ADVANCED MATH / 01 UNDERSTAND

Exponent rules

An illustrated lesson ▪ Theory, reasoning and worked examples

An exponent counts repeated factors

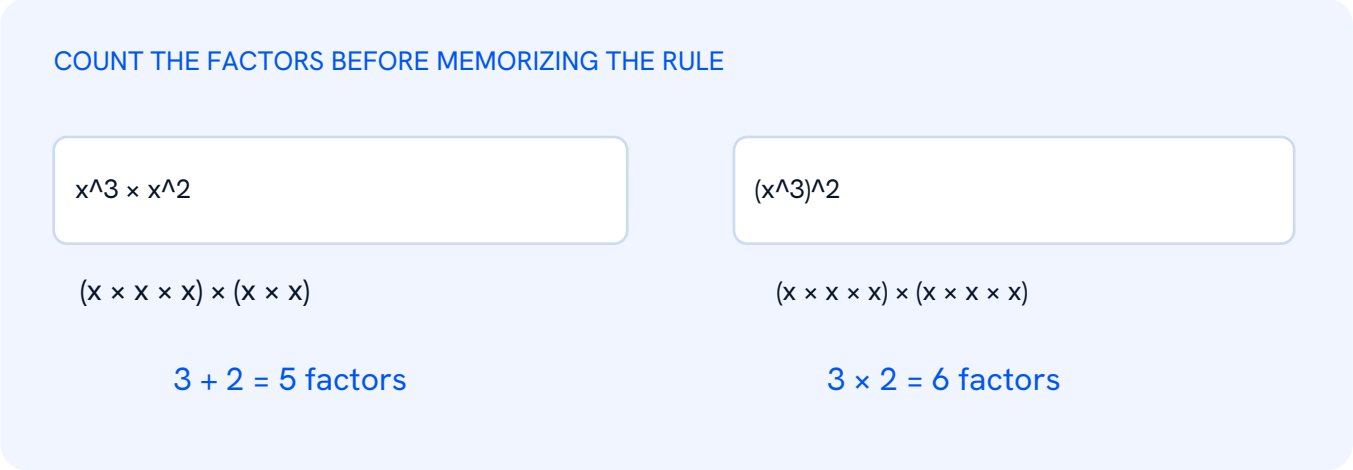
For a positive integer n, a^n means multiplying n copies of a. This definition explains the product rule: $a^m \times a^n = a^{(m+n)}$, because the two groups together contain m + n copies. The rule requires the same base; it does not allow combining 2^3 and 3^4 into a single power by adding exponents.

Division removes matching factors

For a nonzero base, $a^m / a^n = a^{(m-n)}$. Cancelling repeated factors explains why $a^0 = 1$ and $a^{(-n)} = 1/a^n$. A negative exponent indicates a reciprocal, not a negative value. The restriction on zero matters because division by zero is undefined.

Powers of powers multiply exponents

$(a^m)^n = a^{(mn)}$ because each of the n groups contains m factors. A power of a product distributes to every factor: $(ab)^n = a^n b^n$. A power does not distribute across addition: $(a + b)^2$ contains the extra term 2ab.



Illustrative teaching diagram. Values and examples are explained in the lesson.

THE ESSENTIAL IDEA

Multiplying powers with the same base adds their exponents.

ADVANCED MATH / 02 BUILD THE METHOD

From idea to method

Read parentheses before applying a rule

Compare $(-3)^2 = 9$ with $-3^2 = -9$. In the second expression, the exponent applies to 3 before the leading negative sign. Likewise, $(2x)^3 = 8x^3$, while $2x^3$ has an unchanged coefficient 2. Parentheses determine exactly what the base is.

Connect roots and rational exponents

For positive a, $a^{(1/n)}$ is the nth root of a, and $a^{(m/n)}$ can be evaluated as the nth root followed by the mth power. Thus $27^{(2/3)} = 3^2 = 9$. Restricting the base to positive values avoids sign and real-domain complications while learning the rule.

Compare powers with a common base

Rewrite 8^x as $(2^3)^x = 2^{(3x)}$. Then $8^x = 2^{12}$ becomes $2^{(3x)} = 2^{12}$, so $3x = 12$ and $x = 4$. This equal-exponent argument works for a fixed positive base other than 1, whose exponential function is one-to-one.

WORKED EXAMPLE / COMBINE THREE EXPONENT RULES

Simplify $(x^3)^2 / x^4$ for $x > 0$.

01 Set up the reasoning

Apply the power rule to the numerator: $(x^3)^2 = x^6$.

02 Apply the relationship

Divide powers with a common base: $x^6 / x^4 = x^{(6 - 4)} = x^2$.

03 Interpret and check

For $x = 2$, the original is $64/16 = 4$ and the simplified form is also 4. The check supports the algebra.

Keep these distinctions handy

Product / quotient	Same base: add / subtract the exponents.
Power of a power	Multiply the exponents: $(a^m)^n = a^{(mn)}$.
Negative power	For nonzero a: $a^{(-n)} = 1/a^n$.

ADVANCED MATH / 03 CONNECT & REMEMBER

See the deeper pattern

Keep coefficients separate

In $(3x^2)(4x^5)$, multiply coefficients to get 12 and combine variable powers to get x^7. The result is $12x^7$. In $(3x^2)^3$, the coefficient is also cubed, giving $27x^6$. Sorting numerical factors from variable powers makes multi-step simplification less error-prone.

ONE MORE WORKED APPLICATION

For positive t, $t^2 \times t^9 = t^k$. What is k?

1. The bases match, so add exponents.

2. $k = 2 + 9 = 11$.

Answer: 11

Mistakes to recognize

- Add exponents for multiplication; multiply them for a power of a power.
- A negative exponent does not make a positive base negative.
- Do not distribute a square across a sum.

A quick understanding check

Why is x^0 equal to 1 when x is nonzero?

Explanation: Because $x^n/x^n = 1$ and the quotient rule gives $x^{(n - n)} = x^0$.

MORE PRACTICE IN YOUR DASHBOARD

Open prepvora.com/app/ and use the SAT question bank. Work on Advanced Math, then look for exponent rules questions. Solve independently before reviewing the explanation. Use this guide for the theory; use the dashboard for a longer practice session.

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