Objective: Graph Logarithmic Functions and State Key Features

Concept

One Way to Graph Logarithmic Functions

1. Write the powers of the base of the logarithm.
2. The exponents (logarithms) will be the y-values of the points of the logarithmic function. The values of the powers will be the x-values of the points of the logarithmic function. **(power, exponent)**
3. Graph these points, applying any transformations for the function.

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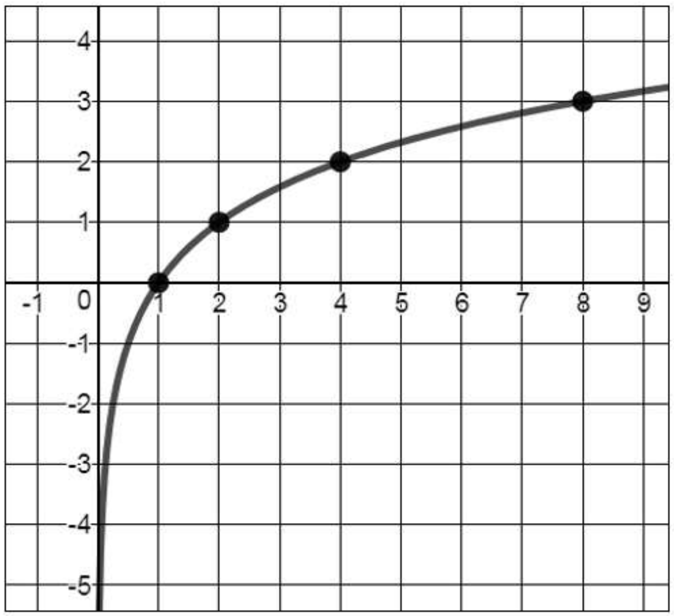
Concept

The Base 2 Logarithm Function

$$f(x) = log_2 x$$



$$y = \log_2 x \rightarrow 2^y = x$$

Powers of 2	x	y
$2^{-1} = \frac{1}{2}$	$\frac{1}{2}$	-1
$2^0 = 1$	1	0
$2^1 = 2$	2	1
$2^2 = 4$	4	2
$2^3 = 8$	8	3

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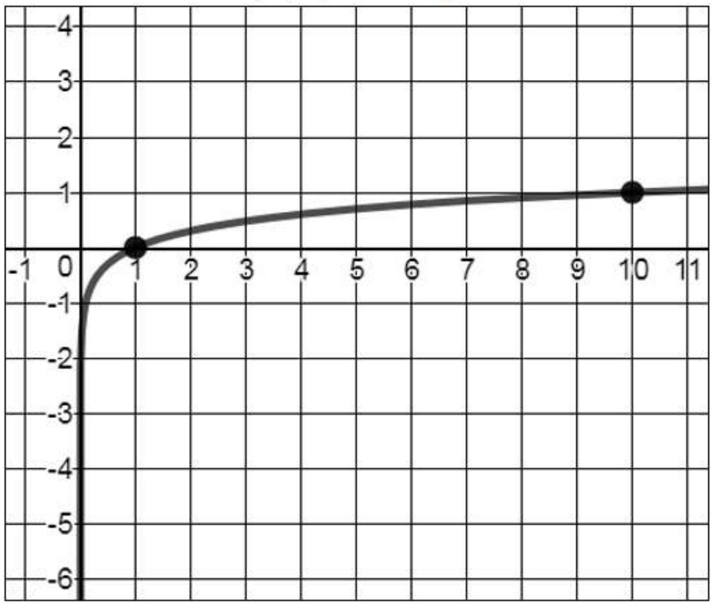
Concept

The Base 10 Logarithm Function

$$f(x) = log x$$



$$y = log\ x \rightarrow 10^y = x$$

Powers of 10	x	y
$10^{-1} = \frac{1}{10}$	$\frac{1}{10}$	-1
$10^0 = 1$	1	0
$10^1 = 10$	10	1
$10^2 = 100$	100	2

