

Exponents

An exponential expression includes a base raised to an exponential power, where the power tells us how many factors of the base should be multiplied together.

Exponential Expression:

- 5^3 (Base 5, exponent 3)
 - Expanded Form: $5 \cdot 5 \cdot 5 = 125$
- $(-2)^4$ (Base -2, exponent 4)
 - Expanded Form: $(-2)(-2)(-2)(-2) = 16$
- $9x^2$ (Coefficient 9, base x , exponent 2)
 - Expanded Form: $9 \cdot x \cdot x$
- $(9x)^2$ (Base $9x$, exponent 2)
 - Expanded Form: $(9x)(9x) = 81 \cdot x \cdot x$

Several rules for working with exponents make simplifying exponential expressions easier.

- **Rule 1:** Products of expressions with the same base
 - Example: $2^3 \cdot 2^2 = (2 \cdot 2 \cdot 2)(2 \cdot 2) = 2^5$
 - Formula: $b^m \cdot b^n = b^{m+n}$
- **Rule 2:** Powers of products
 - Example: $(7x)^3 = (7x)(7x)(7x) = 7^3x^3$
 - Formula: $(ab)^n = a^n b^n$
- **Rule 3:** Powers of powers
 - Example: $(7^2)^3 = 7^2 \cdot 7^2 \cdot 7^2 = 7^6$
 - Formula: $(b^m)^n = b^{mn}$
- **Rule 4:** Quotients of expressions with the same base
 - Example: $\frac{x^6}{x^2} = \frac{x \cdot x \cdot x \cdot x \cdot x \cdot x}{x \cdot x} = x^4$
 - Formula: $\frac{b^m}{b^n} = b^{m-n}$

- **Rule 5:** Zero as an exponent
 - Example: $1 = \frac{x^2}{x^2} = x^{2-2} = x^0$
 - Formula: $b^0 = 1, b \neq 0$
- **Rule 6:** Powers of Quotients
 - Example: $\left(\frac{2}{5}\right)^3 = \left(\frac{2}{5}\right)\left(\frac{2}{5}\right)\left(\frac{2}{5}\right) = \frac{2^3}{5^3}$
 - Formula: $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

For practice using rules I – III, go to [Multiplication with Exponents](#);
to practice rules IV – VI, go to [Division with Exponents](#). Then simplify these expressions:

$$(2t)^4 =$$

$$(5y^6)(3y^2) =$$

$$\frac{12x^7}{3x^5} =$$

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