Sec 8-4: Properties of Logarithms

Power Property:
$$log_a C^b = b \cdot log_a C$$

The exponent becomes a coefficient.

Rewrite using the Power Property:

$$\sqrt{\log W^4 + \log X^7} = 4 \log W + \log X$$

Product Property of Logarithms:

$$log_bMN = log_bM + log_bN$$

Write as a single logarithm then solve:

$$\log_5 x + \log_5 2 = 3$$

$$\begin{array}{c} \log_{5}(2x)^{-3} \\ 5^{3} - 2x \\ 125 - 2x \\ x = 62.5 \end{array}$$

Solve without using the change of base formula. $8^{x} = 90$

$$\log 8^x = \log 90$$
 take the log of both sides

$$\frac{2 \log \xi}{\log \xi} = \frac{\log 90}{\log \xi}$$
 apply the power rule divide by log8 to solve for x
$$\frac{\log 90}{\log 90} = \frac{2.16}{\log 90}$$

Quotient Property of Logarithms:

$$\log_b \frac{M}{N} = \log_b M - \log_b N$$

Write as a single logarithm then solve.

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$$\log_2 8 - \log_2 x = 5$$

$$\log_2 \left(\frac{\$}{x}\right) = 5$$

$$2^5 = \frac{\$}{x}$$

Properties

Properties of Logarithms

For any positive numbers, M, N, and b, $b \ne 1$,

$$\log_b MN = \log_b M + \log_b N$$

Product Property

$$\log_b \frac{M}{N} = \log_b M - \log_b N$$

Quotient Property

$$\log_b M^x = x \log_b M$$

Power Property

2.
$$5\log R - 6\log X + \frac{1}{2}\log Y$$

$$= \log R^{5} - \log X^{6} + \log Y$$

$$= \log \frac{R^{5}}{\chi_{6}} + \log Y$$

$$= \log \left(\frac{\rho^{5}}{\chi_{6}} \cdot Y\right) - \log \frac{R^{5}}{\chi_{6}}$$

Use the Properties of Logarithms to write each as a single logarithm:

1.
$$3\log_4 K + 2\log_4 Q$$

$$= \log_4 K^3 + \log_4 \varphi^2$$

$$= \log_4 (K^3 \varphi^2)$$

3.
$$3\log_2 A^3 - \frac{1}{3}\log_2 B^3 - 4\log_2 C^3$$

$$\log_2 A^3 - \log_2 3 B - \log_2 C^4$$

$$= \log_2 \left(\frac{A^3}{3BC^4}\right)$$

Solving Exponential Equations:

- 1. Isolate the exponential (b^x)
- 2. Change to a Logarithm
- 3. Solve for x, if necessary.

Solve each exponential equation:

1.
$$7 + 4^{x+3} = 100$$

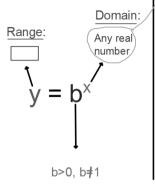
$$-7 - 7$$

$$4^{x+3} = 93$$

$$\log_{4} 93 = x+3$$

$$x = \frac{\log_{13}}{\log_{4}} - 3 = .27$$





Since the exponent of an exponential equation can be any real number when we are solving for the exponent you won't have to worry about getting extraneous solutions. But checking your answer to make sure you didn't make a mistake is always a good idea.

2.
$$5 \cdot e^{2x-1} + 4 = 49$$

$$\frac{5 e^{2x-1}}{5} = \frac{45}{5}$$

$$e^{2x-1} = 9$$

$$\ln 9 = 2x-1$$

$$\chi = \frac{\ln 9 + 1}{3} = \frac{1.6}{5}$$