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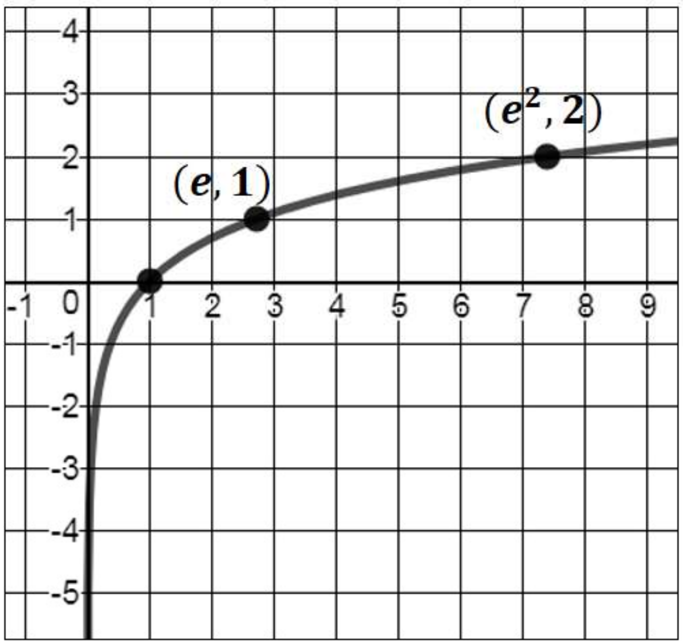
Concept

The Base *e* Logarithm Function

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



$$y = ln\, x \rightarrow e^y = x$$

Powers of *e*	x	y
$e^0 = 1$	1	0
$e^1 \approx 2.718$	≈ 2.7	1
$e^2 \approx 7.4$	≈ 7.4	2

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Concept

The logarithmic function of the form $f(x) = a\log_b(c(x-h)) + k$ has, in general, the following key features.

1. A vertical asymptote at $x = h$.

2. A domain of $x > h\ or\ x < h$.

3. A range of all real numbers, $-\infty < y < \infty$.

Objective: Graph Logarithmic Functions and State Key Features

Ex) Graph $g(x) = -3\log x + 2$. Complete the key features. Estimate when necessary.

base = 10
powers of 10
$10^{-1} = \frac{1}{10}$
$10^{0} = 1$
$10^{1} = 10$

power exp.
$(\frac{1}{10}, -1)$
$(1, 0)$
$(10, 1)$

transformations
$a = -3 \rightarrow$ x-axis refl. vert. stretch
$k = 2$ up

Domain: $\{x \mid x > 0\}$ set / $(0, \infty)$ int. Range: $\{y \mid -\infty < y < \infty\}$ / $(-\infty, \infty)$

Asymptote: $x = 0$ (y-axis)

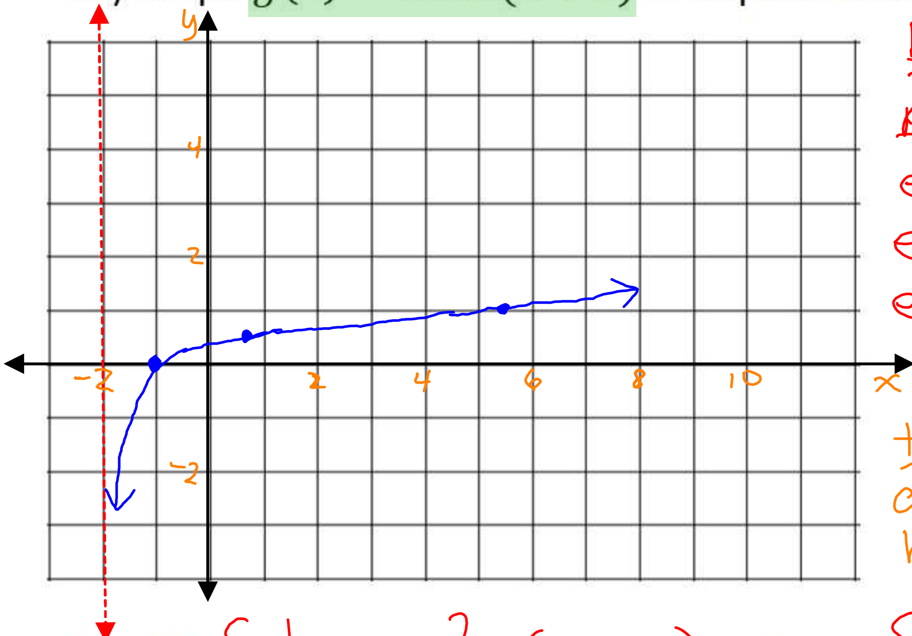
Zero: ≈ 4 y-intercept: none

End Behavior: as $x \to 0^+$, $g(x) \to \infty$ / as $x \to \infty$, $g(x) \to -\infty$

Increasing function / Decreasing function

Objective: Graph Logarithmic Functions and State Key Features

Ex) Graph $g(x) = 0.5\ln(x+2)$. Complete the key features. Estimate when necessary.



base = e

powers of e

$e^0 = 1$

$e^1 \approx 2.7$

$e^2 \approx 7.4$

power exp.

