

Objective

Students will be able to use the properties of exponents to evaluate and simplify expressions along with writing in scientific notation.

power

base

exponent

The diagram illustrates the components of the mathematical expression x^n . The letter x is the base, indicated by a red arrow pointing to it from the label "base". The letter n is the exponent, indicated by a red arrow pointing to it from the label "exponent". A blue bracket groups both x and n , with the label "power" pointing to the bracket, indicating that the entire expression x^n represents a power.

Properties of Exponents

Let a and b be real numbers and let m and n be integers.

Property Name	Definition	Example
Product of Powers	$a^m \cdot a^n = a^{m+n}$	$5^3 \cdot 5^{-1} = 5^{3+(-1)} = 5^2 = 25$
Power of a Power	$(a^m)^n = a^{mn}$	$(3^3)^2 = 3^{3 \cdot 2} = 3^6 = 729$
Power of a Product	$(ab)^m = a^m b^m$	$(2 \cdot 3)^4 = 2^4 \cdot 3^4 = 1296$
Negative Exponent	$a^{-m} = \frac{1}{a^m}, a \neq 0$	$7^{-2} = \frac{1}{7^2} = \frac{1}{49}$
Zero Exponent	$a^0 = 1, a \neq 0$	$(-89)^0 = 1$
Quotient of Powers	$\frac{a^m}{a^n} = a^{m-n}, a \neq 0$	$\frac{6^{-3}}{6^{-6}} = 6^{-3-(-6)} = 6^3 = 216$
Power of a Quotient	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}, b \neq 0$	$\left(\frac{4}{7}\right)^2 = \frac{4^2}{7^2} = \frac{16}{49}$

****never leave exponents as a negative!**

Evaluate the following expressions:

$$\begin{aligned} 1) \left(-4 \cdot 2^5\right)^2 &= (-4)^2 \cdot (2^5)^2 = 16 \cdot 2^{5 \cdot 2} = 16 \cdot 2^{10} \\ &= 16 \cdot 1024 = 16,384 \end{aligned}$$

$$\begin{aligned} 2) \left(\frac{11^5}{11^8}\right)^{-1} &= \frac{11^{-5}}{11^{-8}} = \frac{11^8}{11^5} = 11^{8-5} = 11^3 \\ &= 1331 \end{aligned}$$

Simplify the following expressions:

$$3) \ b^{-4}b^6b^7 = b^{-4+6+7} = b^9$$

$$4) \ \left(\frac{r^{-2}}{s^3}\right)^{-3} = \frac{(r^{-2})^{-3}}{(s^3)^{-3}} = \frac{r^6}{s^{-9}} = r^6s^9$$

$$5) \ \frac{16m^4n^{-5}}{2n^{-5}} = 8m^4n^{-5-(-5)} = 8m^4n^0 = 8m^4$$

Scientific Notation

A number is expressed in scientific notation if it is in the form $c \times 10^n$ where $1 \leq c < 10$ and n is an integer.

Use the properties of exponents to help you when you are writing in scientific notation

Example: 1.06×10^5

Write the following in scientific notation:

$$1) (6.3 \times 10^5)(8.9 \times 10^{-12})$$

$$\begin{aligned} &= 56.07 \times 10^{5+(-12)} = 56.07 \times 10^{-7} \\ &= 5.607 \times 10^{-6} \end{aligned}$$

$$2) (2.1 \times 10^{-4})^3$$

$$= (2.1)^3 \times (10^{-4})^3 = 9.261 \times 10^{-12}$$

Write the following in scientific notation:

$$3) \frac{8.1 \times 10^{12}}{5.4 \times 10^9} = 1.5 \times 10^{12-9} = 1.5 \times 10^3$$

$$4) \frac{(7.5 \times 10^8)(4.5 \times 10^{-4})}{1.5 \times 10^7} = \frac{33.75 \times 10^4}{1.5 \times 10^7}$$
$$= \frac{3.375 \times 10^5}{1.5 \times 10^7} = 2.25 \times 10^{5-7} = 2.25 \times 10^{-2}$$

Homework

You can choose which worksheet you want to do for homework.

One worksheet is for those of us who are still *developing* our skills on properties of exponents.

The other worksheet is for those of us who have *mastered* the skill already.