96122 \\
 \underline{236400} \\
 192244 \\
 \underline{44156}
 \end{array}$$

∴ the square root of 23.1 is 4.806

(ix) 2.5

By using long division method

$$\begin{array}{r}
 1.5811 \\
 1 \overline{) 2.500000} \\
 \underline{1} \\
 25 \\
 \underline{150} \\
 308 \\
 \underline{2500} \\
 3161 \\
 \underline{2464} \\
 3161 \\
 \underline{3600} \\
 3161 \\
 \underline{3161} \\
 31621 \\
 \underline{43900} \\
 31621 \\
 \underline{2279}
 \end{array}$$

∴ the square root of 2.5 is 1.581

(x) 237.615

By using long division method

	15.4147
1	237.615000
	1
25	137
	125
304	1261
	1216
3081	4550
	3081
30824	146900
	123296
308287	2360400
	2158009
	202391

∴ the square root of 237.615 is 15.415

(xi) 15.3215

By using long division method

	3.9142
3	15321500
	9
69	632
	621
781	1115
	781
7824	33400
	31296
78282	210400
	156564
	53836

∴ the square root of 15.3215 is 3.914

(xii) 0.9

By using long division method

$$\begin{array}{r}
 0.9486 \\
 0 \overline{) 0.900000} \\
 \underline{0} \\
 9 \\
 \underline{090} \\
 184 \\
 \underline{900} \\
 1888 \\
 \underline{16400} \\
 18966 \\
 \underline{15104} \\
 18966 \\
 \underline{129600} \\
 18966 \\
 \underline{113796} \\
 18966 \\
 \underline{15804}
 \end{array}$$

\therefore the square root of 0.9 is 0.949

(xiii) 0.1

By using long division method

$$\begin{array}{r}
 0.3162 \\
 0 \overline{) 0.100000} \\
 \underline{0} \\
 3 \\
 \underline{10} \\
 61 \\
 \underline{9} \\
 61 \\
 \underline{100} \\
 626 \\
 \underline{3900} \\
 6322 \\
 \underline{3756} \\
 6322 \\
 \underline{14400} \\
 6322 \\
 \underline{12644} \\
 6322 \\
 \underline{1756}
 \end{array}$$

\therefore the square root of 0.1 is 0.316

(xiv) 0.016

By using long division method

$$\begin{array}{r}
 0.1264 \\
 0 \overline{) 0.016000} \\
 \underline{0} \\
 1 \\
 \underline{001} \\
 22 \\
 \underline{1} \\
 22 \\
 \underline{060} \\
 246 \\
 \underline{44} \\
 246 \\
 \underline{1600} \\
 2524 \\
 \underline{1476} \\
 2524 \\
 \underline{12400} \\
 2524 \\
 \underline{10096} \\
 2524 \\
 \underline{2304}
 \end{array}$$

\therefore the square root of 0.016 is 0.126

(xv) 0.00064

By using long division method

$$\begin{array}{r}
 0.0252 \\
 0 \overline{) 0.000640} \\
 \underline{0} \\
 0 \ 0.00 \\
 \underline{0} \\
 2 \ 006 \\
 \underline{4} \\
 45 \ 240 \\
 \underline{225} \\
 502 \ 1500 \\
 \underline{1004} \\
 496
 \end{array}$$

\therefore the square root of 0.00064 is 0.025

(xvi) 0.019

By using long division method

$$\begin{array}{r}
 0.1378 \\
 0 \overline{) 0.019000} \\
 \underline{0} \\
 1 \ 01 \\
 \underline{1} \\
 23 \ 090 \\
 \underline{69} \\
 267 \ 2100 \\
 \underline{1869} \\
 2748 \ 23100 \\
 \underline{21984} \\
 1116
 \end{array}$$

\therefore the square root of 0.019 is 0.138

(xvii) $7/8$

By using long division method

	0.9354
0	0.875000
	0
9	087
	81
183	650
	549
1865	10100
	9325
18704	77500
	74816
	2684

∴ the square root of $7/8$ is 0.935

(xviii) $5/12$

By using long division method

	0.6454
0	0.416666
	0
6	41
	36
124	566
	496
1285	7066
	6245
12904	64100
	51616
	12484