(1 , 0)

(2.7 , 1)

(7.4 , 2)

transformations

$a = 0.5 \rightarrow$ vert. comp.

$h = -2$ left 2

Domain: $\{x \mid x > -2\}$ / $(-2, \infty)$ Range: $\{y \mid -\infty < y < \infty\}$ / $(-\infty, \infty)$

Asymptote: $x = -2$

Zero: -1 y-intercept: $(0, \approx 0.4)$

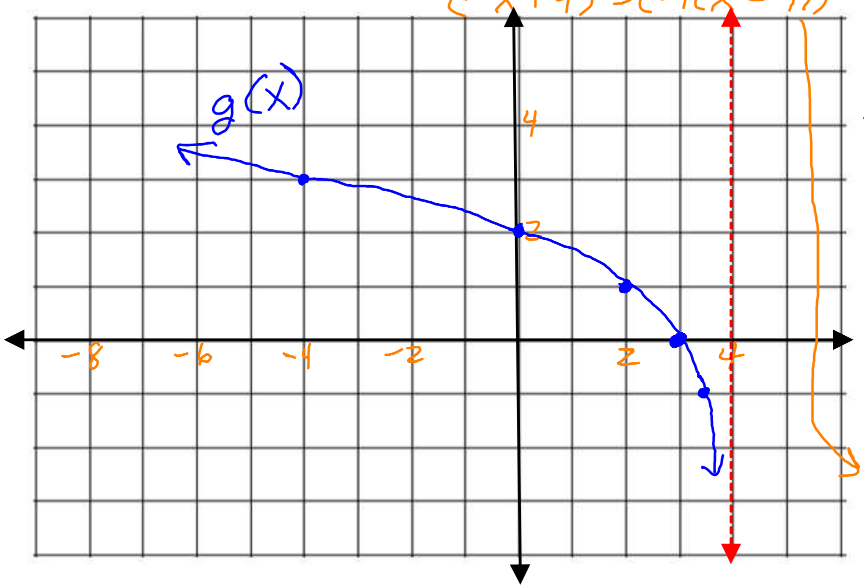
End Behavior: as $x \rightarrow -2^+$, $g(x) \rightarrow -\infty$ / as $x \rightarrow \infty$, $g(x) \rightarrow \infty$

Increasing function / Decreasing function

Objective: Graph Logarithmic Functions and State Key Features

Ex) Graph $g(x) = \log_2(4 - x)$. Complete the key features. Estimate when necessary.

$(-x+4) \rightarrow (-1(x-4))$



base = 2

powers of 2

		power	exp.
$2^{-1} = \frac{1}{2}$		$(\frac{1}{2}$,	$-1)$
$2^0 = 1$		$(1$,	$0)$
$2^1 = 2$		$(2$,	$1)$
$2^2 = 4$		$(4$,	$2)$
$2^3 = 8$		$(8$,	$3)$

transformations

$h = 4 \rightarrow$ right

$\frac{1}{b} = -1 \rightarrow$ y-axis refl.

Domain: $\{x \mid x < 4\}$ / $(-\infty, 4)$ Range: $\{y \mid -\infty < y < \infty\}$ / $(-\infty, \infty)$

Asymptote: $x = 4$

Zero: 3 y-intercept: $(0, 2)$

End Behavior: as $x \rightarrow -\infty$, $g(x) \rightarrow \infty$ / as $x \rightarrow 4^-$, $g(x) \rightarrow -\infty$

Increasing function /Decreasing function

Objective: Graph Logarithmic Functions and State Key Features

Closure

Will a logarithmic function always, sometimes, or never have a y-intercept? Explain.

A logarithmic function will sometimes have a y-intercept. There will be a y-intercept if 0 is part of the domain.

Will a logarithmic function always, sometimes, or never have a zero? Explain.

A logarithmic function will always have a zero because the range of a logarithmic function is the set of all real numbers, which includes the y value of 0.