Exponent Rules to Remember

By: Bryant Nelson

Product Rule

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

Example:

$7^3 \cdot 7^4 = 7^7 = 823543$ ✓

When multiplying exponential expressions with the same base you can add their exponents.

Quotient Rule

$\frac{b^m}{b^n} = b^m \cdot b^{-n} = b^{m-n} \quad b \neq 0$

Example:

$\frac{3^5}{3^3} = 3^2 = 9$ ✓

When dividing exponential expressions with the same base you can subtract their exponents.

Zero-Exponent Rule

$b^0 = 1$

Example:

$\left(\sqrt{\pi}\right)^0 = 1$ ✓

Anything raised to the "zero" power is equal to 1.

Negative-Exponent Rule

$b^{-x} = \frac{1}{b^x}$ or $\frac{1}{b^{-x}} = b^x$

Example:

$2^{-3} = \frac{1}{2^3} = \frac{1}{8}$ ✓

$\frac{1}{3^{-2}} = 3^2 = 9$ ✓

A negative exponent moves it from the numerator to the denominator or from the denominator to the numerator.

Power Rule (Powers to Powers)

$\left(b^m\right)^n = b^{m \cdot n}$

Example:

$\left(2^3\right)^4 = 2^{12} = 4096$ ✓

When an exponential is raised to a power you multiply the exponents.

Products to Powers

$(a \cdot b)^n = a^n \cdot b^n$

Example:

$(2 \cdot 3)^3 = 2^3 \cdot 3^3 = 8 \cdot 27 = 216$ ✓

When a product is raised to a power, you can raise each term to that power, and multiply the results.

Quotients to Powers

$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

Example:

$\left(\frac{2}{3}\right)^4 = \frac{2^4}{3^4} = \frac{16}{81}$ ✓

When a quotient is raised to a power, you can raise each term to that power, and divide the results.

Steps for Simplifying Exponential Expressions

		Example
1.	If necessary, remove parentheses by using the "***products to powers***" rule or "***quotients to powers***" rule. $(a \cdot b)^n = a^n \cdot b^n$ or $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$	$(x \cdot y)^3 = x^3 \cdot y^3$
2.	If necessary simplify "***powers to powers***". $(b^m)^n = b^{m \cdot n}$	$(x^4)^3 = x^{4 \cdot 3} = x^{12}$
3.	If necessary, be sure that each base only appears once by using the "***product***" and "***quotient***" rules. $b^m \cdot b^n = b^{m+n}$ or $\frac{b^m}{b^n} = b^m \cdot b^{-n} = b^{m-n}$	$x^3 \cdot x^5 = x^{3+5} = x^8$
4.	If necessary, rewrite exponential expression with "***zero***" powers as 1. Also, write negative exponents as positive by using the "***negative-exponent***" rule. $b^0 = 1$ or $b^{-x} = \frac{1}{b^x}$ or $\frac{1}{b^{-x}} = b^x$	$\frac{x^5}{x^8} = x^{5-8} = x^{-3} = \frac{1}{x^3}$

Example:

$$\frac{-35x^2y^4}{5x^6y^{-8}}$$

Solution:

$\frac{-35x^2y^4}{5x^6y^{-8}}$	$=$	$\left(\frac{-35}{5}\right)\left(\frac{x^2}{x^6}\right)\left(\frac{y^4}{y^{-8}}\right)$	**Group factors with the same bases.**
	$=$	$(-7)(x^{2-6})(y^{4-(-8)})$	**When dividing expressions with the same base subtract the exponents. (quotient rule)**
	$=$	$-7x^{-4}y^{12}$	**Simplify.**
	$=$	$\frac{-7y^{12}}{x^4}$	**Move the base with the negative exponent, x^{-4}, to the other side of the fraction bar and make the negative exponent positive. (negative-exponent rule)**