



Laws of Exponents

Review From Gr. 9

Product of powers law: $a^m \cdot a^n = a^{m+n}$

Quotient of powers law: $\frac{a^m}{a^n} = a^{m-n}$

Power of a power law: $(a^m)^n = a^{mn}$

$$a^0 = 1$$

Write as a single power.


a) $3^2 \cdot 3^5 = 3^{2+5} = 3^7$

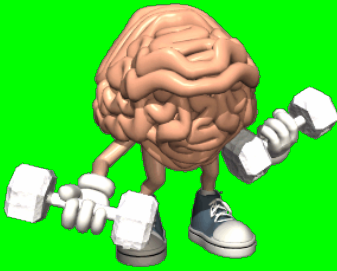
b) $(4^2)^5 = 4^{2 \times 5} = 4^{10}$

c) $(-5)^{10} \div (-5)^8 = (-5)^{10-8} = (-5)^2$



Homework Questions???

 Page 218-219 #11j, 12b,d,f,h,i, 19(a,b,c), 20, 21, 22a, 23



Warm Up

A
 x^y
 y^x
 \square^{\square}

Name: _____

Period: _____

Simplify then evaluate

$$1) (2^4)^3$$

$$= 2^{12}$$

$$= 4096$$

$$2) [(-5)^2 \times 2]^3$$

$$(-5)^6 \times (2)^3$$

$$15625 \times 8$$

$$125000$$

$$3) [(-1)^{11}]^3$$

$$= (-1)^{33}$$

$$= -1$$

Write each expression as a product or quotient of powers. Then evaluate.

$$1) [(-3) \times (5)]^2$$

$$(-3)^2 \times (5)^2$$

$$= 9 \times 25$$

$$= 225$$

$$2) \left(\frac{6}{5}\right)^4$$

$$= \frac{6^4}{5^4}$$

$$= \frac{1296}{625}$$

Save for review tomorrow

Math 10: Numbers, Functions & Relations

Name _____



Laws of Exponents Review

Date _____

Simplify. Your answer should contain only positive exponents.

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

2) $\left(\frac{2^8}{2^3 \cdot 2^3}\right)^4$

3) $\frac{2^2}{4^2}$

4) $\frac{(2^3 \cdot 2^4)^4}{2}$

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 $0.87^{\frac{1}{2}}$?



★ Use a calculator to complete the table.

$A^{1/2}$

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

Column 1	Column 2
x	$x^{1/2}$
1	$1^{1/2} =$
4	$4^{1/2} = 4^{0.5} = 2$
9	$9^{1/2} = 3$
16	$16^{1/2} = 4$
25	$25^{1/2} = 5$

a) What do you notice about the numbers in the first column?

b) Compare the numbers in the first and second columns. What conclusions can you make?

c) What do you think the exponent $\frac{1}{2}$ means?

★ Use a calculator to complete the table.

$$x^{1/3} = \sqrt[3]{x}$$

Column 1 Column 2 Column 3

x	$x^{1/3}$
1	$1^{1/3} = 1^{0.333} = 1$
8	$8^{1/3} = \sqrt[3]{8} = 2$
27	$\sqrt[3]{27} = 3$
64	
125	

a) What do you notice about the numbers in the first column?

b) Compare the numbers in the first and second columns. What conclusions can you make?

c) What do you think the exponent $\frac{1}{3}$ means?

★ What do you think $a^{\frac{1}{4}}$ and $a^{\frac{1}{5}}$ mean?

$$a^{\frac{1}{4}} = \sqrt[4]{a}$$

$$a^{\frac{1}{5}} = \sqrt[5]{a}$$

What does $a^{\frac{1}{n}}$ mean? Explain your reasoning.

$$a^{\frac{1}{n}} = \sqrt[n]{a}$$

Rational Exponents and Radicals ☆

Let's examine radicals...

$$(\sqrt{5})^2 = \sqrt{5} \times \sqrt{5} = \sqrt{5 \times 5} = \sqrt{25} = 5$$

How would this play out with exponent laws?

$$5^? \times 5^? = 5^1$$

$$5^{0.5} \times 5^{0.5}$$

$$5^{0.5} = 5^{1/2}$$

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

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

What about other rational exponents and radicals?

$$8^{1/3} \times 8^{1/3} \times 8^{1/3} = 8^{1/3 + 1/3 + 1/3} = 8^1 = 8$$

Rule: $\sqrt[3]{x} = x^{1/3}$

In general... $(\sqrt[n]{x})^m$ OR $\sqrt[n]{x^m} = x^{m/n}$

Rational Exponents

- To evaluate exponents that are rational (fractions), the denominator of the fraction indicates which root to take and the numerator indicates which power the entire base is to be raised.

