8.1 Apply Exponent Properties Involving Products

Goal • Use properties of exponents involving products.

Your Notes

VOCABULARY

Order of magnitude The order of magnitude of a quantity is the power of 10 nearest the quantity.

PRODUCT OF POWERS PROPERTY

Let a be a real number, and let m and n be positive integers.

Words: To multiply powers having the same base, add the exponents.

Algebra: $a^m \cdot a^n = a^{m+n}$

Example: $5^6 \cdot 5^3 = 5^{6+3} = 5^9$

Example 1 ***Use the product of powers property***

Simplify the expression.

a. $2^2 \cdot 2^3 = 2^{2+3}$

$= 2^5$

b. $w^9 \cdot w^2 \cdot w^7 = w^{9+2+7}$

$= w^{18}$

When simplifying powers with numerical bases only, write your answers using exponents.

c. $4^4 \cdot 4 = 4^4 \cdot 4^1$

$= 4^{4+1}$

$= 4^5$

d. $(-6)(-6)^6 = (-6)^1 \cdot (-6)^6$

$= (-6)^{1+6}$

$= (-6)^7$

Your Notes

POWER OF A POWER PROPERTY

Let a be a real number, and let m and n be positive integers.

Words: To find a power of a power, multiply exponents.

Algebra: $(a^m)^n = a^{mn}$

Example: $(3^4)^2 = 3^{4 \cdot 2} = 3^8$

Example 2 *Use the power of a power property*

Simplify the expression.

a. $(5^2)^3 = 5^{2 \cdot 3} = 5^6$

b. $(n^7)^2 = n^{7 \cdot 2} = n^{14}$

c. $[(-3)^5]^3 = (-3)^{5 \cdot 3}$

$= (-3)^{15}$

d. $[(z - 4)^2]^5 = (z - 4)^{2 \cdot 5}$

$= (z - 4)^{10}$

POWER OF A PRODUCT PROPERTY

Let a and b be real numbers, and let m be a positive integer.

Words: To find a power of a product, find the power of each factor and multiply.

Algebra: $(ab)^m = a^m b^m$

Example: $(23 \cdot 17)^5 = 23^5 \cdot 17^5$

Example 3 *Use the power of a product property*

Simplify the expression.

a. $(4 \cdot 16)^7 = 4^7 \cdot 16^7$

b. $(-3rs)^2 = (-3 \cdot r \cdot s)^2 = (-3)^2 \cdot r^2 \cdot s^2$

$= 9r^2s^2$

c. $-(3rs)^2 = -(3 \cdot r \cdot s)^2 = -(3^2 \cdot r^2 \cdot s^2)$

$= -9r^2s^2$

When simplifying powers with numerical and variable bases, evaluate the numerical power.

Your Notes

Checkpoint Simplify the expression.

1. $(-7)^8(-7)^5$ $(-7)^{13}$	2. $k^3 \cdot k \cdot k^2$ k^6	3. $(p^3)^4$ p^{12}
4. $[(q+8)^2]^6$ $(q+8)^{12}$	5. $(8cd)^2$ $64c^2d^2$	6. $-(5z)^3$ $-125z^3$

Example 4 *Use all three properties*

Simplify $x^2 \cdot (3x^3y)^3$.

Solution

$x^2 \cdot (3x^3y)^3 = x^2 \cdot 3^3 \cdot (x^3)^3 \cdot y^3$ Power of a product property

$= x^2 \cdot 27 \cdot x^9 \cdot y^3$ Power of a power property

$= 27x^{11}y^3$ Product of powers property

Checkpoint Simplify the expression.

7. $(2x^5)^4$ $16x^{20}$	8. $(3y^3)^4 \cdot y^5$ $81y^{17}$

Homework