9-4 Graphing Logarithmic Functions

Logarithms & Exponentials

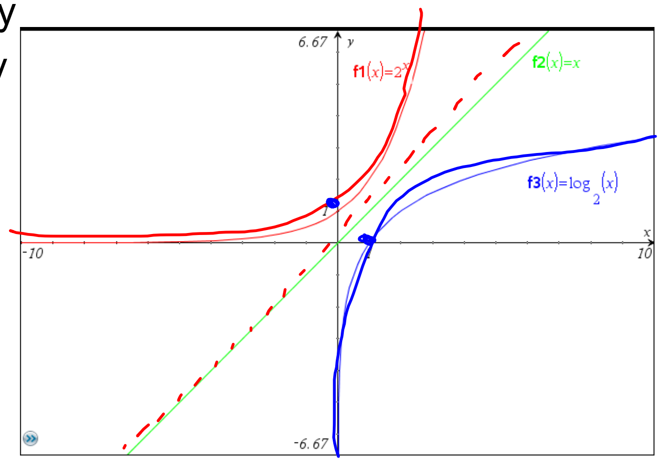
$f(x) = 2^x$ & $f(x) = \log_2 x$ are inverses

$x = 2^y$

$y = \log_2 x$

to find inverse:

1. switch x&y
2. solve for y



(10)

$$M = \frac{2}{3}\log\frac{E}{10^{11.8}}$$

$$\frac{3}{2}\cdot 8.1 = \frac{3}{2}\cdot\frac{2}{3}\log\frac{E}{10^{11.8}}$$

$$12.15 = \log E - \underbrace{\log 10^{11.8}}$$

$$12.15 = \log E - 11.8$$

$$+11.8 \qquad +11.8$$

$$23.95 = \log E$$

$$10^{23.95} = E$$

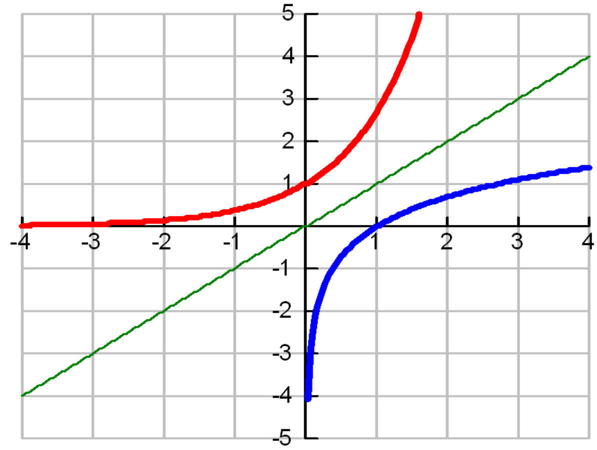
$$\boxed{8.9 \times 10^{23}} = E$$

ergs

natural log

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

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

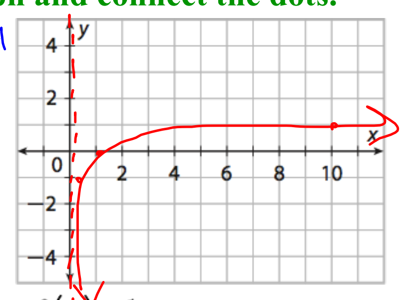


Complete the table for the function $f(x) = \log x$

Then plot the points on the graph and connect the dots.

x	$f(x) = \log x$
0.1	-1
1	0
10	1

$\log \frac{1}{10} = \log 10^{-1}$
$\log 1 = 0$
$\log 10 = 1$

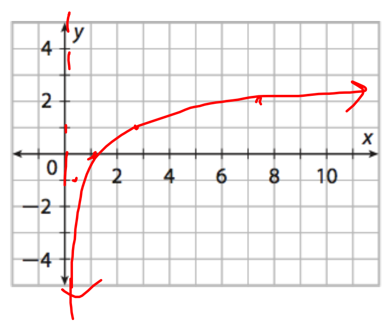


Complete the table for the function $f(x) = \ln x$

Then plot the points on the graph and connect the dots.

x	$f(x) = \ln x$
$\frac{1}{e} \approx 0.368$	-1
1	0
$e \approx 2.72$	1
$e^2 \approx 7.39$	2

$\ln e^2$



Analyze the graphs of:

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

Domain: $(0, \infty)$

Range: $(-\infty, \infty)$

End behavior: $\lim_{x \to \infty} f(x) = \infty$

Asymptote Beh: $\lim_{x \to 0^+} f(x) = -\infty$

VA/~~HA~~: $x = 0$

Increasing/ Decreasing: $(0, \infty)$

Intercepts: $(1, 0)$

Describe the transformations on each graph:

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

left 2

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

v. stretch of 3
h. reflection
down 4

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

v. reflection
v. stretch by 2
h. compression by 2
up 5

Graphing Transformed Logarithmic Functions

When graphing a transformed function, it is helpful to consider the following features of the graph: the vertical asymptote, and two reference points (1,0) and (b,1).