∴ the square root of $5/12$ is 0.645

(xix) $2\frac{1}{2}$

By using long division method

$$\begin{array}{r}
 1.5811 \\
 1 \overline{) 2.500000} \\
 \underline{1} \\
 150 \\
 \underline{125} \\
 308 \\
 \underline{2500} \\
 3161 \\
 \underline{3161} \\
 31621 \\
 \underline{43900} \\
 31621 \\
 \underline{31621} \\
 12279
 \end{array}$$

∴ the square root of $5/2$ is 1.581

(xx) $287 \frac{5}{8}$

By using long division method

$$\begin{array}{r}
 16.9593 \\
 1 \overline{) 287.62} \\
 \underline{1} \\
 26 \\
 \underline{187} \\
 329 \\
 \underline{3162} \\
 3385 \\
 \underline{20100} \\
 33909 \\
 \underline{16925} \\
 33909 \\
 \underline{317500} \\
 305181 \\
 339183 \\
 \underline{1231900} \\
 1017549 \\
 \underline{1017549} \\
 214351
 \end{array}$$

∴ the square root of $2301/8$ is 16.960

2. Find the square root of 12.0068 correct to four decimal places.

Solution:

By using long division method

	3.46508
3	12.0068
	9
64	300
	256
686	4468
	4116
6925	35200
	34625
693008	5750000
	5544064
	205936

\therefore the square root of 12.0068 is 3.4651

3. Find the square root of 11 correct to five decimal places.

Solution:

By using long division method

	3.316624
3	11.000000
	9
63	200
	189
661	1100
	661
6626	43900
	39756
66326	414400
	398196
663322	1620400
	1327444
6633244	29295600
	26532976
	2762624

\therefore the square root of 11 is 3.31662

4. Give that: $\sqrt{2} = 1.414$, $\sqrt{3} = 1.732$, $\sqrt{5} = 2.236$ and $\sqrt{7} = 2.646$, evaluate each of the following:

(i) $\sqrt{(144/7)}$

(ii) $\sqrt{(2500/3)}$

Solution:

(i) $\sqrt{(144/7)}$

Now let us simplify the given equation

$$\begin{aligned}\sqrt{(144/7)} &= \sqrt{(12 \times 12) / \sqrt{7}} \\ &= 12 / 2.646 \\ &= 4.535\end{aligned}$$

(ii) $\sqrt{(2500/3)}$

Now let us simplify the given equation

$$\begin{aligned}\sqrt{(2500/3)} &= \sqrt{(5 \times 5 \times 10 \times 10) / \sqrt{3}} \\ &= 5 \times 10 / 1.732 \\ &= 50 / 1.732 \\ &= 28.867\end{aligned}$$

5. Given that $\sqrt{2} = 1.414$, $\sqrt{3} = 1.732$, $\sqrt{5} = 2.236$ and $\sqrt{7} = 2.646$ find the square roots of the following:

(i) $196/75$

(ii) $400/63$

(iii) $150/7$

(iv) $256/5$

(v) $27/50$

Solution:

(i) $196/75$

Let us find the square root for $196/75$

$$\begin{aligned}\sqrt{(196/75)} &= \sqrt{(196) / \sqrt{(75)}} \\ &= \sqrt{(14 \times 14) / \sqrt{(5 \times 5 \times 3)}} \\ &= 14 / (5\sqrt{3}) \\ &= 14 / (5 \times 1.732) \\ &= 14 / 8.66 \\ &= 1.617\end{aligned}$$

(ii) $400/63$

Let us find the square root for $400/63$

$$\begin{aligned}\sqrt{(400/63)} &= \sqrt{(400) / \sqrt{(63)}} \\ &= \sqrt{(20 \times 20) / \sqrt{(3 \times 3 \times 7)}} \\ &= 20 / (3\sqrt{7}) \\ &= 20 / (3 \times 2.646) \\ &= 20 / 7.938 \\ &= 2.520\end{aligned}$$

