4.4 Graphs of logarithmic functions

Goals: (1) Domain of a logarithmic function.

(2) Graph a logarithmic function using translations of a parent function. V

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Domain of a logarithmic function

$f(x) = \log_b(x)$ Domain: $(0, \infty)$

$f(x) = \log_b(x-6)$ Domain: $(6, \infty)$

$x - 6 > 0$

$x > 6$

In general, $f(x) = \log_b(\text{Stuff})$

To find the domain, we solve the inequality

$\text{Stuff} > 0$

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Ex. $f(x) = \log_6(5-2x)$

Find the domain of f?

$5 - 2x > 0$

$5 > 2x$

$\frac{5}{2} > x$

$x < \frac{5}{2}$

$(-\infty, \frac{5}{2})$.

Ex. $f(x) = \ln(x^2+5x+6)$

To find the domain: Solve $x^2+5x+6 > 0$

$(x+2)(x+3) > 0$

$x > -3$; $x > -2$

$(-2, \infty)$

$(-\infty, -3)$

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$(x+2)(x+3) > 0$

(1) $x+2 > 0$; $x+3 > 0$

$x > -2$; $x > -3$

$(-2, \infty)$

(2) $x+2 < 0$; $x+3 < 0$

$x < -2$; $x < -3$

$(-\infty, -3)$

Domain: $(-\infty, -3) \cup (-2, \infty)$

Solve: $(x+2)(x+3) > 0$.

$(-\infty, -3) \cup (-2, \infty)$

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Graph Logarithmic Functions

Parent function $f(x) = \log_b(x)$.

Characteristics of the graph of $f(x) = \log_b(x)$

E.g. $f(x) = \log_2(x)$

x	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{2}$	1	2	4	8
$f(x)$	-3	-2	-1	0	1	2	3

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$\log_b(x)$; $b > 1$

$\log_b(x)$ $0 < b < 1$

$x = 0$: V.A.

$f(x) = \log_2(x)$

$(1, 0)$

$f(x) = \log_b(x)$; $b \neq 0$; $b > 0$; $b \neq 1$

Characteristics of graph:

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1. Vertical Asymptote: $x = 0$
2. Domain: $(0, \infty)$
3. Range: $(-\infty, \infty)$
4. x-intercept: $(1, 0)$
5. One key point: $(b, 1)$
6. No y-int
7. $b > 1$: $f(x) = \log_b(x)$ is increasing.
8. $0 < b < 1$: $f(x) = \log_b(x)$ is decreasing.

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1. Graph a Horizontal shift of $f(x) = \log_b(x)$

Rule for horizontal shift

E.g. Sketch the horizontal shift $f(x) = \log_3(x-2)$ alongside its parent function. Include the key points $(\frac{1}{3}, -1)$; $(1,0)$; $(3,1)$ of the parent function.

Find the V.A., domain & range.

Parent Function $\log_3(x)$

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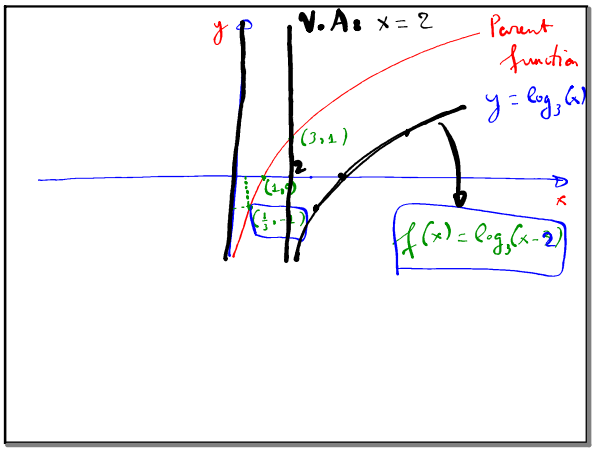

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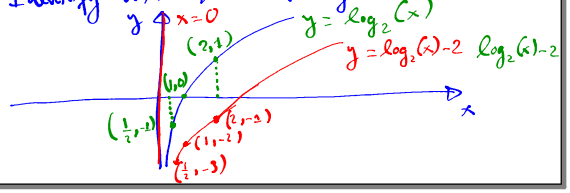
Vertical shift of the parent function $f(x) = \log_b x$.

E.g. Sketch a graph of $f(x) = \log_2(x) - 2$ alongside its parent function $y = \log_2(x)$.

Include 3 key points $(\frac{1}{2}, -1)$; $(1,0)$; $(2,1)$

Identify V.A. Domain & range.



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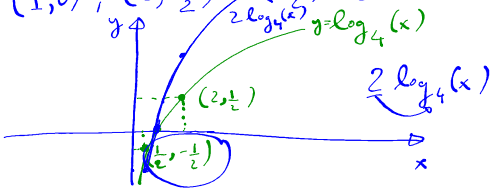
Stretches & Compression.

Sketch a graph of $f(x) = 2\log_4(x)$ alongside its parent function $y = \log_4(x)$.

$(1,0)$; $(2, \frac{1}{2})$; $(\frac{1}{2}, -\frac{1}{2})$



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Find the equation of a logarithmic function from its graph.

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