

Algebra IIB Math
Lesson: April 8, 2020

Learning Target:
Students will graph logarithmic functions


Let's Get Started:
Watch Video: [Graphing a Logarithm - Made Easy](https://www.youtube.com/watch?v=q9DhIR43P7A)

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That was easy?!?!!!!!

Key Points:

- Logarithmic functions are INVERSES of Exponential functions
- The ASYMPTOTE of a logarithmic function is VERTICAL
- If the base (b)>1 then the graph will be INCREASING (GROWTH)
- If the base $0 < (b) < 1$ then the graph will be DECREASING (DECAY)

$$y = \log_b x$$


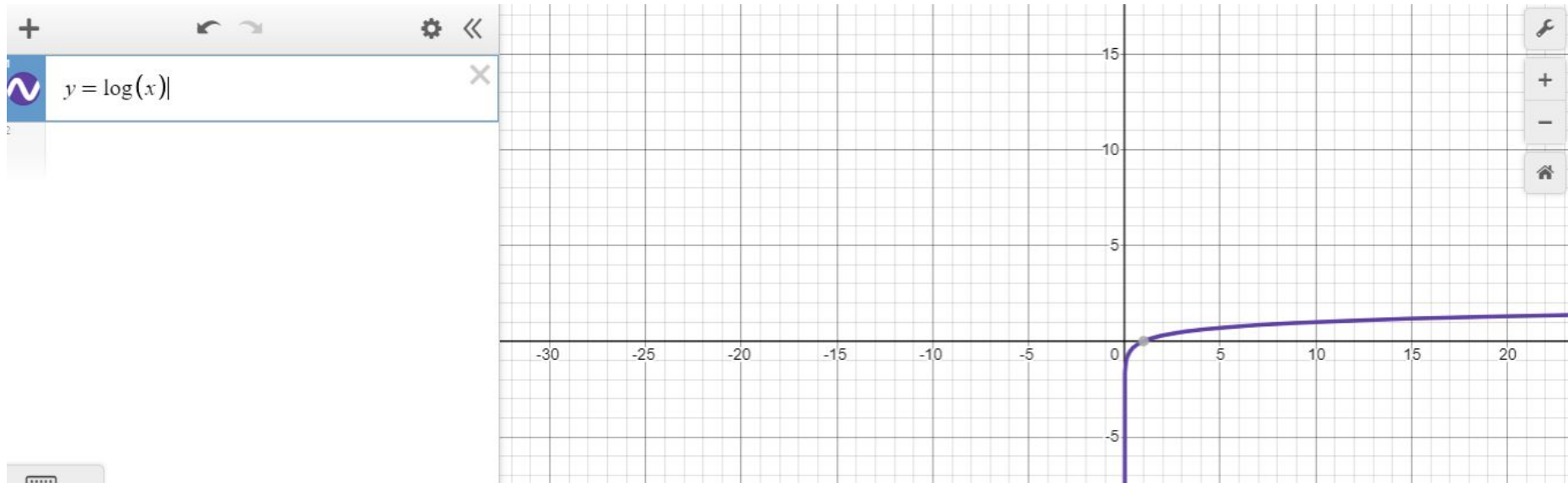
Other standard notation:

If no base is given ($y = \log 30$) then the base is assumed to be 10.

$\log_e(x)$ is the same as $\ln(x)$. \ln is used for natural logs which are logs with base e . Remember that e is an irrational number approximately equal to 2.718281828459.

Let's make it easier by using a graphing calculator.
Go to www.desmos.com and click Start Graphing.

Type in the parent function $y=\log(x)$



Notice:

The vertical asymptote is at $x=0$

The x-intercept is at (1,0)

Changing the base in Desmos

The image shows the Desmos interface. At the top left, the equation editor contains $y = \log_4(x)$. Below it is a calculator keypad with various mathematical symbols and numbers. To the right of the keypad is a functions menu with tabs for Trig, Stats, Dist, and Misc. The Misc tab is selected, showing buttons for lcm, gcd, mod, ceil, floor, round, sign, %, exp, ln, $\sqrt[n]{\quad}$, polygon, log, \log_a , $\frac{d}{dx}$, \int , Σ , and Π . A blue arrow points from the 'functions' button on the keypad to the 'Misc' tab, and another blue arrow points from the 'Misc' tab to the \log_a button. A third blue arrow points from the \log_a button to the equation editor. The background shows a coordinate plane with a grid and a purple logarithmic curve.

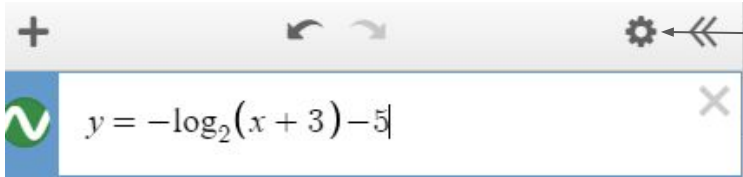
Hit the Keyboard icon, select the “functions” button,

click on the “Misc” button and select “log_a”

How did changing the base to 4 change the graph? How is it the same as the parent function?

Making Tables in Desmos

Graph $y = -\log_2(x + 3) - 5$



Click on the gear icon



Click on the table icon

x	$-\log_2(x + 3)$
-2	-5
-1	-6
0	-6.5849625
1	-7
2	-7.3219281
-3	undefined

You can add numbers to the bottom of the x column.

- List 3 points that can be easily graphed.
- Can you tell from the table where the vertical asymptote is going to be?
- Is that number anywhere in the equation?

You should have noticed that the vertical asymptote is the number inside the parentheses with the x but has the opposite sign. If you add that number to the bottom of your table, the y -value is “undefined”.

Graph each logarithm and identify

- 3 points that you can easily graph**
- The vertical asymptote**
- The approximate x-intercept**
- The approximate y-intercept (if there is one)**

SUPER IMPORTANT HINT!

To type in a fractional base like on the first problem

- Type in: $y=3\log(1/3)(x)+2$
- Highlight $(1/3)$
- Press shift underscore

1) $3 \log_{\left(\frac{1}{3}\right)}(x) + 2$

2) $-\log_3\left(-\frac{1}{3}x\right)$

3) $-2 \log_{\left(\frac{1}{2}\right)}(x - 3) - 3$

4) $-\log_3(3x - 6)$

5) $2 \log_2(-x) + 5$

6) $\log_4(-4x - 8) - 4$

7) $\log_4(-4(x + 2)) - 4$

8) $\ln(x + 2)$

9) $-2 \ln(x) + 4$

Answer to number 1

$$3 \log_{\left(\frac{1}{3}\right)}(x) + 2$$

0	undefined
1	2
2	0.10721074
3	-1
4	-1.7855785
5	-2.3949206
6	-2.8927893
7	-3.3137312
8	-3.6783678
9	-4

a. (1,2) (3,-1) (9,-4)

b. $x=0$

c. (2.08, 0) **hover over intercept**

d. none