7.4 Evaluate Logarithms

Exponential Form	Logarithmic Form
$B^P = A$	$\log_B A = P$
$2^5 = 32$	$\log_2 32 = 5$
$5^3 = 125$	$\log_5 125 = 3$
$4^3 = 64$	$\log_4 64 = 3$

EXAMPLE 1 Rewrite logarithmic equations

Logarithmic Form	Exponential Form
a. $\log_2 8 = 3$	$2^3 = 8$
b. $\log_4 1 = 0$	$4^0 = 1$
c. $\log_{12} 12 = 1$	$12^1 = 12$
d. $\log_{1/4} 4 = -1$	$\left(\frac{1}{4}\right)^{-1} = 4$

Match the following:

EXAMPLE 2 Evaluate logarithms

Evaluate the logarithm.

a. $\log_4 64 = p$

$4^p = 64$

$\boxed{3}$

b. $\log_5 0.2$

$5^p = 0.2$

$5^p = \frac{1}{5}$

$\boxed{-1}$

c. $\log_{1/5} 125$

$\left(\frac{1}{5}\right)^p = 125 \quad -p = 3$

$\left(\frac{1}{5}\right)^p = 5^3 \quad p = -3$

$\boxed{-3}$

$5^{-p} = 5^3$

d. $\log_{36} 6$

$36^p = 6$

$\boxed{\frac{1}{2}}$

Common Logarithm

$\log_{10} x = \log x$

$\log 100 = 2$

$10^p = 100$

$p = 2$

Natural Logarithm

$\log_e x = \ln x$

$\ln e^3$

$e^p = e^3$

$p = 3$

EXAMPLE 3 Evaluate common and natural logarithms

a. $\log 8$

$B^P = A \qquad \log_B A = P$

$10^P = 8$

$\log 8 = 0.903$

$10^{0.90389987} \approx 8$

b. $\ln 0.3$

≈ -1.204

$e^{-1.204} \approx 0.29999\ldots$

EXAMPLE 5 Use inverse properties

Simplify the expression.

a. $10^{\log 4}$

$B^P = A \qquad \log_B A = P$

$\log_{10} A = \log 4$

$\log A = \log 4$

$A = 4$

$\boxed{4}$

b. $\log_5 25^x$

$5^P = 25^x$

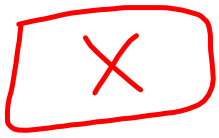
$5^P = (5^2)^x$

$5^P = 5^{2x}$

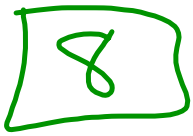
$\boxed{2x}$

USING INVERSE PROPERTIES Simplify the expression.

29. $\log_5 5^x$



31. $10^{\log 8}$



7.4 Graph Logarithmic Functions

EXAMPLE 6 Find inverse functions

Find the inverse of the function.

