

3.3 Logarithmic Functions.

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MATH 2311
Pre-Calculus I
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$$f(x) = \log_b(x)$$

base argument

base: positive real number, $b \neq 1$

$$D: (0, \infty)$$

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

$$V.A: x=0$$

Evaluate:

$$\log_2(4) = 2$$

$$\log_3(1/27) = -3$$

Converting from logarithmic to exponential equation.

$$\log_4(x) = -2$$

$$4^{-2} = x$$

$$\log_{1/3}(9) = x$$

$$\left(\frac{1}{3}\right)^x = 9$$

Exponential \rightarrow logarithmic.

$$7^x = 5$$

$$\log_7(5) = x$$

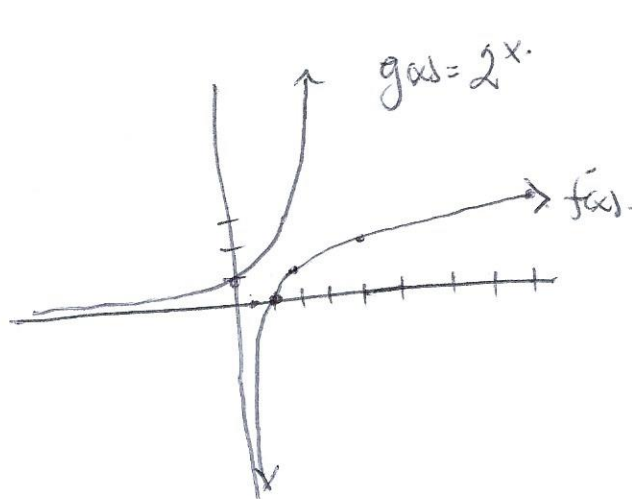
$$2^{-3} = x$$

$$\log_2(x) = -3$$

Graphing

Note: $\log_2 1 = 0$

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



x	y
1	0
2	1
4	2
8	3

$$\log_2 \left(\frac{1}{2}\right) = -1$$

$$f(x) = -\log_3(x+1) + 2.$$

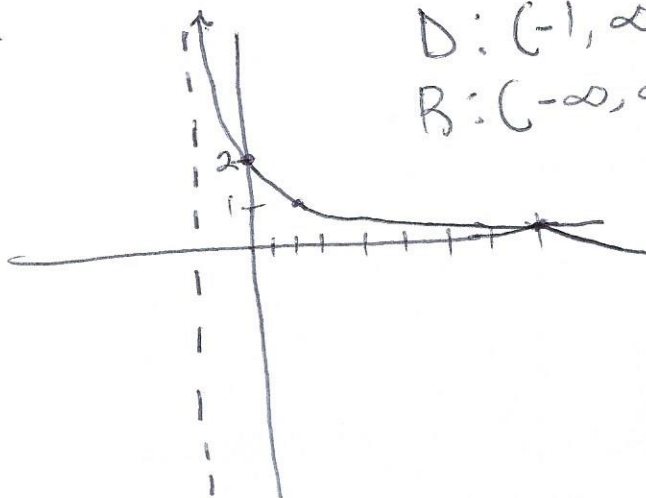
reflect over the x-axis
 left 1.
 up 2.

x	y
0	$-\log_3(1) + 2 = -0 + 2 = 2.$
2	$-\log_3(3) + 2 = -1 + 2 = 1.$
8	$-\log_3(9) + 2 = -2 + 2 = 0.$

