$6^2 = 36$ and $(-6)^2 = 36$

What are the square roots of 36? ± 6

What are the square roots of 81? ± 9

Why are there no real square roots of -36?

How many square roots does any positive number have? 2

NO Real # squared = a neg

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

What are the fourth roots of 81? ± 3

What are the fourth roots of 2401? ± 7

Are there any real fourth roots of -256? *NO b/c no real # raised to the 4th power is neg*

How many fourth 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 $= -5$

Find the cube root of -512 $= -8$

How many cube roots does any number have?   1

The cube root of any number has what sign? *Same sign as radicand*

The number of REAL nth roots of a number

$\sqrt[n]{\text{Radicand}}$

Radicand is	Index is even	Index is odd
Positive	2	1
Zero	1	1
Negative	0	1

There are ___2___ even roots of every positive number.

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

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

$\sqrt{}$ 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___

$\sqrt{25} = 5$

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

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

Solve. $x^2 = 1444$

$x = \pm 38$

Simplify each.

1. $-\sqrt{49} = -7$

2. $\pm\sqrt{36} = \pm 6$

3. $\sqrt{81} = 9$

No symbol in front of the even radical indicates the Principal (Pos) Root.

$2^3 = 8$

What is the cube root of 8? 2

Is there another cube root of 8? NO

no other cubed will equal 8

$(-2)^5 = -32$

What is the 5th root of -32? $= -2$

Is there another 5th root of -32? NO

How many odd roots are there of any number? ONE

$\sqrt[3]{-64} = -4$ $\sqrt[3]{125} = +5$

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 positive root when there are two roots but an odd radical gives only one answer.

What kind of number will come from each?

1. x^{12} pos
2. x^{15} pos or neg depending on the base
3. x^8 pos
4. x^7 pos or neg

A real number raised to an even power is ALWAYS POSITIVE.

A real number raised to an odd power can either be negative or positive.

The answer will have the same sign as the base.

What kind of answer will come from each radical?

1. $\sqrt[4]{}$ pos
2. $\sqrt[5]{}$ pos or neg depending on the radicand
3. $\sqrt[9]{}$ pos or neg
4. $\sqrt[8]{}$ pos

The answer from an even radical must be POSITIVE. "Principal Root"

The answer from an odd radical can be anything.

Answer will have the same sign as the radicand.

What do you do to find a root of a variable with an exponent?

For example: $\sqrt[3]{w^{12}}$ $w^{\frac{12}{3}} = w^4$

To find the answer you divide the exponent by the index.

Simplify.

1. $\sqrt{a^2} \rightarrow$ An even root without any sign in front means the Principal Root (Pos Root).

$$\sqrt{a^2} = \cancel{a} = |a|$$

2. $\sqrt[3]{x^3} = x$ Answer will have the same sign as the radicand which means answer can be either positive OR negative.
DON'T use Absolute Value symbols!

Simplify each. Use absolute value symbols when needed.

1. a. $\sqrt{r^{10}} = \left| r^5 \right|$

   r^5 could be negative. But since it is coming out of an even root we need to make sure it comes out positive so we ensure a positive result by using Absolute Value Symbols

   b. $\sqrt[4]{m^{12}} = \left| m^3 \right|$

   m^3 could be negative. But since it is coming out of an even root we need to make sure it comes out positive so we ensure a positive result by using Absolute Value Symbols

   c. $\sqrt[5]{w^{40}} = w^8$

   There are two reasons we don't need Absolute Value symbols in this answer:
   1. We are taking an odd root which can lead to a positive or negative answer. Therefore, we don't want to force it to be positive.
   2. Since answer is raised to an even power w^8 will automatically be positive.