3.3 Log Functions and their Graphs

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Logarithms

Def of Logarithm: if $b > 0,\ b \neq 0,\ n > 0,$ there is a number p such that $\log_b n = p \ \ iff \ \ b^p = n$

exponent, power

$n = b^p \qquad p = \log_b n$

base - must match

a number or variable

$y = 2^x \qquad x = \log_2 y$

p is the only value that can be negative

$3^2 = 9 \qquad 16^{\frac{1}{2}} = 4 \qquad 2^{-3} = \frac{1}{8}$

$2 = \log_3 9 \qquad \log_{16} 4 = \frac{1}{2} \qquad -3 = \log_2 \frac{1}{8}$

Solve:

1. $\log_6 x = 2$

3. $\log_4 x = \frac{3}{2}$

2. $\log_4 16 = y$

4. $\log_{\frac{1}{3}} 27 = y$

Logs & Exponentials

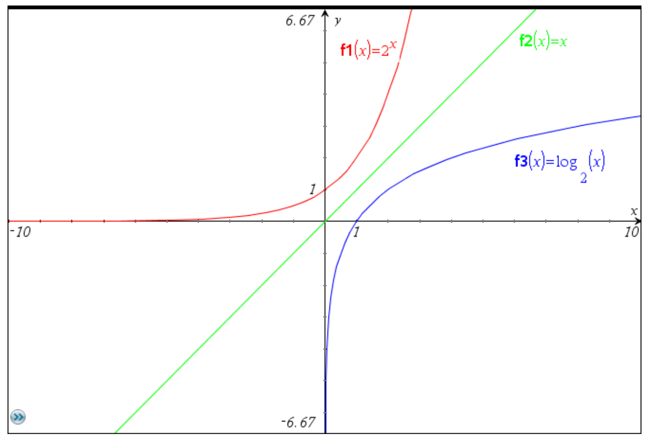
$f(x)=2^x$ & $f(x)=\log_2 x$ are inverses

$x=2^y$

$y=\log_2 x$

to find inverse:

1. switch x&y
2. solve for y



Basic Properties of Logarithms

For 0<b ≠ 1, x > 0, and any real number y,

$\log_b 1 = 0$ because

$\log_b b = 1$ because

$\log_b b^y = y$ because

$b^{\log_b x} = x$ because

Evaluate:

1. $\log_5 5^3$

2. $6^{\log_6 (2x+5)}$

Write the following exponential functions as logs:

$$x = 6^2$$

$$y = 4^{\frac{3}{2}}$$

$$16 = 4^y$$

Write the following logs as exponential functions:

$$\log_8 x = 2$$

$$\log_2 8 = y$$

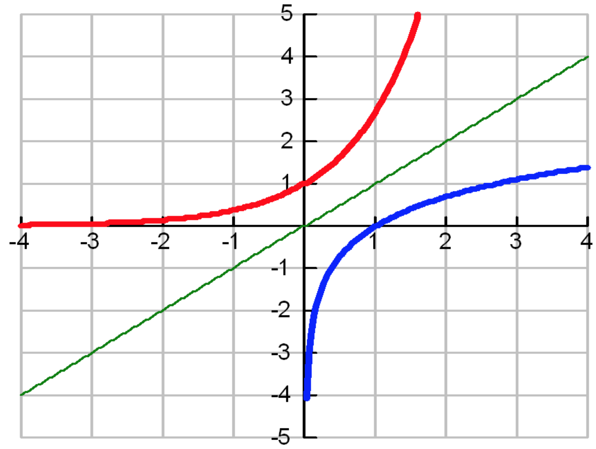
$$\log_{\frac{2}{3}} x = 3$$

$$\log_3 \frac{1}{9} = y$$

natural log

$$f(x) = \ln x$$

$$f(x) = e^x$$



Essentially ln has a base of e

y = lnx iff $e^y = x$

Evaluate without a calculator:

$$\ln\sqrt{e}$$

$$\ln e^5$$

$$e^{\ln 4}$$

Evaluating ln and e on a calculator

Use a calculator to evaluate the logarithmic expressions, if it is defined, and check your result by evaluating the corresponding exponential equation.

$$\ln 23.5$$

$$\ln 0.48$$

$$\ln -5$$

What does it mean if there is no base written on the log?

$$\log 100 = y$$

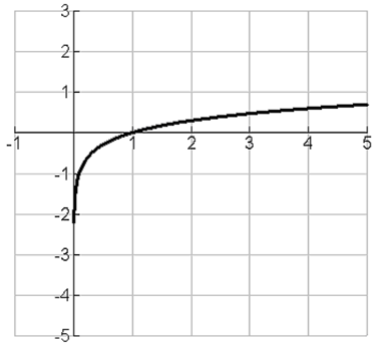
common log

When the base is e - what do we do?

$$16 = e^{y}$$

Graphs

$f(x) = \log x \,/\, f(x) = \ln x$



Domain
Range
$\lim_{x \to \infty}$
$\lim_{x \to -\infty}$
x-intercepts
y-intercepts
VA
HA

Remember logs & exponents are inverses

$b^x \qquad \log(x)$

Describe the transformations on each graph:

$$f(x) = \log(x+2)$$

$$f(x) = 3\log(-x) - 4$$

$$f(x) = -2\ln(2x) + 5$$