(iii) $150/7$

Let us find the square root for $150/7$

$$\begin{aligned}\sqrt{(150/7)} &= \sqrt{(150)}/\sqrt{(7)} \\ &= \sqrt{(3 \times 5 \times 5 \times 2)}/\sqrt{(7)} \\ &= (5\sqrt{3} \times \sqrt{2})/(\sqrt{7}) \\ &= 5 \times 1.732 \times 1.414 / (2.646) \\ &= 12.245 / 2.646 \\ &= 4.628\end{aligned}$$

(iv) 256/5

Let us find the square root for 256/5

$$\begin{aligned}\sqrt{(256/5)} &= \sqrt{(256)}/\sqrt{(5)} \\ &= \sqrt{(16 \times 16)}/\sqrt{(5)} \\ &= 16/(\sqrt{5}) \\ &= 16/2.236 \\ &= 7.155\end{aligned}$$

(v) 27/50

Let us find the square root for 27/50

$$\begin{aligned}\sqrt{(27/50)} &= \sqrt{(27)}/\sqrt{(50)} \\ &= \sqrt{(3 \times 3 \times 3)}/\sqrt{(5 \times 5 \times 2)} \\ &= (3\sqrt{3})/(5\sqrt{2}) \\ &= (3 \times 1.732)/(5 \times 1.414) \\ &= 5.196/7.07 \\ &= 0.735\end{aligned}$$

EXERCISE 3.9

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Square Root Table									
Number	Square Root($\sqrt{\quad}$)	Number	Square Root($\sqrt{\quad}$)	Number	Square Root($\sqrt{\quad}$)	Number	Square Root($\sqrt{\quad}$)	Number	Square Root($\sqrt{\quad}$)
1	1	21	4.583	41	6.403	61	7.81	81	9
2	1.414	22	4.69	42	6.481	62	7.874	82	9.055
3	1.732	23	4.796	43	6.557	63	7.937	83	9.11
4	2	24	4.899	44	6.633	64	8	84	9.165
5	2.236	25	5	45	6.708	65	8.062	85	9.22
6	2.449	26	5.099	46	6.782	66	8.124	86	9.274
7	2.646	27	5.196	47	6.856	67	8.185	87	9.327
8	2.828	28	5.292	48	6.928	68	8.246	88	9.381
9	3	29	5.385	49	7	69	8.307	89	9.434
10	3.162	30	5.477	50	7.071	70	8.367	90	9.487
11	3.317	31	5.568	51	7.141	71	8.426	91	9.539
12	3.464	32	5.657	52	7.211	72	8.485	92	9.592
13	3.606	33	5.745	53	7.28	73	8.544	93	9.644
14	3.742	34	5.831	54	7.348	74	8.602	94	9.695
15	3.873	35	5.916	55	7.416	75	8.66	95	9.747
16	4	36	6	56	7.483	76	8.718	96	9.798
17	4.123	37	6.083	57	7.55	77	8.775	97	9.849
18	4.243	38	6.164	58	7.616	78	8.832	98	9.899
19	4.359	39	6.245	59	7.681	79	8.888	99	9.95
20	4.472	40	6.325	60	7.746	80	8.944	100	10

Using square root table, find the square roots of the following:

1. 7

Solution:

From square root table we know,

Square root of 7 is:

$$\sqrt{7} = 2.645$$

∴ The square root of 7 is 2.645

2. 15

Solution:

We know that,

$$15 = 3 \times 5$$

$$\text{So, } \sqrt{15} = \sqrt{3} \times \sqrt{5}$$

From square root table we know,

Square root of 3 and 5 are:

$$\sqrt{3} = 1.732 \text{ and } \sqrt{5} = 2.236$$

$$\Rightarrow \sqrt{15} = 1.732 \times 2.236 = 3.873$$

∴ The square root of 15 is 3.873

3. 74

Solution:

We know that,

$$74 = 2 \times 37$$

$$\text{So, } \sqrt{74} = \sqrt{2} \times \sqrt{37}$$

From square root table we know,

Square root of 2 and 37 are:

$$\sqrt{2} = 1.414 \text{ and } \sqrt{37} = 6.083$$

$$\Rightarrow \sqrt{74} = 1.414 \times 6.083 = 8.602$$

∴ The square root of 74 is 8.602

4. 82

Solution:

