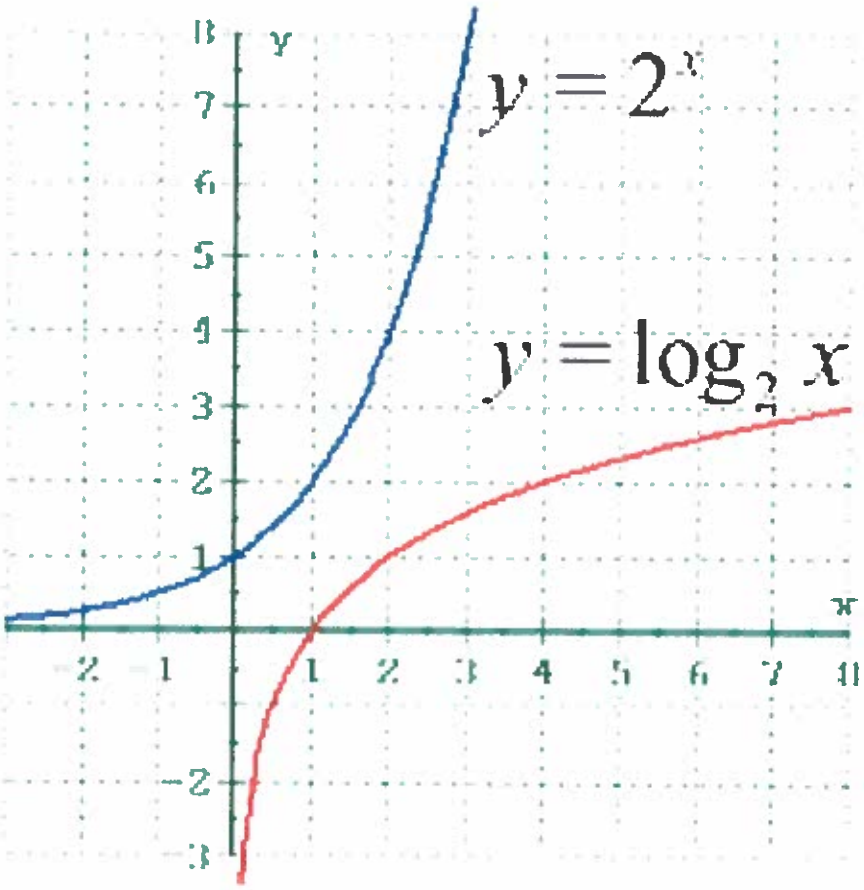
Logarithms and Logarithmic Functions



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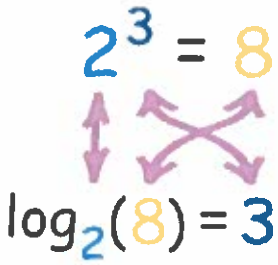
Period 2

Logarithms ($\log_b y=x$)

Logarithms are the inverse of exponents.

Convert $4=2^2$

- use "log bae"
- b is the log base ex. logb —> log2
- a is the answer $\log_2(4)$
- e is the exponent $\log_2(4)=2$



You can also use "log bae" to work backwards

Ex. $\log_2(16)=4$

b: 2

a: 16

e: 4

$16=2^4$

Common and natural log

- **Natural** logarithms are different than **common** logarithms. While the base of a **common logarithm** is 10, the base of a **natural logarithm** is the special number e. Although this looks like a variable, it represents a fixed irrational number approximately equal to 2.718281828459.
- common log is expressed as $\log_{10}$ or log
- Natural log is expressed as ln or $\log_e$

Use calculator to evaluate

1. $\log_6$
2. $\ln_{1/3}$
3. $\ln_{12}$
4. $\log_{2/7}$

Answers

1. .77815
2. -1.099
3. 2.485
4. -.5441

Inverse Properties

- since logarithms are an inverse of exponential functions you can switch them back and forth, and cancel each other out.

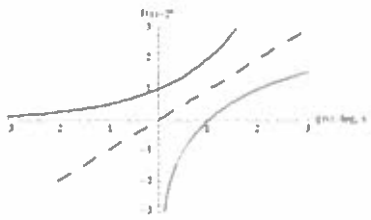
Ex.

$4=10^{\log 4}$

$\log_5 25 = \log_5 (5)^{2x}$

$2x$

Characteristics of Logarithmic Functions



- passes though (1.0)
- Domain: x>0 Range: all real numbers
- an asymptote at the y-axis
- Equation: $y= \log_b x$
- inverse of exponential function $y=b^x$

Graphing Log Functions

Graph: $f(x)=\log_5 x$

Step 1: find inverse of f(x) which is $g(x)= 3^x$

Step 2: make a table

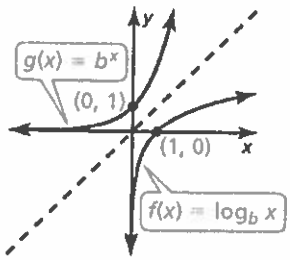
x	-2	-1	0	1	2
g(x)	1/9	1/3	1	3	9

Step 3: plot points for g(x) and connect points with a smooth curve

Step 4: because f(x) and g(x) are inverse functions you can graph g(x) by reflecting f(x) over y=x.Therefore switching the coordinates of f(x) to make g(x)

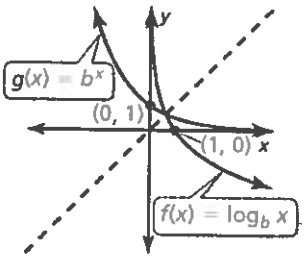
Log functions for when b>1

Graph of $f(x) = \log_b x$ for $b > 1$



Log functions for when 0<b<1

Graph of $f(x) = \log_b x$ for $0 < b < 1$



Parent Graphs for Logarithmic Functions

The graph of $f(x) = \log_b x$ is shown below for $b > 1$ and for $0 < b < 1$. Because $f(x) = \log_b x$ and $g(x) = b^x$ are inverse functions, the graph of $f(x) = \log_b x$ is the reflection of the graph of $g(x) = b^x$ in the line $y = x$.

Note that the y-axis is a vertical asymptote of the graph of $f(x) = \log_b x$. The domain of $f(x) = \log_b x$ is $x > 0$, and the range is all real numbers.

Practice Problems

Rewrite equation in exponential form

1. $\log_3 9 = 2$
2. $\log_6 1 = 0$
3. $\log_4 4 = 1$
4. $\log_7 343 = 3$

Rewrite equation in log form

5. $6^2 = 36$
6. $12^0 = 1$
7. $16^{-1} = 1/16$
8. $5^{-2} = 1/25$

evaluate log

9. $\log_3 81$
10. $\log_3 3$
11. $\log_7 49$
12. $\log_{1/2} 1$

Find the inverse

13. $.3^x$
14. 11^x
15. $\log_2 x$
16. $\log_{1/5} x$

Graph

17. $\log_4 x$
18. $\log_6 x$

Answer Key

1. $3^2 = 9$
2. $6^0 = 1$
3. $4^1 = 4$
4. $7^3 = 343$
5. $\log_6 36 = 2$
6. $\log_{12} 1 = 0$
7. $\log_{16} \frac{1}{16} = -1$
8. $\log_5 \frac{1}{25} = -2$
9. 4
10. 1
11. 2
12. 0
13. $\log_3 X = 4$
14. $\log_1 X = y$
15. $4 = 2^x$
16. $4 = \frac{1}{5}^x$