MATHEMATICS

Chapter 6: Squares and Square Roots

Squares and Square Roots

Square number

- Square of a number is obtained when it is multiplied by itself twice. Thus, square of x = (x × x), denoted by x^2.
- Some of the square numbers are 1, 4, 9, 16, 25, …
- A natural number n is a perfect square if n can be expressed as m^2, for some natural number m. The numbers 1, 4, 9, 16, 25, … are perfect squares.

Steps to find whether a given natural number is a perfect square or not:

i. Step 1: Get the natural number.
ii. Step 2: Find the prime factorization of the given natural number.
iii. Step 3: Group the factors in pairs in such a way that both the factors in each pair are equal.
iv. Step 4: Check if any factor is left over. If no factor is left over in grouping, then the given number is a perfect square. Otherwise, it is not a perfect square.
v. Step 5: To find the square root of a given number, take one factor from each group and multiply them.

Perfect Square Formula

When a polynomial is multiplied by itself, then it is a perfect square. Example – polynomial $ax^2 + bx + c$ is a perfect square if $b^2 = 4ac$.

Perfect Square Formula is given as,

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

Properties of square numbers:

i. A number ending in 2, 3, 7 or 8 is never a perfect square.
ii. A number ending with an odd number of zeroes is never a perfect square.
iii. The number of zeroes at the end of a perfect square is always even.
iv. Squares of even numbers are even.
v. Squares of odd numbers are odd.
vi. If a number has 1 or 9 in the unit's place, then its square ends in 1.
vii. If a square number ends in 6, the number whose square it is, will have either 4 or 6 in the unit's place.

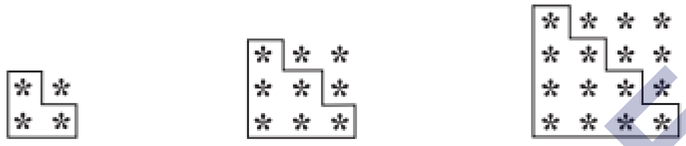
Triangular numbers

- The numbers whose dot patterns can be arranged as triangles are called the

1 3 6 10 15

triangular numbers.

- Adding any two consecutive triangular numbers give a square number, for example:



$1 + 3 = 4 = 2^2$ $3 + 6 = 9 = 3^2$ $6 + 10 = 16 = 4^2$

Adding Triangular Numbers

Triangular numbers: It is a sequence of the numbers 1, 3, 6, 10, 15 etc. It is obtained by continued summation of the natural numbers. The dot pattern of a triangular number can be arranged as triangles.

If we add two consecutive triangular numbers, we get a square number.

Example: $1 + 3 = 4 = 2^2$ and $3 + 6 = 9 = 3^2$.

Numbers between square numbers

There are 2n non perfect square numbers between the squares of the numbers n and (n + 1).

For n = 4, n + 1 = 5

$n^2 = 4^2 = 16$, $(n + 1)^2 = 5^2 = 25$

$n^2 – (n + 1)^2 = 25 – 16 = 9$

There are 8 (2n) non perfect square numbers between 4^2 and 5^2.

Adding consecutive odd numbers

The square of a natural number ‘n’ is equal to the sum of the first ‘n’ odd natural numbers.

1 [one odd number] $= 1 = 1^2$

1 + 3 [sum of first two odd numbers] $= 4 = 2^2$

1 + 3 + 5 [sum of first three odd numbers] $= 9 = 3^2$

1 + 3 + 7 + 9 […] $= 16 = 4^2$

And so on…

There are no natural numbers m and n such that $m^2 = 2n^2$

Square of an odd number

The square of any odd number can be expressed as the sum of two consecutive positive integers.

$3^2 = 9 = 4 + 5$

$5^2 = 25 = 12 + 13$

$7^2 = 49 = 24 + 25$

$9^2 = 81 = 40 + 41$ and so on….

Moreover, if n is the square of an odd number m then the two consecutive numbers whose sum is n are $\frac{n-1}{2}$ and $\frac{n+1}{2}$

The first odd number is 3 and its square is 9 which can be written as 4 + 5

Square of an odd number as a sum

Square of an odd number n can be expressed as sum of two consecutive positive integers

$$\frac{(n^2-1)}{2}$$

and

$$\frac{(n^2+1)}{2}$$

For example: $3^2 = 9 = 4 + 5 =$

$$\frac{(3^2-1)}{2}$$

+

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

Similarly, $5^2 = 25 = 12 + 13 =$

$$\frac{(5^2-1)}{2}$$

+

$$\frac{(5^2 + 1)}{2}$$

Some useful square identities:

If a and b are two natural numbers, then,

i. $(a + 1)(a - 1) = a^2 - 1$

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

iii. $(a - b)^2 = a^2 + b^2 - 2ab$

Note: Square of big numbers can be calculated using these three identities.

