

Laws of Integer Exponents Made Simple

Grade 8 math · Lesson · Standards: 8.EE.A.1

Quick answer: Integer exponents follow a few rules: add exponents when multiplying powers of one base, subtract when dividing, and multiply when raising a power to a power. Any nonzero base to the zero power is 1, and a negative exponent means a reciprocal, so 5^{-2} equals $1/25$.

Standards: 8.EE.A.1 · **Level:** Grade 8

What do the integer exponent rules say?

An exponent counts how many times a base is used as a factor. Because 6^4 means $6 \cdot 6 \cdot 6 \cdot 6$, the rules below are just bookkeeping for counting factors.

Rule	Symbols	Numeric example
Product	$a^m \cdot a^n = a^{m+n}$	$6^4 \cdot 6^3 = 6^7$
Quotient	$a^m \div a^n = a^{m-n}$	$8^9 \div 8^5 = 8^4$
Power of a power	$(a^m)^n = a^{mn}$	$(2^3)^4 = 2^{12}$
Power of a product	$(ab)^n = a^n b^n$	$(2 \cdot 5)^3 = 8 \cdot 125$
Zero exponent	$a^0 = 1$ ($a \neq 0$)	$17^0 = 1$
Negative exponent	$a^{-n} = \frac{1}{a^n}$	$5^{-2} = \frac{1}{25}$



Four factors of 6 plus three factors of 6 make seven factors: $6^4 \cdot 6^3 = 6^7$.

Why does a zero exponent give 1?

Look at the powers of 3 from left to right. Each box is the previous one divided by 3, so the pattern forces $3^1 \div 3 = 3^0 = 1$.

3^3	3^2	3^1	3^0	3^{-1}	3^{-2}	3^{-3}
27	9	3	1	1/3	1/9	1/27

each step to the right divides by 3

Moving one box right divides by 3, so 3^0 must be 1 and 3^{-1} must be $1/3$.

Negative exponent

A negative exponent flips the base to the other side of a fraction bar: a^{-n} is the reciprocal of a^n . It does not make the value negative.

How do you raise a power to a power?

Multiply the exponents. In the picture, $(2^3)^4$ has four boxes with three 2s each, which is 12 factors of 2.



$(2^3)^4$ is four groups of 2^3 , which is $3 \cdot 4 = 12$ factors of 2: 2^{12} .

How do you simplify a mixed expression?

Method

1. Apply the power rules inside parentheses first.
2. Combine powers of the same base: add exponents when multiplying, subtract when dividing.
3. Rewrite any negative exponent as a fraction.
4. Evaluate the final power.

Example: simplify $(4^{-2} \cdot 4^5)^2 \div 4^4$

Inside the parentheses: $-2 + 5 = 3$, so we have $(4^3)^2 \div 4^4$.

Power of a power: $4^6 \div 4^4 = 4^2 = 16$.

Common mistake

The rules need the same base. $2^3 \cdot 5^3$ is not 10^6 ; add exponents only when the bases match. Also, $(-3)^2 = 9$, but $-3^2 = -9$.

Mathbot's tip

Beep! Before you touch the exponents, check the bases. Same base means the rules apply; different bases mean you evaluate each power first.

Key points to remember

- Same base, multiply: add the exponents.
- Same base, divide: subtract the exponents.

- Power of a power: multiply the exponents.
- $a^0 = 1$ for every nonzero a .
- $a^{-n} = 1/a^n$; a negative exponent never makes the value itself negative.

Laws of Integer Exponents Made Simple: frequently asked questions

What is any number to the power of zero?

It equals 1, as long as the base is not zero. The pattern of dividing by the base at each step shows why: $3^2 = 9$, $3^1 = 3$, so $3^0 = 3 \div 3 = 1$.

Does a negative exponent make the answer negative?

No. It makes a reciprocal. For example $2^{-4} = 1/16$, which is positive. The answer is negative only when the base is negative and the exponent is odd.

Can the product rule be used with different bases?

Not directly. The rule $2^3 \cdot 2^5 = 2^8$ needs the same base. With $2^3 \cdot 3^5$ you evaluate each power, or leave the expression as it is.

What is the difference between $(-4)^2$ and -4^2 ?

In $(-4)^2$ the base is -4 , so the result is 16. In -4^2 only 4 is squared and then the sign is applied, so the result is -16 .

How do you write a power with a negative exponent in the denominator?

Move it to the numerator and change the sign of the exponent. So $1/y^{-3} = y^3$, because dividing by a reciprocal is the same as multiplying.