Example

$$16^{1/4}$$

← exponent
← index

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

$$= 2$$

$$125^{1/3}$$

← exponent
← index

$$= \sqrt[3]{125}$$

$$= 5$$

$$125^{2/3}$$

← exponent
← index

$$= (\sqrt[3]{125})^2$$

$$= 5^2$$

$$= 25$$



Example 1

Evaluating Powers of the Form $a^{\frac{1}{n}} = \sqrt[n]{a}$

Evaluate each power without using a calculator.

a) $27^{\frac{1}{3}}$

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

b) $0.49^{\frac{1}{2}}$

$= \sqrt{0.49}$
 $= \frac{\sqrt{49}}{\sqrt{100}}$
 $= \frac{7}{10}$
 $= 0.7$

c) $(-64)^{\frac{1}{3}}$

$= \sqrt[3]{-64}$
 $= -4$

d) $(\frac{4}{9})^{\frac{1}{2}}$

$= \frac{\sqrt{4}}{\sqrt{9}}$
 $= \frac{2}{3}$

applies to both top and bottom



CHECK YOUR UNDERSTANDING



Exponential form

$$X^{\frac{m}{n}}$$

Power
exponent

Root
index

=

Radical form

$$\left(\sqrt[n]{X}\right)^m$$

Write the following in radical form and evaluate.

Ex) $8^{\frac{2}{3}}$

If Exponent is a decimal, then rewrite exponent as a fraction (Reduce Fraction)

$$32^{0.2} =$$

Examples: Express each exponential in radical form, then evaluate.



$$\begin{aligned} 1. \quad 8^{\frac{2}{3}} &= (\sqrt[3]{8})^2 \\ &= 2^2 \\ &= 4 \end{aligned}$$

$$\begin{aligned} 2. \quad 125^{-\frac{1}{3}} &= \sqrt[3]{125} \\ &= 5 \end{aligned}$$

$$\begin{aligned} 3) \quad -32^{0.4} &\leftarrow \text{turn into fraction} \\ &= -32^{\frac{4}{10}} \text{ Reduce fraction} \\ &= -32^{\frac{2}{5}} \\ &= (\sqrt[5]{-32})^2 \\ &= (2)^2 \\ &= 4 \end{aligned}$$



Express as a exponent:

a) $\sqrt[5]{32}$

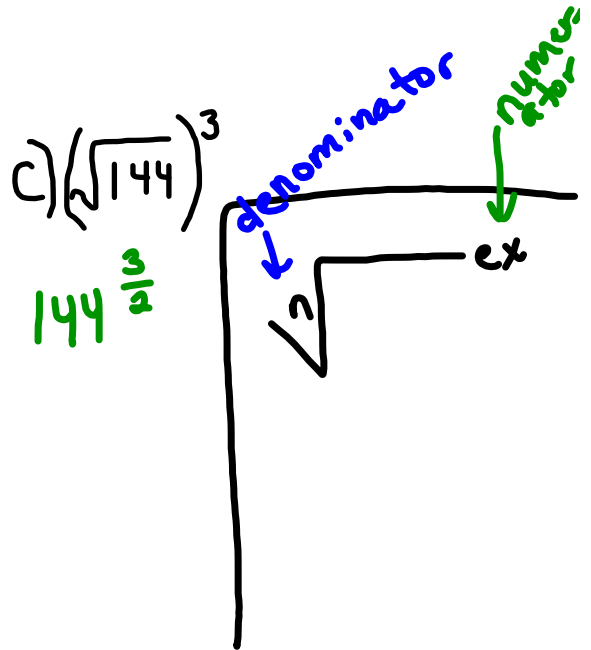
$32^{\frac{1}{5}}$

b) $\sqrt[3]{-64}$

$(-64)^{\frac{1}{3}}$

c) $(\sqrt{144})^3$

$144^{\frac{3}{2}}$



Express as a Radical:

a) $8^{\frac{5}{3}}$

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

$\sqrt[4]{729^2}$

b) $49^{\frac{3}{2}}$

$= (\sqrt{49})^3$

$729^{\frac{2}{4}}$

c) $(-125)^{\frac{2}{3}}$

$(\sqrt[3]{-125})^2$

Homework

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4.4 Fractional Exponents and Radicals

Exercises

- A**
- 3 4 5 6 7
- B**
- 8 9 10 11 12 13 14 15
- 16 17 18 19 20 21
- C**
- 22

#3 a d f
#4 a c d
#5 a b c
#6 a c
#8 a b c
#9
#12 a b f
#15

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