

4.2: Exponent Laws

April 4, 2017 7:59 AM

All exponent laws require the same base.

$$4^3 = 4 \cdot 4 \cdot 4$$

base → 4, exponent → 3 times

Product of Powers

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

* bases must be the same

$$\text{Ex: } 4^3 \cdot 4^7 = 4^{3+7} = 4^{10}$$

$$\text{Ex: } 3^{2x} \cdot 3^{3x} = 3^{2x+3x} = 3^{5x}$$

$$\text{Ex: } 2^x \cdot 2^3 = 2^{x+3}$$

Quotient of Powers

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

$$\text{Ex: } \frac{5^7}{5^4} = 5^{7-4} = 5^3$$

$$\text{Ex: } \frac{2^x}{2^3} = 2^{x-3}$$

Power of Products

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

$$\text{Ex: } (2 \cdot 3)^4 = 2^4 \cdot 3^4$$

$$\text{Ex: } (5 \cdot y)^3 = 5^3 \cdot y^3$$

Power of Quotient

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

$$\text{Ex: } \left(\frac{5}{3}\right)^2 = \frac{5^2}{3^2}$$

$$\text{Ex: } \left(\frac{2x}{5}\right)^3 = \frac{2^3 x^3}{5^3}$$

Power of Powers

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

$$\text{Ex: } (5^2)^3 = 5^{2 \cdot 3} = 5^6$$

$$\text{Ex: } (3x^2)^4 = 3^4 x^8$$

Zero Exponent

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

Explanation: $1x^2 = 1 \cdot x \cdot x$
 $1x^1 = 1 \cdot x$
 $1x^0 = 1$

$$\text{Ex: } (3x - 5x)^0 = 1$$

$$3x^0 = 3 \cdot 1 = 3$$

Negative Exponents

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

$$\text{Ex: } 5x^{-1} = (5)(x^{-1}) = \frac{5}{x} = \frac{5}{x^1} \quad \text{Flip down}$$

Explanation

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

$$\text{Ex: } \frac{1}{5x^{-3}} = \frac{x^3}{5} \quad \text{Flip up}$$

Examples

$$\text{Simplify: } (5^2 \cdot y^3) \cdot (5x) = 5^3 x^2 y^3$$

$$\left(\frac{7x^3y}{14xy^2}\right)^2 = \left(\frac{x^{3-1}y^{1-2}}{2}\right)^2 = \left(\frac{x^2y^{-1}}{2}\right)^2 = \left(\frac{x^2}{2y}\right)^2 = \frac{x^{2 \cdot 2}}{2^2 y^2} = \frac{x^4}{4y^2}$$

$$11 \cdot \frac{1}{4} \cdot \frac{2}{14} \cdot \frac{2}{3^4} \cdot \frac{2}{3^4} \cdot \frac{2}{3^4}$$

$$\left(\frac{3^4 \cancel{x^2} y^{\cancel{6}^1}}{\cancel{2}^2 x^3} \right) \cdot \left(\frac{\cancel{4}^2 x}{9 \cancel{z^9} \cancel{x^2} y} \right) = \frac{3^4 z \cdot 2}{y^3 \cdot 9} = \frac{3^4 z \cdot 2}{\cancel{3^2} y^3} = \frac{3^2 z \cdot 2}{y^3} = \boxed{\frac{18z}{y^3}}$$

Bathroom

Homework 2-10 even
4.2 page 169

$$\left[(a^2)(a^0) \right]^{-4} =$$

$$\left[\left(\frac{3y}{4} \right)^{-2} \left(\frac{3x}{4} \right)^{-2} \right]^{-2} =$$