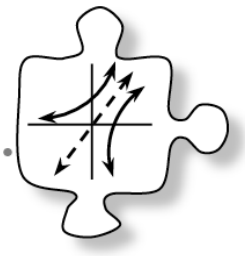
5.4 How can I transform log functions?



Transformations of Logarithmic Functions

In Lesson 5.3, you investigated logarithmic functions with different bases. To do this, you had to convert a log equation into its corresponding exponential form. In this lesson, you will figure out what a calculator can and cannot do with logs. This will help you write a general equation for a log function. As you work with your team, use the following questions to help focus your discussions.

What is a log?

How are logarithms and exponential equations related to each other?

How can we find an equivalent exponential equation for an equation that is in log form?

How can we transform the graphs of log functions?

- **5-93.** SOLVE THE LOG MYSTERY!
- Have you noticed the LOG key on your calculator? Clearly it is a logarithm, but what is its base? It would have been nice if the designers of your graphing calculator had allowed the LOG key to work with any base, but they did not!

  Your Task: Find the base of the LOG key on your calculator. With your team, start by gathering some data and making a table for $y = \log x$. Analyze your data, and when you are sure you have figured out the base, write a clear summary statement justifying your conclusion. Explore using the $y = \log(x)$ eTool (Desmos).

Discussion Points

What input values give whole number outputs?

What do those values tell us?

How can we rewrite $y = \log_? x$?

- **5-94.** Now that you know the base of $f(x) = \log x$, you are ready to use your transformation skills to write a general equation. Explore using 5-94 Student eTool (Desmos).

  a. Copy and complete the following table for $f(x) = \log x$.

x								1	2	3	4	5	6
y	–6	–5	–4	–3	–2	–1	0						

  b. Using a full sheet of graph paper, make an accurate graph of $f(x) = \log(x)$. Remember that, just like the graphs of exponential functions, the graphs of log functions have asymptotes, so make sure any asymptotes on your graph are clearly shown.

  c. Find all of the possible types of transformations of the graph of $f(x) = \log x$. For each transformation you find, show the graph and its equation. Then, find the general form for this family of logarithm graphs. Be prepared to explain your reasoning to the class.

- **5-95.** You have learned a lot about logs in a short time. Use what you have learned so far to answer the questions below.

  a. Why does your calculator say that $\log(6) \approx 0.778$?

  b. Justify why log(6) must have a value less than 1 but greater than 0.