

Day 19: Positive Exponent Properties

Product of Powers Property

Complete the table.

Expression	Expression as repeated multiplication	Number of factors	Simplified expression
$7^4 \cdot 7^5$	$7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$	9	7^9
$(-4)^2 \cdot (-4)^3$	$(-4)(-4)(-4)(-4)(-4)$	5	$(-4)^5$
$x^1 \cdot x^5$	$x \cdot x \cdot x \cdot x \cdot x \cdot x$	6	x^6

Product of Powers Rule:

$$x^a \cdot x^b = x^{a+b}$$

Power of a Power Property

Complete the table.

Expression	Expanded expression	Expression as repeated multiplication	Number of factors	Simplified expression
$(5^3)^2$	$(5^3)(5^3)$	$555 555$	6	5^6
$[(-6)^2]^4$	$(-6)^2(-6)^2(-6)^2(-6)^2$	$(-6)(-6)(-6)(-6)(-6)(-6)(-6)(-6)$	8	$(-6)^8$
$(a^3)^3$	$a^3 a^3 a^3$	$aaa aaa aaa$	9	a^9

Power of a Power Rule:

$$(x^a)^b = x^{a \cdot b}$$

Practice

Simplify the expression. Write your answer using exponents.

1. $5^2 \cdot 5^3 = 5^5$

2. $(-6)^2 \cdot (-6)^3 = (-6)^5$

3. $m^6 \cdot m^4 = m^{10}$

4. $(10^3)^3 = 10^9$

5. $[(-2)^3]^4 = (-2)^{12}$

6. $(c^2)^6 = c^{12}$

Power of a Product Rule:

$$(x^a x^b)^m = x^{ma} x^{mb}$$

Quotient of Powers Property

Complete the table.

Expression	Expression as repeated multiplication	Simplified expression	Simplified expression as a power
$\frac{2^7}{2^3}$	$\frac{\cancel{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}}{\cancel{2 \cdot 2 \cdot 2}}$	$2 \cdot 2 \cdot 2 \cdot 2$	2^4
$\frac{2^5}{2^3}$	$\frac{\cancel{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}}{\cancel{2 \cdot 2 \cdot 2}}$	$2 \cdot 2$	2^2
$\frac{2^4}{2^1}$	$\frac{\cancel{2 \cdot 2 \cdot 2 \cdot 2}}{2}$	$2 \cdot 2 \cdot 2$	2^3
$\frac{5^6}{5^3}$	$\frac{\cancel{5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5}}{\cancel{5 \cdot 5 \cdot 5}}$	$5 \cdot 5 \cdot 5$	5^3
$\frac{4^3}{4^1}$	$\frac{\cancel{4 \cdot 4 \cdot 4}}{4}$	$4 \cdot 4$	4^2
$\frac{(-3)^3}{(-3)^2}$	$\frac{\cancel{(-3)(-3)(-3)}}{\cancel{(-3)(-3)}}$	(-3)	$(-3)^1$

Quotient of Powers Rule:

$$\frac{x^a}{x^b} = x^{a-b}$$

Practice

Simplify the expression. Write your answer using exponents.

1. $\frac{7^6}{7^2}$
 7^4

2. $\frac{6^9}{6^2}$
 6^7

3. $\frac{(-5)^8}{(-5)^3}$
 $(-5)^5$

4. $\frac{(-6)^9}{(-6)^6}$
 $(-6)^3$

5. $\frac{y^8}{y^5}$
 y^3

Power of a Quotient Property

Complete the table.