a. $y = 6^x$

$y = 6^x$

$x = 6^y$

$\log_6 x = y$

b. $y = \ln (x + 3)$

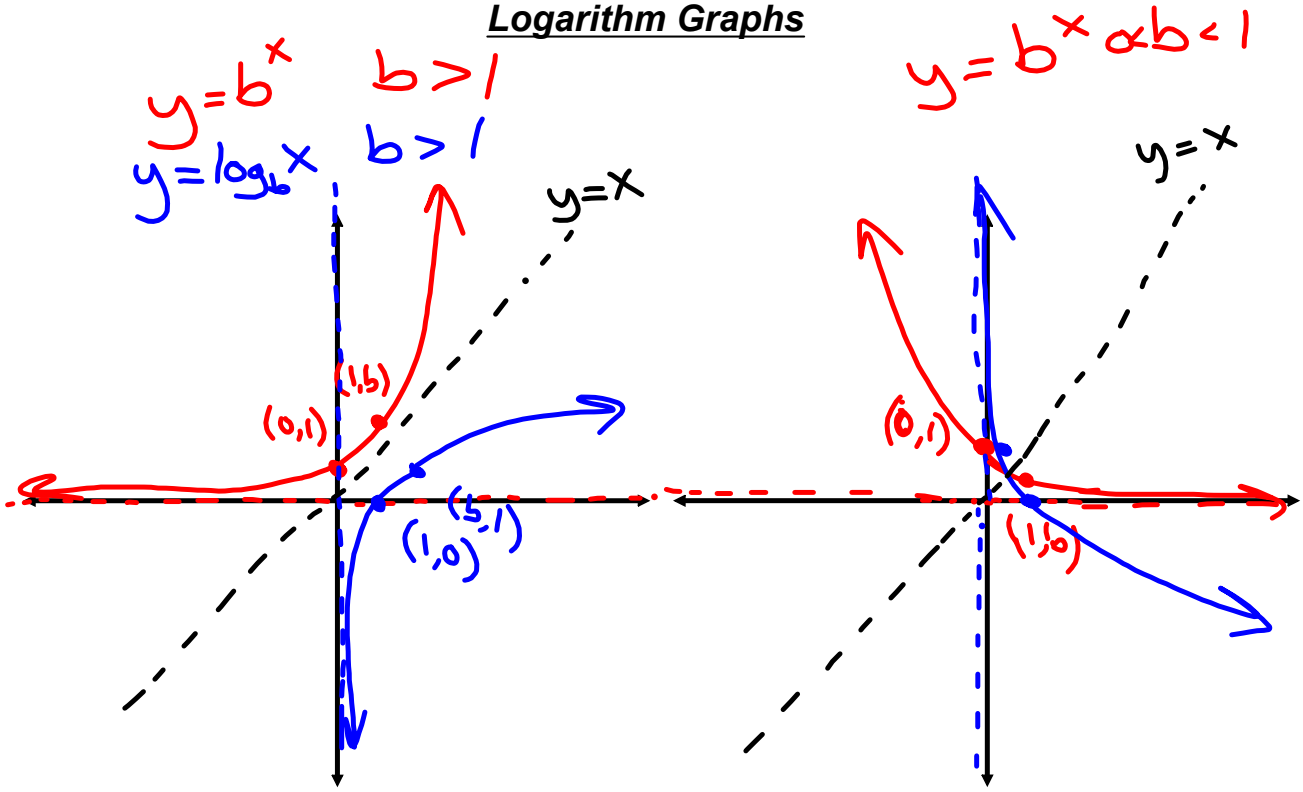
$x = \ln (y + 3)$

$e^x = y + 3$

$-3 \quad -3$

$y = e^x - 3$

Logarithm Graphs

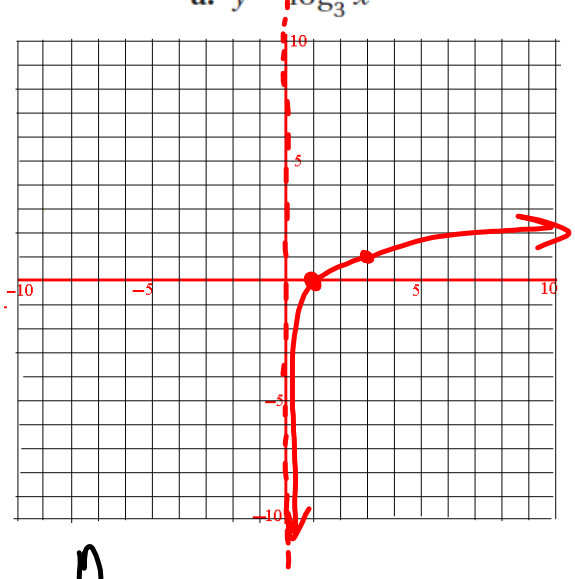


EXAMPLE 7 Graph logarithmic functions

Graph the function.

