

8.3 Lesson

Key Idea

Quotient of Powers Property

Words To divide powers with the same base, subtract their exponents.

Numbers $\frac{4^5}{4^2} = 4^{5-2} = 4^3$

Algebra $\frac{a^m}{a^n} = a^{m-n}$, where $a \neq 0$

EXAMPLE 1 Dividing Powers with the Same Base

a. $\frac{2^6}{2^4} = 2^{6-4}$ Quotient of Powers Property
 $= 2^2$ Simplify.

b. $\frac{(-7)^9}{(-7)^3} = (-7)^{9-3}$ Quotient of Powers Property
 $= (-7)^6$ Simplify.

c. $\frac{h^7}{h^6} = h^{7-6}$ Quotient of Powers Property
 $= h^1 = h$ Simplify.

Common Error

When dividing powers, do not divide the bases.

$\frac{2^6}{2^4} = 2^2$, not 1^2 .

Try It Simplify the expression. Write your answer as a power.

1. $\frac{9^7}{9^4}$

2. $\frac{4.2^6}{4.2^5}$

3. $\frac{(-8)^8}{(-8)^4}$

4. $\frac{x^8}{x^3}$

EXAMPLE 2 Simplifying an Expression

Simplify $\frac{3^4 \cdot 3^2}{3^3}$. Write your answer as a power.

The numerator is a product of powers. Add the exponents in the numerator.

$\frac{3^4 \cdot 3^2}{3^3} = \frac{3^{4+2}}{3^3}$ Product of Powers Property

$= \frac{3^6}{3^3}$ Simplify.

$= 3^{6-3}$ Quotient of Powers Property

$= 3^3$ Simplify.

Try It Simplify the expression. Write your answer as a power.

5. $\frac{6^7 \cdot 6^3}{6^5}$

6. $\frac{2^{15}}{2^3 \cdot 2^5}$

7. $\frac{m^8 \cdot m^6}{m^5}$

EXAMPLE 3**Simplifying Expressions**

$$\text{a. } \frac{(-4)^9}{(-4)^5} \cdot \frac{(-4)^8}{(-4)^2} = (-4)^{9-5} \cdot (-4)^{8-2}$$

Quotient of Powers Property

$$= (-4)^4 \cdot (-4)^6$$

Simplify.

$$= (-4)^{4+6}$$

Product of Powers Property

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

Simplify.

$$\text{b. } \frac{a^{10}}{a^6} \cdot \frac{a^7}{a^4} = a^{10-6} \cdot a^{7-4}$$

Quotient of Powers Property

$$= a^4 \cdot a^3$$

Simplify.

$$= a^{4+3}$$

Product of Powers Property

$$= a^7$$

Simplify.

Math Practice**Look for Structure**

Show how you can simplify the expression in part (b) by first multiplying the numerators and then multiplying the denominators.

Try It Simplify the expression. Write your answer as a power.

$$8. \frac{(-5)^7 \cdot (-5)^6}{(-5)^5 \cdot (-5)^2}$$

$$9. \frac{d^5 \cdot d^9}{d \cdot d^8}$$

$$10. \frac{p^3 \cdot p^6 \cdot p^4}{p^2 \cdot p}$$

**Self-Assessment for Concepts & Skills**

Solve each exercise. Then rate your understanding of the success criteria in your journal.

SIMPLIFYING EXPRESSIONS Simplify the expression. Write your answer as a power.

$$11. \frac{(-3)^9}{(-3)^2}$$

$$12. \frac{8^6 \cdot 8^2}{8^5}$$

$$13. \frac{x^{11}}{x^4 \cdot x^6}$$

$$14. \frac{5^6 \cdot 5^3}{5 \cdot 5^2}$$

$$15. \frac{(-2)^9 \cdot (-2)^4}{(-2)^4 \cdot (-2)^4}$$

$$16. \frac{b^{10} \cdot b^3 \cdot b^5}{b^2 \cdot b^3}$$

17. **WHICH ONE DOESN'T BELONG?** Which quotient does *not* belong with the other three? Explain your reasoning.

$$\frac{(-10)^7}{(-10)^2}$$

$$\frac{6^3}{6^2}$$

$$\frac{(-4)^8}{(-3)^4}$$

$$\frac{5^6}{5^3}$$