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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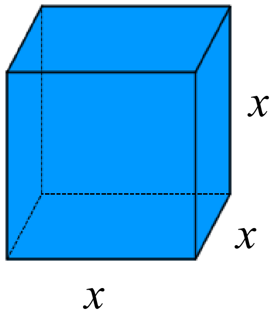
Rational Exponents

Apr. 4/2019

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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$x = V^n$	$x = A^m$
Start with : $V = x^3$	
$V = x^3$	$A = x^2$
$V = (V^n)^3$	$A = (A^m)^2$
$V^1 = V^{3n}$	$A^1 = A^{2m}$
$\Rightarrow 1 = 3n$	$\Rightarrow 1 = 2m$
implies $n = \frac{1}{3}$	$m = \frac{1}{2}$
$\therefore x = V^{\frac{1}{3}}$	$\therefore x = A^{\frac{1}{2}}$
OR	OR
$x = \sqrt[3]{V}$	$x = \sqrt{A}$

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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 even 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) $49^{-\frac{1}{2}}$

$= \sqrt[4]{10000}$

$= 10$

$= \sqrt[3]{-8}$

$= -2$

$= \dfrac{1}{49^{\frac{1}{2}}}$

$= \dfrac{1}{\sqrt{49}}$

$= \dfrac{1}{7}$

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Ex.2 Express in radical notation, then evaluate.

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

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

$= (3)^2$

$= 9$

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

OR

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

OR

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

$= (729)^{\frac{1}{3}}$

$= \sqrt[3]{729}$

$= 9$

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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

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Even & Odd Roots

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

No number multiplied by itself will 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

6ae a a
3ceb f

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

$= (-11)^{2+\frac{3}{4}}$ $= \frac{8}{4}+\frac{3}{4}$

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

(e) $\frac{9^{-\frac{1}{5}}}{9^{\frac{2}{3}}} = 9^{-\frac{1}{5}-\left(\frac{2}{3}\right)}$ $-\frac{1}{5}-\frac{2}{3}$

$= 9^{-\frac{13}{15}}$ $= \frac{-3-10}{15}$

$= \frac{-13}{15}$

(b) $8^{\frac{2}{3}} \div 8^{\frac{1}{3}} = 8^{\frac{2}{3}-\frac{1}{3}}$

$= 8^{\frac{1}{3}}$

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6ae

(a) $4^{\frac{1}{5}}(4^{0.3}) = 4^{\frac{1}{5}+0.3}$

$= 4^{\frac{1}{5}+\frac{3}{10}}$ $\frac{2\times 1}{2\times 5} = \frac{2}{10}$

$= 4^{\frac{2}{10}+\frac{3}{10}}$

$= 4^{\frac{5}{10}}$

$= 4^{\frac{1}{2}}$

$= \sqrt{4}$

$= 2$

(e) $\frac{\left(16^{-2.5}\right)^{-0.2}}{16^{\frac{3}{4}}} = \frac{\left(16^{-\frac{5}{2}}\right)^{-\frac{2}{10}}}{16^{3/4}}$

$= \frac{16^{\left(-\frac{5}{2}\right)\left(-\frac{2}{10}\right)}}{16^{3/4}}$

$\frac{1}{2}-\frac{3}{4}$

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

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

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

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

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

$= \frac{1}{2}$

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12(a) $-(256)^{0.375} = -8$

14 a f

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

$LS = 9^{\frac{1}{2}} + 4^{\frac{1}{2}}$
$= \sqrt{9} + \sqrt{4}$
$= 3+2$
$= 5$

$RS = (9+4)^{\frac{1}{2}}$
$= (13)^{\frac{1}{2}}$
$= \sqrt{13}$
$\neq 5$

$LS \neq RS$

(f) $\left[\left(x^{\frac{1}{3}}\right)\left(y^{\frac{1}{3}}\right)\right]^6 = x^2y^2$?

$LS = \left[(xy)^{\frac{1}{3}}\right]^6$
$= (xy)^2$
$= x^2y^2$
$= RS$

$\left(a^{\frac{1}{3}}\right)^6$
$= a^2$

$LS = RS$
$\therefore$ true.

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