

Simplifying Algebraic Expressions



Level 1 - Simplify expressions where the highest order is 1

Level 2 - Simplify expressions of higher order

Level 3 - Simplify more complex algebraic expressions

A **monomial** is a single term like $6x$, $-3a^2b$, or $5mnp$.

We can **combine like terms** (add or subtract monomials which contain the same variables)

We can **simplify algebraic multiplication** by multiplying coefficients and constants and adding up the common variables.

We can also factor a monomial into its basic building blocks using **prime factorization**, and simplify them by canceling common factors.

On the next page, we'll look at using the **exponent laws** to simplify more efficiently.

Simplify the following algebraic expressions:

<p>Example #1</p> $7x + 3y - 4x + 2y - y$	<p>Example #2</p> $2m \cdot 3n \cdot 2mn \cdot 2$	<p>Example #3</p> $\frac{18x^3y^2}{9x^2y}$
<p>Group like terms:</p> <p>x - terms: $7x - 4x = 3x$</p> <p>y - terms: $3y + 2y - y = 4y$</p> <div style="border: 1px dashed black; padding: 5px; width: fit-content; margin: 10px auto;"> $3x + 4y$ </div>	<p>Multiply coefficients:</p> $2 \cdot 3 \cdot 2 \cdot 2 = 24$ <p>Multiply like variables together:</p> $n \cdot n = n^2$ $m \cdot m = m^2$ $24m^2n^2$ <div style="border: 1px dashed black; padding: 5px; width: fit-content; margin: 10px auto;"> $24m^2n^2$ </div>	<p>Prime factorize the top and the bottom:</p> $\frac{2 \cdot 3 \cdot 3 \cdot x \cdot x \cdot x \cdot y \cdot y}{3 \cdot 3 \cdot x \cdot x \cdot y}$ <p>Cancel common factors:</p> $\frac{\cancel{2} \cdot \cancel{3} \cdot \cancel{3} \cdot x \cdot x \cdot x \cdot y \cdot y}{\cancel{3} \cdot \cancel{3} \cdot x \cdot x \cdot y}$ <div style="border: 1px dashed black; padding: 5px; width: fit-content; margin: 10px auto;"> $2 \cdot x \cdot y$ </div>

Remember:

- In a fraction, write all factors out and only cancel pairs that appear once on top and bottom; rewrite what remains.

Simplifying Algebraic Expressions Using Exponent Rules



We can use the **Exponent Rules** to simplify algebraic expressions efficiently.

Exponents represent **repeated multiplication** of a base. When expressions involve the same base with exponents, specific rules can be applied to simplify them.

We will start with the seven most commonly used rules.

Exponent Rules			
Name	Rule	Example	Description
Product Rule	$a^m \cdot a^n = a^{m+n}$	$3^2 \cdot 3^3 = a^{2+3}$	Multiply expressions with the same base by adding the exponents
Quotient Rule	$\frac{a^m}{a^n} = a^{m-n}$	$\frac{5^5}{5^3} = 5^{5-3}$	Divide expressions with the same base by subtracting the exponents
Power of a Power Rule	$(a^m)^n = a^{m \cdot n}$	$(3^2)^3 = 3^{2 \cdot 3}$	Raise a power to another power by multiplying the exponents
Power of a Product Rule	$(a \cdot b)^m = a^m \cdot b^m$	$(-3 \cdot 4)^2 = (-3)^2 \cdot 4^2$	Distribute the exponent to each factor inside the parentheses
Power of a Quotient Rule	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$	$\left(\frac{2}{3}\right)^4 = \frac{2^4}{3^4}$	Apply the exponent to both the numerator and denominator
Negative Exponent Rule	$a^{-n} = \frac{1}{a^n}$	$3^{-2} = \frac{1}{3^2}$	Take the reciprocal and change the sign to positive
Zero Exponent Rule	$a^0 = 1, \text{ when } a \neq 0$	$-3^0 = 1$	Any non-zero base raised to the 0 power equals 1

Remember:

- Always check that the bases are the same before applying exponent rules.
- Show all steps when simplifying to avoid mistakes with signs or operations.
- Any non-zero number raised to the power of zero equals 1!

You may see these rules referenced as **Exponent Laws**