

Investigating Exponent Properties: Product of Powers

Expression	Expand the expression	Simplified Expression a^b
$5^2 \cdot 5^4$	$5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5$	5^6
$8^4 \cdot 8^5$	$8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8$	8^9
$(-4)^3 \cdot (-4)^5$	$(-4)(-4)(-4)(-4)(-4)(-4)(-4)(-4)(-4)$	$(-4)^8$
$7^4 \cdot 7^4 \cdot 7$	$7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$	7^9
$x^3 \cdot x^7$	$x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x$	x^{10}
$5x^4y^2 \cdot 3x^6y^9$	Try this one without expanding it.	$15x^{10}y^{11}$

Do you see a pattern that relates the expression in the first column to the equivalent simplified expression? Write in words what you notice about the exponents.

When multiplying like bases,
ADD the exponents

Try these on your own

$7^{10} \cdot 7^5$	$7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$	7^{15}
$9x^2y \cdot 8x^0y^5$	$9 \cdot x \cdot x \cdot y \cdot 8 \cdot y \cdot y \cdot y \cdot y \cdot y$	$72x^2y^6$

* any base raised to the zero power is equal to one.

Here is the formal rule when multiplying exponential expressions with the same base:

$$a^m \cdot a^n = a^{m+n}$$

Packet Day 17

Simplify. Your answer should contain only positive exponents.

1) $2^4 \cdot 2^2$

2) $2^0 \cdot 2^2$

3) $3^4 \cdot 3^0$

4) $4^4 \cdot 4^3$

5) $2 \cdot 2^3$

6) $3 \cdot 3^2$

7) $2^3 \cdot 2^3$

8) $2 \cdot 2^2$

9) $3^4 \cdot 3^4$

10) $3^4 \cdot 3^3$

11) $4v^4 \cdot v^4$

12) $4n \cdot 4n^3$

13) $4v \cdot 2v^3$

14) $4a^4 \cdot 3a^4$

15) $4k^3 \cdot 2k^3$

16) $4a^0 \cdot 2a^4$

17) $4x^2y^3 \cdot 3yx^4$

18) $4uv \cdot 2u^0v^4$

19) $x^4y^2 \cdot x^0y^0 \cdot 2y^3$

20) $u^2v^2 \cdot u^4v^0$

21) $2yx^0z^3 \cdot 3x^3z^4 \cdot xz^2$

22) $2x^4y^3 \cdot y^2z^4$

23) $4x^3 \cdot x^3y^2z^2 \cdot 2xyz^3$

24) $rq^2 \cdot pq^0r^2$

Investigating Exponent Properties: Quotient of Powers

Expression	Expanded form	Cancel factors	Simplified Expression a^b
$\frac{4^3}{4^2}$	$\frac{4 \cdot 4 \cdot 4}{4 \cdot 4}$	$\frac{\cancel{4} \cdot \cancel{4} \cdot 4}{\cancel{4} \cdot \cancel{4}}$	4^1
$\frac{3^6}{3^3}$	$\frac{3 \cdot 3 \cdot \cancel{3} \cdot \cancel{3} \cdot \cancel{3} \cdot 3}{3 \cdot 3 \cdot 3}$		3^3
$\frac{1^5}{1^4}$	$\frac{1 \cdot \cancel{1} \cdot \cancel{1} \cdot \cancel{1} \cdot 1}{1 \cdot 1 \cdot 1 \cdot 1}$		1^1
$\frac{x^9}{x^7}$	$\frac{x \cdot x \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot x}{x \cdot x \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot \cancel{x} \cdot x}$		x^2
$\frac{6^{15}y^{45}}{6^7y^{25}}$	Try this one without expanding it.		6^8y^{20}

Do you see a pattern that relates the expression in the first column to the equivalent simplified expression? Write in words what you notice about the exponents.

When dividing like bases,
SUBTRACT the exponents.

Try these on your own

$\frac{9^{10}}{9^3}$	$\frac{9 \cdot 9 \cdot 9 \cdot \cancel{9} \cdot \cancel{9} \cdot \cancel{9} \cdot 9 \cdot 9 \cdot 9 \cdot 9}{\cancel{9} \cdot \cancel{9} \cdot \cancel{9}}$	9^7
$\frac{8^6y^5}{8^3y^3}$	$\frac{\cancel{8} \cdot \cancel{8} \cdot \cancel{8} \cdot 8 \cdot 8 \cdot 8 \cdot y \cdot y \cdot \cancel{y} \cdot \cancel{y} \cdot y}{\cancel{8} \cdot \cancel{8} \cdot \cancel{8} \cdot y \cdot y \cdot y}$	8^3y^2

Here is the formal rule when dividing exponential expressions with the same base:

$$\frac{a^m}{a^n} = a^{m-n}$$

Packet Day 18

Simplify. Your answer should contain only positive exponents.

