

## 7.2 Quotient Exponents

**GOAL** Use properties of exponents involving quotients.

### Common Student Errors

- Using the quotient properties on powers with different bases

**Tip** Stress that the properties of exponents can only be used on powers with the same base.

Student equation:  $\frac{x^5}{y^2} = x^3y$

Suggest students check their answers by substituting values into the variables and evaluating both sides of the equation to verify they are equivalent.

**EXAMPLE 1** Use the quotient of powers property

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Simplify the expression.

$$\begin{aligned}\text{a. } \frac{7^{13}}{7^8} &= 7^{13-8} \\ &= 7^5\end{aligned}$$

$$\begin{aligned}\text{b. } \frac{(-1)^6}{(-1)^2} &= (-1)^{6-2} \\ &= (-1)^4\end{aligned}$$

$$\begin{aligned}\text{c. } \frac{2^3 \cdot 2^9}{2^4} &= \frac{2^{12}}{2^4} \\ &= 2^{12-4} \\ &= 2^8\end{aligned}$$

$$\begin{aligned}\text{d. } \frac{1}{y^7} \cdot y^{18} &= \frac{y^{18}}{y^7} \\ &= y^{18-7} \\ &= y^{11}\end{aligned}$$

**Exercises for Example 1**

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Simplify the expression.

$$1. \frac{12^{15}}{12^6}$$

$$2. \frac{(-8)^{20}}{(-8)^{16}}$$

$$3. \frac{13^6 \cdot 13^8}{13^9}$$

$$4. \frac{1}{w^{16}} \cdot w^{21}$$

**EXAMPLE 2** Use the power of a quotient property

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Simplify the expression.

$$\text{a. } \left(\frac{m}{n}\right)^5 = \frac{m^5}{n^5}$$

$$\text{b. } \left(\frac{3}{p}\right)^3 = \frac{3^3}{p^3} = \frac{27}{p^3}$$

**Exercises for Example 2**

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Simplify the expression.

$$5. \left(\frac{b}{c}\right)^7$$

$$6. \left(-\frac{3}{w}\right)^4$$

**EXAMPLE 3** Use the properties of exponents

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**Simplify the expression.**

<b>a.</b>	$\left(\frac{2x^3}{5y^2}\right)^2 = \frac{(2x^3)^2}{(5y^2)^2}$	Power of a quotient property
	$= \frac{2^2(x^3)^2}{5^2(y^2)^2}$	Power of a product property
	$= \frac{4x^6}{25y^4}$	Power of a power property
<b>b.</b>	$\left(\frac{3k^3}{4l^5}\right)^2 \cdot \frac{l^2}{6k^2} = \frac{3^2(k^3)^2}{4^2(l^5)^2} \cdot \frac{l^2}{6k^2}$	Power of a quotient property
	$= \frac{9k^6}{16l^{10}} \cdot \frac{l^2}{6k^2}$	Power of a power property
	$= \frac{9k^6 l^2}{96l^{10} k^2}$	Multiply fractions.
	$= \frac{3k^4}{32l^8}$	Quotient of a powers property

**Exercises for Example 3**

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**Simplify the expression.**

7.  $\left(\frac{3s^5}{t^4}\right)^3$

8.  $\frac{1}{3m^4} \cdot \left(\frac{3m^2n}{n^2}\right)^3$