

Exponential Form

exponent

base

$$a^n = \underbrace{a \cdot a \cdot a \cdot a \dots}_{n \text{ factors}}, a \neq 0$$

n factors

Examples:

$$2 \cdot 2 \cdot 2 = 2^3 = 8$$

$$n \cdot n \cdot n \cdot n = n^4$$

$$3 \cdot 3 \cdot 3 \cdot x \cdot x = 3^3 x^2 = 27x^2$$

Zero Exponent

$$a^0 = 1, a \neq 0$$

Examples:

$$(-5)^0 = 1$$

$$(3x + 2)^0 = 1$$

$$(x^2y^{-5}z^8)^0 = 1$$

$$4m^0 = 4 \cdot 1 = 4$$

$$\left(\frac{2}{3}\right)^0 = 1$$

Negative Exponent

$$a^{-n} = \frac{1}{a^n}, a \neq 0$$

Examples:

$$4^{-2} = \frac{1}{4^2} = \frac{1}{16}$$

$$\frac{x^4}{y^{-2}} = \frac{x^4}{\frac{1}{y^2}} = \frac{x^4}{1} \cdot \frac{y^2}{1} = x^4 y^2$$

$$(2 - a)^{-2} = \frac{1}{(2 - a)^2}, a \neq 2$$

Product of Powers Property

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

Examples:

$$x^4 \cdot x^2 = x^{4+2} = x^6$$

$$a^3 \cdot a = a^{3+1} = a^4$$

$$w^{\frac{1}{3}} \cdot w^{\frac{1}{4}} = w^{\frac{1}{3} + \frac{1}{4}} = w^{\frac{7}{12}}$$

Quotient of Powers Property

$$\frac{a^m}{a^n} = a^{m-n}, a \neq 0$$

Examples:

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

$$\frac{y^{-3}}{y^{-5}} = y^{-3 - (-5)} = y^2$$

$$\frac{a^4}{a^4} = a^{4-4} = a^0 = 1$$

Power of a Power Property

$$(a^m)^n = a^{m \cdot n}$$

Examples:

$$\left(y^{\frac{1}{4}}\right)^8 = y^{\frac{1}{4} \cdot 8} = y^2$$

$$(g^2)^{-3} = g^{2 \cdot (-3)} = g^{-6} = \frac{1}{g^6}$$

Power of a Product Property

$$(ab)^m = a^m \cdot b^m$$

Examples:

$$(9a^4b^6)^{\frac{1}{2}} = (9)^{\frac{1}{2}} \cdot (a^4)^{\frac{1}{2}} (b^6)^{\frac{1}{2}} = 3a^2b^3$$

$$\frac{-1}{(2x)^3} = \frac{-1}{2^3 x^3} = \frac{-1}{8x^3}$$

Power of Quotient Property

$$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}, b \neq 0$$

Examples:

$$\left(\frac{y}{3}\right)^4 = \frac{y^4}{3^4} = \frac{y}{81}$$

$$\left(\frac{5}{t}\right)^{-3} = \frac{5^{-3}}{t^{-3}} = \frac{\frac{1}{5^3}}{\frac{1}{t^3}} = \frac{1}{5^3} \cdot \frac{t^3}{1} = \frac{t^3}{5^3} = \frac{t^3}{125}$$