1) $\frac{3^3}{3}$

2) $\frac{2^3}{2^{-3}}$

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

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

5) $\frac{2^3}{2^{-4}}$

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

7) $\frac{n^3}{2n^4}$

8) $\frac{m^4}{4m^2}$

9) $\frac{2n^4}{4n^0}$

10) $\frac{4n}{n^3}$

11) $\frac{3k^3}{k^0}$

12) $\frac{3n^3}{2n^4}$

13) $\frac{2m}{4m^3n^3}$

14) $\frac{4y^2}{y^2}$

15) $\frac{xy^4}{2x}$

16) $\frac{x^4y^0}{2x}$

17) $\frac{2a^4b^0c^4}{3cb^3}$

18) $\frac{4ab^4}{2a^0c^4}$

19) $\frac{xy^2z^4}{2x^3y^3z^2}$

20) $\frac{4hk^2}{2h^0j^2k^3}$

Investigating Exponent Properties: Power of a Power

Expression	Expanded Form	Expand further	Simplified Expression a^b
$(9^2)^3$	$9^2 \cdot 9^2 \cdot 9^2$	$9 \cdot 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9$	9^6
$(8^3)^4$	$8^3 \cdot 8^3 \cdot 8^3 \cdot 8^3$	$8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8$	8^{12}
$[(-6)^2]^5$	$(-6)^2 (-6)^2 (-6)^2 (-6)^2 (-6)^2 =$ $(-6)(-6)(-6)(-6)(-6)(-6)(-6)(-6)(-6)(-6)(-6)(-6)$		$(-6)^{10}$
$(x^3)^3$	$x^3 \cdot x^3 \cdot x^3$	$x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x$	x^9
$(x^4 \cdot y^2)^3$	$x^4 y^2 x^4 y^2 x^4 y^2$	$xxxx yy xxxx yy xxxx yy$	$x^{12} y^6$
$(a^{20})^{32}$	Try this one without expanding it.		a^{640}

Do you see a pattern that relates the expression in the first column to the equivalent simplified expression? Write in words what you notice about the exponents.

When raising a power to a power,
MULTIPLY the exponents.

Try these on your own

$(4^6)^4$	$4^6 \cdot 4^6 \cdot 4^6 \cdot 4^6$	4^{24}
$(x^2 y^5 z^3)^3$	$(x^2 y^5 z^3)(x^2 y^5 z^3)(x^2 y^5 z^3)$	$x^6 y^{15} z^9$

Here is the formal rule when multiplying exponential expressions by a power:

$$(a^m)^n = a^{mn}$$

Packet Day 19

Simplify. Your answer should contain only positive exponents.

1) $(3^4)^2$

2) $(3^2)^3$

3) $(4^0)^2$

4) 2^3

5) $(2^2)^2$

6) $(3^3)^4$

7) 3^2

8) $(2^3)^2$

9) $(2n)^4$

10) $(4v^3)^2$

11) $(4b^2)^0$

12) $(a^4)^3$

13) $(k^2)^4$

14) $(3x^4)^4$

15) $(a^2)^4$

16) $(a^2b^0)^4$

17) $(3y^0)^4$

18) $(2y)^4$

19) $(2y^4z^4)^3$

20) $(3h^4k^2)^2$

21) $(a^4b^2)^3$

22) $(3a^4b^3c^2)^2$

Name _____

Date Packet 20

Practice: Rules of Exponents

Alg 2
McCauley**Review: Write the answer in standard form:**

1) $5^3 =$

2) 8 squared =

3) $(-6)^2 =$

4) 9 cubed =

5) $-4^4 =$

6) $2^1 =$

7) $-4^3 =$

8) $(-3)^3 =$

Rule #1: Product of Powers Property $\longrightarrow a^m \cdot a^n = a^{m+n}$

9) $5^3 \times 5^6 =$

10) $7^2 \cdot 7^7 \cdot 7^3 =$

11) $3 \times 3^4 =$

12) $(-8)^{11} \cdot (-8)^2 =$

13) $9 \times 9^2 =$

14) $x^8 \cdot x^8 =$

Rule #2: Quotient of Powers Property $\longrightarrow \frac{a^m}{a^n} = a^{m-n}$

15) $\frac{5^3}{5^1} =$

16) $\frac{(-7)^6}{(-7)^2} =$

17) $\frac{2^4}{2^2} =$

18) $\frac{n^{15}}{n^5} =$

19) $8^5 \div 8^4 =$

20) $(-9)^5 \div (-9)^5 =$

Rule #3: Power of Power Property $\longrightarrow (a^m)^n = a^{m \cdot n}$

21) $(5^3)^6 =$

22) $(n^3)^5 =$

23) $(2^2)^6 =$

24) $[(-5)^3]^2 =$

Mixed Practice/Review:

25) $3^2 \cdot 3 \cdot 3^5 =$

26) $\frac{6^{10}}{6^5} =$

27) $n^9 \div n^2 =$

28) $5^8 \times 5^2 =$

29) $(2^3)^3 =$

30) $[(-4)^2]^9 =$

Name: _____

Date: Packet 21
Alg 2
McCauley**Exponent Test****Fill in the blanks**

- 1) When multiplying exponents with the same base, you _____ the exponents.
 2) When _____ exponents with the same base, you subtract the exponents.
 3) When finding the power of a power, you _____ the exponents.

Simplify #4-9 completely.

- 4) $(-3)^4 =$ _____ 5) $-3^4 =$ _____ 6) (-20) squared = _____
 7) $(-2)^3 =$ _____ 8) (-5) cubed = _____ 9) $-2^3 =$ _____

In #10-24, use your exponent rules to provide an answer in EXPONENT form.

10) $2^5 \cdot 2^4$ Answer: _____	11) $[(-3)^5]^3$ Answer: _____	12) $(-12)^4 \cdot (-12)^6$ Answer: _____	13) $250^{17} \div 250$ Answer: _____
14) $8^{10} \div 8^2$ Answer: _____	15) $(z^3)^6$ Answer: _____	16) $\frac{y^{20}}{y^5}$ Answer: _____	17) $13^7 \cdot 13 \cdot 13^3$ Answer: _____
18) $(9^2)^7$ Answer: _____	19) $\frac{(-7)^3}{(-7)^3}$ Answer: _____	20) $x^{15} \cdot x^6$ Answer: _____	21) $(65^6)^6$ Answer: _____

22) Simplify: $\frac{2^4 \cdot 2^6}{2^5} =$ _____

23) Simplify: $\frac{x^4 \cdot x^6}{x^3 \cdot x^3} =$ _____

24) Simplify: $2^4 \cdot 2^6 \cdot (2^3)^3 =$ _____