

Graphing Calculator Lab

Solving Exponential Equations and Inequalities

You can use a TI-73 Explorer graphing calculator to solve exponential equations by graphing or by using the table feature. To do this, you will write the equations as systems of equations.

ACTIVITY 1

Solve $2^{3x-9} = \left(\frac{1}{2}\right)^{x-3}$.

Step 1 Graph each side of the equation.

Graph each side of the equation as a separate function. Enter $2^{(3x-9)}$ as Y1. Enter $\left(\frac{1}{2}\right)^{(x-3)}$ as Y2. Be sure to include the added parentheses around each exponent. Then graph the two equations.

KEYSTROKES: See Graphing Calculator Lab Lines of Regression.

Step 2 Use the TABLE feature.

You can also use the TABLE feature to locate the point at which the curves cross.

KEYSTROKES: $\boxed{2\text{nd}} \boxed{[TABLE]}$

The table displays x-values and corresponding y-values for each graph. Examine the table to find the x-value for which the y-values for the graphs are equal. At $x = 3$, both functions have a y-value of 1. Thus, the solution of the equation is 3.

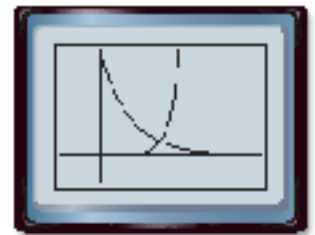
CHECK Substitute 3 for x in the original equation.

$$2^{3x-9} = \left(\frac{1}{2}\right)^{x-3} \quad \text{Original equation}$$

$$2^{3(3)-9} = \left(\frac{1}{2}\right)^{3-3} \quad \text{Substitute 3 for x}$$

$$2^0 = \left(\frac{1}{2}\right)^0 \quad \text{Simplify.}$$

$$1 = 1 \quad \text{The solution checks.}$$



$[-2, 8]$ scl: 1 by $[-2, 8]$ scl: 1

X	Y1	Y2
0	1/8	1/8
1	1/4	1/4
2	1/2	1/2
3	1	1
4	2	1/2
5	4	1/4
6	8	1/8


X=3

A similar procedure can be used to solve exponential inequalities using a graphing calculator.

ACTIVITY 2 Solve $2^{x-2} \geq 0.5^{x-3}$.

Step 1 Enter the related inequalities.

Rewrite the problem as a system of inequalities.

The first inequality is $2^{x-2} \geq y$ or $y \leq 2^{x-2}$. Since this last inequality includes the less than or equal to symbol, shade below the curve. First enter the boundary and then use the arrow and **ENTER** keys to choose the shade below icon, 

The second inequality is $y \geq 0.5^{x-3}$. Shade above the curve since this inequality contains greater than or equal to.

KEYSTROKES:  2  ( = 2     **ENTER** **ENTER**
  **ENTER** **ENTER**   .5  ( = 3 

Step 2 Graph the system.

KEYSTROKES: **GRAPH**

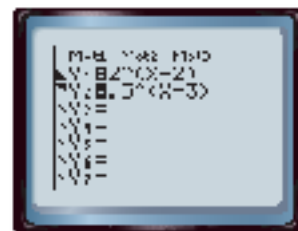
The x-values of the points in the region where the shadings overlap are the solutions of the original inequality.

Step 3 Use the TABLE feature.

Verify using the TABLE feature. Set up the table to show x-values in increments of 0.5.

KEYSTROKES: **2nd** [TBLSET] **C** **ENTER** .5 **ENTER** **2nd** [TABLE]

Notice that for x-values greater than $x = 2.5$, $Y_1 > Y_2$. This confirms the solution of the inequality is $\{x | x \geq 2.5\}$.



$[-2, 8]$ scl: 1 by $[-2, 8]$ scl: 1



EXERCISES

Solve each equation or inequality.

- $9^{x-1} = \frac{1}{81}$
- $4^{x+3} = 2^{5x}$
- $5^{x-1} = 2^x$
- $3.5^{x+2} = 1.75^{x+3}$
- $-3^{x+4} = -0.5^{2x+3}$
- $6^{2-x} - 4 > -0.25^{x-2.5}$
- $16^{x-1} > 2^{2x+2}$
- $3^x - 4 \leq 5^{\frac{x}{2}}$
- $5^{x+3} \leq 2^{x+4}$
- $12^x - 5 > 6^{1-x}$
- Explain why this technique of graphing a system of equations or inequalities works to solve exponential equations and inequalities.