Algebra
Exponent Formulas

Word Description of Property	Math Description of Property	Limitations on variables	Examples
Product of Powers	$a^p \cdot a^q = a^{(p+q)}$		$x^4 \cdot x^3 = x^7$ $x^5 \cdot x^{-8} = x^{-3}$
Quotient of Powers	$\frac{a^p}{a^q} = a^{(p-q)}$	$a \neq 0$	$\frac{y^5}{y^2} = y^3$
Power of a Power	$(a^p)^q = a^{(p \cdot q)}$		$(z^4)^3 = z^{12}$ $(x^{-3})^{-5} = x^{15}$
Anything to the zero power is 1	$a^0 = 1$	$a \neq 0$	$91^0 = 1$ $(xyz^3)^0 = 1$, if $x, y, z \neq 0$
Negative powers generate the reciprocal of what a positive power generates	$a^{(-p)} = \frac{1}{a^p}$	$a \neq 0$	$x^{(-3)} = \frac{1}{x^3}$ $\left(\frac{1}{x}\right)^{-5} = x^5$
Power of a product	$(a \cdot b)^p = a^p \cdot b^p$		$(3y)^3 = 27y^3$ $[(x+1)z]^4 = (x+1)^4 z^4$
Power of a quotient	$\left(\frac{a}{b}\right)^p = \frac{a^p}{b^p}$	$b \neq 0$	$\left(\frac{x}{4}\right)^3 = \frac{x^3}{64}$
Converting a root to a power	$\sqrt[n]{a} = a^{(1/n)}$	$n \neq 0$	$\sqrt{x} = x^{1/2}$

Algebra

Logarithm Formulas

Word Description of Property	Math Description of Property	Limitations on variables	Examples
Definition of logarithm	$(\log_b x = a)$ implies $(b^a = x)$	$b, x > 0$ $b \neq 1$	$\log_3 x = 4$ implies $3^4 = x$ $\log_7(-49)$ is undefined
Log (base anything) of 1 is zero	$\log_b 1 = 0$	$b > 0$ $b \neq 1$	$\log_{32} 1 = 0$ $\ln 1 = 0$
Exponents and logs are inverse operators, leaving what you started with	$b^{(\log_b x)} = x$	$b, x > 0$ $b \neq 1$	$3^{(\log_3 92)} = 92$ $e^{(ln\, x)} = x$
Logs and exponents are inverse operators, leaving what you started with	$\log_b(b^x) = x$	$b, x > 0$ $b \neq 1$	$\log_6(6^{xyz}) = xyz$ $\ln\ (e^{4y}) = 4y$
The log of a product is the sum of the logs	$\log_b(m \cdot n) = \log_b m + \log_b n$	$m, n, b > 0$ $b \neq 1$	$\log_2(32x) = 5 + \log_2 x$ $\ln\ (8e) = \ln(8) + 1$
The log of a quotient is the difference of the logs	$\log_b\left(\frac{m}{n}\right) = \log_b m - \log_b n$	$m, n, b > 0$ $b \neq 1$	$\log_3\left(\frac{3}{x}\right) = 1 - \log_3 x$ $\ln\left(\frac{12}{e}\right) = \ln(12) - 1$
The log of something to a power is the power times the log	$\log_b(m^p) = p \cdot \log_b m$	$m, b > 0$ $b \neq 1$	$\log_4(x^{23}) = 23 \cdot \log_4 x$ $\ln\ (3^z) = z \cdot \ln(3)$
nge the base to whatever you want by dividing by the log of the old base	$\log_b m = \frac{\log_a m}{\log_a b}$	$m, a, b > 0$ $a, b \neq 1$	$\log_{100} x = \frac{\log_{10} x}{2}$

Table of Exponents and Logarithms

Definition: $b^a = c$ if and only if $\log_b c = a$

$2^0 = 1$	$\log_2 1 = 0$
$2^1 = 2$	$\log_2 2 = 1$
$2^2 = 4$	$\log_2 4 = 2$
$2^3 = 8$	$\log_2 8 = 3$
$2^4 = 16$	$\log_2 16 = 4$
$2^5 = 32$	$\log_2 32 = 5$
$2^6 = 64$	$\log_2 64 = 6$
$2^7 = 128$	$\log_2 128 = 7$
$2^8 = 256$	$\log_2 256 = 8$
$2^9 = 512$	$\log_2 512 = 9$
$2^{10} = 1024$	$\log_2 1024 = 10$
$3^0 = 1$	$\log_3 1 = 0$
$3^1 = 3$	$\log_3 3 = 1$
$3^2 = 9$	$\log_3 9 = 2$
$3^3 = 27$	$\log_3 27 = 3$
$3^4 = 81$	$\log_3 81 = 4$
$3^5 = 243$	$\log_3 243 = 5$
$4^0 = 1$	$\log_4 1 = 0$
$4^1 = 4$	$\log_4 4 = 1$
$4^2 = 16$	$\log_4 16 = 2$
$4^3 = 64$	$\log_4 64 = 3$
$4^4 = 256$	$\log_4 256 = 4$
$5^0 = 1$	$\log_5 1 = 0$
$5^1 = 5$	$\log_5 5 = 1$
$5^2 = 25$	$\log_5 25 = 2$
$5^3 = 125$	$\log_5 125 = 3$
$5^4 = 625$	$\log_5 625 = 4$

$6^0 = 1$	$\log_6 1 = 0$
$6^1 = 6$	$\log_6 6 = 1$
$6^2 = 36$	$\log_6 36 = 2$
$6^3 = 216$	$\log_6 216 = 3$
$7^0 = 1$	$\log_7 1 = 0$
$7^1 = 7$	$\log_7 7 = 1$
$7^2 = 49$	$\log_7 49 = 2$
$7^3 = 343$	$\log_7 343 = 3$
$8^0 = 1$	$\log_8 1 = 0$
$8^1 = 8$	$\log_8 8 = 1$
$8^2 = 64$	$\log_8 64 = 2$
$8^3 = 512$	$\log_8 512 = 3$
$9^0 = 1$	$\log_9 1 = 0$
$9^1 = 9$	$\log_9 9 = 1$
$9^2 = 81$	$\log_9 81 = 2$
$9^3 = 729$	$\log_9 729 = 3$
$10^0 = 1$	$\log_{10} 1 = 0$
$10^1 = 10$	$\log_{10} 10 = 1$
$10^2 = 100$	$\log_{10} 100 = 2$
$10^3 = 1000$	$\log_{10} 1000 = 3$
$11^0 = 1$	$\log_{11} 1 = 0$
$11^1 = 11$	$\log_{11} 11 = 1$
$11^2 = 121$	$\log_{11} 121 = 2$
$11^3 = 1331$	$\log_{11} 1331 = 3$

The student should try to memorize as much of this as possible!