

7-4 Division Properties of Exponents

[Warm Up](#)

[Lesson Presentation](#)

[Lesson Quiz](#)

7-4 Division Properties of Exponents

Warm Up
Simplify.

- $(x^2)^3$ 10^6
- 2^{-3} $\frac{1}{2^3}$ or $\frac{1}{8}$
- $3^2 \cdot x^{-1}$ $\frac{9}{x}$
- $(v^{-2}w^3)^{-3}$ $\frac{v^6}{w^9}$
- $3^8 \cdot 3^{-2}$ 3^6
- $\left(\frac{y}{z}\right)^3$ $\frac{y^3}{z^3}$

Write in Scientific Notation.

- 30×10^{-3} 3×10^{-2}
- 0.16×10^7 1.6×10^6

7-4 Division Properties of Exponents

Objective

Use division properties of exponents to evaluate and simplify expressions.

7-4 Division Properties of Exponents

A quotient of powers with the same base can be found by writing the powers in a factored form and dividing out common factors.

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

Notice the relationship between the exponents in the original quotient and the exponent in the final answer: $5 - 3 = 2$.

7-4 Division Properties of Exponents

Quotient of Powers Property

| WORDS | NUMBERS | ALGEBRA |
|--|-----------------------------------|--|
| The quotient of two nonzero powers with the same base equals the base raised to the difference of the exponents. | $\frac{6^7}{6^4} = 6^{7-4} = 6^3$ | If a is a nonzero real number and m and n are integers, then $\frac{a^m}{a^n} = a^{m-n}$. |

When dividing numbers with the same base subtract their exponents

Holt Algebra 1
Copyright © by Holt, Rinehart and Winston. All Rights Reserved.

7-4 Division Properties of Exponents

Example 1: Finding Quotients of Powers

Simplify.

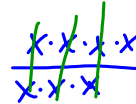
A. $\frac{2^7}{2^2}$

$2^7 \cdot 2^{-2}$

$\frac{2^{\cancel{5}}}{\cancel{2^2}} = 2^{7-2}$

$= 2^5 = 32$

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



$\frac{x^4}{x^3} = x^{4-3}$

$= x^1 = x$

Holt Algebra 1
Copyright © by Holt, Rinehart and Winston. All Rights Reserved.

7-4 Division Properties of Exponents

Example 1: Finding Quotients of Powers

Simplify.

C. $\frac{d^4 e^3}{(de)^2}$

$\frac{d^4 e^3}{d^2 e^2} = \frac{d^{\cancel{2}} e^{\cancel{1}}}{\cancel{d^2} \cancel{e^2}}$

$d^2 e$

D. $\frac{3^1 \cdot 4^2 \cdot 5^3}{3^2 \cdot 4^3 \cdot 5^3}$

$\frac{5}{3 \cdot 4} = \frac{5}{12}$

$3^{-2} \quad 3^{-1} = \frac{1}{3}$

Holt Algebra 1
Copyright © by Holt, Rinehart and Winston. All Rights Reserved.

7-4 Division Properties of Exponents

Check It Out! Example 1

Simplify.

a. $\frac{2^9}{2^7}$

$\frac{2^9}{2^7} = 2^{9-7}$

$= 2^2 = 4$

b. $\frac{x^1}{y^4}$

$\frac{y^1}{y^4} = y^{1-4}$

$= y^{-3} = \frac{1}{y^3}$

Holt Algebra 1
Copyright © by Holt, Rinehart and Winston. All Rights Reserved.

7-4 Division Properties of Exponents

Check It Out! Example 1

Simplify.

c. $\frac{m^5 n^4}{(m^5)^2 n}$

Handwritten work: $\frac{m^5 n^4}{(m^5)^2 n} = \frac{m^5 n^4}{m^{5 \cdot 2} n} = \frac{m^5 n^4}{m^{10} n}$
 $\frac{m^5 n^4}{m^{10} n} = \frac{m^{\cancel{5}} n^{\cancel{4} 3}}{m^{\cancel{10} 5} \cancel{n}}$
 $\frac{n^3}{m^5}$

d. $\frac{3^5 \cdot 2^4 \cdot 4^3}{3^4 \cdot 2^2 \cdot 4^6}$

Handwritten work: $\frac{3^{\cancel{5} 1} \cdot 2^{\cancel{4} 2} \cdot 4^3}{3^{\cancel{4} 1} \cdot 2^2 \cdot 4^6} = \frac{3 \cdot 2^2}{4^3}$

Holt Algebra 1 Copyright © by Holt, Rinehart and Winston. All Rights Reserved.

7-4 Division Properties of Exponents

Example 2: Dividing Numbers in Scientific Notation

Simplify $(3 \times 10^{10}) \div (6 \times 10^6)$ and write the answer in scientific notation

$(3 \times 10^{10}) \div (6 \times 10^6) = \frac{3 \times 10^{10}}{6 \times 10^6}$

$= \frac{3}{6} \times \frac{10^{10}}{10^6}$ *Write as a product of quotients.*

$= 0.5 \times 10^{10-6}$ *Simplify each quotient.*

$= 0.5 \times 10^4$ *Simplify the exponent.*

$= 5 \times 10^{-1} \times 10^4$ *Write 0.5 in scientific notation as 5×10^{-1} .*

$= 5 \times 10^{-1+4}$ *The second two terms have the same base, so add the exponents.*

$= 5 \times 10^3$ *Simplify the exponent.*

Holt Algebra 1 Copyright © by Holt, Rinehart and Winston. All Rights Reserved.

7-4 Division Properties of Exponents

Writing Math

You can "split up" a quotient of products into a product of quotients:

$$\frac{a \times c}{b \times d} = \frac{a}{b} \times \frac{c}{d}$$

Holt Algebra 1 Copyright © by Holt, Rinehart and Winston. All Rights Reserved.

7-4 Division Properties of Exponents

Check It Out! Example 2

Simplify $(3.3 \times 10^6) \div (3 \times 10^8)$ and write the answer in scientific notation.

$(3.3 \times 10^6) \div (3 \times 10^8) = \frac{3.3 \times 10^6}{3 \times 10^8}$

$= \frac{3.3 \times 10^6}{3 \times 10^8}$ *Write as a product of quotients.*

$= 1.1 \times 10^{6-8}$ *Simplify each quotient.*

$= 1.1 \times 10^{-2}$ *Simplify the exponent.*

Holt Algebra 1 Copyright © by Holt, Rinehart and Winston. All Rights Reserved.

7-4 Division Properties of Exponents

Example 3: Application

The Colorado Department of Education spent about 4.408×10^9 dollars in fiscal year 2004-05 on public schools. There were about 7.6×10^5 students enrolled in public school. What was the average spending per student? Write your answer in standard form.

To find the average spending per student, divide the total debt by the number of students.

$$\begin{aligned} \frac{\$ \text{ Total Spending}}{\# \text{ of students}} &= \frac{4.408 \times 10^9}{7.6 \times 10^5} && \$5,800 \text{ per student} \\ &= \frac{4.408}{7.6} \times \frac{10^9}{10^5} && 58 \times 10^4 \text{ Write as a product of} \\ &&& \text{quotients.} \end{aligned}$$

Holt Algebra 1

Copyright © by Holt, Rinehart and Winston. All Rights Reserved.

$$\left(\frac{4408}{76}\right)^{-3} \cdot \frac{10^9}{10^5} \rightarrow \frac{125}{8}$$