

Warm-up!

A) What transformation turns the graph of $f(x) = \log_2(x)$ into the graph of $g(x) = \log_2(8x)$?

B) What transformation turns the graph of $f(x) = \log_2(x)$ into the graph of $h(x) = \log_2(\sqrt[3]{x})$?

C) What transformation turns the graph of $f(x) = \log_2(x)$ into the graph of $k(x) = \log_{\frac{1}{2}}(x)$?

Log Functions Day 3:
(2.11) Graphs of Log
Functions

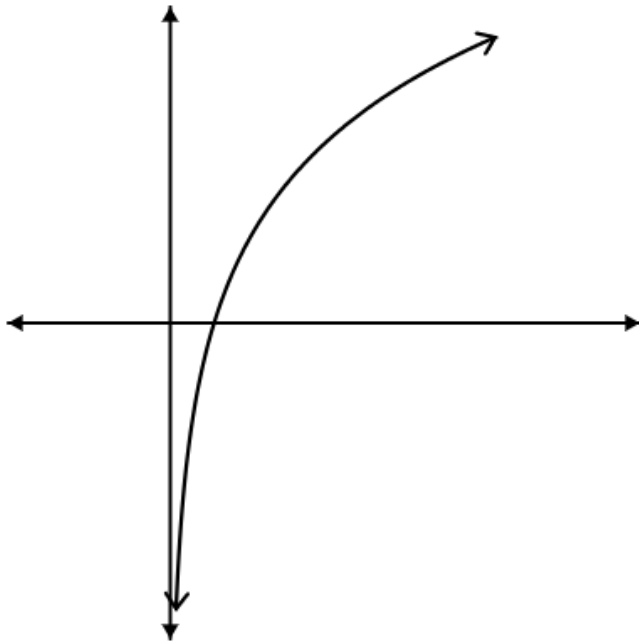
Homework: Logarithmic
Functions and Their Graphs

Quiz: Class After Next. Goes
up to the material from
today (including the material
from today)

Graphs of Logarithmic Functions

$$f(x) = a \log_b x$$

$a > 0$ and $b > 1$



Domain:

Range:

$$\lim_{x \rightarrow \infty} f(x) =$$

$$\lim_{x \rightarrow 0^+} f(x) =$$

Increasing vs Decreasing

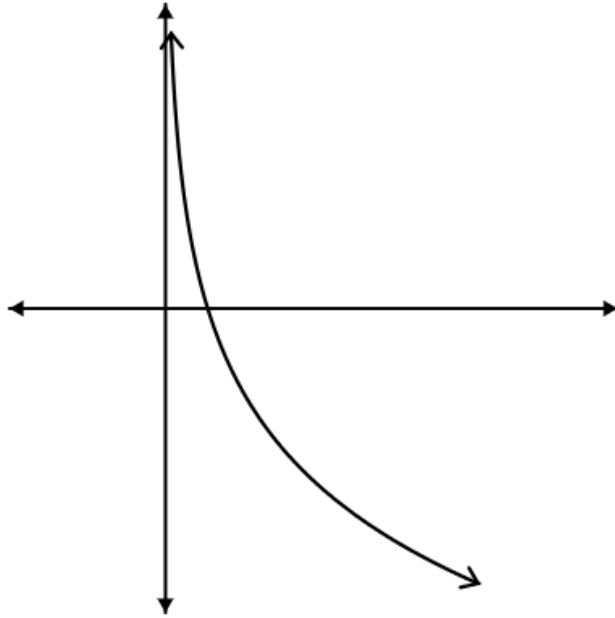
CCU vs CCD

What happens if $a < 0$

Graphs of Logarithmic Functions

$$f(x) = a \log_b x$$

$a < 0$ and $b > 1$



Domain:

Range:

$$\lim_{x \rightarrow \infty} f(x) =$$

$$\lim_{x \rightarrow 0^+} f(x) =$$

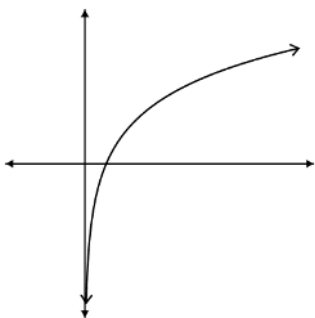
Increasing vs Decreasing

CCU vs CCD

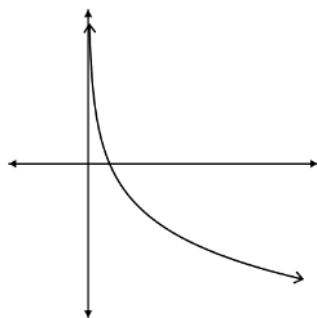
What happens if $0 < b < 1$

If the base of the log is $0 < b < 1$, then it flips the graph vertically, just like $a < 0$