We know that,

$$82 = 2 \times 41$$

$$\text{So, } \sqrt{82} = \sqrt{2} \times \sqrt{41}$$

From square root table we know,

Square root of 2 and 41 are:

$$\sqrt{2} = 1.414 \text{ and } \sqrt{41} = 6.403$$

$$\Rightarrow \sqrt{82} = 1.414 \times 6.403 = 9.055$$

∴ The square root of 82 is 9.055

5. 198

Solution:

We know that,

$$198 = 2 \times 9 \times 11$$

$$\text{So, } \sqrt{198} = \sqrt{2} \times \sqrt{9} \times \sqrt{11}$$

From square root table we know,

Square root of 2, 9 and 11 are:

$$\sqrt{2} = 1.414, \sqrt{9} = 3 \text{ and } \sqrt{11} = 3.317$$

$$\Rightarrow \sqrt{198} = 1.414 \times 3 \times 3.317 = 14.071$$

\therefore The square root of 198 is 14.071

6. 540

Solution:

We know that,

$$540 = 6 \times 9 \times 10$$

$$\text{So, } \sqrt{540} = \sqrt{6} \times \sqrt{9} \times \sqrt{10}$$

From square root table we know,

Square root of 6, 9 and 10 are:

$$\sqrt{6} = 2.449, \sqrt{9} = 3 \text{ and } \sqrt{10} = 3.162$$

$$\Rightarrow \sqrt{540} = 2.449 \times 3 \times 3.162 = 23.24$$

\therefore The square root of 540 is 23.24

7. 8700

Solution:

We know that,

$$8700 = 87 \times 100$$

$$\text{So, } \sqrt{8700} = \sqrt{87} \times \sqrt{100}$$

From square root table we know,

Square root of 87 and 100 are:

$$\sqrt{8700} = 9.327 \text{ and } \sqrt{100} = 10$$

$$\Rightarrow \sqrt{8700} = 9.327 \times 10 = 93.27$$

\therefore The square root of 8700 is 93.27

8. 3509

Solution:

We know that,

$$3509 = 121 \times 29$$

$$\text{So, } \sqrt{3509} = \sqrt{121} \times \sqrt{29}$$

From square root table we know,

Square root of 121 and 29 are:

$$\sqrt{121} = 11 \text{ and } \sqrt{29} = 5.385$$

$$\Rightarrow \sqrt{3509} = 11 \times 5.385 = 59.235$$

\therefore The square root of 3509 is 59.235

9. 6929

Solution:

We know that,

$$6929 = 169 \times 41$$

$$\text{So, } \sqrt{6929} = \sqrt{169} \times \sqrt{41}$$

From square root table we know,

Square root of 169 and 41 are:

$$\sqrt{169} = 13 \text{ and } \sqrt{41} = 6.403$$

$$\Rightarrow \sqrt{6929} = 13 \times 6.403 = 83.239$$

\therefore The square root of 6929 is 83.239

10. 25725

Solution:

We know that,

$$25725 = 3 \times 7 \times 25 \times 49$$

$$\text{So, } \sqrt{25725} = \sqrt{3} \times \sqrt{7} \times \sqrt{25} \times \sqrt{49}$$

From square root table we know,

Square root of 3, 7, 25 and 49 are:

$$\sqrt{3} = 1.732, \sqrt{7} = 2.646, \sqrt{25} = 5 \text{ and } \sqrt{49} = 7$$

$$\Rightarrow \sqrt{25725} = 1.732 \times 2.646 \times 5 \times 7 = 160.41$$

\therefore The square root of 25725 is 160.41

11. 1312.

Solution:

We know that,

$$1312 = 2 \times 16 \times 41$$

$$\text{So, } \sqrt{1312} = \sqrt{2} \times \sqrt{16} \times \sqrt{41}$$

From square root table we know,

Square root of 2, 16 and 41 are:

$$\sqrt{2} = 1.414, \sqrt{16} = 4 \text{ and } \sqrt{41} = 6.403$$

$$\Rightarrow \sqrt{1312} = 1.414 \times 4 \times 6.403 = 36.22$$

\therefore The square root of 1312 is 36.22

12. 4192

Solution:

