Product Property

$x^m \cdot x^n = x^{m+n}$ $\quad x^7 \cdot x^{-3} = x^4$

Quotient Property

$\frac{x^m}{x^n} = x^{m-n}$ $\quad \frac{x^5}{x^3} = \frac{x \cdot x \cdot x \cdot x \cdot x}{x \cdot x \cdot x} = x^2$

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

Negative exponents

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

or

$\frac{1}{x^{-m}} = x^m$ $\quad \frac{1}{x^{-4}} = x^4$

Power of a power

$(x^m)^n = x^{mn}$ $\quad (x^5)^3 = x^{15}$

Power of a product

$(xy)^m = x^m y^m$ $\quad (x^2 y^3)^4 = (x^2)^4 (y^3)^4 = x^8 y^{12}$

Power of a Quotient

$\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}, y \neq 0$ $\quad \left(\frac{x^3}{y^5}\right)^2 = \frac{x^6}{y^{10}}$

$\left(\frac{x}{y}\right)^{-m} = \left(\frac{y}{x}\right)^m = \frac{y^m}{x^m}$

$= \frac{x^{-m}}{y^{-m}} = \frac{y^m}{x^m}$

Zero Power

$x^0 = 1$

$\boxed{x^0} y^2 = y^2$

$5^0 = 1$

$12^0 =$

$(-18)^0 =$

$(-18)^0 = -1$

Study tip

to simplify
- no powers of powers $(x^2)^3$
- each base appears exactly once
- all fractions in simplest form
- no negative exponents

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ex. 1 $(3x^3y^2)(-4x^0y^4) = -12x^5y^6$

$3 \cdot -4 \quad x^3 \cdot x^0 \quad y^2 \cdot y^4$

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ex. A $(-2x^4y^3z^2)^3 = -8x^{12}y^9z^6$

$(-2)^3 \quad (x^4)^3 \quad (y^3)^3 \quad (z^2)^3$

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ex B $\frac{25x^4y}{5x^2y^3} = 5x^2y^{-2} = \frac{5x^2}{y^2}$

$\frac{25}{5} \quad \frac{x^4}{x^2} \quad \frac{y^1}{y^3}$

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ex. C $\left(\frac{-18a^4b^2}{-24ac^3}\right)^2 = \left(\frac{3a^3b^2}{4c^3}\right)^2 = \frac{9a^6b^4}{16c^6}$

$\frac{-18}{-24} \quad \frac{a^4}{a}$

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ex. D $\left(\frac{x^4y^2}{x^7y}\right)^{-3} = (x^{-3}y)^{-3} = x^9y^{-3} = \frac{x^9}{y^3}$

$\frac{x^4}{x^7} \quad \frac{y^2}{y^1} \quad (x^{-3})^{-3} \quad (y^1)^{-3}$

ex. E $\dfrac{(2x^2y^3)^2(3x^4y^5)}{6x^4y^2} = \dfrac{4x^4y^6(3x^4y^5)}{6x^4y^2}$ $x^4 \cdot x^4$

$= \dfrac{12x^8y^{11}}{6x^4y^2} = 2x^4y^9$

ex F: $\left(\dfrac{45m^4n^2p^{-7}}{9m^{-8}n^4p^5}\right)^0 = 1$

ex G: $\dfrac{45m^4n^2p^{-7}}{9m^{-8}n^4p^5} = 5m^{12}n^{-2}p^{-12}$

$= \dfrac{5m^{12}}{n^2p^{12}}$

$\dfrac{8^{98}}{8^{96}} = 8^2 = 64$

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