

Grade 8 · Square Roots and Cube Roots · Lesson

Common Core 8.EE.A.2 · mathovore.fr

A square root of p is a number whose square is p , and a cube root of p is a number whose cube is p . To solve $x^2 = p$, take square roots: a positive p gives two solutions. To solve $x^3 = p$, take the cube root, which gives one. Most roots, such as $\sqrt{2}$, are irrational.

Grade 8 Common Core: 8.EE.A.2

Key facts:

- Standard 8.EE.A.2: solve $x^2 = p$ and $x^3 = p$ for small perfect squares and perfect cubes, and know that $\sqrt{2}$ is irrational.
- The equation $x^2 = p$ with $p > 0$ has two solutions, $\sqrt{p}$ and $-\sqrt{p}$; $x^3 = p$ has exactly one.
- Perfect squares to remember: 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144.
- Perfect cubes to remember: 1, 8, 27, 64, 125, 216, 343, 512, 729, 1,000.
- The side of a square is the square root of its area; the edge of a cube is the cube root of its volume.

What is a square root?

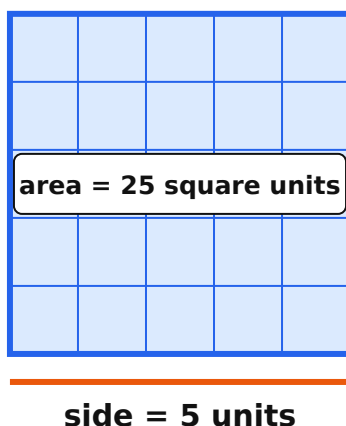
Squaring a number means multiplying it by itself, so $7^2 = 49$. A **square root** goes the other way: $\sqrt{49} = 7$ because $7 \cdot 7 = 49$. Picture a square floor with area 49 square feet; its side is the square root of 49, or 7 feet.

Vocabulary

Perfect square: the square of a whole number, such as 1, 4, 9, 16, 25.

Perfect cube: the cube of a whole number, such as 1, 8, 27, 64, 125.

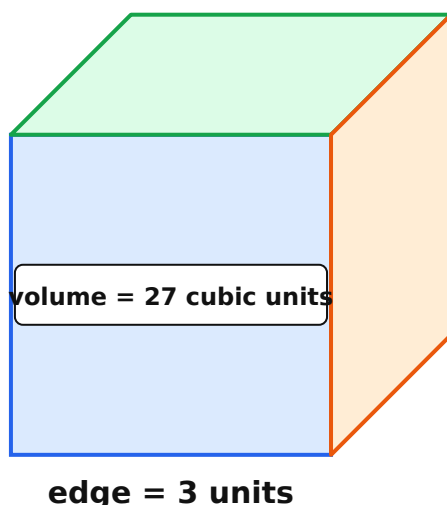
Radical symbol: the sign $\sqrt{}$ means the positive square root; the same sign with a small 3 in its crook means the cube root.



A square made of 25 unit squares has a side of 5 units, so $\sqrt{25} = 5$.

What is a cube root?

Cubing a number means using it as a factor three times, so $3^3 = 27$. A **cube root** undoes that: $\sqrt[3]{27} = 3$. A cube-shaped box that holds 27 cubic inches has an edge of 3 inches. Unlike square roots, a cube root can be negative: $\sqrt[3]{-8} = -2$ because $(-2)(-2)(-2) = -8$.



A cube with volume 27 cubic units has edge length $\sqrt[3]{27} = 3$ units.

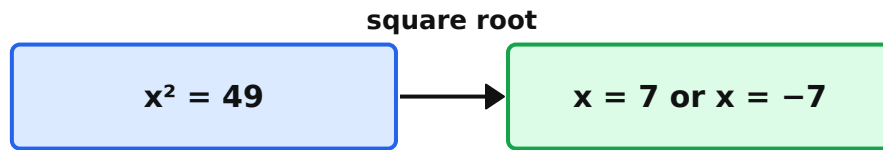
n	1	2	3	4	5	6	7	8	9	10
n^2	1	4	9	16	25	36	49	64	81	100
n^3	1	8	27	64	125	216	343	512	729	1,000

How do you solve $x^2 = p$ and $x^3 = p$?

1. Look at the exponent. A square calls for a square root; a cube calls for a cube root.
2. For $x^2 = p$ with $p > 0$, write both answers: $x = \sqrt{p}$ or $x = -\sqrt{p}$.
3. For $x^3 = p$, write the single answer $x = \sqrt[3]{p}$; it has the same sign as p .

4. Check by raising your answer to the power.

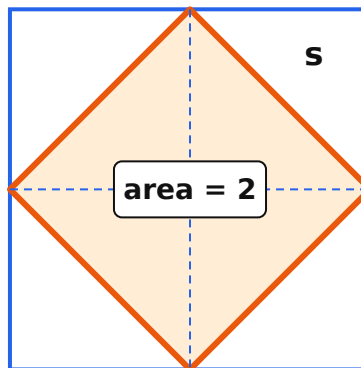
Worked example. Solve $x^2 = 49$. Both 7 and -7 square to 49, so $x = 7$ or $x = -7$. Now solve $x^3 = -125$: the only number that cubes to -125 is -5 . The equation $x^2 = -9$ has no solution, because no real number squared is negative.



Taking the square root of both sides gives two solutions.

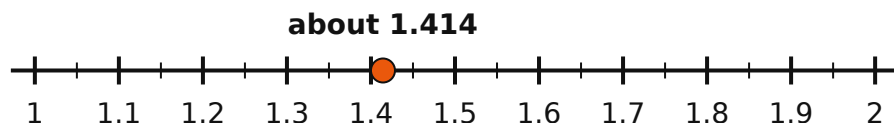
Why is the square root of 2 irrational?

Draw a square on a grid, then join the midpoints of its sides. The tilted square covers exactly half the big one. With a big square of area 4, the tilted square has area 2, so its side is $\sqrt{2}$. Since $1.4^2 = 1.96$ and $1.5^2 = 2.25$, the number is between 1.4 and 1.5. But no fraction squares to exactly 2, so $\sqrt{2}$ is **irrational**: its decimal never ends or repeats, and 1.414 is only an approximation.



The big square has area 4; the tilted square has area 2

The side s of the tilted square satisfies $s^2 = 2$.



The point for $\sqrt{2}$ sits between 1 and 2, about 1.414.

Square Roots and Cube Roots: frequently asked questions

Does $x^2 = 25$ have one answer or two?

It has two: $x=5$ and $x=-5$, because both numbers square to 25. The symbol $\sqrt{25}$ alone means only the positive root, 5.

Can you take the cube root of a negative number?

Yes. Because a negative times a negative times a negative is negative, $\sqrt[3]{-27} = -3$. Only square roots of negative numbers are not real.

What is the difference between a perfect square and a perfect cube?

A perfect square is a whole number squared, like 36 from 6^2 . A perfect cube is a whole number cubed, like 216 from 6^3 . The number 64 is both.

How can you tell that the square root of 2 is irrational?

No fraction multiplied by itself equals exactly 2. Calculators show 1.41421356 and more digits that never end or repeat, so any decimal you write is only an approximation.

How do you estimate a square root that is not a perfect square?

Find the two perfect squares around it. Since $49 < 50 < 64$, the number $\sqrt{50}$ is between 7 and 8, and a little closer to 7.