We know that,

$$4192 = 2 \times 16 \times 131$$

$$\text{So, } \sqrt{4192} = \sqrt{2} \times \sqrt{16} \times \sqrt{131}$$

From square root table we know,

Square root of 2 and 16 are:

$$\sqrt{2} = 1.414 \text{ and } \sqrt{16} = 4$$

The square root of 131 is not listed in the table

Thus, let's apply long division to find it

	1	1	.4	4	5
1	1	31	.00	00	00
	1	⋮	⋮	⋮	⋮
21	31	⋮	⋮	⋮	⋮
	21	⋮	⋮	⋮	⋮
224	10	00	⋮	⋮	⋮
	8	96	⋮	⋮	⋮
2284	1	04	00	⋮	⋮
		91	36	⋮	⋮
22885		12	64	00	⋮
		11	44	25	⋮
22890		1	19	75	⋮

So, square root of 131 is 11.445

Now,

$$\Rightarrow \sqrt{4192} = 1.414 \times 4 \times 11.445 = 64.75$$

∴ The square root of 4192 is 64.75

13. 4955

Solution:

We know that,

$$4955 = 5 \times 991$$

$$\text{So, } \sqrt{4955} = \sqrt{5} \times \sqrt{991}$$

From square root table we know,

Square root of 5 is:

$$\sqrt{5} = 2.236$$

The square root of 991 is not listed in the table

Thus, let's apply long division to find it

	3	1	.4	8	0
3	$\overline{9}$	$\overline{91}$	$\overline{.00}$	$\overline{00}$	$\overline{00}$
	9	·	·	·	·
61	91				
	61				
624	30	00			
	24	96			
6288	5	04	00		
	5	03	04		
62960			96	00	
				0	
62960			96	00	

So, square root of 991 is 31.480

Now,

$$\Rightarrow \sqrt{4955} = 2.236 \times 31.480 = 70.39$$

\therefore The square root of 4955 is 70.39

14. 99/144

Solution:

We know that,

$$99/144 = (9 \times 11) / (12 \times 12)$$

$$\begin{aligned} \text{So, } \sqrt{99/144} &= \sqrt{[(9 \times 11) \times (12 \times 12)]} \\ &= 3/12 \times \sqrt{11} \end{aligned}$$

From square root table we know,

Square root of 11 is:

$$\sqrt{11} = 3.317$$

$$\Rightarrow \sqrt{99/144} = 3/12 \times 3.317 = 3.317/4 = 0.829$$

\therefore The square root of 99/144 is 0.829

15. 57/169

Solution:

We know that,

$$57/169 = (3 \times 19) / (13 \times 13)$$

$$\begin{aligned} \text{So, } \sqrt{57/169} &= \sqrt{[(3 \times 19) \times (13 \times 13)]} \\ &= \sqrt{3} \times \sqrt{19} \times 1/13 \end{aligned}$$

From square root table we know,

Square root of 3 and 19 is:

$$\sqrt{3} = 1.732 \text{ and } \sqrt{19} = 4.359$$

$$\Rightarrow \sqrt{(57/169)} = 1.732 \times 4.359 \times 1/13 = 0.581$$

\therefore The square root of $57/169$ is 0.581

16. 101/169

Solution:

We know that,

$$101/169 = 101 / (13 \times 13)$$

$$\text{So, } \sqrt{(101/169)} = \sqrt{[101 / (13 \times 13)]}$$
$$= \sqrt{101/13}$$

From square root table we don't have the square root of 101

Thus, we have to manipulate the number such that we get the square root of a number less than 100

$$\sqrt{101} = \sqrt{(1.01 \times 100)}$$
$$= \sqrt{1.01 \times 10}$$

Now, we have to find the square of 1.01

We know that,

$$\sqrt{1} = 1 \text{ and } \sqrt{2} = 1.414 \text{ (From the square root table)}$$

$$\text{Their difference} = 1.414 - 1 = 0.414$$

Hence, for a difference of 1 (2 - 1), the difference in the value of the square root is 0.414

So,

For the difference of 0.01, the difference in the value of the square roots will be
 $0.01 \times 1.414 = 0.00414$

$$\therefore \sqrt{1.01} = 1 + 0.00414 = 1.00414$$

$$\text{Then, } \sqrt{101} = 1.00414 \times 10 = 10.0414$$

$$\Rightarrow \sqrt{(101/169)} = \sqrt{101/13} = 10.0414/13$$

\therefore The square root of $101/169$ is 0.773

17. 13.21

Solution:

