Examples Using the Properties of Logarithms

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Preliminaries and Objectives

Preliminaries
- Laws of Logarithms
- Laws of Exponents

Objectives
- Simplify expressions using logarithms
- Solve equations involving logarithms

Laws of Logarithms

$$b^m = x \qquad \log_b x = m$$
$$b^n = y \qquad \log_b y = n$$

$$\log_b 1 = 0 \qquad \log_b \frac{1}{x} = -\log_b x$$

$$\log_b b = 1 \qquad \log_b xy = \log_b x + \log_b y$$

$$\log_b b^m = m \qquad \log_b \frac{x}{y} = \log_b x - \log_b y$$

$$b^{\log_b x} = x \qquad \log_b x^n = n \cdot \log_b x$$

Example 4

Write $2\log_{10} 3$ as a single logarithm

$$2\log_{10} 3 = \log_{10} 3^2 = \log_{10} 9$$

Example 5

Write as a single logarithm

$$\log_{10} 7 + \log_{10} 4 = \log_{10}(7)(4) = \log_{10} 28$$

Example 6

$$3\log_{10} 6 - 2\log_{10} 5$$

$$= \log_{10} 6^3 - \log_{10} 5^2$$

$$= \log_{10} 216 - \log_{10} 25$$

$$= \log_{10} \frac{216}{25}$$

$$= \log_{10} 8.64$$

Example 7

$$3^{\log_3 10 - \log_3 7}$$

$$= 3^{\log_3 \frac{10}{7}}$$

$$= \frac{10}{7}$$

Example 8

Solve for x

$$\log_4 x = 2$$

Ans: $4^2 = x$
$$x = 16$$

Example 9

Solve for x

$$\log_{10}(3x + 1) = 1$$

Ans: $10^1 = 3x + 1$

$x = 3$

Example 10

Solve for x

$$\log_4(x + 2) = \log_4 8$$

Ans: $x + 2 = 8$

$x = 6$

Example 11

Solve for x

$$\log_{10} 2x - \log_{10}(x - 3) = 1$$

Ans: $\log_{10} \dfrac{2x}{x - 3} = 1$

$10^1 = \dfrac{2x}{x - 3}$

$10(x - 3) = 2x$

$10x - 30 = 2x$

$8x = 30$

$x = \dfrac{30}{8}$