Calculating the square of a number with unit digit 5

Consider a number with unit digit 5, say, (a5).

$(a5)^2 = (10a + 5)^2$

$= 10a(10a + 5) + 5(10a + 5)$

$= 100a^2 + 50a + 50a + 25$

$= 100a(a + 1) + 25$

$= a(a + 1)$ hundred $+ 25$

Hence, $(a5)^2 = a(a + 1)$ hundred $+ 25$.

For example: $35^2 = 3(3 + 1)\ 100 + 25 = 3(4)100 + 25 = 1225$.

Pythagorean triplet

- A triplet (a, b, c) of three natural numbers a, b and c is called a Pythagorean triplet if $a^2 + b^2 = c^2$.
- For any natural number m greater than 1, $(2m, m^2 - 1, m^2 + 1)$ is a Pythagorean triplet.

What is square root?

- Square root is the inverse operation of square.
- Square of 2 is 4, and so, the square root of 4 is 2.
- Finding the number with the known square is known as finding the square root.

Number of digits in the square root

If a perfect square is of n-digits, then its square root will have $\frac{n}{2}$ digits if n is even or $\frac{n+1}{2}$ digits if n is odd.

Square root of a number

The square root of a number 'x' is that number which when multiplied by itself gives 'x' as the product.

We denote the square root of x by $\sqrt{x}$.

Finding square roots through different methods

Repeated subtraction

We stated above that the square of a number is the sum of first n odd natural numbers. So, square root of a square number can be obtained by subtracting the successive odd natural numbers starting from 1 till we get 0.

Example: To find $\sqrt{49}$

49 – 1 = 48, 48 – 3 = 45, 45 – 5 = 40, 40 – 7 = 33, 33 – 9 = 24, 24 – 11 = 13, 13 – 13 = 0

We subtracted 7 successive odd natural numbers.

Thus, 7 is the square root of 49.

Prime factorization

Express the number as the product of prime numbers, group the common primes in a pair, take one prime from each pair and then multiply to get the square root.

Calculation of square root of 9604 using prime factorization method:

$9604 = \underline{2 \times 2} \times \underline{7 \times 7} \times \underline{7 \times 7}$

$\therefore \sqrt{9604} = 2 \times 7 \times 7 = 98$

Note: If one or more primes are not in pairs, the number is not a perfect square.

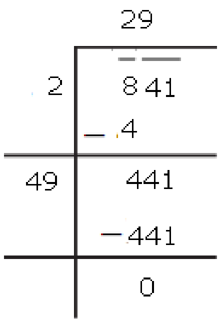
Division method

Steps to perform division:

- Place a bar over every pair of digits starting from the one's digit.
- Find the largest number whose square is less than or equal to the number under the left-most bar (take this as dividend) and take this as a divisor. Divide and get the remainder.
- Bring down the number under the next bar and place it to the right of the remainder and this will act as the new dividend.
- Double the quotient and write it with a blank on its right.
- Find the largest digit to fill the blank which also becomes the new digit in quotient such that the product of new quotient and new divisor gives a number less than or equal to the dividend.

- Continue this process till we get the remainder as 0. The quotient becomes the square root of the number.

  Example: Square root of 841



$\therefore \sqrt{841} = 29$

Note: This method can also be used to find the square root of a non-perfect square or decimal number.

For positive numbers a and b, we have:

i. $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$

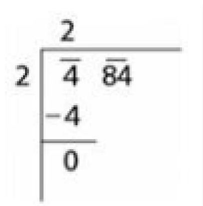
ii. $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$

Finding Square Root by Long Division Method

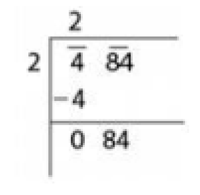
Steps involved in finding the square root of 484 by Long division method:

Step 1: Place a bar over every pair of numbers starting from the digit at units place. If the number of digits in it is odd, then the left-most single-digit too will have a bar.