Expression	Expanded expression	Product of fractions	Product as a quotient of powers
$(\frac{5}{8})^3$	$\frac{5}{8} \cdot \frac{5}{8} \cdot \frac{5}{8}$	$\frac{5 \cdot 5 \cdot 5}{8 \cdot 8 \cdot 8}$	$\frac{5^3}{8^3}$
$(\frac{4}{7})^5$	$\frac{4}{7} \cdot \frac{4}{7} \cdot \frac{4}{7} \cdot \frac{4}{7} \cdot \frac{4}{7}$	$\frac{4 \cdot 4 \cdot 4 \cdot 4 \cdot 4}{7 \cdot 7 \cdot 7 \cdot 7 \cdot 7}$	$\frac{4^5}{7^5}$
$(\frac{1}{2})^4$	$(\frac{1}{2})(\frac{1}{2})(\frac{1}{2})(\frac{1}{2})$	$\frac{1 \cdot 1 \cdot 1 \cdot 1}{2 \cdot 2 \cdot 2 \cdot 2}$	$\frac{1^4}{2^4}$
$(\frac{3}{5})^3$	$\frac{3}{5} \cdot \frac{3}{5} \cdot \frac{3}{5}$	$\frac{3 \cdot 3 \cdot 3}{5 \cdot 5 \cdot 5}$	$\frac{3^3}{5^3}$
$(-\frac{2}{3})^2$	$(-\frac{2}{3})(-\frac{2}{3})$	$\frac{-2 \cdot -2}{3 \cdot 3}$	$\frac{2^2}{3^2}$

Power of a Quotient Rule:

$$\left(\frac{x}{y}\right)^a = \frac{x^a}{y^a}$$

Practice

Simplify the expression. Write your answer using exponents.

1. $(\frac{1}{3})^6$

$$\frac{1^6}{3^6} = \frac{1}{3^6}$$

2. $(\frac{2}{5})^9$

$$\frac{2^9}{5^9}$$

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

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

4. $(-\frac{4}{5})^3$

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

5. $(\frac{x}{4})^7$

$$\frac{x^7}{4^7}$$

Practice: Positive Exponent Properties

Write the Rules from the boxes on the previous pages:

Product of Powers: $x^a \cdot x^b = x^{a+b}$

Power of a Power: $(x^a)^b = x^{a \cdot b}$

Power of a Product: $(x^a \cdot x^b)^m = x^{am} \cdot x^{bm}$

Quotient of Powers: $\frac{x^a}{x^b} = x^{a-b}$

Power of a Quotient: $(\frac{x}{y})^a = \frac{x^a}{y^a}$

Product of Powers PRACTICE: Simplify the expression.

1. $3^2 \cdot 3^7$
 3^9

2. $5^4 \cdot 5^9$
 5^{13}

3. $(-7)^2 \cdot (-7)$
 $(-7)^3$

4. $x^2 \cdot x^6 \cdot x$
 x^9

Power of a Power PRACTICE: Simplify the expression.

5. $(4^2)^7$
 4^{14}

6. $[(-2)^4]^5 = 2^{20}$

7. $(n^3)^6 = n^{18}$

8. $[(m+1)^5]^4$
 $(m+1)^{20}$

Power of a Product PRACTICE: Simplify the expression.

9. $(x \cdot y)^2$
 $x^2 y^2$

10. $(-3n)^2$
 $9n^2$

11. $(9m^3n)^4$
 $9^4 m^{12} n^4$

12. $5x \cdot (5x^2)^4$
 $5x \cdot 5^4 x^8$
 $5^5 x^9$

Quotient of Powers PRACTICE: Simplify the expression.

13. $\frac{2^5}{2^3} = 2^2$

14. $\frac{x^8 y^7}{x^5 y^6} = x^3 y$

Power of a Quotient PRACTICE: Simplify the expression.

15. $(\frac{2x}{3y})^3 = \frac{8x^3}{27y^3}$

16. $\frac{m^3}{n^5} \cdot (\frac{m^4}{n^2})^3 = \frac{m^3}{n^5} \cdot \frac{m^{12}}{n^6} = \frac{m^{15}}{n^{11}}$

Combined PRACTICE:

Simplify the following expression. Only the variables should have exponents. Compute any bases with actual numbers!

18. $(-5x)^2 = 25x^2$

19. $-(7xy^2)^2 = -49x^2 y^4$

20. $(3x^5)(2x^7)^2 = 3x^5 \cdot 4x^{14}$
 $12x^{19}$