Evaluating Logs and Properties of Logs Video Lecture

Sections 12.4, 12.5 and 12.6

Course Learning Objective:

1) **Solve certain types of logarithmic equations.**
2) **Demonstrate appropriate manipulation of exponential and logarithmic expressions.**

Weekly Learning Objectives:

1) **Write exponential equations with logarithmic notation and logaritmic equations with exponential notation.**
2) **Solve logarithmic equations by using exponential notation.**
3) **Use the product property of logarithms.**
4) **Use the quotient property of logarithms.**
5) **Use the power property of logarithms.**
6) **Use the properties of logarithms together.**
7) **Identify common logarithms and approximate them with a calculator.**
8) **Evaluate common logarithms of powers of 10.**
9) **Identify natural logarithms and approximate them by a calculator.**
10) **Evaluate natural logarithms of powers of e.**
11) **Use the change of base formula.**

Evaluating Logarithms and Properties of Logarithms

A logarithm is the inverse of an exponential:

$y = \log_b x$ means $x = b^y$

We can think of a logarithm (log) as being an exponent.

Exponent Statement	Logarithmic Statement
$3^2 = 9$	
	$\log_6 1 = 0$
$4^{-2} = \frac{1}{16}$	
	$\log_8 2 = \frac{1}{3}$
$e^0 = 1$	
	$\ln e = 1$

Evaluate each of the following logarithmic expressions without a calculator:

$\log_2 16$

$\log_{10} .1$

$\log_3 27$

$\log_2 \frac{1}{8}$

$\log_2 1$

$\log_3 \frac{1}{27}$

$\log_{\frac{3}{4}} \frac{4}{3}$

$\log \sqrt{10}$

$\log \frac{1}{100}$

$\ln e$

$\ln e^2$

$\ln \sqrt{e}$

Properties of Logarithms:

For any positive real number b, $b \neq 1$

① $\log_b b = 1$

② $\log_b 1 = 0$

③ $\log_b b^x = x$

④ $b^{\log_b x} = x$

⑤ $\log_b(xy) = \log_b(x) + \log_b(y)$ Product Property

⑥ $\log_b\left(\frac{x}{y}\right) = \log_b(x) - \log_b(y)$ Quotient Property

⑦ $\log_b(x)^r = r\log_b(x)$ Power Property

Note: $\log_b(x+y) \neq \log_b x + \log_b y$

$\log_b x - \log_b y = \log_b\left(\frac{x}{y}\right)$ NOT $\frac{\log_b x}{\log_b y}$

Write each of the following as a single logarithm:

$\log_2 9 + \log_2 3$

$\log_7 20 - \log_7 4$

$\log_6 18 + \log_6 2 - \log_6 9$

$3\ln 2 + 2\ln 3$

$\log_9(4x) - \log_9(x-3) - \log_9(x^3+1)$

$\log x + \log y - \log z + \log w - \log p$

$5\ln x - \frac{1}{2}\ln x + 3\ln x$

Write each expression as a sum or difference of logarithms:

$\log_4 \frac{2}{9z}$

$\ln\sqrt{\frac{3}{y}}$

$\log_3 \frac{(x+5)^2}{x}$

$\log_4 \frac{\sqrt[4]{z} \cdot \sqrt[5]{w}}{t^2}$

If $\log_b 3 = .5$ and $\log_b 5 = .7$, find:

$\log_b 25$

$\log_b \frac{3}{5}$

Change of Base Formula:

$$\log_b a = \frac{\log_c a}{\log_c b}$$

Find to four decimal places:

$\log_3 2$

$\log_{\frac{1}{3}} 2$