5.2.4 How can I transform log functions?

Transformations of Logarithmic Functions

In Lesson 5.2.3, 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.

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.

c. Create a Learning Log entry that includes your answers to the focus questions from today's lesson, reprinted below. Show examples and use color or arrows to help explain your ideas. Title this entry "Working with Logs" and label it with today's date.

What is a log?

How are logarithms and exponential equations related to each other?

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

How can you transform the graphs of log functions?

Review & Preview

5-96. Last night, while on patrol, Agent 008 came upon a spaceship! He hid behind a tree and watched a group of little space creatures carry all sorts of equipment out of the ship. But suddenly, he sneezed. The creatures jumped back into their ship and sped off into the night. 008 noticed that they had dropped something, so he went to pick it up. It was a calculator! What a great find. He noticed that it had a LOG button, but he noticed something interesting: log 10 did not equal 1! With this calculator, log10 ≈ 0.926628408. He tried some more: log 100 ≈ 1.853256816 and log 1000 ≈ 2.779885224. Help (Html5)⇔Help (Java)

a. What base do the space creatures work in? Explain how you can tell.

b. How many fingers do you think the space creatures have?

5-97. Copy these equations and solve for x. You should be able to do all these problems without a calculator. Help (Html5)⇔Help (Java)

a. $\log_x(25) = 1$

b. $x = \log_3(9)$

c. $3 = \log_7(x)$

d. $\log_3(x) = \frac{1}{2}$

e. $3 = \log_x(27)$

f. $\log_{10}(10000) = x$

5-98. Is log(0.3) greater than or less than one? **Justify** your anwer. Help (Html5)⇔Help (Java)

5-99. Solve $1.04^x = 2$. Your answer should be accurate to three decimal places. Help (Html5)⇔Help (Java)

5-100. This problem is a checkpoint for factoring quadratics. It will be referred to as Checkpoint 5B.

Factor each expression below.

a. $4x^2 - 1$

b. $4x^2 + 4x + 1$

c. $2y^2 + 5y + 2$

d. $3m^2 - 5m - 2$

Check your answers by referring to the Checkpoint 5B materials.

If you needed help solving these problems correctly, then you need more practice. Review the Checkpoint 5B materials and try the practice problems. Also, consider getting help outside of class time. From this point on, you will be expected to do problems like these quickly and easily.

5-101. Solve the following inequalities. Help (Html5)⇔Help (Java)

a. $x^2 - 2x < 3$

b. $3x - x^2 \leq 2$

5-102. Is it true that $\log_3(2) = \log_2(3)$? Justify your answer. Help (Html5)⇔Help (Java)

5-103. Consider the general form of an exponential function: $y = ab^x$. Help (Html5)⇔Help (Java)

a. Solve for a.

b. Solve for b.

5-104. Make a sketch of a graph that is a decreasing exponential function with the x-axis as the horizontal asymptote. Then make a similar sketch, but this time with the line $y = 5$ as the horizontal asymptote.