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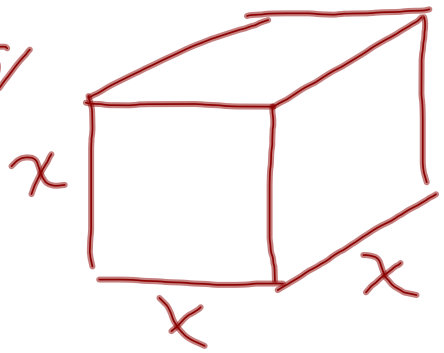
CUBE



$V = 200\text{cm}^3$

$(x)(x)(x) = 200$

$\sqrt[3]{x^3} = \sqrt[3]{200}$

$x = \sqrt[3]{200}$

$x = \sqrt[3]{8 \times 25}$

$x = \sqrt[3]{8} \cdot \sqrt[3]{25}$

$\boxed{x = 2\sqrt[3]{25}\text{ cm}}$

$V = lwh$

$\sqrt{a^2} = \sqrt{81}$

$a = 9$

20. $8\sqrt[3]{2} = 8 \cdot \sqrt[3]{2}$ I

$= \sqrt[3]{2} \cdot \sqrt[3]{2}$ II → $\sqrt[3]{8^3 \cdot 2}$

$\sqrt[3]{512}$ $= \sqrt[3]{2 \cdot 2}$ III

$= \sqrt[3]{4}$ IV

4.4 Fractional Exponents and Radicals

LESSON FOCUS Relate rational exponents and radicals.

Make Connections

Coffee, tea, and hot chocolate contain caffeine. The expression $100(0.87)^{\frac{1}{2}}$ represents the percent of caffeine left in your body $\frac{1}{2}$ h after you drink a caffeine beverage.

Given that $0.87^1 = 0.87$ and $0.87^0 = 1$, how can you estimate a value for $0.87^{\frac{1}{2}}$?

Recall from past work with exponents...

Make Connections

Recall the exponent laws for integer bases and whole number exponents.

Product of powers:	$a^m \cdot a^n = a^{m+n}$
Quotient of powers:	$a^m \div a^n = a^{m-n}$, $a \neq 0$
Power of a power:	$(a^m)^n = a^{mn}$
Power of a product:	$(ab)^m = a^m b^m$
Power of a quotient:	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$, $b \neq 0$

$(x^3)^6 = x^{18}$

x^9

$(x^3y^4)^3 = x^9y^{12}$

How about zero as an exponent?

$b^0 = 1$

$(a^2+b^3)^2 = a^4+b^6$

$(a^2+b^3)(a^2+b^3)$

$2^0 = 1$

$2^0 = 1$

$2^1 = 2$

$2^2 = 4$

$5^0 = 1$

$5^1 = 5$

$5^2 = 25$

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

$= 2^0$

$= 1$

Connecting Radicals and Exponents:

$\sqrt{a} \times \sqrt{b} = \sqrt{ab}$

Time to continue our development of the properties of radicals…

What is the value of each of the following:

$5^{\frac{1}{2}} \cdot 5^{\frac{1}{2}} = 5^1$

$\sqrt{5} \bullet \sqrt{5} = \sqrt{25} = 5$

$(\sqrt{5})^2 = 5$

$5^{1/2} \cdot 5^{1/2} = 5^1$

$\sqrt[3]{3} \times \sqrt[3]{3} \times \sqrt[3]{3} = \sqrt[3]{27} = 3$

How about the following:

$x^{\frac{1}{2}} \bullet x^{\frac{1}{2}} = x^1$

$\pi^{\frac{1}{3}} \bullet \pi^{\frac{1}{3}} \bullet \pi^{\frac{1}{3}} = \pi^1$

$x^{1/2} = \sqrt{x}$

$x^{1/n} = \sqrt[n]{x}$

Based on the previous slide it would seem that...

$\sqrt{x} = x^{\frac{1}{2}}$ $\qquad$ $\sqrt[3]{x} = x^{\frac{1}{3}}$

Generally then... $\sqrt[n]{x} = x^{\frac{1}{n}}$

Powers with Rational Exponents with Numerator 1

When n is a natural number and x is a rational number, $x^{\frac{1}{n}} = \sqrt[n]{x}$

ex. $16^{1/2} = \sqrt{16} = 4$ $\qquad$ $27^{1/3} = \sqrt[3]{27} = 3$

What about when numerator in NOT a 1??

ie. Something like $8^{\frac{5}{3}}$??

$5 \cdot \frac{1}{3}$

Let's relate back to exponent laws...which one would help?

5

$?$

$(m^2)^{?} = m^{\frac{10}{2}}$

$(8^{1/3})^5 = 8^{5/3}$

$(\sqrt[3]{8})^5$ OR $(8^5)^{1/3} = 8^{5/3}$

$(2)^5$

$= 32$

$\sqrt[3]{8^5}$

Important Property!!

Powers with Rational Exponents

When m and n are natural numbers, and x is a rational number,

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

NO CALCULATOR…Evalute the following:

$0.25 = \frac{1}{4}$

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

$36^{\frac{1}{2}} = \sqrt{36} = 6$

$16^{-0.25} = 16^{1/4} = \sqrt[4]{16} = 2$

$27^{\frac{2}{3}} = \left(\sqrt[3]{27}\right)^2 = 3^2 = 9$

$32^{\frac{6}{5}} = \left(\sqrt[5]{32}\right)^6 = (2^6) = 64$

$125^{\frac{4}{3}} = \left(\sqrt[3]{125}\right)^4 = 5^4$

$4^{1.5} = 4^{3/2} = \left(\sqrt{4}\right)^3 = 8$

$(-10)^{3/5} = \left(\sqrt[5]{-10}\right)^3$

Practice Problems...

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