The **Properties of Exponents** can be used to simplify exponential expressions.

Properties of Exponents	For all nonzero real numbers *x* and *y* and integers *m* and *n*.	Algebra	Numbers
Product of Powers Property	To multiply powers with the same base, add the exponents.	$x^m \cdot x^n = x^{m+n}$	$4^3 \cdot 4^2 = 4^{3+2} = 4^5$
Quotient of Powers Property	To divide powers with the same base, subtract the exponents.	$\frac{x^m}{x^n} = x^{m-n}$	$\frac{3^7}{3^2} = 3^{7-2} = 3^5$
Power of a Power Property	To raise one power to another, multiply the exponents.	$(x^m)^n = x^{m \cdot n}$	$(4^3)^2 = 4^{3 \cdot 2} = 4^6$
Power of a Product Property	To find the power of a product, apply the exponent to each factor.	$(xy)^m = x^m y^m$	$(3 \cdot 4)^2 = 3^2 \cdot 4^2$
Power of a Quotient Propterty	To find the power of a quotient, apply the exponent to the numerator and denominator.	$\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}$	$\left(\frac{3}{5}\right)^2 = \frac{3^2}{5^2}$
Negative Exponent Property	A nonzero base raised to the negative exponent is equal to the reciprocal of the base raised to the positive exponent.	$x^{-n} = \left(\frac{1}{x}\right)^n$ $\left(\frac{x}{y}\right)^{-n} = \left(\frac{y}{x}\right)^n$	$7^{-2} = \left(\frac{1}{7}\right)^2$ $\left(\frac{3}{2}\right)^{-4} = \left(\frac{2}{3}\right)^4$
Identity Exponent Property	A nonzero quantity raised to the first power is equal to itself.	$x^1 = x$	$8^1 = 8$
Zero Exponent Property	A nonzero quantity raised to the zero power is equal to 1.	$x^0 = 1$	$125^0 = 1$

Laws of Exponents

For all nonzero real numbers x and y and integers m and n

Product of Powers	$x^m \cdot x^n$	$= x^{m+n}$
Quotient of Powers	$\frac{x^m}{x^n}$	$= x^{m-n}$
Power of a Power	$(x^m)^n$	$= x^{m \cdot n}$
Power of a Product	$(xy)^m$	$= x^m y^m$
Power of a Quotient	$\left(\frac{x}{y}\right)^m$	$= \frac{x^m}{y^m}$
Negative Exponent	x^{-n}	$= \left(\frac{1}{x}\right)^n$
	$\left(\frac{x}{y}\right)^{-n}$	$= \left(\frac{y}{x}\right)^n$
Identity Exponent	x^1	$= x$
Zero Exponent	x^0	$= 1$

Summary of Logarithmic Properties (for all formulas, x, y, and b, are all > 0, a and $b \neq 1$)		
Product Rule:	$\log_b(xy) = \log_b x + \log_b y$	Remember, if you multiply **inside** the parentheses, you **add** logs on the outside.
Division Rule:	$\log_b\left(\frac{x}{y}\right) = \log_b x - \log_b y$	Remember, if you divide **inside** the parentheses, you **subtract** logs on the outside.
Power Rule:	$\log_b(x^p) = p\log_b x$	Remember, if you raise to a power **inside** the parentheses, you **multiply** by that power on the outside.
Change of Base Rule:	$\log_b(x) = \frac{\log_{10} x}{\log_{10} b}$ or $\log_b(x) = \frac{\ln x}{\ln b}$	Remember, put the larger number (argument) on top, the smaller (base) on bottom. This is useful for the calculator if you don't have the **LOGBASE** function.

Note that $\log x$ and $\ln x$ are not defined when x is negative or 0.

1. $\log(AB) = \log A + \log B$
2. $\log\left(\frac{A}{B}\right) = \log A - \log B$
3. $\log(A^p) = p \log A$
4. $\log(10^x) = x$
5. $10^{\log x} = x$

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4. $\ln e^x = x$
5. $e^{\ln x} = x$

In addition, $\log 1 = 0$ because $10^0 = 1$, and $\ln 1 = 0$ because $e^0 = 1$.

Operation	Laws of exponents	Laws of logs
Multiplication	$x^m \cdot x^n = x^{m+n}$	$\log(a \cdot b) = \log(a) + \log(b)$
Division	$\frac{x^m}{x^n} = x^{m-n}$	$\log\left(\frac{a}{b}\right) = \log(a) - \log(b)$
Exponentiation	$(x^m)^n = x^{mn}$	$\log(a^n) = n \cdot \log(a)$ One of the most useful properties of logs
Zero property	$x^0 = 1$	$\log(1) = 0$
Inverse	$x^{-1} = \frac{1}{x}$	$\log(x^{-1}) = \log\left(\frac{1}{x}\right) = -\log(x)$