

LOGARITHM LAWS

ALGEBRA 2 WITH TRIGONOMETRY

Logarithms have properties, just as exponents do, that are important to learn because they allow us to solve a variety of problems where logarithms are involved. Keep in mind that since logarithms give exponents, the laws that govern them should be similar to those that govern exponents. Below is a summary of these laws.

EXPONENT AND LOGARITHM LAWS

LAW	EXPONENT VERSION	LOGARITHM VERSION
Product	$b^x \cdot b^y = b^{x+y}$	$\log_b(x \cdot y) = \log_b x + \log_b y$
Quotient	$\frac{b^x}{b^y} = b^{x-y}$	$\log_b\left(\frac{x}{y}\right) = \log_b x - \log_b y$
Power	$(b^x)^y = b^{x \cdot y}$	$\log_b(x^y) = y \cdot \log_b x$

Exercise #1: Which of the following is equal to $\log_3(9x)$?

- (1) $\log_3 2 + \log_3 x$ (3) $2 + \log_3 x$
 (2) $2\log_3 x$ (4) $x + \log_3 2$

Exercise #2: The expression $\log\left(\frac{x^2}{1000}\right)$ can be written in equivalent form as _____

- (1) $2\log x - 3$ (3) $2\log x - 6$
 (2) $\log 2x - 3$ (4) $\log 2x - 6$

Exercise #3: If $a = \log 3$ and $b = \log 2$ then which of the following correctly expresses the value of $\log 12$ in terms of a and b ? _____

- (1) $a^2 + b$ (3) $2a + b$
 (2) $a + b^2$ (4) $a + 2b$

Exercise #4: Which of the following is equivalent to $\log_2\left(\frac{\sqrt{x}}{y^5}\right)$?

- (1) $\sqrt{\log_2 x} - 5\log_2 y$ (3) $\frac{1}{2}\log_2 x - 5\log_2 y$
 (2) $2\log_2 x + 5\log_2 y$ (4) $2\log_2 x - 5\log_2 y$



Exercise #5: The value of $\log_3\left(\frac{\sqrt{5}}{27}\right)$ is equal to

- (1) $\frac{\log_3 5 - 6}{2}$ (3) $\frac{\log_3 5 - 3}{2}$
(2) $2\log_3 5 + 3$ (4) $2\log_3 5 - 3$ _____

Exercise #6: If $f(x) = \log(x)$ and $g(x) = 100x^3$ then $f(g(x)) =$

- (1) $100\log x$ (3) $300\log x$
(2) $6 + \log x$ (4) $2 + 3\log x$ _____

Exercise #7: The expression $\log(\sec x)$ is equivalent to

- (1) $-\log(\cos x)$ (3) $\log(\sin x)$
(2) $\log(\tan x)$ (4) $-\log(\sin x)$ _____

Exercise #8: The logarithmic expression $\log_2 \sqrt{32x^7}$ can be rewritten as

- (1) $\sqrt{\log_2 35x}$ (3) $\sqrt{5 + 7\log_2 x}$
(2) $\frac{5 + 7\log_2 x}{2}$ (4) $\frac{35 + \log_2 x}{2}$ _____

Exercise #9: The expression $\log_4(y^2 - 16) - \log_4(y + 4)$, assuming $y \neq -4$, can be simplified to

- (1) $2\log_4 x - 12$ (3) $\log_4(y + 4)$
(2) $\log_4(y - 4)$ (4) $\log_4 y - 1$ _____

Exercise #10: If $\log 7 = k$ then $\log(4900)$ can be written in terms of k as

- (1) $2(k + 1)$ (3) $2(k - 3)$
(2) $2k - 1$ (4) $2k + 1$ _____



Name: _____

Date: _____

LOGARITHM LAWS
ALGEBRA 2 WITH TRIGONOMETRY - HOMEWORK

SKILLS

1. Which of the following is not equivalent to $\log 36$?

(1) $\log 2 + \log 18$ (3) $\log 30 + \log 6$

(2) $2\log 6$ (4) $\log 4 + \log 9$ _____

2. The $\log_3 20$ can be written as

(1) $2\log_3 2 + \log_3 5$ (3) $\log_3 15 + \log_3 5$

(2) $2\log_3 10$ (4) $2\log_3 4 + 3\log_3 4$ _____

3. Which of the following is equivalent to $\log\left(\frac{x^3}{\sqrt[3]{y}}\right)$?

(1) $\log x - \log y$ (3) $3\log x - \frac{1}{3}\log y$

(2) $9\log(x - y)$ (4) $\log(3x) - \log\left(\frac{y}{3}\right)$ _____

4. The difference $\log(\cos x) - \log(\sin x)$ can be expressed as

(1) $\log(\sin 2x)$ (3) $\log(\tan x)$

(2) $\log(\cos 2x)$ (4) $\log(\cot x)$ _____

5. If $\log 5 = p$ and $\log 2 = q$ then $\log 200$ can be written in terms of p and q as

(1) $4p + q$ (3) $2(p + q)$

(2) $2p + 3q$ (4) $3p + 2q$ _____



6. When rounded to the nearest hundredth, $\log_3 7 = 1.77$. Which of the following represents the value of $\log_3 63$ to the nearest *hundredth*?

(1) 3.54

(3) 3.77

(2) 8.77

(4) 15.93

7. Which of the following is equivalent to $\log(x-6) - \log(x^2 - 2x - 24)$, assuming $x \neq 6$?

(1) $\log(x+4)$

(3) $\log(x+6)$

(2) $\log\left(\frac{1}{x+4}\right)$

(4) $\log\left(\frac{1}{x+6}\right)$

8. The expression $4\log x - \frac{1}{2}\log y + 3\log z$ can be rewritten equivalently as

(1) $\log\left(\frac{x^4 z^3}{\sqrt{y}}\right)$

(3) $\log\left(\frac{x^4 z^3}{2y}\right)$

(2) $\log\left(\frac{6xz}{y}\right)$

(4) $\log\left(\frac{6x^4 z^3}{y}\right)$

9. If $k = \log_2 3$ then $\log_2 48 =$

(1) $2k + 3$

(3) $k + 8$

(2) $3k + 1$

(4) $k + 4$

10. If $g(x) = 8x^6$ and $f(x) = \log_4(2x)$ then $f(g(x)) = ?$

(1) $4\log_4 x + 1$

(3) $2(3\log_4 x + 1)$

(2) $3(\log_4 x + 2)$

(4) $6\log_4 x + 4$

