Recall: Exponent Laws (same base)

$$(a^x)(a^y) = a^{x+y}$$

$$a^x \div a^y = \frac{a^x}{a^y} = a^{x-y},\ a \neq 0$$

$$a^{-x} = \frac{1}{a^x},\ a \neq 0$$

$$\left(a^x\right)^y = a^{xy}$$

$$a^0 = 1,\ a \neq 0$$

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Recall: Exponent Laws (different base)

$$\left(ab\right)^x = \left(a^x\right)\left(b^x\right)$$

$$\left(\frac{a}{b}\right)^x = \frac{a^x}{b^x},\ b \neq 0$$

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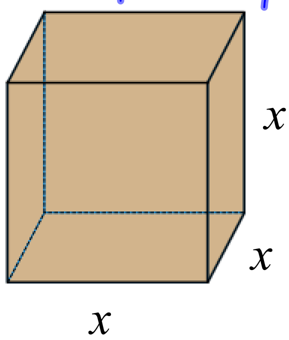
Rational Exponents

April 12/2012

For a cube of side length x,

volume: $V(x) = x^3$

area of a side: $A_{side}(x) = x^2$



How could we represent the side length, x, as a power (i.e., exponential relation) of the volume or area?

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if $V = x^3$

then $x = V^n$

$V = x^3$

$V^1 = (V^n)^3$

$V^1 = V^{3n}$

$\frac{1}{3} = \frac{3n}{3}$

$n = \frac{1}{3}$

Since bases are the same, the exponents must be the same

$x = A^m$

$A = x^2$

$A = (A^m)^2$

$A^1 = A^{2m}$

$1 = 2m$

$m = \frac{1}{2}$

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Summary: A rational exponent is equivalent to a radical.

$(b)^{\frac{1}{n}} = \sqrt[n]{b}$, also called the nth root of b,

where n > 0, n is an integer.

Note: Typical rules/restrictions apply, such as
- cannot divide by zero
- cannot take the square root of a negative

Ex.1 Express in radical notation, then evaluate.

(a) $10000^{\frac{1}{4}}$ (b) $(-8)^{\frac{1}{3}}$ (c) $49^{-\frac{1}{2}}$

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Ex.1 Express in radical notation, then evaluate.

(a) $10000^{\frac{1}{4}}$ (b) $(-8)^{\frac{1}{3}}$ (c) $49^{-\frac{1}{2}}$

(a) $= \sqrt[4]{10000}$

$= 10$

(b) $= \sqrt[3]{-8}$

$= -2$

$(-2)^3$

$= (-2)(-2)(-2)$

$= -8$

(c) $= \dfrac{1}{49^{\frac{1}{2}}}$

$= \dfrac{1}{\sqrt[2]{49}}$

$= \dfrac{1}{7}$

by convention, do not write 2

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Ex.2 Express in radical notation, then evaluate.

(a) $27^{\frac{2}{3}}$ $= \left(27^{\frac{1}{3}}\right)^2$

$= \left(\sqrt[3]{27}\right)^2$ $= \sqrt[3]{27^2}$

$= (3)^2$

$= 9$

$\frac{1}{3} \times \frac{2}{1} = \frac{2}{3}$

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Ex.2 Express in radical notation, then evaluate.

(b) $(-27)^{\frac{4}{3}}$ $= \left[(-27)^{\frac{1}{3}}\right]^4$

$= \left(\sqrt[3]{-27}\right)^4$

$= (-3)^4$

$= 81$

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Summary: The numerator of a rational exponent may be a value other than 1. Use exponent laws to express as a combination of a power and a radical.

$$(b)^{\frac{m}{n}} = \left(\sqrt[n]{b}\right)^{m} = \sqrt[n]{b^{m}}$$

where n and m are integers, n > 0, m > 0

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<u>Even & Odd Roots</u>

Recall: It is not possible to take the <u>square root</u> of a negative number. Why?

No number multiplied by itself would be negative.

Similarly, you cannot take any even root (2, 4, 6, etc) of a negative number.

With odd roots (3, 5, 7, etc), it is possible to have positive or negative values under the root.

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Assigned Work:

handout # (1-6)(odd), 8, 10, 12, 14

2e, 6e 14a
3c
4c

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2(e) $\sqrt[5]{-\frac{32}{243}} = \left(-\frac{32}{243}\right)^{\frac{1}{5}}$

$= \frac{(-32)^{1/5}}{(243)^{1/5}}$

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

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3(c) $(-11)^2(-11)^{3/4}$

$= (-11)^{2+\frac{3}{4}}$

$= (-11)^{11/4}$

DNE

$2 + \frac{3}{4}$

$= \frac{8}{4} + \frac{3}{4}$

$= \frac{11}{4}$

$(-(11^2))(-(11^{3/4}))$

$= +11^{11/4}$

$-2^2 = -4$ $\quad (-2)^2 = 4$

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4(c) $\frac{\sqrt{28}\sqrt{4}}{\sqrt{7}} = \sqrt{\frac{28 \cdot 4}{7}}$

$= \sqrt{\frac{4 \cdot 4}{1}}$

$= \sqrt{16}$

$= 4$

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6(e) $\dfrac{(16^{-2.5})^{-0.2}}{16^{3/4}} = \dfrac{(16^{-5/2})^{-\frac{1}{5}}}{16^{3/4}}$

$-\dfrac{\cancel{5}^{1}}{2} \times -\dfrac{1}{\cancel{5}_{1}}$

$= +\dfrac{1}{2}$

$= \dfrac{16^{1/2}}{16^{3/4}}$

$= 16^{\frac{1}{2}-\frac{3}{4}}$

$= 16^{\frac{2}{4}-\frac{3}{4}}$

$= 16^{-\frac{1}{4}}$

$= \dfrac{1}{16^{1/4}}$

$= \dfrac{1}{\sqrt[4]{16}}$

$= \dfrac{1}{2}$

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14(a) $9^{\frac{1}{2}} + 4^{\frac{1}{2}} = (9+4)^{\frac{1}{2}}$?

$x^n + y^n = (x+y)^n$?

$LS = 9^{1/2} + 4^{1/2}$

$= 3 + 2$

$= 5$

$RS = (9+4)^{1/2}$

$= (13)^{1/2}$

$= \sqrt{13}$

$LS \neq RS$

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