Properties of Exponents

Warm Up

Problem of the Day

Lesson Presentation

Lesson Quizzes

Properties of Exponents

Warm Up

Evaluate.

1. 3^3 27

2. $4 \cdot 4 \cdot 4 \cdot 4$ 256

3. b^2 for $b = 4$ 16

4. n^2r for $n = 3$ and $r = 2$ 18

Problem of the Day

Calculate 6 to the fourth power minus 56.

1240

Properties of Exponents

Learn to apply the properties of exponents.

Properties of Exponents

The factors of a power, such as 7^4, can be grouped in different ways. Notice the relationship of the exponents in each product.

$$7 \cdot 7 \cdot 7 \cdot 7 = 7^4$$

$$(7 \cdot 7 \cdot 7) \cdot 7 = 7^3 \cdot 7^1 = 7^4$$

$$(7 \cdot 7) \cdot (7 \cdot 7) = 7^2 \cdot 7^2 = 7^4$$

Properties of Exponents

MULTIPLYING POWERS WITH THE SAME BASE		
Words	**Numbers**	**Algebra**
To multiply powers with the same base, keep the base and add the exponents.	$3^5 \cdot 3^8 = 3^{5+8} = 3^{13}$	$b^m \cdot b^n = b^{m+n}$

Additional Example 1: Multiplying Powers with the Same Base

Multiply. Write the product as one power.

A. $6^6 \cdot 6^3$

6^{6+3} *Add exponents.*

6^9

B. $n^5 \cdot n^7$

n^{5+7} *Add exponents.*

n^{12}

Additional Example 1: Multiplying Powers with the Same Base Continued

Multiply. Write the product as one power.

C. $2^5 \cdot 2$

2^{5+1} *Think:* $2 = 2^1$

2^6 *Add exponents.*

D. $24^4 \cdot 24^4$

24^{4+4} *Add exponents.*

24^8

Check It Out: Example 1

Multiply. Write the product as one power.

A. $4^2 \cdot 4^4$

4^{2+4} *Add exponents.*

4^6

B. $x^2 \cdot x^3$

x^{2+3} *Add exponents.*

x^5

Check It Out: Example 1

Multiply. Write the product as one power.

C. $x^5 \bullet y^2$

$x^5 \bullet y^2$ *Cannot combine; the bases are not the same.*

D. $41^2 \bullet 41^7$

41^{2+7} *Add exponents.*

41^9

Properties of Exponents

Notice what occurs when you divide powers with the same base.

$$\frac{5^5}{5^3} = \frac{5 \cdot 5 \cdot 5 \cdot 5 \cdot 5}{5 \cdot 5 \cdot 5} = \frac{\cancel{5} \cdot \cancel{5} \cdot \cancel{5} \cdot 5 \cdot 5}{\cancel{5} \cdot \cancel{5} \cdot \cancel{5}} = 5 \cdot 5 = 5^2$$

DIVIDING POWERS WITH THE SAME BASE		
Words	**Numbers**	**Algebra**
To divide powers with the same base, keep the base and subtract the exponents.	$\frac{6^9}{6^4} = 6^{9-4} = 6^5$	$\frac{b^m}{b^n} = b^{m-n}$

Additional Example 2: Dividing Powers with the Same Base

Divide. Write the quotient as one power.

A. $\dfrac{7^5}{7^3}$

7^{5-3} *Subtract exponents.*

7^2

B. $\dfrac{x^{10}}{x^9}$

x^{10-9} *Subtract exponents.*

x *Think: $x^1 = x$*

Properties of Exponents

Check It Out: Example 2

Divide. Write the product as one power.

A. $\dfrac{9^9}{9^2}$

9^{9-2} *Subtract exponents.*

9^7

B. $\dfrac{e^{10}}{e^5}$

e^{10-5} *Subtract exponents.*

e^5

Properties of Exponents

RAISING A POWER TO A POWER		
Words	Numbers	Algebra
To raise a power to a power, keep the base and multiply the exponents.	$(9^4)^5 = 9^{4 \cdot 5} = 9^{20}$	$(b^m)^n = b^{m \cdot n}$

Reading Math

$(9^4)^5$ is read as "nine to the fourth, to the fifth."

Properties of Exponents

Additional Example 3: Raising a Power to a Power

Simplify.

A. $(5^4)^2$

$(5^4)^2$

$5^{4 \cdot 2}$ *Multiply exponents.*

5^8

B. $(6^7)^9$

$(6^7)^9$

$6^{7 \cdot 9}$ *Multiply exponents.*

6^{63}

Properties of Exponents

Additional Example 3: Raising a Power to a Power

Simplify.

C. $\left(\left(\frac{2}{3}\right)^{12}\right)^{-3}$

Multiply exponents.

$\left(\frac{2}{3}\right)^{12 \cdot -3}$

$\left(\frac{2}{3}\right)^{-36}$

D. $(17^2)^{-20}$

$(17^2)^{-20}$

Multiply exponents.

$17^{2 \cdot -20}$

17^{-40}

Check It Out: Example 3

Simplify.

A. $(3^3)^4$

$(3^3)^4$

$3^{3 \cdot 4}$ *Multiply exponents.*

3^{12}

B. $(4^8)^2$

$(4^8)^2$

$4^{8 \cdot 2}$ *Multiply exponents.*

4^{16}

Check It Out: Example 3

Simplify.

C. $\left(\left(\frac{1}{4}\right)^{11}\right)^{-2}$

Multiply exponents.

$\left(\frac{1}{4}\right)^{11 \cdot -2}$

$\left(\frac{1}{4}\right)^{-22}$

D. $(13^4)^{-10}$

$(13^4)^{-10}$

Multiply exponents.

$13^{4 \cdot -10}$

13^{-40}

Lesson Quizzes

Standard Lesson Quiz

Lesson Quiz for Student Response Systems

Properties of Exponents

Lesson Quiz

Write the product or quotient as one power.

1. $n^3 \times n^4$ n^7

2. $8 \cdot 8^8$ 8^9

3. $\frac{10^9}{10^5}$ 10^4

4. $\frac{t^9}{t^7}$ t^2

5. $3^2 \cdot 3^3 \cdot 3^5$ 3^{10}

6. $(m^2)^{19}$ m^{38}

7. $(9^{-8})^9$ 9^{-72}

8. $(10^4)^0$ 1

Properties of Exponents

Lesson Quiz for Student Response Systems

1. Write the product as one power.

$d^4 \times d^3$

A. d^7

B. d^{12}

C. $7d$

D. $12d$

Properties of Exponents

Lesson Quiz for Student Response Systems

2. Write the product as one power.

$4^4 \times 4^3 \times 4^2$

A. 4^9

B. 4^{14}

C. 4^{24}

D. 4^{432}

Properties of Exponents

Lesson Quiz for Student Response Systems

3. Write the product as one power.
$(10^{-1})^0$

A. 10^{-10}

B. 0

C. 1

D. 10