a. $y = \log_3 x$

b = 3

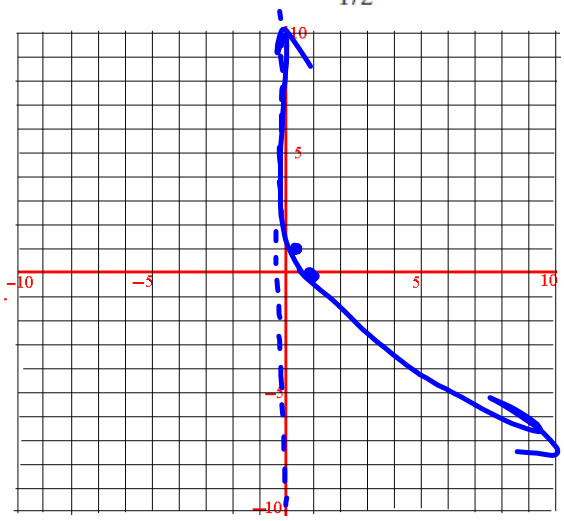


Dom: $x > 0$

Range: $\mathbb{R}$

b. $y = \log_{1/2} x$

$b = \frac{1}{2}$

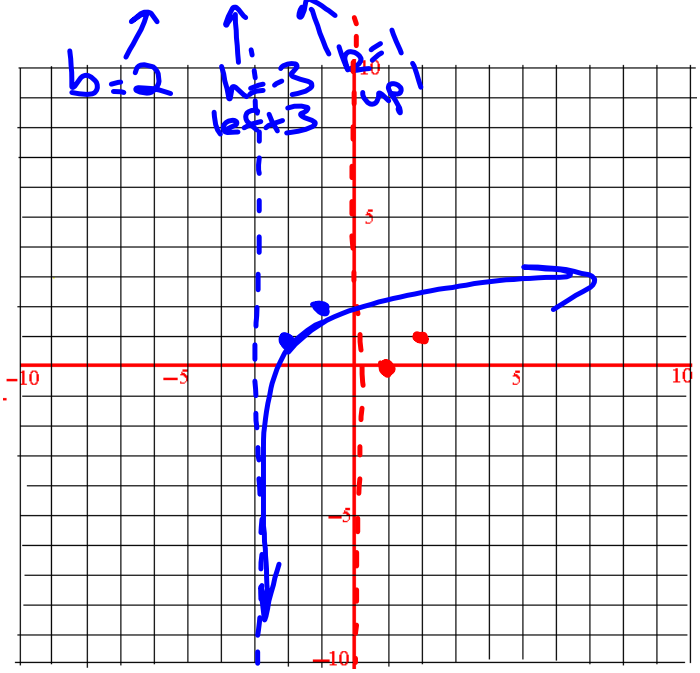


Dom: $x > 0$

Range: $\mathbb{R}$

EXAMPLE 8 Translate a logarithmic graph

Graph $y = \log_2 (x + 3) + 1$. State the domain and range.



