5.5. Advanced Algebra
Roots of Real Numbers

DATE: 5/15

Target 10A. Simplify radical expressions with various indices.

Finding the square root of a number and squaring a number and squaring a number are inverse operations.

Definition of Square Root

For any real numbers a and b, if $a^2 = b$, then a is a square root of b.

squaring

square rooting

Example: $(2)^2 = 4 \Rightarrow 2 = \sqrt[2]{4}$

$(-2)^2 = 4 \Rightarrow -2 = \sqrt[2]{4}$

Since finding the square root of a number and squaring a number are inverse operations, it makes sense that the inverse of raising a number

Since finding the square root of a number and squaring a number are inverse operations, it makes sense that the inverse of raising a number to the nth power is finding the nth root of a number.

Powers	Factors	Roots
$a^3 = 125$	$125 = 5 \cdot 5 \cdot 5$	5 is a cube root of 125
$a^4 = 81$	$81 = 3 \cdot 3 \cdot 3 \cdot 3$	3 is a fourth root of 81
$a^5 = 32$	$32 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$	2 is a fifth root of 32

Definition of nth Root

For any real numbers a and b, and any positive integer n, if $a^n = b$, then $a = \sqrt[n]{b}$.

Example: $4^3 = 64 \Rightarrow 4 = \sqrt[3]{64}$

cubing

taking 3rd root

Find Roots

Recall rule: $a^n \cdot a^m = a^{n+m}$, $(a^m)^n = a^{mn}$

Simplify. Assume all variables are positive.

1. $\sqrt[2]{25x^4}$

$\sqrt[2]{(5)^2 x^2 x^2}$

$5xx$

$5x^2$

2. $-\sqrt[2]{225a^8b^{10}}$

$-\sqrt[2]{(3)^2(5)^2(a^4)^2(b^5)^2}$

$-3 \cdot 5 \cdot a^4 \cdot b^5$

$-15a^4b^5$

3. $\sqrt[5]{32x^{15}y^{20}}$

$\sqrt[5]{(2)^5 x^{15} y^{20}}$

$2x^3y^4$

4. $\sqrt[2]{-9}$

$\sqrt{-1 \cdot 9}$

$3i$

Recall: $\sqrt{-1} = i$

5. $\pm\sqrt{16x^6}$

6. $\sqrt[3]{(2y)^6}$

5. $\pm\sqrt{16x^6}$

$\pm\sqrt[2]{16x^6}$

$\pm 4x^3$

6. $\sqrt[3]{(2y)^6}$

$(2y)^2 = 2^2y^2 = 4y^2$

MII : $\sqrt[3]{(2y)^3(2y)^3}$

$2y \cdot 2y$

$4y^2$

7. $\sqrt[3]{-27c^9d^{12}}$

$\sqrt[3]{(-3)^3c^9d^{12}}$

$-3c^3d^4$

8. $\sqrt[3]{\frac{1}{125}}$

$= \frac{\sqrt[3]{1}}{\sqrt[3]{125}} = \frac{1}{\sqrt[3]{(5)^3}} = \frac{1}{5}$

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5. $\pm\sqrt[2]{16x^6}$

6. $\sqrt[3]{(2y)^6}$

7. $\sqrt[3]{-27c^9d^{12}}$

8. $\sqrt[3]{\frac{1}{125}}$