I. Positive Integer Exponents

Ex. \(2^3\)

II. Zero as an Exponent

Ex. \(2^0\)

III. Negative Integer Exponents

Ex. \(2^{-3}\)

IV. Rational (Fractional) Exponents

Ex. \(8^{\frac{2}{3}}, 27^{-\frac{1}{3}}\)

I. Positive Integer Exponents

\[3 \rightarrow \text{exponent or power}\]

\[2 \rightarrow \text{base}\]

\[2^3 \rightarrow 2 \cdot 2 \cdot 2 = 8\]

\[3 \times 5 \rightarrow \text{Not correct}\]

\[3 \times \times \times \times \times \rightarrow \text{Correct} \]

The guiding principle for how to distinguish what the base is that the base is the factor immediately next to the exponent. Unless (s) tell you otherwise.

Ex. \(5xy^3 = 5 \cdot x \cdot y \cdot y \cdot y\)

\((-2)^4 = (-2)(-2)(-2)(-2)\)

\(5(xy)^3 = 5(xy)(xy)(xy)\)

\(-2^4 = \frac{-1(2 \cdot 2 \cdot 2 \cdot 2)}{\text{Coefficient} \times \text{base multiplied 4 times}}\)

\(-2^4 = \frac{-1(2 \cdot 2 \cdot 2 \cdot 2)}{\text{Coefficient} \times \text{base multiplied 4 times}}\)
A negative number to an even power will be positive.
A negative number to an odd power will be negative.

\[
(\text{Neg})^{\text{even}} = \text{Pos} \\
(\text{Neg})^{\text{odd}} = \text{Neg}
\]

Example Quiz Question

\[
(-1)^{431} =
\]

A. 431
B. -431
C. 1
D. -1

Correct Answer: D. -1

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First Property of Exponents

\[
X^3 \cdot X^2 = (X \cdot X \cdot X) \cdot (X \cdot X) = (X \cdot X \cdot X \cdot X \cdot X) = X^5
\]

Same base → \( X^{3+2} \)

\[
\alpha^7 \cdot \alpha^3 \cdot \alpha = \alpha^{7+3+1} = \alpha^{11} \quad \text{Since} \quad \alpha = \alpha^1
\]

3ab^2 \cdot 5a^2b^4 \cdot 6ab^3 = (3 \cdot 5 \cdot 6)(a \cdot a^2 \cdot a)(b^2 \cdot b^4 \cdot b^3) = 90(a^{1+2+1})(b^{2+4+3}) = 90a^4b^7

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Second Property of Exponents

\[
(X^3)^2 = X^{3 \cdot 2} = X^6
\]

\[
(X^3)^2 = (X^3)(X^3) = X^6
\]

\[
(xy^2z^3)^5 = x^5y^{10}z^{15}
\]

\[
(2a^3)^3 = 2^3a^9 = 8a^9
\]

\[(X^3)^2 \text{ is known as a power of a power.}\]
II. Zero as an Exponent

$2^0 = 1$

$2^3 \cdot 2^0 = 2^{3+0} = 2^3 = 8$

\[ \frac{8}{1} = 8 \]

So the blank must be 1 since no other number will work.

$7^0 = 1$  $13.5^0 = 1$  $\pi^0 = 1$  $\left(\frac{1}{19}\right)^0 = 1$  $(-37.2)^0 = 1$

Any real number to the zero power is 1.

$-7^0 = -1(7^0) = -1(1) = -1$

$(-7)^0 = 1$
Example Problems from WebAssign

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

you can cancel