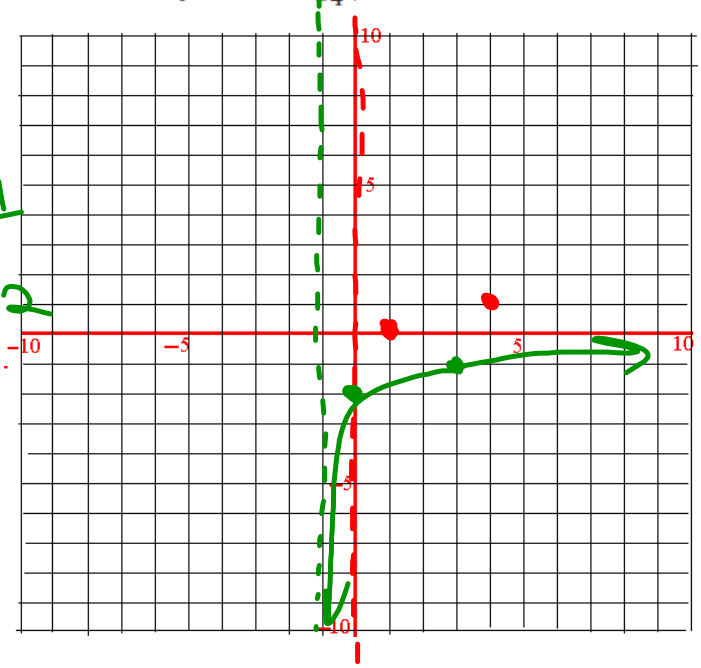
Dom: $x > -3$

Range: $\mathbb{R}$

EXAMPLE 8 Translate a logarithmic graph

Graph the function. State the domain and range.

$$f(x) = \log_4 (x + 1) - 2$$



$b = 4$

$h = -1$ left 1

$k = -2$ down 2

Dom: $x > -1$

Range: $\mathbb{R}$

FINDING INVERSES Find the inverse of the function.

41. $y = e^{x+2}$

$x = e^{y+2}$

$\log_e x = y+2$

$\ln x = y+2$

$-2 \quad -2$

$y = \ln x - 2$

$A = B^P$

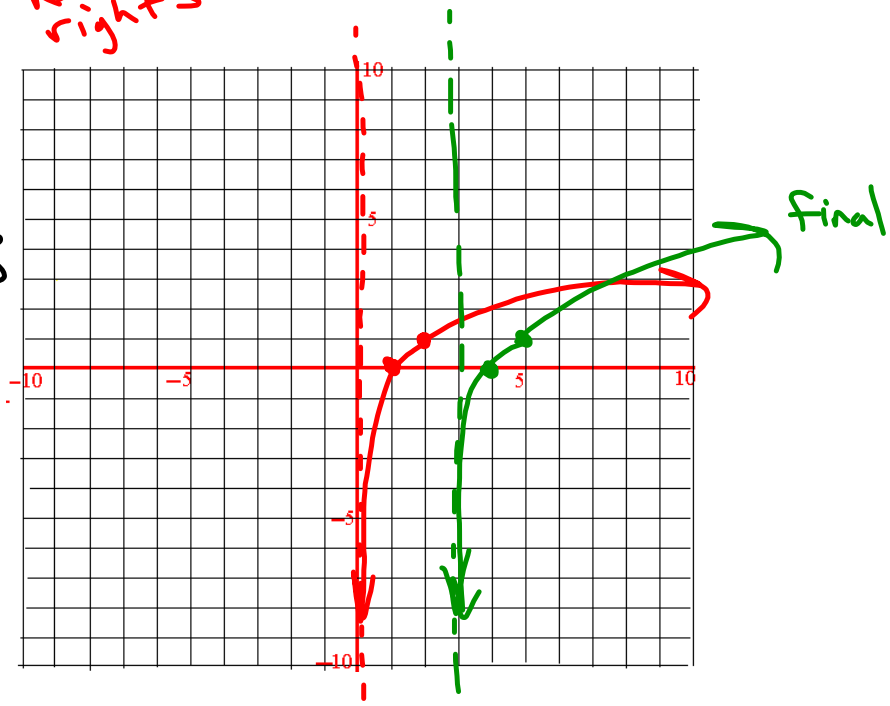
$\log_B A = P$

GRAPHING FUNCTIONS Graph the function. State the domain and range.

49. $y = \log_2 (x - 3)$

b=2

h=3
right+3



Dom: $x > 3$

Range: $\mathbb{R}$

CHALLENGE Evaluate the logarithm. (*Hint:* For each logarithm $\log_b x$, rewrite b and x as powers of the same number.)

55. $\log_8 32$ = $\frac{5}{3}$

$8^p = 32$

$(2^3)^p = 2^5$

$2^{3p} = 2^5$

$3p = 5$

$p = \frac{5}{3}$

$8^{\frac{5}{3}} = 32$

$(2^3)^{\frac{5}{3}}$

2^5

32