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Simplifying Radical Expressions (4.1) Date: ____________

After this lesson and practice, I will be able to …

☐ simplify radical algebraic expressions. (LT 2)

Warm Up: Write each number or expression as the square of a number or expression (i.e. $16 = 4^2$).

a. $\frac{4}{49}$ b. x^{10} c. $144x^6y^8$

Since $5^2 = 25$, 5 is a square root of 25.

Since $5^4 =$ 625, 5 is a fourth root of 625.

Since $5^3 =$ 125, 5 is a cube root of 125

Since $5^5 =$ 3125 5 is a fifth root of 3125

Definition: **nth Root** – For real numbers *a* and *b* and any positive integer *n*, if $a^n = b$ then a is an nth root of b.

Notation: $\sqrt[n]{b} = a$ if $a^n = b$

What are the real fourth root(s) of 16? 2 and −2 because $2^4 = 16$, $(-2)^4 = 16$

What are the real fourth root(s) of -16? There are none.

What are the real cube root(s) of -8? −2

Type of Number	*Number of nth Roots when n is even*	*Example*	*Number of nth Roots when n is odd*	*Example*
Positive	2	$\sqrt{9} = \pm 3$	1	$\sqrt[3]{64} = 4$
0	1	$\sqrt{0} = 0$	1	$\sqrt[3]{0} = 0$
Negative	0	$\sqrt{-9} = N/A$ Not a real #	1	$\sqrt[3]{-8} = -2$

Example 1: Find all real roots of each number.

MATH
4: $\sqrt[3]{\ }$
5: $\sqrt[x]{\ }$

A) The cube roots of -1000 and $\frac{1}{27}$

$\sqrt[3]{-1000} = -10$

$\sqrt[3]{\frac{1}{27}} = \frac{1}{3}$

B) The fourth roots of 1, -0.0001, and $\frac{16}{625}$

$\sqrt[4]{1} = 1$

$\sqrt[4]{-0.0001} =$ No real roots

$\sqrt[4]{\frac{16}{625}} = \frac{2}{5}$

When a number has two real roots, the positive root is called the principal root. The ? sign indicates that you are to calculate the principal root of the radicand.

Example 2: Find each real-number root.

A) $\sqrt[3]{-8}$

-2

B) $\sqrt{-100}$

No real root

C) $\sqrt[4]{81}$

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When finding principal roots (especially when negatives are involved), one observation is required...

Property 1: For any negative number a, $\sqrt[n]{a^n} = a$ when n is odd Why?!

Example 3: Simplify each radical expression.

A) $\sqrt{4x^6}$

$2x^3$

B) $\sqrt[3]{a^3b^6}$

ab^2

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

xy^2

D) $\sqrt{4x^2y^4}$

E) $\sqrt[3]{-27c^6}$

$-3c^2$

F) $\sqrt[4]{x^8y^{12}}$

x^2y^3

G) $\sqrt[3]{40x^8y^{12}}$

40 → 8, 5; 8 → 4, 2; 4 → 2, 2

$\sqrt[3]{2\cdot2\cdot2\cdot5x^8y^{12}}$

$\frac{8}{3} = 2\frac{2}{3}$

$\frac{12}{3} = 4$

$\boxed{2x^2y^4\sqrt[3]{5x^2}}$

H) $\sqrt[4]{112ac^6}$

112 → 2, 56; 56 → 2, 28; 28 → 2, 14; 14 → 2, 7

$\sqrt[4]{2\cdot2\cdot2\cdot2\cdot7\,a\,cccccc}$

$\boxed{2c\sqrt[4]{7ac^2}}$

I) $\sqrt[4]{20{,}000a^{10}b^{15}}$

Example 5: A citrus grower wants to ship oranges that weigh between 8 and 9 ounces in gift cartons. Each carton will hold three-dozen oranges, in 3 layers of 3 oranges by 4 oranges. The weight of each orange is related to its diameter by the formula $w = \frac{d^3}{4}$, where d is the diameter in inches and w is the weight in ounces. Cartons can only be ordered in whole-number dimensions. What are the dimensions of the container the grower should order?

FINAL CHECK:

I can simplify radical algebraic expressions. (LT2).

1. Simplify each expression. Use absolute values when necessary.

a. $\sqrt{144a^6b^{20}}$

b. $\sqrt[3]{-125x^{12}y^6}$

c. $\sqrt[4]{64x^{18}y^{12}}$