Module – 3/4

SQUARES AND SQUARE ROOTS

You can download the chapter of NCERT textbook → http://ncert.nic.in/textbook/textbook.htm?hemh1=6-16

Square Roots

Look the squares with given areas.

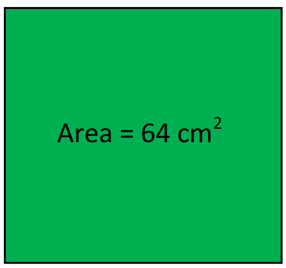

Figure (i)

Figure (ii)

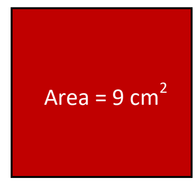

Figure (iii)

In Figure (i) [GREEN]

Area = 64 cm^2

Area of square = $side \times side$

64 cm^2 = $side \times side$

8 cm × 8 cm = $side \times side$

So, side = 8 cm

In Figure (ii) [BLUE]

Area = 36 cm^2

Area of square = $side \times side$

36 cm^2 = $side \times side$

6 cm × 6 cm = $side \times side$

So, side = 6 cm

In Figure (iii) [RED]

Area = 9 cm^2

Area of square = $side \times side$

9 cm^2 = $side \times side$

3 cm × 3 cm = $side \times side$

So, side = 3 cm

Based on figure (i) [GREEN], figure (ii) [BLUE] and figure (iii) [RED], we can find the side of a square with given area.

In all the above cases, we need to find a number whose square is known.

Square Root

Finding the number with the known square is known as finding the square root.

Finding square roots

Finding the square root is the inverse operation of squaring.

We have, $1^2 = 1$, therefore square root of 1 is 1

$2^2 = 4$, therefore square root of 4 is 2

$3^2 = 9$, therefore square root of 9 is 3

$4^2 = 16$, therefore square root of 16 is 4

Now try these

(i) $11^2 = 121$. What is the square root of 121?

Yes, the square root of 121 is 11.

(ii) $14^2 = 196$. What is the square root of 196?

Yes, the square root of 196 is 14.

- ***Since $9^2 = 81$, and $(-9)^2 = 81$***

We say that square roots of 81 are 9 and –9.

So there are two integral square roots of a perfect square number.

But here, we shall take up only positive square root of a natural number.

Positive square root of a number is denoted by the symbol $\sqrt{\ }$.

For example:

$\sqrt{4} = 2$ (not –2);

$\sqrt{9} = 3$ (not –3) etc.

Finding square root through repeated subtraction

Consider 81. Then,

(i) $81 - 1 = 80$
(ii) $80 - 3 = 77$
(iii) $77 - 5 = 72$
(iv) $72 - 7 = 65$
(v) $65 - 9 = 56$
(vi) $56 - 11 = 45$
(vii) $45 - 13 = 32$
(viii) $32 - 15 = 17$
(ix) $17 - 17 = 0$

Total 9 steps in obtaining 0

From 81 we have subtracted successive odd numbers starting from 1 and obtained 0 at 9th step.

Therefore $\sqrt{81} = 9$.

Finding square root through prime factorisation

Consider the prime factorisation of the following numbers and their squares.

Sl. No	Number	Prime factorization of Number	Square of Number	Prime factorization of square of Number
1.	6	2×3	36	$2 \times 2 \times 3 \times 3$
2.	8	$2 \times 2 \times 2$	64	$2 \times 2 \times 2 \times 2 \times 2 \times 2$
3.	15	3×5	225	$3 \times 3 \times 5 \times 5$
4.	18	$2 \times 3 \times 3$	324	$2 \times 2 \times 3 \times 3 \times 3 \times 3$

We will find that each prime factor in the prime factorisation of the square of a number, occurs twice the number of times it occurs in the prime factorisation of the number itself. By pairing the prime factors, we can get the square root of a perfect square.

In 1st Row,

Number = $6 = 2 \times 3$ Square = $36 = 2 \times 2 \times 3 \times 3$

So, square root of 36 = $\sqrt{36} = \sqrt{\mathbf{2} \times \mathbf{2} \times 3 \times 3} = 2 \times 3 = 6$

In 4th Row,

Number = $18 = 2 \times 3 \times 3$ Square = $324 = 2 \times 2 \times 3 \times 3 \times 3 \times 3$

So, square root of 324 = $\sqrt{324} = \sqrt{\mathbf{2} \times \mathbf{2} \times 3 \times 3 \times \mathbf{3} \times \mathbf{3}} = 2 \times 3 \times 3 = 18$

Is 48 a perfect square?

We know $48 = \mathbf{2} \times \mathbf{2} \times 2 \times 2 \times 3$

Since all the factors are **not in pairs** so 48 is not a perfect square.

To complete pairs, we need to multiply by 3 or divide by 3.

So $48 \times 3 = 144$ is a perfect square number

or $48 \div 3 = 16$ are perfect square numbers.

Example - Find the smallest multiple of 48 that is a perfect square,

Solution – here $48 = \mathbf{2} \times \mathbf{2} \times 2 \times 2 \times 3$, in this 3 is the only factor that does not have a pair. So we need to multiply by 3 to complete the pair.

Hence $48 \times 3 = 144$ is a perfect square.

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