Properties of Exponents

$a^0 = 1$ (0^0 is undefined)	Any number or variable (except zero) raised to the zero power equals 1. $7^0 = 1 \qquad y^0 = 1 \qquad (-5)^0 = 1 \qquad -2(x-3)^0 = -2$
$a^1 = a$	Any number or variable raised to the 1st power equals itself $7^1 = 7 \qquad y^1 = y \qquad (-5)^1 = -5 \qquad -2(x-3)^1 = -2(x-3)$
$a^m a^n = a^{(m+n)}$	To MULTIPLY the SAME base, <u>keep</u> the base and <u>ADD</u> the exponents $x^2 x^5 = (x \cdot x)(x \cdot x \cdot x \cdot x \cdot x) = x^{2+5} = x^7$ $4^3 \cdot 4^5 = (4 \cdot 4 \cdot 4)(4 \cdot 4 \cdot 4 \cdot 4 \cdot 4) = 4^{3+5} = 4^8$ $(x+6)^4 (x+6)^{11} = (x+6)^{4+11} = (x+6)^{15}$
$(a^m)^n = a^{(mn)}$	To Raise a POWER to a POWER, <u>keep</u> the base and <u>MULTIPLY</u> the exponents $(x^2)^5 = (x \cdot x)(x \cdot x)(x \cdot x)(x \cdot x)(x \cdot x) = x^{2 \cdot 5} = x^{10}$ $(3^4)^2 = (3 = 3^{2 \cdot 4} = 3^8$ $((x+6)^4)^{11} = (x+6)^{4 \cdot 11} = (x+6)^{44}$
$\dfrac{a^m}{a^n} = a^{(m-n)}$	To DIVIDE the SAME base, <u>keep</u> the base and <u>SUBTRACT</u> the exponents $\dfrac{x^5}{x^2} = x^{5-2} = x^3 \quad OR \quad \dfrac{x^5}{x^2} = \dfrac{x \cdot \cancel{x} \cdot \cancel{x} \cdot x \cdot x}{\cancel{x} \cdot \cancel{x}} = \dfrac{x \cdot x \cdot x}{1} = x^3$ $\dfrac{5^3}{5^6} = 5^{3-6} = 5^{-3} = \dfrac{1}{5^3} = \dfrac{1}{125} \quad OR \quad \dfrac{5^3}{5^6} = \dfrac{\cancel{5 \cdot 5 \cdot 5}}{\cancel{5 \cdot 5 \cdot 5} \cdot 5 \cdot 5 \cdot 5} = \dfrac{1}{5 \cdot 5 \cdot 5} = \dfrac{1}{125}$
$a^{-m} = \dfrac{1}{a^m}$	A NEGATIVE exponent moves the number or variable that it touches across the fraction bar and makes the exponent positive. $3^{-2} = \dfrac{3^{-2}}{1} = \dfrac{1}{3^2} = \dfrac{1}{9} \qquad \dfrac{4^{-3}x^7}{n^6 x^{-2}} = \dfrac{x^7 x^2}{4^3 n^6} = \dfrac{x^{(7+2)}}{4^3 n^6} = \dfrac{x^9}{64 n^6}$
$(ab)^n = a^n b^n$	An exponent outside of a term is applied to every factor in that term $(5xy^3)^2 = 5^2 x^2 y^{3 \cdot 2} = 25 x^2 y^6$ This does <u>**NOT**</u> apply if you are adding or subtracting inside the parenthesis *Watch out!!!!* $(x+5)^3 \neq x^3 + 5^3$!!!!! (They are <u>**NOT**</u> equal) $(x+5)^3 = (x+5)(x+5)(x+5) = x^3 + 15x^2 + 75x + 125$
$\left(\dfrac{a}{b}\right)^n = \dfrac{a^n}{b^n}$	An exponent outside of a fraction is applied to both the numerator and denominator of the fraction (both top and bottom) $\left(\dfrac{9}{k}\right)^2 = \dfrac{9^2}{k^2} = \dfrac{81}{k^2}$
$a^{\frac{n}{m}} = \sqrt[m]{a^n}$	The denominator of the rational exponent becomes the index of a radical. $27^{\frac{2}{3}} = (\sqrt[3]{27})^2 = 3^2 = 9$