

### 7-4 Division Properties of Exponents

Warm Up

Lesson Presentation

Lesson Quiz

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### 7-4 Division Properties of Exponents

A power of a quotient can be found by first writing the numerator and denominator as powers.

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

$\frac{2^3}{3} = \frac{8}{3}$

Notice that the exponents in the final answer are the same as the exponent in the original expression.

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### 7-4 Division Properties of Exponents

DACB     $\sqrt{\quad} =$      $A =$      $B =$      $L =$

**Positive Power of a Quotient Property**

WORDS	NUMBERS	ALGEBRA
A quotient raised to a positive power equals the quotient of each base raised to that power.	$\left(\frac{3}{5}\right)^4 = \frac{3}{5} \cdot \frac{3}{5} \cdot \frac{3}{5} \cdot \frac{3}{5} = \frac{3 \cdot 3 \cdot 3 \cdot 3}{5 \cdot 5 \cdot 5 \cdot 5} = \frac{3^4}{5^4}$	If $a$ and $b$ are nonzero real numbers and $n$ is a positive integer, then $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$ .

S =                      P =    C =

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### 7-4 Division Properties of Exponents

Example 4A: Finding Positive Powers of Quotient

**Simplify.**

$$\left(\frac{4}{7}\right)^2 = \frac{4^2}{7^2} = \frac{16}{49}$$

$\frac{16}{7}$

Use the Power of a Quotient Property.

Simplify.

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**7-4 Division Properties of Exponents**

**Example 4B: Finding Positive Powers of Quotient**

Simplify.

$$\left(\frac{3d^2}{ef}\right)^4$$

*Handwritten:*  $\frac{d^8}{e^4 f^4} = \frac{81d^8}{e^4 f^4}$

$$\begin{aligned} \left(\frac{3d^2}{ef}\right)^4 &= \frac{(3d^2)^4}{(ef)^4} \\ &= \frac{3^4(d^2)^4}{e^4 f^4} \\ &= \frac{81d^8}{e^4 f^4} \end{aligned}$$

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**7-4 Division Properties of Exponents**

**Example 4C: Finding Positive Powers of Quotient**

Simplify.

$$\left(\frac{2x^3}{xy^3}\right)^2$$

*Handwritten:*  $\frac{2^2 x^6}{x^2 y^6} = \frac{4x^4}{y^6}$

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**7-4 Division Properties of Exponents**

**Example 4C Continued**

Simplify.

$$\frac{4x^6}{x^6 y^6} = \frac{4}{y^6}$$

*Use the Power of a Product Property:  $4x^{3 \cdot 2} = 4x^6$  and  $x^{3 \cdot 2} y^{3 \cdot 2} = x^6 y^6$*

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**7-4 Division Properties of Exponents**

**Check It Out! Example 4a**

Simplify.

$$\left(\frac{2^3}{3^2}\right)^2 = \frac{64}{81}$$

*Use the Power of a Quotient Property.*

$$\frac{2^6}{3^4} = \frac{64}{81}$$

*Simplify.*

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### 7-4 Division Properties of Exponents

**Check It Out! Example 4b**

Simplify.

$$\left(\frac{ab^4}{c^2d^3}\right)^5$$

*Handwritten work:*

$$\frac{a^5 b^{20}}{c^{10} d^{15}}$$

*Handwritten work:*

$$\frac{a^5 b^9}{c^7 d^8}$$

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### 7-4 Division Properties of Exponents

**Check It Out! Example 4c**

Simplify.

$$\left(\frac{a^3b}{a^2b^2}\right)^3$$

*Handwritten work:*

$$\frac{a^9 b^3}{a^6 b^6} = \frac{a^3}{b^3}$$

*Handwritten work:*

$$\left(\frac{a}{b}\right)^3$$

Use the Power of a Quotient Property.

Use the power of a Quotient Property:  $(a^3b)^3 = a^{3 \cdot 3} b^3$  and  $(a^2b^2)^3 = a^{2 \cdot 3} b^{2 \cdot 3}$ .

Use the power of a Quotient Property:  $a^{3 \cdot 3} b^3 = a^9 b^3$  and  $a^{2 \cdot 3} b^{2 \cdot 3} = a^6 b^6$ .

Simplify.

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### 7-4 Division Properties of Exponents

**Negative Power of a Quotient Property**

WORDS	NUMBERS	ALGEBRA
A quotient raised to a negative power equals the reciprocal of the quotient raised to the opposite (positive) power.	$\left(\frac{2}{3}\right)^{-4} = \left(\frac{3}{2}\right)^4 = \frac{3^4}{2^4}$	If $a$ and $b$ are nonzero real numbers and $n$ is a positive integer, then $\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n = \frac{b^n}{a^n}$ .

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### 7-4 Division Properties of Exponents

**Example 5A: Finding Negative Powers of Quotients**

Simplify.

$$\left(\frac{3}{4}\right)^{-3}$$

*Handwritten work:*

$$\frac{4^3}{3^3} = \frac{64}{27}$$

Use the Powers of a Quotient Property.

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### 7-4 Division Properties of Exponents

**Example 5B: Finding Negative Powers of Quotients**

Simplify.  $\left(\frac{2x^2}{y^3}\right)^{-2}$

$$\left(\frac{y^3}{2x^2}\right)^2$$

$$\frac{y^6}{4x^4}$$

*Rewrite with a positive exponent.*

*Use the power of a Quotient Property.*

*Use the power of a Power Property:  $(y^3)^2 = y^{3 \cdot 2} = y^6$*

*Use the power of a Power Property:  $2^2 x^{2 \cdot 2} = 4x^4$*

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### 7-4 Division Properties of Exponents

**Helpful Hint**

Whenever all of the factors in the numerator or the denominator divide out, replace them with 1.

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### 7-4 Division Properties of Exponents

**Check It Out! Example 5b**

Simplify.  $\left(\frac{2a}{b^2c^3}\right)^{-4}$

$$\left(\frac{b^2c^3}{2a}\right)^4 = \frac{b^8c^{12}}{16a^4}$$

*Rewrite with a positive exponent.*

*Use the Power of a Quotient Property.*

*Use the Power of a Power Property:  $(b^2c^3)^4 = b^{2 \cdot 4}c^{3 \cdot 4} = b^8c^{12}$  and  $(2a)^4 = 2^4a^4 = 16a^4$ .*

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### 7-4 Division Properties of Exponents

**Check It Out! Example 5c**

Simplify.  $\left(\frac{s}{3}\right)^2 \left(\frac{9s^2}{t}\right)^{-1}$

$$\left(\frac{3}{s}\right)^2 \left(\frac{t}{9s^2}\right)$$

$$\left(\frac{\cancel{9}}{s^2}\right) \left(\frac{t}{\cancel{9}s^2}\right) = \frac{\cancel{9}t}{9s^4}$$

*Rewrite each fraction with a positive exponent.*

*Use the Power of a Quotient Property.*

*Use the Power of a Product Property:  $(3)^2 = 9$ .*

*Add exponents and divide out common terms.*

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