

Exponents and Powers

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An exponent or power is a mathematical representation that indicates the number of times that a number is multiplied by itself.

If a number is multiplied by itself m times, then it can be written as: $a \times a \times a \times a \times a \dots m \text{ times} = a^m$. Here, a is called the base, and m is called the exponent or power or index.

Numbers raised to the power of two are called square numbers. Square numbers are also read as two-square, three-square, four-square, five-square, and so on. Numbers raised to the power of three are called cube numbers. Cube numbers are also read as two-cube, three-cube, four-cube, five-cube, and so on.

Negative numbers can also be written using exponents. If $a^n = b$, where a , b and n are integers, then a^n is called the exponential form of b . When numbers are expressed as the product of the powers of their prime factors, we get the prime factor product form. The order of factors in the prime factor product form of a number can be interchanged without changing the value of the number.

$$\text{e.g. } a^x \times b^y = b^y \times a^x.$$

When numbers are expressed using powers of 10, we get the expanded form of numbers. The value of an exponential number with a negative base raised to the power of an even number is positive. The value of an exponential number with a negative base raised to the power of an odd number is negative.

$$(-1)^{\text{odd number}} = -1$$

$$(-1)^{\text{even number}} = +1$$

If the base of two exponential numbers is the same, then the number with the greater exponent is greater than the number with the smaller exponent.

A number can be expressed as a decimal number between 1.0 and 10.0, including 1.0, multiplied by a power of 10. Such a form of a number is known as its standard form. Large numbers when written in the standard form is much easier to read, understand and compare.

Laws of Exponents

Multiplication of Powers with the Same Base

When numbers with the same base are multiplied, the power of the product is equal to the sum of the powers of the numbers.

If ' a ' is a non-zero integer, and ' m ' and ' n ' are whole numbers then, $a^m \times a^n = a^{m+n}$.

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Division of Powers with the Same Base

When numbers with the same base are divided, then the power of the quotient is equal to the difference between the powers of the dividend and the divisor.

If 'a' is a non-zero integer, and 'm' and 'n' are whole numbers then, $a^m \div a^n = a^{m-n}$.

Power of a Power

If 'a' is any non-zero integer, and 'm' and 'n' are whole numbers then, $(a^m)^n = a^{mn}$.

Multiplication of Powers with the Same Exponent

If 'a' is any non-zero integer, and 'm' is a whole number then, $a^m \times b^m = (ab)^m$.

Division of Powers with the Same Exponent

If a and b are any non-zero integers and m is a whole number then, $a^m \div b^m = (a/b)^m$.

Numbers with an Exponent of Zero

For any non-zero integer a, $a^0 = 1$.