Operations with Exponents

La Salle Academy

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Algebra 1

Terminology

A **power** is the value indicated by a **base** with an **exponent**.

$$BASE^{EXPONENT}$$

Some examples of bases and exponents are

$$10^2$$

$$4^3$$

$$m^n$$

Some general rules

Any base to the 0 power will ALWAYS = 1

$$4^0 = 1 \qquad P^0 = 1$$

Any base to the 1st power will ALWAYS = itself

$$6^1 = 6 \qquad (m+n)^1 = m+n$$

Any negative exponent can be written as a unit fraction with a positive exponent in the denominator (and vice versa)

$$3^{-2} = \frac{1}{3^2} = \frac{1}{9} \qquad -3^{-2} = -\frac{1}{3^2} = -\frac{1}{9} \qquad (-3)^{-2} = \frac{1}{3^2} = \frac{1}{9}$$

Rules for Operations with Terms and Exponents

Addition and Subtraction

Like bases with unlike exponents cannot be added or subtracted unless they can be evaluated first.

NO SHORTCUTS!

$$2^2 + 2^3 = 4 + 8 = 12 \qquad 3^3 - 3^2 = 27 - 9 = 18$$

$$A^2 + A^3 = A^2 + A^3 \qquad A^3 - A^2 = A^3 - A^2$$

Multiplication

To multiply powers of like bases, ADD the exponents.

$$3^4 \bullet 3^5 = 3^9$$

$$a^2 \bullet a^3 = a^{2+3} = a^5$$

$$a^{-4} \bullet a^5 = a^{-4+5} = a^1 = a$$

Division

To divide powers of like bases, SUBTRACT the exponent of the denominator from the exponent of the numerator.

$$\frac{4^7}{4^5} = 4^{7-5} = 4^2$$

$$\frac{a^5}{a^2} = a^{5-2} = a^3$$

$$\frac{a^3}{a^8} = a^{3-8} = a^{-5} = \frac{1}{a^5}$$

Raising a power to a power

To divide powers of like bases, SUBTRACT the exponent of the denominator from the exponent of the numerator.

$$\left(5^2\right)^3 = 5^{2\bullet 3} = 5^6$$

$$\left(a^4\right)^3 = a^{4\bullet 3} = a^{12}$$

Raising a fraction to a power

To raise a fraction to a power, raise the numerator and the denominator each INDEPENDENTLY to that power.

$$\left(\frac{3}{5}\right)^2 = \frac{3^2}{5^2} = \frac{9}{25}$$

$$\left(\frac{a}{b}\right)^7 = \frac{a^7}{b^7}$$

Raising a product to a power

To raise a product to a power, raise each factor to that power.

$$(5 \bullet 2)^3 = 5^3 \bullet 2^3 = 1{,}000$$

$$(4a)^2 = 4^2 \bullet a^2 = 16a^2$$

$$(ab)^5 = a^5 b^5$$

Useful tips to remember about working with negative bases

$-x^n$ *means* $-(x)^n$

For example: $-3^2 = -(3)^2 = -9$

$(-x)^n$ *means* $(-x)(-x)(-x)$

For example: $(-3)^2 = (-3)(-3) = 9$

When a negative base is raised to an *even* power, the result becomes positive.

$$(-2)^4 = (-2)(-2)(-2)(-2) = 16$$

When a negative base is raised to an *odd* power, the result becomes negative.

$$(-2)^3 = (-2)(-2)(-2) = -8$$

Practice

Simplify all expressions, use only positive exponents.

$5^2 \bullet 5^4 =$ 5⁶

$\frac{1}{b^{-8} \bullet b^5} =$ b³

$s^4 \bullet t^5 \bullet t^3 =$ s⁴t⁸

$\left(\frac{2a}{4b}\right)^2 =$ $\frac{4a^2}{16b^2}$

$\left(x^2\right)^4 =$ x⁸

$3^{-1} - 2^0 =$ -2/3

$(3m)^2 =$ 9m²

$n^{-3} \bullet n^{-4} =$ n⁻⁷

$-5^3 =$ -125

$6^7 \div 6^5 =$ 6²

$3^1 + 9^0 - 2^2 = 0$

$\left(\frac{x}{y^2}\right)^3 =$ x³/y⁶

The End