Exponent Rules

Vocabulary
Exponent - the raised number. It identifies how many times the base is to be multiplied against itself. (e.g. $4^3 = 4 \cdot 4 \cdot 4$) Also called power, "squared" if a 2, and "cubed" if a 3.
Base - the item before the exponent. It can be a letter or a number (e.g.4^3 base is 4, $3x^2$ base is x)
Coefficient - the number in front of a letter base (e.g. $3x^2$ coefficient is 3, in a^5 it's an assumed 1)
******* no visible exponent means an assumed exponent of 1.
******* any base to the 0 power equals 1.

If the operation is:	and you have:	then you can:
Addition/Subtraction	same base and same exponent ("like terms")	add the coefficients, without changing the base or exponent.
Examples:	$3a^2 + 4a^2 =$	$7a^2$
	$6x^4 + 3x^3 =$	$6x^4 + 3x^3$
	$x^3 + 3x^2 - x^2 + 2x^3 =$	$3x^3 + 2x^2$

Multiplication	same base	multiply the coefficients and add the exponents
Examples:	$14^3 (14^4) =$	14^7
	$2x^8 (5x^3) =$	$10x^{11}$
	$xy^2 \cdot x^3yz^2 =$	$x^4y^3z^2$

Division	same base	divide the coefficients and subtract the exponents
Examples:	$\frac{6a^5}{3a^3} =$	$2a^2$
	$\frac{9^3}{9} =$	9^2
	$\frac{4x^7y^2}{x^2y^2z^2} =$	$\frac{4x^5}{z^2}$

Raising to a power	exponent is outside the ( )	multiply exponents
Examples:	$(3^4)^3 =$	3^{12}
	$(x^5)^6 =$	x^{30}

Distribution of an exponent to a term	** apply to coefficients and to assumed exponents of 1	multiply the outer exponent with <u>each</u> item in the term
Examples:	$(xy)^4 =$	x^4y^4
	$(3m^2)^4 =$	$3^4m^8 = 81m^8$
	$(4a^2bc^4)^3 =$	$4^3a^6b^3c^{12} = 64a^6b^3c^{12}$
	$(2a + 3)^2 =$	$(2a + 3)(2a + 3) = 4a^2 + 12a + 9$

****Remember, $(x + y)^2 = (x + y)(x + y)$** Why is this different from distributing exponent?

Other Exponent Forms

What if the exponent is a negative number?
This exponent form is usually introduced in Beginning Algebra:

Negative Exponents	Exponent is negative. This doesn't affect coefficient sign.	Move to other side of fraction line. Use integer rules if mult. or division.
Examples:	$\frac{a^3b^{-2}}{xy^3} =$	$\frac{a^3}{b^2xy^3}$
	$4x^{-1}y^{-3}$	$\frac{4}{xy^3}$
	$(a^{-3}b^5c)(b^2d^{-2}e^{-1}) =$	$\frac{b^7c}{a^3d^2e}$
	$\frac{x^{-2}yz^{-1}}{xy^{-5}z^{-3}} =$	$\frac{y^6z^2}{x^3}$
	$(\frac{-6a^2b^{-3}}{2a^{-3}b})^{-3} = \frac{-6^{-3}a^{-6}b^9}{2^{-3}a^9b^{-3}}$	$-\frac{b^{12}}{9a^{15}}$

What if the exponent is a fraction?
This exponent form is usually introduced in Intermediate Algebra:

Rational Exponents	Exponent is a fraction.	Numerator is power, denominator is index. Use fraction rules if mult. or division.
Examples:	$a^{\frac{2}{3}} =$	$\sqrt[3]{a^2}$ or $(\sqrt[3]{a})^2$
	$(x^{\frac{1}{3}})(x^{\frac{1}{4}}) =$	$x^{\frac{7}{12}}$ or $\sqrt[12]{x^7}$ or $(\sqrt[12]{x})^7$
	$\frac{x^{\frac{1}{3}}}{x^{\frac{1}{4}}} = x^{\frac{1}{3}-\frac{1}{4}} = x^{\frac{4}{12}-\frac{3}{12}}$	$x^{\frac{1}{12}}$ or $\sqrt[12]{x}$
	$(m^{\frac{2}{3}})^{\frac{6}{7}}$	$m^{\frac{4}{7}}$ or $\sqrt[7]{m^4}$ or $\left(\sqrt[7]{m}\right)^4$

What if the exponent is a variable, like 7^x ? That's a logarithm; we'll talk about that later….