Lesson Title 5.1 n^{th} Roots & Rational Exponents Notes **ALG 2** **Date** _____

OBJECTIVE 1: n^{th} Root

index → $\sqrt[n]{a}$ "nth root of a"

The index "n" can change to whatever it wants. We call them square roots because if there is not a number there it defaults to a 2 for "square." If it is a 3, then it is called a cube root.

The index tells us how many of the same number we need in order for it to come outside of the radical.

ie: $\sqrt[2]{4} = \sqrt[2]{2 \cdot 2} = 2$ *or* $\sqrt[3]{8} = \sqrt[3]{2 \cdot 2 \cdot 2} = 2$ *or* $\sqrt{8} = \sqrt{2 \cdot 2 \cdot 2} = 2\sqrt{2}$

It matters if the "n" is an even number or an odd number when it comes to + and – signs.

TASK 1: Find the indicated real n^{th} root(s) of "a".
Show the set up and then simplify if possible.

a) n = 4 & a = 16

$\sqrt[4]{16} = \sqrt[4]{2 \cdot 2 \cdot 2 \cdot 2}$

$2 \cdot 2 \cdot 2 \cdot 2 = 2$

b) n = 3 & a = - 125

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

$5 \cdot 25$

$5 \cdot 5$

-5

c) n = 5 & a = - 243

$\sqrt[5]{-243}$

-3

$9 \cdot 27$

$3 \cdot 3 \quad 3 \cdot 9$

$3 \cdot 3$

$\sqrt[5]{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3}$

Real nth Roots of a			
n is even		*n is odd*	
a < 0	imaginary	a < 0	$\sqrt[n]{a} = a^{\frac{1}{n}}$
a = 0	0	a = 0	0
a > 0	$\pm\sqrt[n]{a} = \pm a^{\frac{1}{n}}$	a > 0	$\sqrt[n]{a} = a^{\frac{1}{n}}$

OBJECTIVE 2: Rational Exponents

TASK 2:

Evaluate WITHOUT a calculator **and** then with a calculator.

a) $4^{\frac{5}{2}}$

$(\sqrt[2]{4})^5$ or $\sqrt[2]{4^5}$

$(2)^5 = 32$

b) $81^{\frac{3}{4}}$

$(\sqrt[4]{81})^3$ or $\sqrt[4]{81^3}$

$(3)^3 = 27$

c) $(\sqrt[4]{16})^5$ or $\sqrt[4]{16^5}$

$(2)^5 = 32$

Let $a^{\frac{1}{n}}$ be an *n*th root of *a*, and let *m* be a positive integer.

$$a^{\frac{m}{n}} = \left(a^{\frac{1}{n}}\right)^m = \left(\sqrt[n]{a}\right)^m \quad \text{OR} \quad \sqrt[n]{a^m}$$

$$a^{-\frac{m}{n}} = \frac{1}{\left(a^{\frac{1}{n}}\right)^m} = \frac{1}{\left(\sqrt[n]{a}\right)^m}, \; a \neq 0$$

OBJECTIVE 3: Solving Equations with n^{th} Roots

STEPS:

1) Get the exponent alone
2) Use the inverse to "cancel" the exponent
   - A square cancels a square root
   - A cube cancels a cube root
   - A fourth cancels a fourth root

TASK 3: Solve the Equations with the n^{th} Roots

a) $8x^3 = 64$

$\frac{8x^3}{8} = \frac{64}{8}$

$\sqrt[3]{x^3} = \sqrt[3]{8}$ $\quad 4 < 2^2$

$x = 2$

b) $\frac{1}{2}x^5 = 512$ $\cdot 2$

$\sqrt[5]{x^5} = \sqrt[5]{1024}$

$x = 4$

c) $\sqrt[4]{(x+5)^4} = \sqrt[4]{16}$ $\quad 4 < 2^2$

$x + 5 = \sqrt[4]{16}$

$x + 5 = \pm 2$

$-5 \quad -5$

$x = -5 \pm 2$

$-5 + 2 = -3$

$-5 - 2 = -7$

$x = -3, -7$

Still need help with: