Operations with Exponents

La Salle Academy Mrs. Masullo Algebra 1

Terminology

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

BASE EXPONENT

 10^{2}

 Λ^3

 m^n

Some examples of bases and exponents are

Some general rules

Any base to the 0 power will ALWAYS = 1

$$4^0 = 1$$
 $P^0 = 1$

Any base to the 1st power will ALWAYS = itself

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

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

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

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!

$$2^{2} + 2^{3} = 4 + 8 = 12$$
 $3^{3} - 3^{2} = 27 - 9 = 18$

$$A^{2} + A^{3} = A^{2} + A^{3}$$
 $A^{3} - A^{2} = A^{3} - A^{2}$

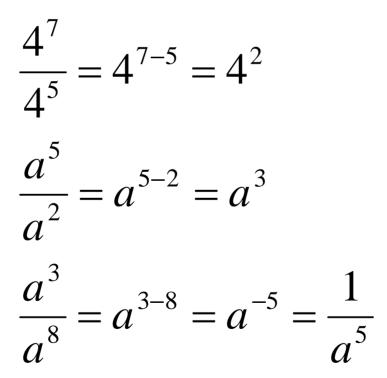
Multiplication

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.



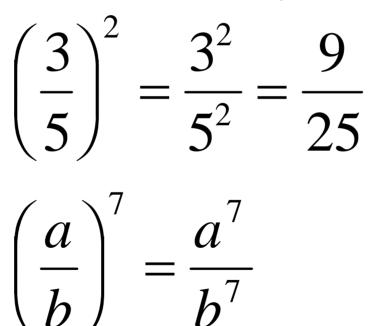
Raising a power to a power

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

$$(5^{2})^{3} = 5^{2 \cdot 3} = 5^{6}$$
$$(a^{4})^{3} = a^{4 \cdot 3} = a^{12}$$

Raising a fraction to a power

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



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

$$-x^{n} \operatorname{means} -(x)^{n} \qquad (-x)^{n} \operatorname{means} (-x)(-x)(-x)$$

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

$$5^{2} \bullet 5^{4} = 5^{6} \qquad \frac{1}{b^{-8} \bullet b^{5}} = b^{3} \qquad s^{4} \bullet t^{5} \bullet t^{3} = s^{4}t^{8}$$
$$\left(\frac{2a}{4b}\right)^{2} = \frac{4a^{2}}{16b^{2}} \qquad \left(x^{2}\right)^{4} = x^{8} \qquad 3^{-1} - 2^{\circ} = -2/3$$
$$\left(3m\right)^{2} = 9m^{2} \qquad n^{-3} \bullet n^{-4} = n^{-7} \qquad -5^{3} = -125$$
$$6^{7} \div 6^{5} = 6^{2} \qquad 3^{1} + 9^{\circ} - 2^{2} = 0 \qquad \left(\frac{x}{y^{2}}\right)^{3} = x^{3}/y^{6}$$