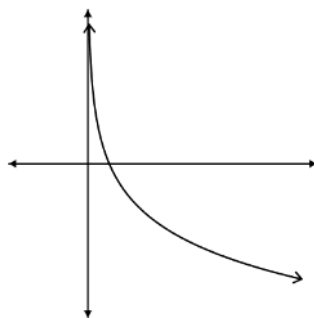
$$y = \log_4(x)$$



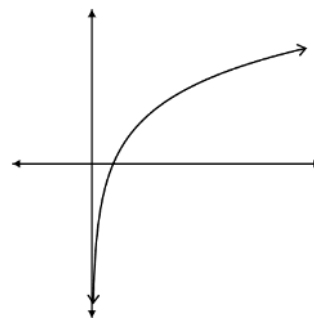
$$y = \log_{\frac{1}{4}}(x)$$



$$y = -\log_4(x)$$



$$y = -\log_{\frac{1}{4}}(x)$$



Describe the vertical asymptote and end behavior using limits

A) $f(x) = -4 \ln(x)$

B) $g(x) = 6 \log_2(-x)$

Describe the vertical asymptote and end behavior using limits

C) $f(x) = \log(x - 5) + 2$

D) $g(x) = -\log_4(x - 1)$

Find the Domain

A) $f(x) = \log_2(x - 4)$

Graphically

Algebraically

Find the Domain

B) $g(x) = 3 \log_5(x + 6) + 1$

C) $h(x) = \frac{1}{2} \ln(-x) - 5$

Let $g(x) = \log_3(3x - 1) + 4$

Find the domain.

Does this function increase or decrease?

Is this function concave up or concave down?

Describe the end behavior and vertical asymptote using limits.

Find the range.

Let $h(x) = -2 \log_3(1 - x) + 10$

Find the domain.

Does this function increase or decrease?

Is this function concave up or concave down?

Describe the end behavior and vertical asymptote using limits.

Find the range.

$f(x)$ is of the form $f(x) = a \log_b(x - c) + d$

How can we tell $f(x)$ is of this form?

x	13	29	37	41	43
$f(x)$	6	10	14	18	22

Justifying our choice for "Look at this table. What type of function is it?" questions.

Statement	Justification
f is best modelled by a linear function...	...since consecutive equally spaced input values correspond with output values with constant first differences
f is best modelled by a quadratic function...	...since consecutive equally spaced input values correspond with output values with constant second differences
f is best modelled by a cubic function...	...since consecutive equally spaced input values correspond with output values with constant third differences
f is best modelled by an exponential function...	...since consecutive equally spaced input values correspond with output values that change proportionally (in the case of an exponential function that underwent a vertical translation, you will instead note that consecutive equally spaced input values correspond with output values with first differences that change proportionally)
f is best modelled by a logarithmic function...	...since consecutive equally spaced output values correspond with input values that change proportionally (in the case of a logarithmic function that underwent a horizontal translation, you will instead note that consecutive equally spaced output values correspond with input values with first differences that change proportionally)

Some Examples of Tables of Values for Different Function Types

		+8	+8	+8	+8	+8
x	-6	2	10	18	26	34
$f(x)$	20	13	9	8	10	15
First Differences of Output Values		-7	-4	-1	+2	+5
Second Differences of Output Values			+3	+3	+3	+3

		$\times \frac{1}{2}$	$\times \frac{1}{2}$	$\times \frac{1}{2}$	$\times \frac{1}{2}$	$\times \frac{1}{2}$
x	160	80	40	20	10	5
$g(x)$	-3	3	9	15	21	27
		+6	+6	+6	+6	+6

		+5	+5	+5	+5	+5
x	-10	-5	0	5	10	15
$h(x)$	-50	31	85	121	145	161
First Differences of Output Values		+81	+54	+36	+24	+16
			$\times \frac{2}{3}$	$\times \frac{2}{3}$	$\times \frac{2}{3}$	

$g(x)$ and $h(x)$ are logarithmic functions. Find the value of k and p

x	-36	18	36	k	44
$g(x)$	5	10	15	20	25

x	p	25	85	235	610
$h(x)$	-4	-2	0	2	4

Find the equation of the vertical asymptote of each of the following functions.

A) $f(x) = 2 \log_3(2x - 8) - 4$

B) $f(x) = -4 \log_2 \left(\frac{1}{2}x + 3 \right) + 1$

C) $f(x) = \frac{1}{3} \ln(5 - x) + 8$

D) $f(x) = -8 \log_6(-x) + 10$

Which one of the above functions decreases at an increasing rate?

Rewrite each as a single logarithm.

$$-\ln(6x^3) + 2\ln(3x^4)$$

$$-\log_2(10x^7) - 2\log_2(x) + 3$$