Warm Up

Write each expression using an exponent.

1. $2 \cdot 2 \cdot 2$

2. $x \cdot x \cdot x \cdot x$

3. $\frac{1}{4 \cdot 4}$

Write each expression without using an exponent.

4. 4^3

5. y^2

6. m^{-4}

Homework - Rational Exponents WS

1) $(\sqrt[4]{2})^3$ 2) $(\sqrt[3]{7})^4$ 3) $(\sqrt[3]{7})^2$ 4) $6^{\frac{4}{3}}$

5) $10^{\frac{1}{6}}$ 6) $4^{\frac{2}{3}}$ 7) 9 8) 27

9) 729 10) 625

Objective

Use multiplication properties of exponents to evaluate and simplify expressions.

Simplified Exponential Expressions

An exponential expression is completely simplified if...

- There are no negative exponents.
- The same base does not appear more than once in a product or quotient.
- No powers are raised to powers.
- No products are raised to powers.
- No quotients are raised to powers.
- Numerical coefficients in a quotient do not have any common factor other than 1.

Examples	Nonexamples
$\frac{b}{a}$ x^3 z^{17} a^2b^4 $\frac{\sqrt{5}}{\sqrt{3}}$ $\frac{5a^2}{2b}$	e^{-2ba} $x \cdot x^2$ $(z^3)^{10}$ $(ab)^4$ $\left(\frac{3}{11}\right)^5$ $\frac{10x^6}{4b}$

When you multiply powers w the same base, add exponents.

Products of powers with the same base can be found by writing each power as a repeated multiplication.

$3^5 \cdot 3^2 = (3 \cdot 3 \cdot 3 \cdot 3 \cdot 3) \cdot (3 \cdot 3) = 3^7$

Notice the relationship between the exponents in the factors and the exponents in the product $5 + 2 = 7$.

Product of Powers Property

WORDS	NUMBERS	ALGEBRA
The product of two powers with the same base equals that base raised to the sum of the exponents.	$6^3 \cdot 6^4 = 6^{7+4} = 6^{11}$	If a is a nonzero real number and m and n are integers, then $a^m \cdot a^n = a^{m+n}$.

Example 1: Finding Products of Powers

Simplify.

A. $3^2 \cdot 3^5$

B. $2^4 \cdot 3^4 \cdot 2^{-2} \cdot 3^2$

$2^2 \cdot 36$

$4 \cdot 729 = 2916$

C. $q^3 \cdot r^2 \cdot q^6$

$q^9 \cdot r^2$

D. $n^3 \cdot n^{-4} \cdot n$

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Remember!

A number or variable written without an exponent actually has an exponent of 1.

$10 = 10^1$

$y = y^1$

Check It Out! Example 1

Simplify.

a. $7^8 \cdot 7^4$

b. $3^{-3} \cdot 5^8 \cdot 3^4 \cdot 5^2$

c. $m \cdot n^{-4} \cdot m^4$

d. $x \cdot x^{-1} \cdot x^{-3} \cdot x^{-4}$

Simplify.

1. $x^4y^3x^{-7}x^{-2}y$

$x^{-5}y^4$ $\quad \frac{y^4}{x^5}$

2. $\frac{x^{-3}}{y^{-5}}$ $\quad \frac{y^5}{x^3}$

3. $x^6y^{-4}x^2$

$\frac{x^8}{y^4}$

Power of a Power Property

WORDS	NUMBERS	ALGEBRA
A power raised to another power equals that base raised to the product of the exponents.	$(6^2)^4 = 6^8 = 6^{2 \cdot 4}$	If a is any nonzero real number and m and n are integers, then $(a^m)^n = a^{mn}$

* When you have a power raised to a power multiply the exponents.

Example 3: Finding Powers of Powers

Simplify.

A. $(5^2)^4 = 5^8$

B. $(4^3)^0 = 1$

C. $(x^3)^{-5} \cdot x^4$

$\frac{1}{x^{11}}$

Check It Out! Example 3

Simplify.

a. $(3^4)^5$ $= 3^{20}$

b. $(6^0)^3$ $= 1$

c. $(a^3)^4 \cdot (a^{-2})^{-3}$ a^{18}

Homework

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Objective

Use multiplication properties of exponents to evaluate and simplify expressions.

Powers of products can be found by using the meaning of an exponent.

$(8x)^3 = 8x \cdot 8x \cdot 8x = 8 \cdot 8 \cdot 8 \cdot x \cdot x \cdot x = 8^3x^3 = 512x^3$

Powers of Products (7.3.4)

WORDS	NUMBERS	ALGEBRA
A product raised to a power equals the product of each factor raised to that power.	$(2 \cdot 4)^3 = 2^3 \cdot 4^3$ $= 8 \cdot 64$ $= 512$	If a and b are any nonzero real numbers and n is any integer, then $(ab)^n = a^n b^n$.

Example 4: Finding Powers of Products

Simplify.

A. $-(2y)^2$

B. $(-2y)^3$

C. $(x^6 \cdot y^{-3})^2$

Check It Out! Example 4

Simplify.

a. $(4p)^3$

b. $(-5t^2)^2$

c. $(x^2y^3)^4 \cdot (x^2y^4)^{-4}$

Lesson Quiz: Part I

Simplify.

1. $3^2 \cdot 3^4$
2. $z^4 \cdot z^{-2} \cdot z$
3. $(x^3)^2$
4. $-(t^{-3})^5$
5. $(5g)^3$
6. $\left(-3f^{-4}\right)^2$
7. $\left(x^2y\right)^3 \cdot \left(x^3y^2\right)^{-2}$

Daily Practice

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