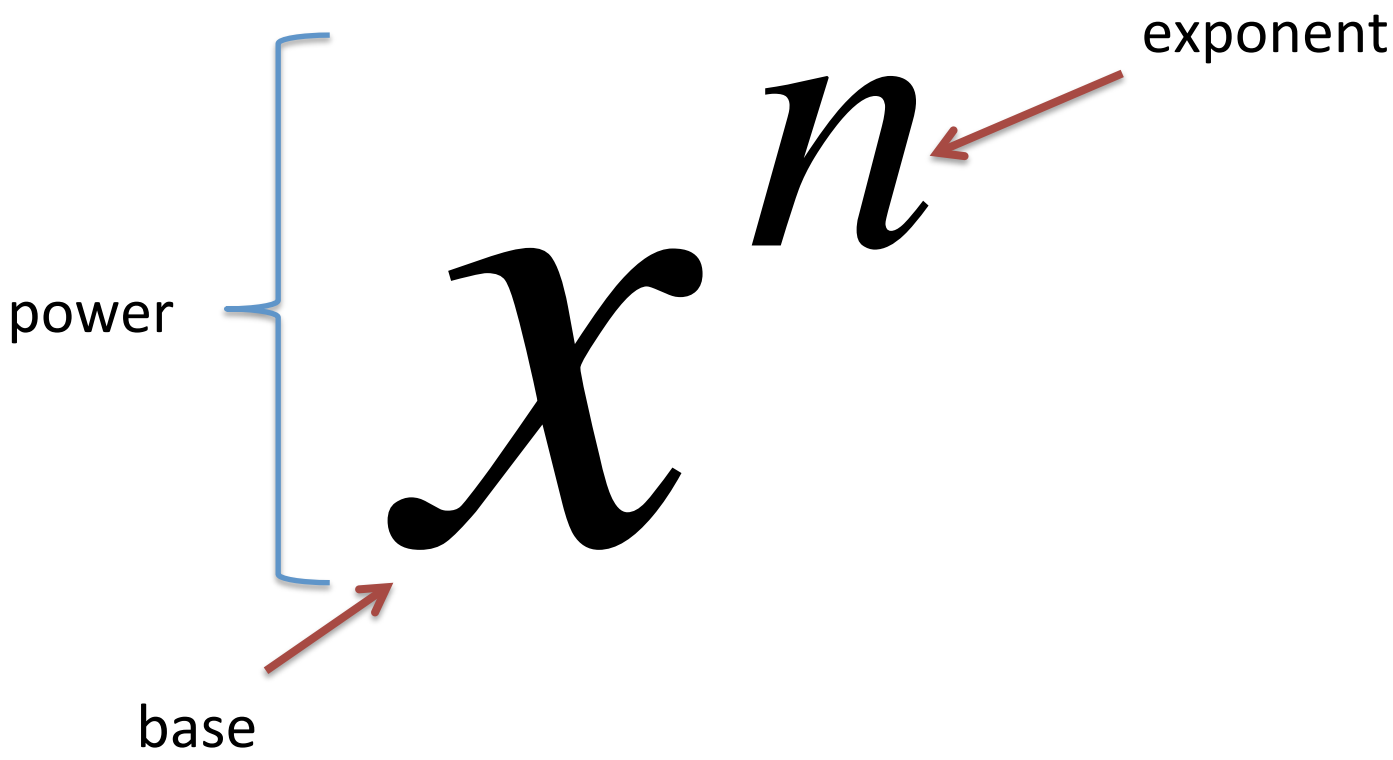
Objective

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


exponent
power
x^n
base

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:

1) $\left(-4\cdot 2^5\right)^2 = \left(-4\right)^2\cdot\left(2^5\right)^2 = 16\cdot 2^{5\cdot 2} = 16\cdot 2^{10}$

$= 16\cdot 1024 = 16{,}384$

2) $\left(\frac{11^5}{11^8}\right)^{-1} = \frac{11^{-5}}{11^{-8}} = \frac{11^8}{11^5} = 11^{8-5} = 11^3$

$= 1331$

Simplify the following expressions:

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

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

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

Scientific Notation

A number is expressed in <u>scientific notation</u> 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) $(6.3 \times 10^{5})(8.9 \times 10^{-12})$

$= 56.07 \times 10^{5+(-12)} = 56.07 \times 10^{-7}$

$= 5.607 \times 10^{-6}$

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) $\frac{8.1\times10^{12}}{5.4\times10^{9}} = 1.5\times10^{12-9} = 1.5\times10^{3}$

4) $\frac{(7.5\times10^{8})(4.5\times10^{-4})}{1.5\times10^{7}} = \frac{33.75\times10^{4}}{1.5\times10^{7}}$

$= \frac{3.375\times10^{5}}{1.5\times10^{7}} = 2.25\times10^{5-7} = 2.25\times10^{-2}$

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.