



This symbol is called a **radical**

it indicates finding a root, i.e. undoing an exponent.

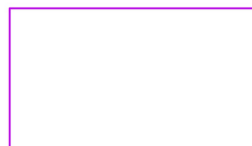
The number in this spot
is called the **Index**.

It indicates what
root you are finding.

If there is no index it means
Square Root.



This quantity is
called
the **Radicand**



$$3^4 = 81$$

$$(-3)^4 = 81$$

What are the real fourth roots of 81? ± 3

What are the real fourth roots of 2401? ± 7

Are there any real fourth roots of -256?

No. No real number raised to the fourth power will be negative.

How many real fourth roots does
any positive number have? 2

$$6^2 = 36 \text{ and } (-6)^2 = 36$$

What are the real square roots of 36? ± 6

What are the real square roots of 81? ± 9

Why are there no real square roots of -36?

Because no real number squared will equal -36

How many real square roots does
any positive number have? 2

$$5^3 = 125$$

$$(-5)^3 = -125$$

How many cube roots does 125 have? 1

Find the cube root of -125 $\sqrt[3]{-125} = -5$

Find the cube root of -512 $\sqrt[3]{-512} = -8$

How many cube roots does any
number have? 1

The cube root of any number
has what sign?

The same sign as the radicand

The number of **REAL** nth roots of a radicand.

| Radicand is | Index is even | Index is odd | $\sqrt[n]{\text{Radicand}}$ |
|-------------|---------------|--------------|-----------------------------|
| Positive | 2 | 1 | |
| Zero | 1 | 1 | |
| Negative | 0 | 1 | |

The radical symbol $\sqrt{\quad}$ by itself means the positive root.
Also known as the **PRINCIPAL ROOT**

There are 2 even roots of every positive number.

$-\sqrt{\quad}$ asks for the **Negative Root**

$\pm\sqrt{\quad}$ asks for the **Pos & Neg Roots**

$\sqrt{\quad}$ asks for the **Positive Root**

What numbers could you square and get 81? ± 9

What are the square roots of 49? ± 7

Solve. $x^2 = 36$ ± 6

Simplify. $\sqrt{441}$ 21

\swarrow
no symbol in front of the radical means the positive answer

Solve. $x^2 = 25$

$$\sqrt{x^2} = \sqrt{25}$$

$$x = \pm 5$$

This is asking you to find all the numbers you could square and get 25. Find ALL the square roots of 25.

Simplify: $\sqrt{25} = 5$

in this situation $\sqrt{\quad}$ indicates the **Principal Root**

When there are two roots the **Principal Root** is the positive root.

$$\sqrt[3]{-64} = -4$$

$$\sqrt[3]{125} = 5$$

The answer to an odd root has the Same sign as the radicand.

Why is there no principal root of an odd radical?

By definition the **Principal Root** is the pos when there are two roots but an odd radi only one ansv

$$4^3 = 64$$

$$4^2 = 16$$

$$4^1 = 4$$

$$4^{\square} = \square$$

$$4^0 = 1$$

Given the pattern shown the missing exponent must be one-half. It turns out this equals 2.

$$4^{\frac{1}{2}} = 2$$

$$4^{\frac{1}{2}} = \sqrt{4}$$

The exponent one-half actually represent the square root.

Rational exponents represent radicals.

The denominator of the rational exponent represents the **INDEX** of the radical.

If $4^{\frac{1}{2}} = \sqrt{4}$, then

what do these represent?

$$4^{\frac{1}{3}} = \sqrt[3]{4} \text{ the cube root of } 4$$

$$4^{\frac{1}{4}} = \sqrt[4]{4} \text{ the fourth root of } 4$$

$$4^{\frac{1}{5}} = \sqrt[5]{4} \text{ the fifth root of } 4$$



What would this represent?

$$4^{\frac{1}{n}} = \sqrt[n]{4} \text{ the "n"}^{\text{th}} \text{ root of } 4$$

If $\sqrt{x} = x^{\frac{1}{2}}$

How would you write this as a power of x? $\sqrt{x^3}$

$$\sqrt{x^3} = x^{\frac{3}{2}}$$

$$a^{\frac{1}{n}} = \sqrt[n]{a} \quad \text{"the nth root of a"}$$

The denominator of the rational exponent represents the **INDEX** of the radical.

$$a^{\frac{m}{n}} = \sqrt[n]{a^m} \text{ or } (\sqrt[n]{a})^m$$

Get a small white board, marker, and rag.

Write in exponential form:

This means to write each using rational exponents.

1. $\sqrt[4]{g^9}$
 $g^{\frac{9}{4}}$

2. $\sqrt{h^5}$
 $h^{\frac{5}{2}}$

3. $\sqrt[3]{a}$
 $a^{\frac{1}{3}}$

Write in exponential form:

4. $\sqrt[5]{3c^2}$
 $= (3c^2)^{\frac{1}{5}}$
or
 $3^{\frac{1}{5}} c^{\frac{2}{5}}$

5. $\sqrt[4]{(11e)^7}$
 $= (11e)^{\frac{7}{4}}$
or
 $11^{\frac{7}{4}} e^{\frac{7}{4}}$

Write in exponential form:

6. $\sqrt[9]{x^3}$
 $= x^{\frac{3}{9}}$
 $= x^{\frac{1}{3}}$

7. $\sqrt{(2mn)^8}$
 $= (2mn)^{\frac{8}{2}}$
 $= (2mn)^4$
 $= 16m^4n^4$

Write each in radical form.

1. $w^{\frac{2}{11}}$

$$= \sqrt[11]{w^2}$$

or

$$(\sqrt[11]{w})^2$$

2. $k^{\frac{5}{2}}$

$$= \sqrt{k^5}$$

or

$$(\sqrt{k})^5$$

3. $x^{\frac{1}{7}}$

$$= \sqrt[7]{x}$$