Lesson 1 - EXPONENTS

Grade 9

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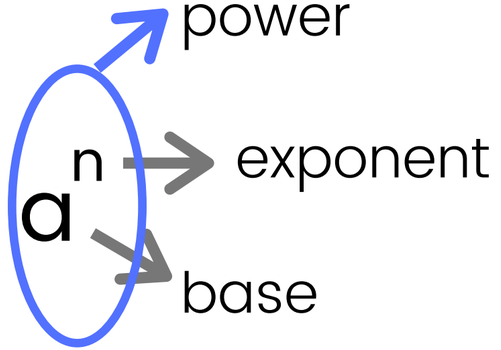
When number represented by a variable **a** is multiplied by itself **n** number of times, such product can be recorded as:

$$\underbrace{a \times a \times a \times \ldots\ldots\ldots\ldots \times a}_{n \text{ times}} = a^{n}$$



$a^{1} = a$

any base raised to
the exponent 1
is equal to the base

$a^{0} = 1$

any base raised
to the exponent 0
is equal to 1

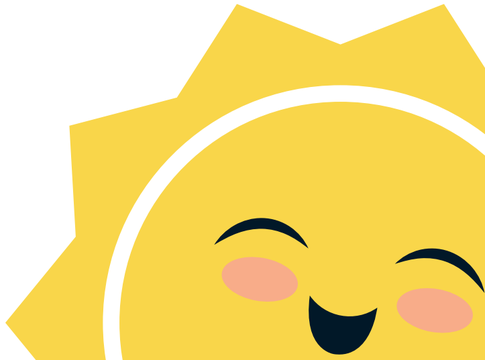
$1^{n} = 1$

the base of 1 raised
to any exponent is
equal to 1

ORDER OF OPERATIONS

According to the order of operations (BEDMAS) exponent comes second after operations in brackets.
If the expression does not contain operations in brackets, perform the operation of raising to the exponent first, prior to dividing, multiplying, adding and subtracting.

$$3^2 + (5 - 3) + 6 \times 2^3$$



EXPONENT LAWS

Natural Number Exponents

When multiplying powers with the same bases, keep the base and add the exponents

$$a^m \times a^n = a^{m+n} \qquad 2^5 \times 2^3 = 2^{5+3} = 2^8$$

When dividing powers with the same bases, keep the base and subtract the exponents

$$a^m \div a^n = a^{m-n} \qquad 2^5 \div 2^3 = 2^{5-3} = 2^2$$

When raising a power to an exponent, multiply the exponents

$$(a^m)^n = a^{mn} \qquad (3^2)^3 = 3^6$$

$a \neq 0$ when it is in the denominator

EXPONENT LAWS

Natural Number Exponents

When raising a product of terms to the exponent, raise every term of the product to that exponent separately

$$(ab)^m = a^m b^m \qquad (2 \times 3)^2 = 2^2 \times 3^2$$

When raising a quotient of terms to the exponent, raise every term of the quotient to that exponent separately

$$\left(\frac{a}{b}\right)^m = \frac{b^m}{a^m} \qquad \left(\frac{5}{6}\right)^2 = \frac{5^2}{6^2}$$

When raising a base to a negative exponent, change the base to its reciprocal and the sign of the exponent to a positive

$$\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n \qquad \left(\frac{2}{3}\right)^{-4} = \left(\frac{3}{2}\right)^4$$

$a, b \neq 0$ when they are in the denominator

TRY IT YOURSELF

EVALUATE:

$2^{10} \times 2^{3} =$

$5^{17} \div 5^{13} =$

$(2xy)^{3} =$

$\left(\frac{3}{5}\right)^{-3} =$

WHEN THE BASE IS NEGATIVE AND THE EXPONENT IS AN EVEN NUMBER

$-2^{2} = -(2) \times (2) = -4$ BUT $(-2)^{2} = (-2) \times (-2) = 4$

INTO MATH
LEARN IT FAST

MOVE ON TO GRADE 9 LESSON 2