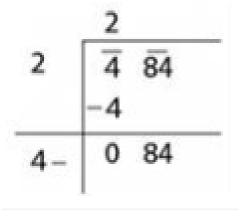
Step 2: Take the largest number as divisor whose square is less than or equal to the number on the extreme left. Divide and write quotient.



Step 3: Bring down the number which is under the next bar to the right side of the remainder.

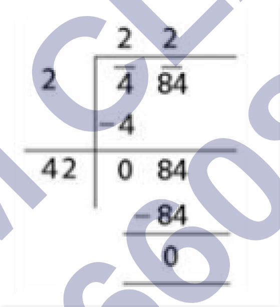


Step 4: Double the value of the quotient and enter it with a blank on the right side.



Step 5: Guess the largest possible digit to fill the blank which will also become the new digit in the quotient, such that when the new divisor is multiplied to the new

quotient the product is less than or equal to the dividend.



The remainder is 0, therefore, $\sqrt{484} = 22$.

Random Interesting Patterns Followed by Square Numbers

Patterns in numbers like 1, 11, 111, … :

$1^2 =$ 1

$11^2 =$ 1 2 1

$111^2 =$ 1 2 3 2 1

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

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

$11111111^2 =$1 2 3 4 5 6 7 8 7 6 5 4 3 2 1

Patterns in numbers like 6, 67, 667, ... :

$7^2 = 49$

$67^2 = 4489$

$667^2 = 444889$

$6667^2 = 44448889$

$66667^2 = 4444488889$

$666667^2 = 444444888889$

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Square and Square root

interesting patterns

$(a5)^2 = (10a+5)^2$
$= 100a^2 + 25 + 2\times(10a)\times(5)$
$= 100a^2 + 100a + 25$
$= 100a(a+1) + 25$
$= a(a+1)\text{hundred} + 25$

e.g. $(25)^2 = 2(2+1)\text{hundred} + 25$
$= (2\times3)100 + 25$
$= 600 + 25$
$= 625$

$7^2 = 49$
$67^2 = 4489$
$667^2 = 444889$
$6667^2 = 44448889$

$1^2 = 1$
$11^2 = 121$
$111^2 = 12321$
$1111^2 = 1234321$
$11111^2 = 123454321$

Properties of square number

- No ending with 2,3,7,8 is never a perfect square
- Square of even no is even
- Square of odd no is add
- Square of a proper fraction is Smaller than the fraction
- Product of two consecutive even or odd number $(a+1)(a-1) = a^2 - 1$

Pythagorean triplets

- For every natural no.m > 1 $2m, m^2-1, m^2+1$ is a pythagorean triplet
- If m,n,p are natural then $m^2 + n^2 = p^2$
  - Ex (3,4,5),(6,8,10)

Finding square root

- By division method
- By prime factorisation method
  - Find prime factors f a number
  - Pair these factors
  - Select one factor From each pair

Important Questions

Multiple Choice Questions:

Question 1. The square root of 169 is

(a) 13

(b) 1.3

(c) -1.3

(d) $\frac{13}{10}$

Question 2. What could be the possible "one's digit" of the square root of 625?

(a) 5

(b) 0

(c) 4

(d) 8

Question 3. Sum of squares of two numbers is 145. If square root of one number is 3, find the other number.

(a) 136

(b) 9

(c) 64

(d) 8

Question 4. The square root of 1.21 is

(a) 1.1

(b) 11

(c) 21

(d) 2.1

Question 5. How many numbers lie between square of 12 and 13

(a) 22

(b) 23

(c) 24

(d) 25

Question 6. Which is the greatest three-digit perfect square?

(a) 999

(b) 961

(c) 962

(d) 970

Question 7. How many natural numbers lie between 9^2 and 10^2?

(a) 15

(b) 19

(c) 18

(d) 17

Question 8. The largest perfect square between 4 and 50 is

(a) 25

(b) 36

(c) 49

(d) 45

Question 9. Sum of squares of two numbers is 145. If square root of one number is 3, find the other number.

(a) 136

(b) 8

(c) 9

(d) 64

Question 10. Find the square of 39.

(a) 1500

(b) 78

(c) 1521

(d) none of these

Very Short Questions:

1. Find the perfect square numbers between 40 and 50.
2. Which of the following 24^2, 49^2, 77^2, 131^2 or 189^2 end with digit 1?
3. Find the value of each of the following without calculating squares.