$$V.A \Rightarrow x = -1.$$

$$D: (-1, \infty)$$

$$R: (-\infty, \infty).$$



$$f(x) = \log_4(x-2) + 3.$$

$$D: (2, \infty)$$

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

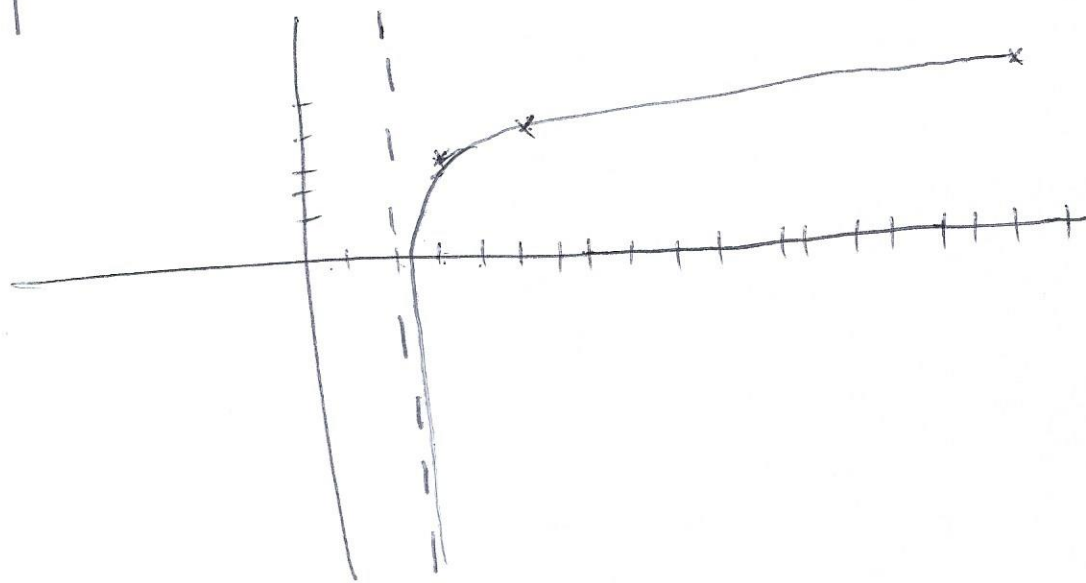
$$V.A: x=2.$$

Finding Domain:

$$x-2 > 0$$

$$x > 2.$$

x	y
3	$\log_4(3-2)+3 = 0+3=3.$
6	$\log_4(4)+3 = 1+3=4$
18	$\log_4(16)+3 = 2+3=5.$
$2\frac{1}{4}$	$\log_4(\frac{1}{4})+3 = -1+3=2.$



Special logarithms:

$$* \log_{10}(x) = \log(x).$$

$$* \log_e(x) = \ln(x) = \ln(x).$$

Example of graphing: $\frac{1}{2}$

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

x	y
4	1
5	2
7	3
11	4
$3\frac{1}{2}$	0

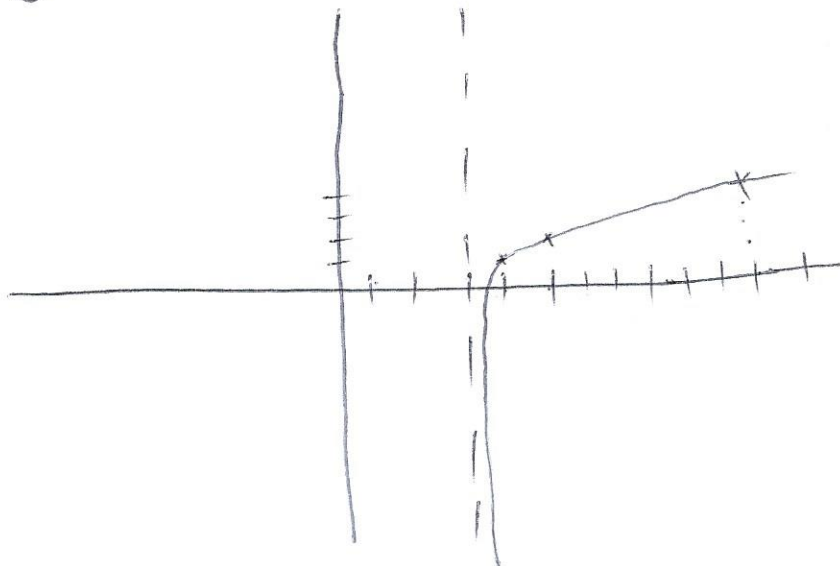
$$2^{-1} = \frac{1}{2}$$

$$2^0 = 1$$

$$2^1 = 2$$

$$2^2 = 4$$

$$2^3 = 8$$



$$\log_4(x-1) + 3.$$

$$\log_4(x) + 3$$

~~$x + 3$~~

x	y
2	3
5	4
17	5

$$\log_4(1) + 3.$$

$0 + 3 = 3.$

$$\log_4(4) + 3$$

$1 + 3 = 4.$

$$\log_4(16) + 3$$

$2 + 3 = 5.$

$$4^{-1} = \frac{1}{4}$$
$$4^0 = 1$$
$$4^1 = 4$$
$$4^2 = 16$$
$$4^{-2} = \frac{1}{16}.$$

VA: $x = 1.$

D: $(1, \infty).$

R: $(-\infty, \infty).$