

Happy Thursday! Welcome to class

-All cell phones in holder.

- Quiz will be Wednesday 11/20

-Test will be after the break

$$0 < x \leq 15$$

a) $[0, 15]$ b) $(0, 15)$

c) $[0, 15)$ *d) $(0, 15]$

$$y > 4$$

$[4, \infty)$

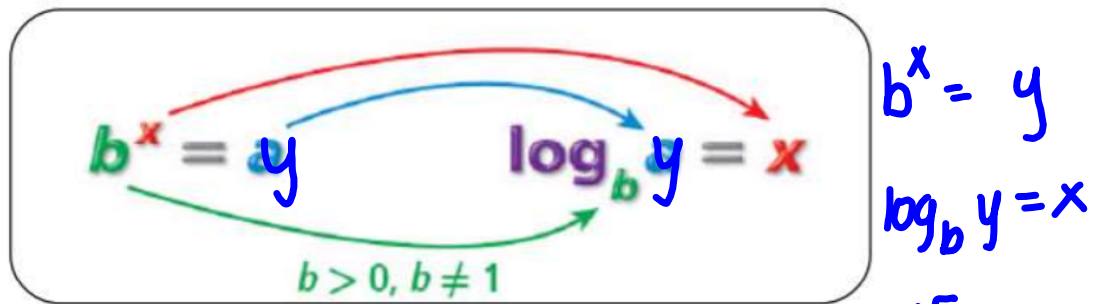
$(4, \infty)$

Introduction to Logarithms

Logs are the inverse of an exponential

You can convert any exponential to a log or a log to an exponential.

To convert you use the following



You read a log as follows $\log_b a = x$ "log base b of a is x"

There are 3 types of logs

Written	$y = \ln x$	$y = \log x$	$y = \log_b x$
Base	Natural log e	Common log 10	b

Example 1: Write each exponential form in logarithmic form.

Exponential Form	Logarithmic Form
$3^5 = 243$	$\log_3 243 = 5$
$25 = 5^2$	$\log_5 25 = 2$
$10^4 = 10,000$	$\log 10,000 = 4$
$6^{-1} = x$	$\log_6 x = -1$
$a^b = c$	$\log_a C = b$

Example 2: Write each logarithmic form in exponential form.

Logarithmic Form	Exponential Form
$\log_9 9 = 1$	$9^1 = 9$
$\log_2 512 = 9$	$2^9 = 512$
$\log_8 2 = x$	$8^x = 2$
$\log_4 x = -2$	$4^{-2} = x$
$\log_b 1 = 0$	$b^0 = 1$

Special Properties of Logarithms

For any base b such that $b > 0$ and $b \neq 1$,

LOGARITHMIC FORM	EXPONENTIAL FORM	EXAMPLE
Logarithm of Base b $\log_b b = 1$	$b^1 = b$	$\log_{10} 10 = 1$ $10^1 = 10$
Logarithm of 1 $\log_b 1 = 0$	$b^0 = 1$	$\log_{10} 1 = 0$ $10^0 = 1$

$\log_5 5 = 1$
 $\ln 15$

$\log_5 5 = 1$
 $\log_{15} 15 = 1$
 $\log_3 1 = 0$
 $\log_{115} 1 = 0$

Evaluating Logs:

How to evaluate a log

1. set equal to x
2. Convert to an exponential
3. Solve the exponential

Evaluate each expression below.

1. $\log_3 243 = 5$ 2. $\log_8 2 = \frac{1}{3}$ 3. $\log_{27} 81 = \frac{4}{3}$ 4. $\log_4 \frac{1}{32} = -\frac{5}{2}$

$\log_3 243 = x$
 $3^x = 243$
 $3^x = 3^5$
 5

$\log_8 2 = x$
 $8^x = 2$
 $2^{3x} = 2^1$
 $3x = 1$
 $\frac{1}{3}$

$\log_{27} 81 = x$
 $27^x = 81$
 $3^{3x} = 3^4$
 $\frac{4}{3}$
 $\log_{27} 81 = \frac{4}{3}$

$\log_4 \frac{1}{32} = x$
 $4^x = \frac{1}{32}$
 $2^{2x} = 2^{-5}$
 $-\frac{5}{2}$

Base 10: Plug directly into the calculator!

*If you have the TI-36 Pro, hit the "log" button **TWICE**.

Example: Evaluate. Round any decimal answers to the hundredths place.

a.) $\log 100$

2

b.) $\log \frac{1}{10}$

-1

c.) $\log 30$

1.48

d.) $\ln 256$

5.55

Non-Base 10: Use the "change of base" formula to calculate!

*If you have the TI-36 Pro, hit the "log" button **3 times** and type in calculator without having to use formula.

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

Example: Evaluate. Round any decimal answers to the hundredths place.

a.) $\log_5 125$

$$\frac{\log 125}{\log 5} = 3 \quad \frac{\ln 125}{\ln 5}$$

b.) $\log_2 27$

$$\frac{\log 27}{\log 2} = 4.75$$

$2^x = 27$

c.) $\log_{\frac{1}{2}} 40$

$$\frac{\ln 40}{\ln \frac{1}{2}} \quad \frac{\log 40}{\log \frac{1}{2}}$$

-5.32

d.) $\log_7 \frac{1}{49}$

$$\frac{\log \frac{1}{49}}{\log 7} = -2$$

$$\log \sqrt{1000} = \frac{3}{2}$$

$$\log_{10} \sqrt{10^3}$$

$$\log_{10} 10^{\frac{3}{2}} = x$$

$$10^x = 10^{\frac{3}{2}}$$

$$\log .01$$

$$10^x = .01$$

$$10^x = \frac{1}{100}$$

$$10^x = 10^{-2}$$

$$\log x \leftarrow 10$$

$$\ln x \leftarrow e$$

$$\log_3 x \leftarrow 3$$

$$\log_m m^3 = x$$
$$m^x = m^3$$
$$3$$