# Exponent Rules

## The Product Rule for Exponents
## (Multiplying Like Bases With Exponents)

**When you multiply like bases you add your exponents.**

$$x^n \bullet x^m = x^{n+m}$$

$$2^3 \bullet 2^5 = 2^{3+5} = 2^8$$

$$w^2 \bullet w^3 = w^5$$

## Quotient Rule for Exponents
## (Dividing Like Bases With Exponents)

**When you divide like bases you subtract their exponents.**

$$a^m \div a^n = a^{m-n}$$

$$7^5 \div 7^2 = 7^{5-2} = 7^3$$

$$2^2 \div 2^5 = 2^{2-5} = 2^{-3} = \frac{1}{2^3} = \frac{1}{8}$$

## Power of a Power Rule for Exponents
## (Base Raised to Two Exponents)

**When you raise a base to two exponents, you multiply those exponents together.**

$$\left(a^m\right)^n = a^{m \times n}$$

$$\left(a^5\right)^2 = a^{5 \times 2} = a^{10}$$

$$\left(2^2\right)^{-3} = 2^{2 \times -3} = 2^{-6} = \frac{1}{2^6} = \frac{1}{64}$$

## Power of a Product Rule for Exponents
## (A Product Raised to an Exponent)

When you have a PRODUCT (not a sum or difference) raised to an exponent, you can simplify by raising each base in the product to that exponent.

$$(ab)^m = a^m b^m \qquad (2x^2)^3 = 2^3 x^6 = 8x^6 \qquad (2x^2)^{-3} = 2^{-3} x^{-6} = \frac{1}{2^3 x^6} = \frac{1}{8x^6}$$

## Power of a Quotient
## (A Quotient Raised to an Exponent)

When you have a QUOTIENT (not a sum or difference) raised to an exponent, you raise each base in the numerator and denominator of the quotient to that exponent.

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n} \qquad \left(\frac{x^5}{y^2}\right)^3 = \frac{x^{15}}{y^6} \qquad \left(\frac{2^3}{4}\right)^2 = \frac{2^6}{4^2} = \frac{64}{16} = 4$$

## Zero Exponents

Any base raised to an exponent of 0 has a value of 1.

$$a^0 = 1 \qquad 100^0 = 1 \qquad 5xyz^0 = 5xy \qquad (5xyz)^0 = 1$$

## Negative Exponents

A base raised to a negative exponent has the same value as the reciprocal of the base to the positive of the exponent.

$$a^{-4} = \left(\frac{1}{a}\right)^4 = \frac{1}{a^4} \qquad 10^{-4} = \left(\frac{1}{10}\right)^4 = \frac{1}{10^4} \qquad \left(\frac{2}{3}\right)^{-2} = \left(\frac{3}{2}\right)^2 = \frac{3^2}{2^2} = \frac{9}{4}$$