   (i) $27^2 – 26^2$

   (ii) $118^2 – 117^2$
4. Write each of the following numbers as difference of the square of two consecutive natural numbers.

   (i) 49

   (ii) 75

   (iii) 125

5. Write down the following as sum of odd numbers.

(i) 7^2

(ii) 9^2

6. Express the following as the sum of two consecutive integers.

(i) 15^2

(ii) 19^2

7. Find the product of the following:

(i) 23×25

(ii) 41×43

8. Find the squares of:

(i) $\frac{-3}{7}$

(ii) $\frac{-9}{17}$

Short Questions:

1. Check whether (6, 8, 10) is a Pythagorean triplet.

2. Using property, find the value of the following:

(i) $19^2 - 18^2$

(ii) $23^2 - 22^2$

3. Using the prime factorisation method, find which of the following numbers are not perfect squares.

(i) 768

(ii) 1296

4. Which of the following triplets are Pythagorean?

(i) (14, 48, 50)

(ii) (18, 79, 82)

5. Find the square root of the following using successive subtraction of odd numbers starting from 1.

(i) 169

(ii) 81

(iii) 225

6. Find the square root of the following using prime factorisation.

(i) 441

(ii) 2025

(iii) 7056

(iv) 4096

7. Find the least square number which is divisible by each of the number 4, 8 and 12.

8. Find the square roots of the following decimal numbers

(i) 1056.25

(ii) 10020.01

Long Questions:

1. What is the least number that must be subtracted from 3793 so as to get a perfect square? Also, find the square root of the number so obtained.

2. Simplify: √900 + √0.09 + √0.000009

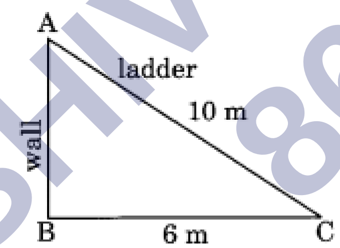
3. Find the value of x if

$$\sqrt{1369} + \sqrt{0.0615 + x} = 37.25$$

4. Simplify:

$$\sqrt{\frac{(0.105+0.024-0.008)\times 0.85}{1.7\times 0.022\times 0.25}}$$

5. A ladder 10 m long rests against a vertical wall. If the foot of the ladder is 6 m away from the wall and the ladder just reaches the top of the wall, how high is the wall?



6. Find the length of a diagonal of a rectangle with dimensions 20 m by 15 m.

7. The area of a rectangular field whose length is twice its breadth is 2450 m2. Find the perimeter of the field.

8. **Which of the following numbers are perfect squares? 11, 12, 16, 32, 36**

Answer Key-

Multiple Choice Questions:

1. (a) 13
2. (a) 5
3. (d) 8
4. (a) 1.1
5. (c) 24
6. (b) 961
7. (c) 18
8. (c) 49
9. (b) 8
10. (c) 1521

Very Short Answer:

1. Perfect square numbers between 40 and 50 = 49.
2. Only 49^2, 131^2 and 189^2 end with digit 1.
3. (i) $27^2 - 26^2 = 27 + 26 = 53$

   (ii) $118^2 - 117^2 = 118 + 117 = 235$
4. (i) $49 = 2 \times 24 + 1$

   $49 = 25^2 - 24^2$

   (ii) $75 = 2 \times 37 + 1$

   $75 = 38^2 - 37^2$

   (iii) $125 = 2 \times 62 + 1$

   $125 = 63^2 - 62^2$
5. (i) 72 = Sum of first 7 odd numbers = 1 + 3 + 5 + 7 + 9 + 11 + 13

   (ii) 92 = Sum of first 9 odd numbers = 1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + 17
6.

   (i) $15^2 = 225 = 112 + 113$

   $$\left[\because 112 = \frac{15^2 - 1}{2} \text{ and } 113 = \frac{15^2 + 1}{2}\right]$$

   (ii) $19^2 = 361 = 180 + 181$

   $$\left[\because 180 = \frac{19^2 - 1}{2} \text{ and } 181 = \frac{19^2 + 1}{2}\right]$$

7. (i) $23 \times 25 = (24 - 1)(24 + 1) = 24^2 - 1 = 576 - 1 = 575$

(ii) $41 \times 43 = (42 - 1)(42 + 1) = 42^2 - 1 = 1764 - 1 = 1763$

8.