We need to find $\sqrt{13.21}$

From square root table we know,

Square root of 13 and 14 are:

$$\sqrt{13} = 3.606 \text{ and } \sqrt{14} = 3.742$$

$$\text{Their difference} = 3.742 - 3.606 = 0.136$$

Hence, for a difference of 1 (14 - 13), the difference in the value of the square root is 0.136

So,

For the difference of 0.21, the difference in the value of the square roots will be
 $0.136 \times 0.21 = 0.0286$

$$\Rightarrow \sqrt{13.21} = 3.606 + 0.0286 = 3.635$$

\therefore The square root of 13.21 is 3.635

18. 21.97

Solution:

We need to find $\sqrt{21.97}$

From square root table we know,

Square root of 21 and 22 are:

$$\sqrt{21} = 4.583 \text{ and } \sqrt{22} = 4.690$$

$$\text{Their difference} = 4.690 - 4.583 = 0.107$$

Hence, for a difference of 1 (23 - 22), the difference in the value of the square root is 0.107
So,

For the difference of 0.97, the difference in the value of the square roots will be

$$0.107 \times 0.97 = 0.104$$

$$\Rightarrow \sqrt{21.97} = 4.583 + 0.104 = 4.687$$

\therefore The square root of 21.97 is 4.687

19. 110**Solution:**

We know that,

$$110 = 11 \times 10$$

$$\text{So, } \sqrt{110} = \sqrt{11} \times \sqrt{10}$$

From square root table we know,

Square root of 11 and 10 are:

$$\sqrt{11} = 3.317 \text{ and } \sqrt{10} = 3.162$$

$$\Rightarrow \sqrt{110} = 3.317 \times 3.162 = 10.488$$

\therefore The square root of 110 is 10.488

20. 1110**Solution:**

We know that,

$$1110 = 37 \times 30$$

$$\text{So, } \sqrt{1110} = \sqrt{37} \times \sqrt{30}$$

From square root table we know,

Square root of 37 and 30 are:

$$\sqrt{37} = 6.083 \text{ and } \sqrt{30} = 5.477$$

$$\Rightarrow \sqrt{1110} = 6.083 \times 5.477 = 33.317$$

\therefore The square root of 1110 is 33.317

21. 11.11**Solution:**

We need to find $\sqrt{11.11}$

From square root table we know,

Square root of 11 and 12 are:

$$\sqrt{11} = 3.317 \text{ and } \sqrt{12} = 3.464$$

Their difference = $3.464 - 3.317 = 0.147$

Hence, for a difference of 1 (12 - 11), the difference in the value of the square root is 0.147

So,

For the difference of 0.11, the difference in the value of the square roots will be

$$0.11 \times 0.147 = 0.01617$$

$$\Rightarrow \sqrt{11.11} = 3.317 + 0.0162 = 3.333$$

\therefore The square root of 11.11 is 3.333

22. The area of a square field is 325m^2 . Find the approximate length of one side of the field.

Solution:

We know that the given area of the field = 325 m^2

To find the approximate length of the side of the field we will have to calculate the square root of 325

$$\sqrt{325} = \sqrt{25 \times 13}$$

From the square root table, we know

$$\sqrt{25} = 5 \text{ and } \sqrt{13} = 3.606$$

$$\Rightarrow \sqrt{325} = 5 \times 3.606 = 18.030$$

\therefore The approximate length of one side of the field is 18.030 m

23. Find the length of a side of a square, whose area is equal to the area of a rectangle with sides 240 m and 70 m.

Solution:

We know that from the question,

Area of square = Area of rectangle

$$\text{Side}^2 = 240 \times 70$$

$$\text{Side} = \sqrt{(240 \times 70)}$$

$$= \sqrt{(10 \times 10 \times 2 \times 2 \times 2 \times 3 \times 7)}$$

$$= 20\sqrt{42}$$

Now, from the square root table, we know $\sqrt{42} = 6.481$

$$= 20 \times 6.48$$

$$= 129.60 \text{ m}$$

\therefore The length of side of the square is 129.60 m