

Exponent Guide

Exponent Rules

Ex1) Suppose you have $x^3 \cdot x^4$ expand this out to read $x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x$ now rewrite that with an exponent and you should get x^7 .

Product rule for exponents:

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

A) $x^{10} \cdot x^{14} = x^{24}$

B) $2^3 \cdot 2^4 = 2^{3+4} = 2^7 = 128$

C) $yx^3 \cdot y^5x^4 = x^7y^6$

Ex2) Suppose you have $\frac{x^5}{x^3}$ expand this out and reduce. $\frac{x \cdot x \cdot x \cdot x \cdot x}{x \cdot x \cdot x} = x^2$

Quotient Rule for Exponents: $\frac{x^m}{x^n} = x^{m-n} \quad x > 0$

Practice using quotient rule

a) $\frac{x^{57}}{x^{30}} = x^{27}$

b) $\frac{3^5}{3^3} = 3^{5-3} = 3^2 = 9$

c) $\frac{x^4}{x^5} = \frac{1}{x^1} = \frac{1}{x}$

Rule of Negative Exponents

$x^{-c} = \frac{1}{x^c}$ Note: There is no value exponent that can change the sign of any number x (from + to -)

a) $3x^{-7} = \frac{3}{x^7}$

b) $(3x)^{-3} = \frac{1}{3^3x^3} = \frac{1}{27x^3}$

c) $4(2x^3)^{-4} = \frac{4}{2^4x^{3 \times 4}} = \frac{4}{16x^{12}} = \frac{1}{4x^{12}}$

Zero Rule for Exponents

$$(x)^0 = 1$$

a) $(7)^0 = 1$

b) $-(3x)^0 = -1$

c) $-2(-x)^0 = -2$

Power of a Power Rule

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

a) $(2^3)^2 = 2^{3 \times 2} = 2^6 = 64$

b) $(x^3)^y = x^{3 \times y} = x^{3y}$

$$c) \left(e^{\frac{1}{2}}\right)^4 = e^{\frac{1}{2} \times 4} = e^2$$

Power of a Product Rule

$$(ab)^x = a^x b^x$$

- a) $(a^2 b^3)^4 = a^{2 \times 4} b^{3 \times 4} = a^8 b^{12}$
 b) $(x^{-5} y^{-3})^{-3} = x^{-5 \times -3} y^{-3 \times -3} = x^{15} y^9$
 c) $(4x^7 y^9 z^2)^3 = 4^{1 \times 3} x^{7 \times 3} y^{9 \times 3} z^{2 \times 3} = 4^3 x^{21} y^{27} z^6 = 64x^{21} y^{27} z^6$

Power of a Fraction Rule

$$\left(\frac{x^a}{y^b}\right)^c = \frac{x^{a \times c}}{y^{b \times c}}$$

- a) $\left(\frac{x^3}{z^8}\right)^3 = \frac{x^{3 \times 3}}{z^{8 \times 3}} = \frac{x^9}{z^{24}}$
 b) $\left(\frac{4x^2}{8p^6}\right)^2 = \frac{4^2 x^{2 \times 2}}{8^2 p^{6 \times 2}} = \frac{16x^4}{64p^{12}} = \frac{x^4}{4p^{12}}$ *note: $\frac{16}{64} = \frac{1}{4}$*
 c) $\left(\frac{eh^3}{h^5}\right)^{-4} = \left(\frac{h^5}{eh^3}\right)^4 = \frac{h^{5 \times 4}}{e^{1 \times 4} h^{3 \times 4}} = \frac{h^{20}}{e^4 h^{12}} = \frac{h^{20-12}}{e^4} = \frac{h^8}{e^4}$
 a. $\left(\frac{eh^3}{h^5}\right)^{-4} = \left(\frac{e}{h^2}\right)^{-4} = \left(\frac{h^2}{e}\right)^4 = \frac{h^8}{e^4}$

Fractional Exponent Rule

$$\sqrt[y]{b^x} = b^{\frac{x}{y}}$$

- a) $\sqrt{x} = x^{\frac{1}{2}}$
 b) $\sqrt[3]{8^5} = 8^{\frac{5}{3}} = 2^5 = 32$ *note: $\sqrt[3]{8}$ and $8^{\frac{1}{3}} = 2$*
 c) $\sqrt[2]{4x^4 y^8 z^7} = 4^{\frac{1}{2}} x^{\frac{4}{2}} y^{\frac{8}{2}} z^{\frac{7}{2}} = 2x^2 y^4 z^{\frac{7}{2}}$