
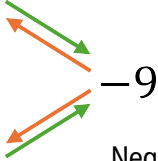


**TOPIC: INTRODUCTION TO RADICAL EXPRESSIONS**

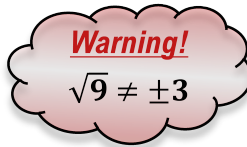
**Introduction to Square Roots**

◆ The \_\_\_\_\_ of **squaring** a number is taking the **square root**.

▶ Positive real numbers always have TWO roots: A \_\_\_\_\_ ("principal") and a \_\_\_\_\_ **root**.

Square Roots	
 $\sqrt{9} = \underline{\hspace{2cm}}$ $\sqrt{9} = \underline{\hspace{2cm}}$	 $\sqrt{-9} = \underline{\hspace{2cm}}$ <p>Negative #s _____ be square rooted!</p>

**Radical Symbol** {  $\sqrt{\hspace{1cm}}$  means **positive** root;  
 $-\sqrt{\hspace{1cm}}$  means **negative** root;  
 $\pm\sqrt{\hspace{1cm}}$  means **both**



**Radicand:** Term inside the radical

MEMORY TOOL
Negatives _____ side $\sqrt{\hspace{1cm}}$ → <u>  </u> <i>kay</i>
Negatives _____ side $\sqrt{\hspace{1cm}}$ → <u>  </u> <i>maginary</i>

**EXAMPLE:** Evaluate the radicals.

(A)  $\sqrt{36}$

(B)  $-\sqrt{36}$

(C)  $\sqrt{-36}$

**PRACTICE**

Evaluate the radical.

$$\sqrt{(-5)^2}$$

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**PRACTICE**

Extract the following square roots.

(A)  $\sqrt{144}$

(B)  $-\sqrt{121}$

**PRACTICE**

Determine if the following square roots evaluate to a real number.

(A)  $-\sqrt{4}$

[ REAL | NOT REAL ]

(B)  $\sqrt{64}$

[ REAL | NOT REAL ]

(C)  $-\sqrt{-25}$

[ REAL | NOT REAL ]

## TOPIC: INTRODUCTION TO RADICAL EXPRESSIONS

### Finding Higher Roots: Even Roots

◆ The reverse of raising a number to the  $n$ th power is taking the  $n$ th root; the **index**  $n$  is written at top-left of radical.

Even Roots ( $n = 2, 4, 6, \dots$ )	
Square Roots ( $n = 2$ )	
$a^2 = b \leftrightarrow \sqrt{b} = a$	$a^n = b \leftrightarrow \sqrt[n]{b} = a$ <small>Index</small>
<b>Positive Root:</b> $3^2 = 9 \leftrightarrow \sqrt{9} = 3$	<b>Positive Root:</b> $2^4 = 16 \leftrightarrow \sqrt[4]{\quad} =$
<b>Negative Root:</b> $(-3)^2 = 9 \leftrightarrow -\sqrt{9} = -3$	<b>Negative Root:</b> $(-2)^4 = 16 \leftrightarrow -\sqrt[4]{\quad} =$
<b>Imaginary:</b> $(?)^2 = -9 \leftrightarrow \sqrt{-9} = \text{imaginary}$	<b>Imaginary:</b> $(?)^4 = -16 \leftrightarrow \sqrt[4]{\quad} =$

#### EXAMPLE

Evaluate each root.

(A)  $\sqrt[4]{81} =$

(B)  $-\sqrt[8]{256} =$

#### PRACTICE

Simplify the root.

(A)  $\sqrt[4]{256}$

(B)  $-\sqrt[4]{10,000}$

(C)  $\sqrt[4]{-625}$

## TOPIC: INTRODUCTION TO RADICAL EXPRESSIONS

### Finding Higher Roots: Odd Roots

◆ Unlike even roots, odd  $n$ th roots can have a negative radicand.

Recall	Even Index ( $n = 2, 4, 6, \dots$ )	New	Odd Index ( $n = 3, 5, 7, \dots$ )
	$a^n = b \leftrightarrow \sqrt[n]{b} = a$		
	$2^4 = 16 \leftrightarrow \sqrt[4]{16} = 2$		$2^3 = 8 \leftrightarrow \sqrt[3]{\quad} =$
	$(-2)^4 = 16 \leftrightarrow -\sqrt[4]{16} = -2$		$(-2)^3 = -8 \leftrightarrow \sqrt[3]{\quad} =$
	$(?)^4 = -16 \leftrightarrow \sqrt[4]{-16} = \text{imaginary}$		
	<b>[ 2   1 ]</b> root(s): 1 positive & 1 negative		<b>[ 2   1 ]</b> root(s): always _____ sign as radicand
	Negative radicand $\rightarrow$ [ <b>IMAGINARY</b>   <b>NEGATIVE</b> ]		Negative radicand $\rightarrow$ [ <b>IMAGINARY</b>   <b>NEGATIVE</b> ]

#### EXAMPLE

Evaluate the following.

(A)  $\sqrt[3]{27} =$

(B)  $\sqrt[5]{-32} =$

#### PRACTICE

Simplify the root.

(A)  $\sqrt[5]{243}$

(B)  $\sqrt[3]{-125}$

(C)  $-\sqrt[5]{1024}$

## TOPIC: INTRODUCTION TO RADICAL EXPRESSIONS

### Approximating Roots Using a TI-84

◆ The square root of #s that aren't perfect squares are **irrational numbers** that we can approx. using a calculator.

▶ For square roots, press  $\text{2nd}$   $x^2$  ( $\sqrt{\quad}$ ). For  $n$ th roots, press  $\text{MATH}$   $5$  ( $\sqrt[n]{\quad}$ )

#### EXAMPLE

Approximate each radical to three decimal places.

(A)  $\sqrt{90}$

(B)  $\sqrt[3]{45}$

(C)  $\sqrt[4]{12}$

#### PRACTICE

Estimate the square root between two consecutive whole numbers.

$$\sqrt{138}$$

#### PRACTICE

Use a calculator to evaluate the following and round to the nearest hundredths.

(A)  $\sqrt[5]{75}$

(B)  $-\sqrt[8]{\frac{45}{29}}$

## TOPIC: INTRODUCTION TO RADICAL EXPRESSIONS

### Simplifying $n$ th Root of $n$ th Power

- ◆ Taking the  $n$ th root of something raised to the  $n$ th power ( $\sqrt[n]{a^n}$ ) "cancels" the exponent.

New $n^{\text{th}}$  Root of  $n^{\text{th}}$  Powers

If  $n$  is **odd**:  $\sqrt[n]{a^n} = \underline{\hspace{2cm}}$

If  $n$  is **even**:  $\sqrt[n]{a^n} = \underline{\hspace{2cm}}$

$\sqrt[3]{(-24)^3} =$

$\sqrt{(-24)^2} =$

#### EXAMPLE

Simplify.

(A)  $\sqrt[5]{(9)^5} =$

(B)  $\sqrt[8]{(x-2)^8} =$

(C)  $\sqrt{16x^4} =$

- ◆ Sometimes, the radicand may need to be rewritten if it doesn't have the same power as the root.

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**PRACTICE**

Simplify the following.

(A)  $\sqrt[3]{(-5)^3}$

(B)  $\sqrt[4]{(-x)^4}$

(C)  $\sqrt[4]{x^4y^8}$

**PRACTICE**

Simplify the following.

(A)  $\sqrt[4]{(2-a)^4}$

(B)  $\sqrt[7]{(-x-1)^7}$

(C)  $-\sqrt[8]{(x+1)^8}$