

Section 5.5
LOGARITHMIC FUNCTIONS

A log is an exponent

If $b^x = y$ then $\log_b y = x$
(exponential form) (log form)

Exp. Form

$$2^3 = 8$$

$$3^4 = 81$$

$$5^{-2} = 1/25$$

Log Form

$$\log_2 8 = 3$$

$$\log_3 81 = 4$$

$$\log_5 \frac{1}{25} = -2$$

Common Logarithms

-Base 10

-Written as $\log x = y$ means $10^y = x$

Natural Logarithms

-Base e

-Written as $\ln x = y$ means $e^y = x$

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Examples

Solve for x.

1) $\log_{10} 10^1 = x$

$$10^x = 10$$

$$x = 1$$

2) $\ln e^2 = x$

$$e^x = e^2$$

$$x = 2$$

3) $\ln e^1 = x$

$$e^x = e^1$$

$$x = 1$$

Short Cut

$$\log_a a^b = b$$

If the bases are the same, then the answer is the exponent.

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Examples

4) $\log_2 16 = x$

$2^x = 16$
 $x = 4$

5) $\log_{10} 1000 = x$

$10^x = 1000$
 $x = 3$

6) $\log_7 1 = x$

$7^x = 1$
 $x = 0$

7) $\log_2 2^{11} = x$

$2^x = 2^{11}$
 $x = 11$

8) $\log_{49} 7 = x$

$49^x = 7$
 $(7^2)^x = 7^1$ $7^{2x} = 7^1$
 $2x = \frac{1}{2}$ $x = \frac{1}{4}$

9) $\log_{10} .1 = x$

$10^x = .1$
 $10^x = \frac{1}{10}$
 $x = -1$

Examples - use a calculator

10) $\log 14 = x$

$10^x = 14$ $x = 1.15$

11) $\log 250 = x$

$x = 2.40$

12) $\ln 4 = x$

$e^x = 4$
 $x = 1.39$

Cannot solve without calc.

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TI-SmartView

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TI-84 Plus Silver Edition
 TEXAS INSTRUMENTS

Equation

Table

Graph

Key Press History Large Screen

log key \rightarrow Base 10 = common log
 ln key \rightarrow Base e = natural log

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Exponential and Logarithmic Equations are INVERSES

Ex 13

Graph $y = 2^x$ and its inverse.

$$f(x)$$

x	y
0	1
1	2
2	4
-1	$\frac{1}{2}$

D: $\{x | \mathbb{R}\}$
 R: $\{y | y > 0\}$
 Asymptote:

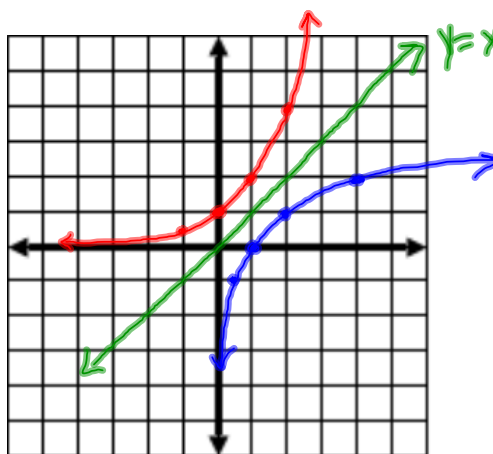
$y = 0$
 x-axis

$$f^{-1}(x)$$

x	y
1	0
2	1
4	2
$\frac{1}{2}$	-1

D: $\{x | x > 0\}$
 R: $\{y | \mathbb{R}\}$
 Asymptote:

$x = 0$
 y-axis



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Examples

Solve without a calculator. Leave answers in terms of e.

14) $\log x = 2$

$$10^2 = x$$

$$x = 100$$

15) $\log |x| = 4$

$$10^4 = |x|$$

$$10,000 = |x|$$

$$x = \pm 10,000$$

16) $\ln x = 3$

$$e^3 = x$$

Solve using a calculator.

17) $\log x = 2.3$

$$10^{2.3} = x$$

$$x = 199.53$$

*Do not have decimal exponents in final answer

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Homework

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#1 - 17 odd

#35 - 43 odd

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