(i) $\left(-\frac{3}{7}\right)^2 = \left(-\frac{3}{7}\right)\left(-\frac{3}{7}\right) = \frac{9}{49}$

(ii) $\left(-\frac{9}{17}\right)^2 = \left(-\frac{9}{17}\right)\left(-\frac{9}{17}\right) = \frac{81}{289}$

Short Answer:

1. $2m$, $m^2 - 1$ and $m^2 + 1$ represent the Pythagorean triplet.

Let $2m = 6 \Rightarrow m = 3$

$m^2 - 1 = (3)^2 - 1 = 9 - 1 = 8$

and $m^2 + 1 = (3)^2 + 1 = 9 + 1 = 10$

Hence (6, 8, 10) is a Pythagorean triplet.

Alternative Method:

$(6)^2 + (8)^2 = 36 + 64 = 100 = (10)^2$

$\Rightarrow$ (6, 8, 10) is a Pythagorean triplet.

2. (i) $19^2 - 18^2 = 19 + 18 = 37$

(ii) $23^2 - 22^2 = 23 + 22 = 45$

3.

(i)

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

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

Here, 3 is not in pair.

768 is not a perfect square.

(ii)

2	1296
2	648
2	324
2	162
3	81
3	27
3	9
3	3
	1

$1296 = \underline{2 \times 2} \times \underline{2 \times 2} \times \underline{3 \times 3} \times \underline{3 \times 3}$

Here, there is no number left to make a pair.

1296 is a perfect square.

4. We know that 2m, $m^2 - 1$ and $m^2 + 1$ make Pythagorean triplets.

(i) For (14, 48, 50),

Put 2m =14 ⇒ m = 7

$m^2 - 1 = (7)^2 - 1 = 49 - 1 = 48$

$m^2 + 1 = (7)^2 + 1 = 49 + 1 = 50$

Hence (14, 48, 50) is a Pythagorean triplet.

(ii) For (18, 79, 82)

Put 2m = 18 ⇒ m = 9

$m^2 - 1 = (9)^2 - 1 = 81 - 1 = 80$

$m^2 + 1 = (9)^2 + 1 = 81 + 1 = 82$

Hence (18, 79, 82) is not a Pythagorean triplet

5. (i) 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

We have subtracted odd numbers 13 times to get 0.

√169 = 13

(ii) 81 – 1 = 80, 80 – 3 = 77, 77 – 5 = 72, 72 – 7 = 65, 65 – 9 = 56, 56 – 11 = 45, 45 – 13 = 32, 32 – 15 = 17, 17 – 17 = 0

We have subtracted 9 times to get 0.

√81 = 9

(iii) 225 – 1 = 224, 224 – 3 = 221, 221 – 5 = 216, 216 – 7 = 209, 209 – 9 = 200, 200 – 11 = 189, 189 – 13 = 176, 176 – 15 = 161, 161 – 17 = 144, 144 – 19 = 125, 125 – 21 = 104, 104 – 23 = 81, 81 – 25 = 56, 56 – 27 = 29, 29 – 29 = 0

We have subtracted 15 times to get 0.

√225 = 15

6. (i) 441 = 3 × 3 × 7 × 7

√441 = 3 × 7 = 21

3	441
3	147
7	49
7	7
	1

(ii) 2025 = 3 × 3 × 3 × 3 × 5 × 5

√2025 = 3 × 3 × 5 = 45

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

(iii) 7056 = 2 × 2 × 2 × 2 × 3 × 3 × 7 × 7

√7056 = 2 × 2 × 3 × 7 = 84

2	7056
2	3528
2	1764
2	882
3	441
3	147
7	49
7	7
	1

(iv) 4096 = 2 × 2 × 2 × 2 × 2 × 2 × 2 × 2 × 2 × 2 × 2 × 2

√4096 = 2 × 2 × 2 × 2 × 2 × 2 = 64

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

7. LCM of 4, 8, 12 is the least number divisible by each of them.

LCM of 4, 8 and 12 = 24

24 = $\underline{2 \times 2} \times 2 \times 3$

To make it perfect square multiply 24 by the product of unpaired numbers, i.e., 2 × 3 = 6

Required number = 24 × 6 = 144

2	4, 8, 12
2	2, 4, 6
2	1, 2, 3
3	1, 1, 3
	1, 1, 1

8.

