Precalculus 5.2 Key Points

Logarithms:
Logarithms (often shortened to "logs") are similar to exponents.
If $log_a(b) = c$, then $a^c = b$
For the logarithm above: a is the <u>base</u>, b is the <u>argument</u>, c is the <u>result</u>
For example, if $2^3 = 8$, then $If\ log_2(8) = 3$. This is saying that, to raise 2 to the power of some number to get 8, it needs to be raised to the power of 3.
If a logarithm is written without a base, such as $log(5)$, then it can be assumed that the base is 10. So, $log(5) = log_{10}(5)$
If a logarithm has a base of e, then it can be written as ln, which is called the "natural log." So, $ln(8) = log_e(8)$

Logarithm Properties:

<u>Property</u>	<u>Example</u>
Inverse Property $log_b(b) = 1$	$log_2(2) = 1$
Addition/Product Property $log_b(xy) = log_b(x) + log_b(y)$	$log_4(11 \bullet y) = log_4(11) + log_4(y)$
Subtraction/Quotient Property $log_b(\frac{x}{y}) = log_b(x) - log_b(y)$	$log_4(\frac{x}{14}) = log_4(x) - log_4(14)$
Power Property $log_b(x^n) = n \bullet log_b(x)$	$log_5(x^8) = 8 \bullet log_5(x)$
Change of Base Formula $log_b(a) = \frac{log_c(a)}{log_c(b)}$	$log_{17}(23) = \frac{log_{10}(23)}{log_{10}(17)}$ (This is especially useful if your calculator only has base-10 logs)

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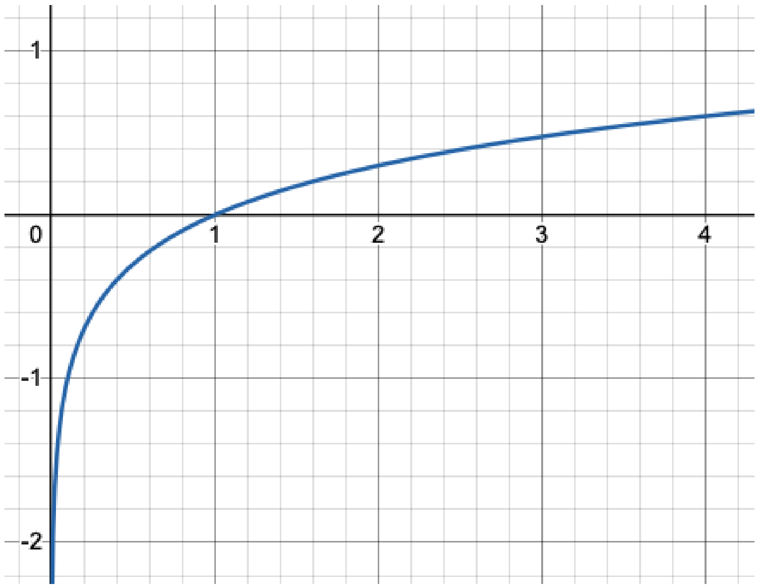
Graphing Logarithms:
Here is the parent graph for a logarithm, $log(x)$. Notice the vertical asymptote at $x = 0$



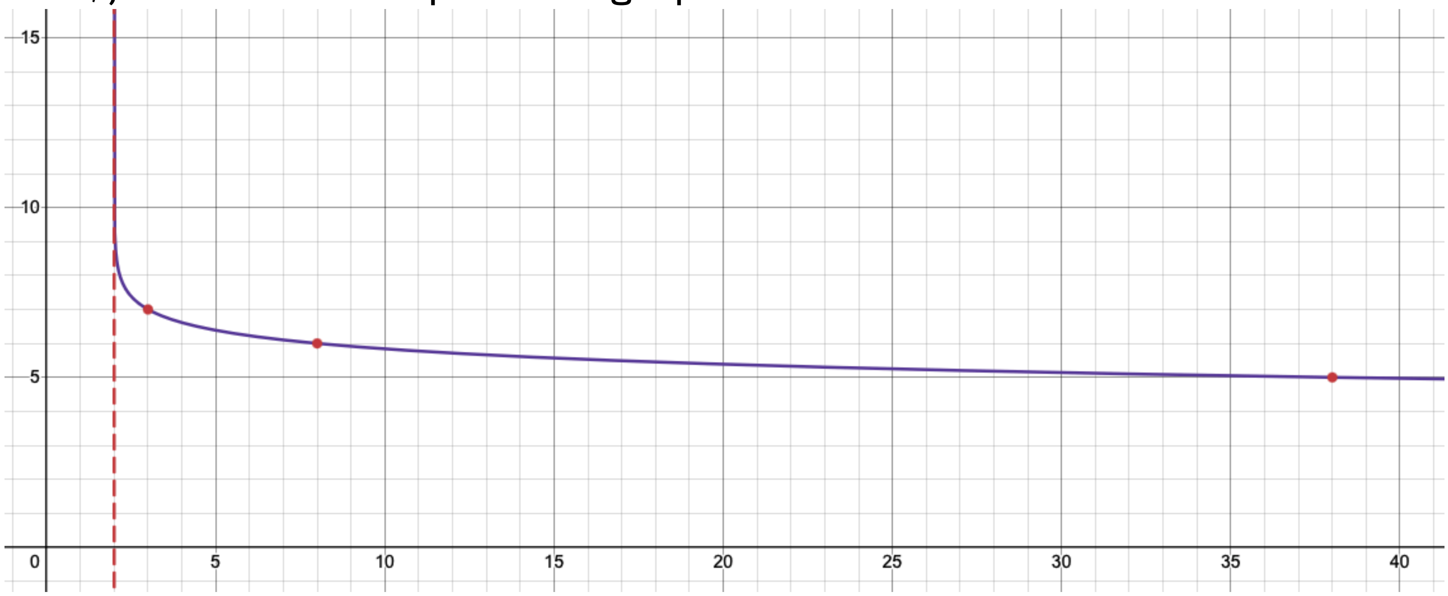
To graph logarithms, begin by identifying the vertical asymptote. This will be the value that causes the input into the logarithm to equal 0. For example, $y = log(3x - 2)$ will have a vertical asymptote when $3x - 2 = 0$, or when $x = \frac{2}{3}$

Afterwards, use transformations or plug in a few points to graph. There are multiple ways to graph logarithms.

Example:
$y = -log_6(x - 2) + 7$

The vertical asymptote will be when $x - 2 = 0$, which is when $x = 2$
Next, plug in a few values into the equation. Some easy values are those that cause the logarithmic input to equal 1, the base of the logarithm, and the square of the logarithm.
When $x = 3$ and the logarithmic input equals 1, then $log_6(1) = 0$, so $y = 7$
When $x = 8$ and the logarithmic input equals 6, then $log_6(6) = 1$, so $y = 6$
When $x = 38$ and the logarithmic input equals 36, then $log_6(36) = 2$, so $y = 5$

Now, just connect the points to graph the function



Another approach to graphing this logarithm would be to graph $y = log_6(x)$, and then use transformations to shift the graph into

$y =- log_6(x - 2) + 7$

In this case, this would mean shifting $log_6(x)$ right two units and up seven units and flipping the graph because of the negative out front