

HAT
Logarithm Properties

11/27/17

Warm Up: Solve for x.

$$\log_2 4 + \log_2 8 = \log_2 x$$

$$2 + 3 = \log_2 x$$

$$5 = \log_2 x$$

$$2^5 = x$$

$$x = 32$$

$$\log_3 27 - \log_3 9 = \log_3 x$$

$$3 - 2 =$$

$$1 = \log_3 x$$

$$3^1 = x$$

$$x = 3$$

$$x \cdot \log_2 4 = \log_2 16$$

$$x \cdot 2 = 4$$

$$x = 2$$

Sometimes there is a benefit to using log properties to expand or condense an expression.

Product Property: $\log_a(m \cdot n) = \log_a m + \log_a n$

$$\log_2 4 + \log_2 8 = \log_2 4 \cdot 8 = \log_2 32$$

Quotient Property: $\log_a \frac{m}{n} = \log_a m - \log_a n$

$$\log_3 27 - \log_3 9 = \log_3 \left(\frac{27}{9} \right) = \log_3 3$$

Power Property: $\log_a m^n = n \log_a m$

$$\log_2 16 = \log_2 4^2 = 2 \cdot \log_2 4$$

$\log_{\frac{1}{3}} x$ same as $-\log_3 x$

The diagram illustrates the relationship between the logarithm of x with base $\frac{1}{3}$ and the negative logarithm of x with base 3 . It features three expressions: $\log_{\frac{1}{3}} x$ on the left, $-\log_3 x$ on the right, and $\log_3 x$ with a circled minus sign in the center. A curved arrow points from the left expression to the central one, and another curved arrow points from the central one to the right expression.

(NC) Simplify using the log properties. Do not use a calculator.

a. $\log_6 2 + \log_6 3$

$$\log_6 6$$
$$\textcircled{1}$$

c. $\log_5 200 - \log_5 8$

$$\log_5 25$$
$$\textcircled{2}$$

b. $\log_{10} 5 + \log_{10} 20$

$$\log_{10} 100$$
$$\textcircled{2}$$

d. $\log_5 15 - \log_5 3$

$$\log_5 5$$
$$\textcircled{1}$$

(NC) Use $\log_2 3 = 1.585$ and $\log_2 7 = 2.807$ to evaluate each expression.

a. $\log_2 49 =$

$$\log_2 7^2$$

$$2 \cdot \log_2 7$$

$$2 \cdot 2.807$$

$$5.614$$

b. $\log_2 27 =$

$$\log_2 3^3$$

$$3 \cdot \log_2 3$$

$$3 \cdot 1.585 = 4.755$$

c. $\log_2 \frac{7}{3} =$

$$\log_2 7 - \log_2 3$$

d. $\log_2 36 =$

$$\log_2 4 + \log_2 9$$

$$2 + 2 \log_2 3$$

e. $\log_2 0.75 =$

$$\log_2 \frac{3}{4}$$

$$\log_2 3 - \log_2 4$$

$$\log_2 3 - 2$$

f. $\log_2 \frac{7}{16} =$

$$\log_2 7 - \log_2 2^4$$

$$\log_2 7 - 4$$

Expand the logarithmic expression.

a. $\log_3\left(\frac{7}{x}\right)$

$$\log_3 7 - \log_3 x$$

b. $\log_6(x^2y^3)$

$$\log_6 x^2 + \log_6 y^3$$

$$2 \log_6 x + 3 \log_6 y$$

c. $\log\left(\frac{\sqrt{xy^2}}{z}\right)$

$$\log_{10} x^{\frac{1}{2}} \cdot y^2 - \log_{10} z$$

$$\log x^{\frac{1}{2}} + \log y^2 - \log z$$

$$\frac{1}{2} \log x + 2 \log y - \log z$$

Solve each of the following. Do not use a calculator.

a. $\log_2 5 + \log_2 x = \log_2 35$

$$\log_2 5x = \log_2 35$$

$$5x = 35$$

$$x = 7$$

c. $\log_6(x^2 - 4) + \log_6 3 = \log_6 36$

$$\log_6(x^2 - 4) = \log_6 12$$

$$x^2 - 4 = 12$$

$$x^2 = 16$$

$$x = \pm 4$$

b. $\log_9 24 - \log_9(x+2) = \log_9 3$

$$\log_9 24 - \log_9 3 = \log_9(x+2)$$

$$\log_9 8 = \log_9(x+2)$$

$$8 = x+2$$

$$6 = x$$

d. $\log_7(x) + \log_7(x-1) = \log_7 12$

$$\log_7(x^2 - x) = \log_7 12$$

$$x^2 - x = 12$$

$$x^2 - x - 12 = 0$$

Assignment:

pg. 488 #25, 26, 29, 30, 33, 34, 37, 46, 47, 49, 51, 57, 58