	32.5
3	$\overline{10}\,\overline{56}.\overline{25}$
	9
62	156
	124
645	3225
	3225
	0

Hence $\sqrt{1056.25} = 32.5$

(ii)

```
              100.1
      1    | 10020.01
           | 1
    -------|---------
    2001   | 002001
           |   2001
           |---------
           |      0
```

Hence $\sqrt{10020.01} = 100.1$

Long Answer:

1. First, we find the square root of 3793 by division method.

```
          61
     6  | 3793
        | 36
    ----|-----
    121 |  193
        |  121
        |-----
        |   72
```

Here, we get a remainder 72

$61^2 < 3793$

Required perfect square number = 3793 – 72 = 3721 and √3721 = 61

2. Simplify: √900 + √0.09 + √0.000009

Solution:

We know that √(ab) = √a × √b

√900 = √(9 × 100) = √9 × √100 = 3 × 10 = 30

√0.09 = √(0.3 × 0.3) = 0.3

√0.000009 = √(0.003 × 0.003) = 0.003

√900 + √0.09 + √0.000009 = 30 + 0.3 + 0.003 = 30.303

3.

We have $\sqrt{1369} + \sqrt{0.0615 + x} = 37.25$

$\because \sqrt{1369} = 37$

```
          37
     3  | 1369
        | 9
    ----|-----
    67  |  469
        |  469
        |-----
        |    0
```

$$\therefore 37 + \sqrt{0.0615 + x} = 37.25$$

$$\Rightarrow \sqrt{0.0615 + x} = 37.25 - 37$$

$$\Rightarrow \sqrt{0.0615 + x} = 0.25$$

Squaring both sides, we have

$$0.0615 + x = 0.0625$$

$$\Rightarrow x = 0.0625 - 0.0615$$

$$\therefore x = 0.0010$$

Hence $x = 0.001$

4.

$$\sqrt{\frac{(0.105 + 0.024 - 0.008) \times 0.85}{1.7 \times 0.022 \times 0.25}}$$

$$= \sqrt{\frac{(0.129 - 0.008) \times 0.85}{1.7 \times 0.022 \times 0.25}}$$

$$= \sqrt{\frac{0.121 \times 0.85}{1.7 \times 0.22 \times 0.25}}$$

$$= \sqrt{\frac{\cancel{121}^{11} \times \cancel{85}^{5}}{\cancel{17} \times \cancel{22}_{2} \times \cancel{25}_{5}}}$$

[Removing the decimals]

$$= \sqrt{\frac{11}{10}} = \sqrt{1.1}$$

Hence, the required result = $\sqrt{1.1}$.

5. Let AC be the ladder.

Therefore, AC = 10 m

Let BC be the distance between the foot of the ladder and the wall.

Therefore, BC = 6 m

ΔABC forms a right-angled triangle, right angled at B.

By Pythagoras theorem,

$AC^2 = AB^2 + BC^2$

$10^2 = AB^2 + 6^2$

or $AB^2 = 10^2 - 6^2 = 100 - 36 = 64$

or $AB = \sqrt{64} = 8$m

Hence, the wall is 8 m high.

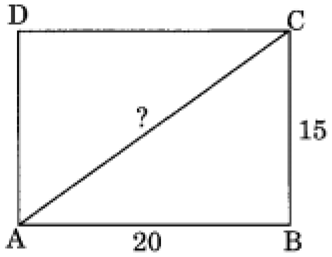
6. Using Pythagoras theorem, we have Length of diagonal of the rectangle = $\sqrt{l^2 + b^2}$ units

$= \sqrt{(20^2 + 15^2)}$ m

$= \sqrt{400 + 225}$ m

$= \sqrt{625}$ m

$= 25$ m



Hence, the length of the diagonal is 25 m.

7. Let the breadth of the field be x metres. The length of the field 2x metres.

Therefore, area of the rectangular field = length × breadth = (2x)(x) = ($2x^2$) m2

Given that area is 2450 m^2.

Therefore, $2x^2 = 2450$

$\Rightarrow x^2 = 1225$

$\Rightarrow x = \sqrt{1225}$ or x = 35 m

Hence, breadth = 35 m

and length = 35 × 2 = 70 m

Perimeter of the field = 2 (l + b) = 2(70 + 35) m = 2 × 105 m = 210 m.

8.

11 is not a perfect square because it is a prime number.

12 is not a perfect square because its units digit is 2.

16 is a perfect square because 16 = 4 x 4.

32 is not a perfect square because its units digit is 2.

36 is a perfect square because 36 = 6 x 6.