Function	$f(x) = \log_b x$	$g(x) = a \log_b (x - h) + k$
Asymptote	$x = 0$	$x = h$
Reference point	$(1, 0)$	$(1 + h, k)$
Reference point	$(b, 1)$	$(b + h, a + k)$

Graph and analyze the following functions:

$\log_a 1 = 0$

$\log_a a = 1$

$$f(x) = 2 \cdot \log(x - 1)$$

$= 2 \cdot \log(2 - 1)$

$2 \cdot \log 1$

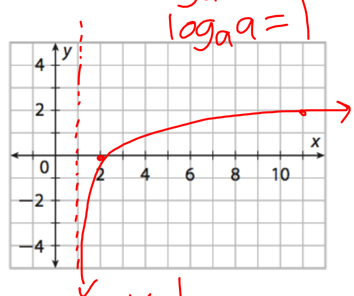
$2 \cdot 0$

0

$2 \cdot \log(11 - 1)$

$2 \cdot \log 10$

$2 \cdot 1 = 2$



x	y
2	0
11	2

Domain:

Range:

End behavior:

VA/HA:

Increasing/ Decreasing:

Intercepts:

$$f(x) = \log_2(x+1) - 3$$

$\log_a 1 =$

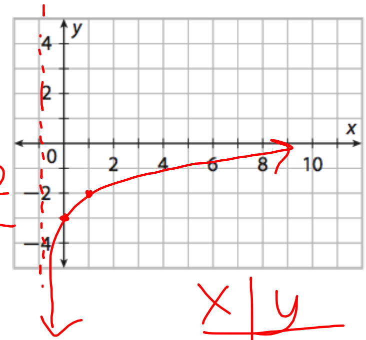
$\log_a a =$

Domain: $\log_2(1+1) - 3$

$\underbrace{\log_2(2)} - 3$

$1 - 3 = -2$

Range:



End behavior: $\log_2(0+1) - 3$

$\log_2 1 - 3$

$0 - 3$

-3

x	y
1	-2
0	-3

VA/HA:

Increasing/ Decreasing:

Intercepts:

$$f(x) = 3 \cdot \ln(x) + 2$$

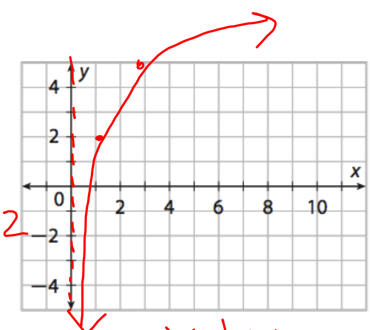
$f(1) = 3 \bullet \ln(1) + 2$

$= 3 \cdot 0 + 2$

$= 0 + 2 = 2$

Domain:

Range:



$f(e) = 3 \bullet \cancel{\ln e}^{1} + 2$

$= 3(1) + 2$

$= 3 + 2$

$= 5$

End behavior:

x	y
1	2
2.72=e	5

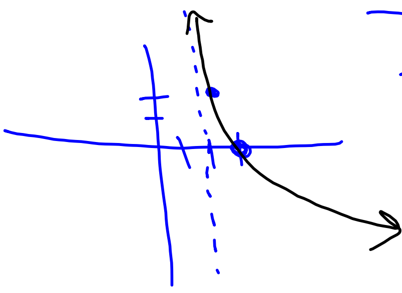
VA/HA:

Increasing/ Decreasing:

Intercepts:

$g(x)=2\cdot\log_{1/2}(x-2)$

x	y
3	0
$2\frac{1}{2}$	2



$f(3)=2\cdot\log_{1/2}(3-2)$

$=2\cdot 0$

$=0$

$f(2\frac{1}{2})=2\cdot\log_{1/2}(2\frac{1}{2}-2)$

$=2\cdot\log_{1/2}\frac{1}{2}$

$=2\cdot 1$

$=2$