

3.3 Logarithms and Their Graphs

ESSENTIAL QUESTIONS: How do you

1. convert between logarithmic and exponential form,
2. evaluate common and natural logs,
3. graph common and natural log functions?

Definition of logarithm

$\log_b y = x$ if and only if $b^x = y$.

Convert to exponential form:

1. $\log_2 8 = 3$

2. $\log_5 \frac{1}{5} = -1$

3. $\log_8 1 = 0$

Convert to logarithmic form:

4. $3^2 = 9$

5. $16^{-1/2} = \frac{1}{4}$

Evaluate these logs:

1. $\log_5 125$

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

3. $\log_{10} 1$

4. $\log_6 6$

Basic Properties of All Logs

1. $\log_b 1 = 0$

2. $\log_b b = 1$

3. $\log_b b^y = y$

4. $b^{\log_b x} = x$

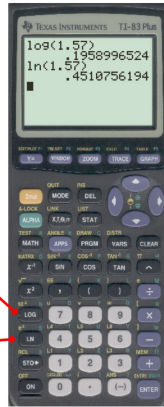
COMMON LOGS are base 10 logs. Usually the 10 is omitted when we write common log expressions.

Evaluate:

1. $\log 1000$

2. $\log 0.01$

NATURAL LOGS have base e . They are written $\ln x$ instead of $\log_b x$. They have the same properties as other logs.



common log
(base 10)

natural log
(base e)

Solve simple log equation by converting to exponential form.

1. $\log_3(3x-2) = 3$

2. $\ln e^5 = x$

3. $\log_2 x^2 = 4$

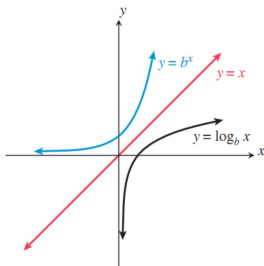
4. $\log(2 - 5x) = 2$

Definition of logarithm

$\log_b y = x$ if and only if $b^x = y$.

According to the definition, logs and exponential functions are inverses.

Reflect the graph of $y = b^x$ in the line $y = x$ and you get the graph of $y = \log_b x$.



What is the domain and range of $y = \log_b x$?

Describe how to transform the graph of $y = \ln x$ or $y = \log x$ into the graph of the given function.

(a) $g(x) = \ln(x + 2)$

(b) $h(x) = \ln(3 - x)$

(c) $g(x) = 3 \log x$

(d) $h(x) = 1 + \log x$

