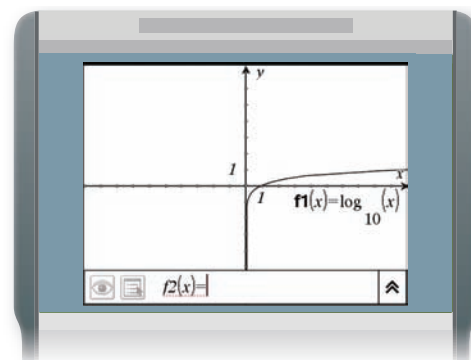


Graphing Technology Lab

Solving Logarithmic Equations and Inequalities

You have solved logarithmic equations algebraically. You can also solve logarithmic equations by graphing or by using a table. TI-Nspire Technology has $y = \log_{10} x$ as a built-in function. Enter **ctrl** **log** press the right arrow on the wheel **X** **→** to view this graph. To graph logarithmic functions with bases other than 10, you must use the Change of Base Formula, $\log_a n = \frac{\log_b n}{\log_b a}$.



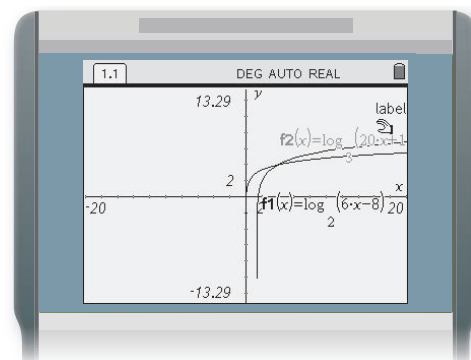
ACTIVITY 1

Solve $\log_2(6x - 8) = \log_3(20x + 1)$.

Step 1 Graph each side of the equation.

Graph each side of the equation as a separate function. Enter $\log_2(6x - 8)$ as $f1(x)$ and $\log_3(20x + 1)$ as $f2(x)$. Then graph the two equations.

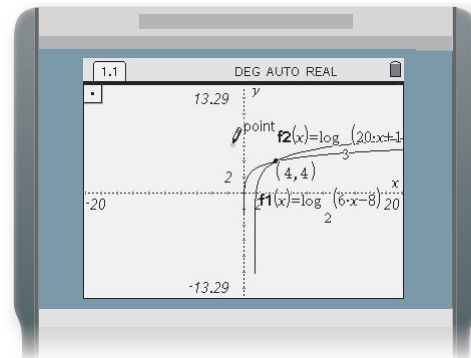
KEYSTROKES: **ctrl** **log** **2** press the right arrow on the wheel
6 **X** **-** **8** **→**
ctrl **log** **3** press the right arrow on the wheel
2 **0** **X** **+** **1** **ENTER**



Step 2 Use the Point feature.

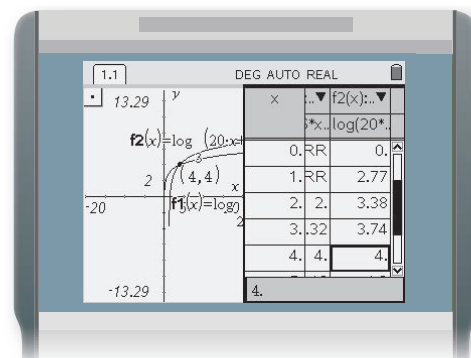
Use the **Point** feature on the **Points & Lines** menu to approximate the ordered pair of the point at which the curves intersect.

The calculator screen shows that the x -coordinate of the point at which the curves intersect is 4. Therefore, the solution of the equation is 4.



Step 3 Use the Add Function Table feature in the view menu.

Examine the table to find the x -value for which the y -values for the graphs are equal. At $x = 4$, both functions have a y -value of 4. Thus, the solution of the equation is 4.



You can use a similar procedure to solve logarithmic inequalities using a graphing calculator.

ACTIVITY 2

Solve $\log_4(10x + 1) < \log_5(16 + 6x)$.

Step 1 Enter the inequalities.

Rewrite the problem as a system of inequalities.

The first inequality is $\log_4(10x + 1) < y$ or $y > \log_4(10x + 1)$. Since this inequality includes the *greater than* symbol, shade above the curve.

The second inequality is $y < \log_5(16 + 6x)$. Shade below the curve since this inequality contains *less than*.

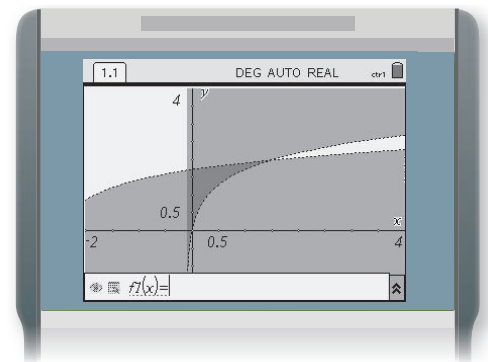
KEYSTROKES: 6: New Document 2: Add Graphs & Geometry CLEAR > ctrl log 4 right arrow on wheel 10 x + 1 CLEAR < ctrl log 5 press the right arrow on the wheel 1 6 + 6 x ENTER

Step 2 Find the solution.

The left boundary of the solution set is where the first inequality is undefined. It is undefined for $10x + 1 \leq 0$.

$$\begin{aligned} 10x + 1 &\leq 0 \\ 10x &\leq -1 \\ x &\leq -\frac{1}{10} \end{aligned}$$

Use the calculator's **intersect points** feature to find the right boundary. You can conclude that the solution set is $\{x \mid -0.1 < x < 1.5\}$.

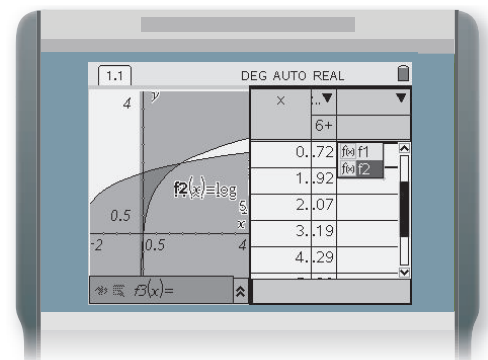


$[-2, 4] [-0.5, 4]$

Step 3 Use the **TABLE** feature to check your solution.

Enter the related functions. From the **view** menu, choose **Add Function Table**. Use the arrow pad to scroll through the table.

The table confirms the solution of the inequality is $\{x \mid -0.1 < x < 1.5\}$.



Exercises

Solve each equation or inequality. Check your solution.

- $\log_2(3x + 2) = \log_3(12x + 3)$
- $\log_6(7x + 1) = \log_4(4x - 4)$
- $\log_2 3x = \log_3(2x + 2)$
- $\log_{10}(1 - x) = \log_5(2x + 5)$
- $\log_4(9x + 1) > \log_3(18x - 1)$
- $\log_3(3x - 5) \geq \log_3(x + 7)$
- $\log_5(2x + 1) < \log_4(3x - 2)$
- $\log_2 2x \leq \log_4(x + 3)$