TOPIC: INTRODUCTION TO LOGARITHMS

Evaluate Logarithms

◆ You can evaluate many logarithms using properties that come from the log being the __________ of an exponential.

New **Properties of Logarithms**

Name	Example	Property	Description
Inverse Property	$\log_2 2^3 =$ ____ $2^{\log_2 3} =$ ____	$\log_b b^x = x$ $b^{\log_b x} = x$	Logs & exponentials w/ the *same base* _________
Log of the Base	$\log_2 2 =$ ___	$\log_b b = 1$	Log of its *base* equals ___
Log of 1	$\log_2 1 =$ ____ _____________ *"2 to what power gives 1?"*	$\log_b 1 = 0$	*ANY* log of 1 equals ___

EXAMPLE Using known properties, evaluate the given logarithms.

(***A***) $\log_2 \sqrt[3]{2}$

(***B***) $\ln 1$

(***C***) $\log 10$

(***D***) $\log_5 \frac{1}{5}$

TOPIC: INTRODUCTION TO LOGARITHMS

PRACTICE Evaluate the given logarithm.

(***A***)

$$\log_7 7^{0.3}$$

(***B***)

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

(***C***)

$$\log_9 \frac{1}{81}$$

TOPIC: PROPERTIES OF LOGARITHMS

Product, Quotient, and Power Rules of Logs

◆ Properties of **exponents** correspond to properties of **logarithms** that we can use to expand log expressions.

New — **Properties of Logarithms**

Name	Exponents	Property	Description
Product Rule	$b^m \times b^n = b^{m+n}$	$\log_b(m \times n) = \log_b m$ ___ $\log_b n$ **EX.** $\log_2 3x =$	*Multiply* terms in a log ⟶ [ADD|SUBTRACT] logs
Quotient Rule	$\frac{b^m}{b^n} = b^{m-n}$	$\log_b\left(\frac{m}{n}\right) = \log_b m$ ___ $\log_b n$ **EX.** $\log_5 \frac{5}{y} =$	*Divide* terms in a log ⟶ [ADD|SUBTRACT] logs
Power Rule	$(b^m)^n = b^{m \cdot n}$	$\log_b m^n =$ ___ $\log_b m$ **EX.** $\ln 7^2 =$	Term to a *power* ⟶ __________ log by power

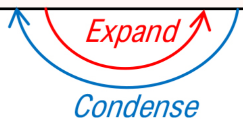
Expand & Condense Expressions Using Properties of Logs

◆ You may be given problems in which you are asked to either **expand** ***OR*** __________ logarithmic expressions.

- Properties of logarithms can be applied in _________ directions depending on your goal.

Properties of Logarithms

Name	Property
Product Rule	$\log_b(m \times n) = \log_b m + \log_b n$
Quotient Rule	$\log_b\left(\frac{m}{n}\right) = \log_b m - \log_b n$
Power Rule	$\log_b m^n = n \log_b m$



EXAMPLE Expand the log expression as much as possible.

$\log_2 3xy^2$

EXAMPLE Condense the given expression into a single log.

$2 \ln x - \ln(x+2)$

◆ When condensing logs, remember the base must be the ________ & always apply the power rule _________.

TOPIC: PROPERTIES OF LOGARITHMS

PRACTICE Write each logarithmic expression as a single log.

(***A***)

$$\log_2 \frac{1}{9x} + 2\log_2 3x$$

(***B***)

$$\ln \frac{3x}{y} + 2\ln 2y - \ln 4x$$

PRACTICE Write each single logarithm as a sum or difference of logs.

(***A***)

$$\log_3\left(\frac{\sqrt{x}}{9y^2}\right)$$

(***B***)

$$\log_5\left(\frac{5(2x+3)^2}{x^3}\right)$$

TOPIC: PROPERTIES OF LOGARITHMS

Evaluating Logarithms Using the Change of Base Property

- If a logarithm doesn't have a base that is easy to evaluate, you can simply ____________ the base.
  - You'll most often want to change the base to be either ____ or ____, to easily evaluate with any calculator.

New — **Change of Base Property**

$$\log_b M = \frac{\log_a \quad}{\log_a \quad}$$

$$\log_b M = \frac{\log_{10} M}{\log_{10} b} = \frac{\quad}{\quad}$$

$$\log_b M = \frac{\log_e M}{\log_e b} = \frac{\quad}{\quad}$$

EXAMPLE

Evaluate the given logarithms using the change of base property and a calculator. Use common logs for (***A***), (***B***) and natural logs for (***C***), (***D***).

(***A***) $\log_7 31 =$

(***B***) $\log_\pi 9 =$

(***C***) $\log_\pi 9 =$

(***D***) $\log_{\sqrt{3}} e =$

TOPIC: PROPERTIES OF LOGARITHMS

PRACTICE Evaluate the given logarithms using the change of base formula and a calculator. Use common logs.

(***A***) $\log_3 17$

(***B***) $\log_9 67$

PRACTICE Evaluate the given logarithms using the change of base formula and a calculator. Use natural logs.

(***A***) $\log_8 41$

(***B***) $\log_2 3789$