

# Reteaching 8-5

## Division Properties of Exponents

**OBJECTIVE:** Applying division properties of exponents

**MATERIALS:** None

To divide powers with the same base, subtract exponents.

### Example

Simplify  $\frac{4^3}{4^5}$ .

#### Method 1

$$\frac{4 \cdot 4 \cdot 4}{4 \cdot 4 \cdot 4 \cdot 4 \cdot 4}$$

← Expand the numerator and the denominator.

$$\frac{\cancel{4} \cdot \cancel{4} \cdot \cancel{4}}{\cancel{4} \cdot \cancel{4} \cdot \cancel{4} \cdot 4 \cdot 4}$$

← Draw lines through terms that are in both the numerator and the denominator.

$$\frac{1}{4 \cdot 4}$$

← Cancel.

$$\frac{1}{4^2} \text{ or } 4^{-2}$$

← Rewrite with exponents.

#### Method 2

$$3 - 5 = -2$$

← Subtract the exponents from the original equation. Compare this to the exponent in the first answer.

$$\text{So } \frac{4^3}{4^5} = 4^{3-5} = 4^{-2}.$$

← Subtract the exponents from the original equation. Compare this to the exponent in the first answer.

$$\frac{1}{4^2}$$

← Write with positive exponents.

To raise a quotient to a power use repeated multiplication.

### Exercises

Use both methods shown in the example to simplify each expression. Use only positive exponents.

1.  $\frac{z^6}{z^3}$

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

3.  $\frac{m^{-3}}{m^{-4}}$

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

5.  $\left(\frac{b^7}{b^5}\right)^3$

6.  $\frac{5a^5}{15a^2}$

7.  $\frac{2^2}{2^5}$

8.  $\frac{d^8}{d^3}$

9.  $\frac{x^7}{x^5}$

10.  $\left(\frac{10^8}{10^2}\right)^3$

11.  $\frac{14x^{11}}{7x^{10}}$

12.  $\frac{8x^9}{12x^6}$

13.  $\frac{x^{12}}{x^5}$

14.  $\frac{6x^4}{4x^2}$

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

16.  $\left(\frac{x^5}{x^3}\right)^4$

# Practice 8-5

## Division Properties of Exponents

Simplify each expression.

- |   |  |   |  |
|---|--|---|--|
| 1. $\frac{c^{15}}{c^9}$                         | 2. $\left(\frac{x^3y^{-2}}{z^{-5}}\right)^{-4}$  | 3. $\frac{x^7y^9z^3}{x^4y^7z^8}$              | 4. $\left(\frac{a^2}{b^3}\right)^5$                |
| 5. $\frac{3^7}{3^4}$                            | 6. $\left(\frac{a^3}{b^2}\right)^4$              | 7. $\left(\frac{2}{3}\right)^{-2}$            | 8. $\left(\frac{p^{-3}q^{-2}}{q^{-3}r^5}\right)^4$ |
| 9. $\frac{a^6b^{-5}}{a^{-2}b^7}$                | 10. $\frac{7^{-4}}{7^{-7}}$                      | 11. $\frac{a^7b^6}{a^5b}$                     | 12. $\left(\frac{a^2b^{-4}}{b^2}\right)^5$         |
| 13. $\left(-\frac{3}{2^3}\right)^{-2}$          | 14. $\frac{z^7}{z^{-3}}$                         | 15. $\left(\frac{5a^0b^4}{c^{-3}}\right)^2$   | 16. $\frac{x^4y^{-8}z^{-2}}{x^{-1}y^6z^{-10}}$     |
| 17. $\frac{m^6}{m^{10}}$                        | 18. $\left(\frac{2^3m^4n^{-1}}{p^2}\right)^0$    | 19. $\left(\frac{s^{-4}}{t^{-1}}\right)^{-2}$ | 20. $\left(\frac{2a^3b^{-2}}{c^3}\right)^5$        |
| 21. $\left(\frac{x^{-3}y}{xz^{-4}}\right)^{-2}$ | 22. $\frac{h^{-13}}{h^{-8}}$                     | 23. $\frac{4^6}{4^8}$                         | 24. $\left(\frac{1}{3}\right)^3$                   |
| 25. $\frac{x^5y^3}{x^2y^9}$                     | 26. $\left(\frac{m^{-3}n^4}{n^{-2}}\right)^4$    | 27. $\frac{4^{-1}}{4^2}$                      | 28. $\left(\frac{a^8b^6}{a^{11}}\right)^5$         |
| 29. $\frac{n^9}{n^{15}}$                        | 30. $\left(\frac{r^3s^{-1}}{r^2s^6}\right)^{-1}$ | 31. $\frac{n^{-8}}{n^4}$                      | 32. $\frac{m^8n^3}{m^{10}n^5}$                     |

Simplify each quotient. Write each answer in scientific notation.

- |  |   |  |  |
|--|---|--|--|
| 33. $\frac{3.54 \times 10^{-9}}{6.15 \times 10^{-5}}$    | 34. $\frac{9.35 \times 10^{-3}}{3.71 \times 10^{-5}}$ | 35. $\frac{495 \text{ billion}}{23.9 \text{ million}}$ | 36. $\frac{8 \times 10^9}{4 \times 10^5}$            |
| 37. $\frac{9.5 \times 10^9}{5 \times 10^{12}}$           | 38. $\frac{6.4 \times 10^9}{8 \times 10^7}$           | 39. $\frac{298 \text{ billion}}{49 \text{ million}}$   | 40. $\frac{1.8 \times 10^{-8}}{0.9 \times 10^3}$     |
| 41. $\frac{3.6 \times 10^6}{9 \times 10^{-3}}$           | 42. $\frac{8.19 \times 10^7}{4.76 \times 10^{-2}}$    | 43. $\frac{65 \text{ million}}{19.5 \text{ billion}}$  | 44. $\frac{4.9 \times 10^{12}}{7 \times 10^3}$       |
| 45. $\frac{36.2 \text{ trillion}}{98.5 \text{ billion}}$ | 46. $\frac{3.9 \times 10^3}{1.3 \times 10^8}$         | 47. $\frac{5.6 \times 10^{-5}}{8 \times 10^{-7}}$      | 48. $\frac{40 \text{ million}}{985 \text{ million}}$ |

49. The half-life of uranium-238 is  $4.5 \times 10^9$  years. The half-life of uranium-234 is  $2.5 \times 10^5$  years. How many times greater is the half-life of uranium-238 than that of uranium-234.

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