Exponents

An exponential expression includes a base raised to an exponential power, where the power tells us how many factors of the base should be multiplied together.

Exponential Expression:

- 5^3 (Base 5, exponent 3)

  - Expanded Form: $5 \cdot 5 \cdot 5 = 125$

- $(-2)^4$ (Base -2, exponent 4)

  - Expanded Form: $(-2)(-2)(-2)(-2) = 16$

- $9x^2$ (Coefficient 9, base x, exponent 2)

  - Expanded Form: $9 \cdot x \cdot x$

- $(9x)^2$ (Base 9x, exponent 2)

  - Expanded Form: $(9x)(9x) = 81 \cdot x \cdot x$

Several rules for working with exponents make simplifying exponential expressions easier.

- **Rule 1:** Products of expressions with the same base

  - Example: $2^3 \cdot 2^2 = (2 \cdot 2 \cdot 2)(2 \cdot 2) = 2^5$

  - Formula: $b^m \cdot b^n = b^{m+n}$

- **Rule 2:** Powers of products

  - Example: $(7x)^3 = (7x)(7x)(7x) = 7^3 x^3$

  - Formula: $(ab)^n = a^n b^n$

- **Rule 3:** Powers of powers

  - Example: $(7^2)^3 = 7^2 \cdot 7^2 \cdot 7^2 = 7^6$

  - Formula: $(b^m)^n = b^{mn}$

- **Rule 4:** Quotients of expressions with the same base

  - Example: $\dfrac{x^6}{x^2} = \dfrac{x \cdot x \cdot x \cdot x \cdot x \cdot x}{x \cdot x} = x^4$

  - Formula: $\dfrac{b^m}{b^n} = b^{m-n}$

- **Rule 5:** Zero as an exponent

  - Example: $1 = \dfrac{x^2}{x^2} = x^{2-2} = x^0$

  - Formula: $b^0 = 1, b \neq 0$

- **Rule 6:** Powers of Quotients

  - Example: $\left(\dfrac{2}{5}\right)^3 = \left(\dfrac{2}{5}\right)\left(\dfrac{2}{5}\right)\left(\dfrac{2}{5}\right) = \dfrac{2^3}{5^3}$

  - Formula: $\left(\dfrac{a}{b}\right)^n = \dfrac{a^n}{b^n}$

For practice using rules I – III, go to Multiplication with Exponents;
to practice rules IV – VI, go to Division with Exponents. Then simplify these expressions:

$(2t)^4 =$

$(5y^6)(3y^2) =$

$\dfrac{12x^7}{3x^5} =$