

# Solving Exponential Equations and Inequalities

You can use a Casio FX-9750G 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 your textbook to review graphing equations.

**Step 2** Use the intersect feature.

You can use the intersect feature on the G-Solv menu to approximate the ordered pair of the point at which the curves cross.

**KEYSTROKES:** See your textbook to review how to use the intersect feature.

The calculator screen shows that the  $x$ -coordinate of the point at which the curves cross is 3. Therefore, the solution of the equation is 3.

**Step 3** Use the TABLE feature.

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

**KEYSTROKES:** **MENU** 7 **F6**

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.

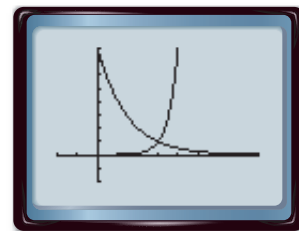
**CHECK** Substitute 3 for  $x$  in the original equation.

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

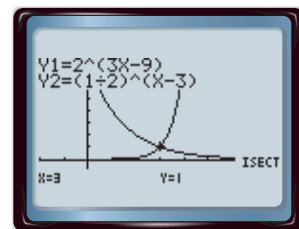
$$2^{3(3)-9} \stackrel{?}{=} \left(\frac{1}{2}\right)^{3-3} \quad \text{Substitute 3 for } x.$$

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

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



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



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

X	Y1	Y2
1	0.0156	4
2	0.125	2
3	1	1
4	8	0.5

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  $y \leq 2^{x-2}$ .

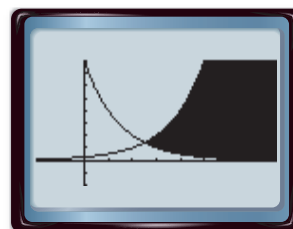
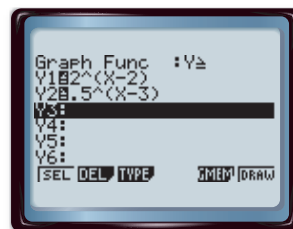
The second inequality is  $y \geq 0.5^{x-3}$ .

KEYSTROKES:  $\boxed{\text{F3}}$   $\boxed{\text{F6}}$   $\boxed{\text{F4}}$   $2$   $\boxed{\wedge}$   $\boxed{(\text{X},\theta,\text{T})}$   $\boxed{-}$   $2$   $\boxed{)}$   $\boxed{\text{EXE}}$   
 $\boxed{\text{F3}}$   $\boxed{\text{F6}}$   $\boxed{\text{F3}}$   $5$   $\boxed{\wedge}$   $\boxed{(\text{X},\theta,\text{T})}$   $\boxed{-}$   $3$   $\boxed{)}$   $\boxed{\text{EXE}}$

**Step 2** Graph the system.

KEYSTROKES:  $\boxed{\text{F6}}$

The  $x$ -values of the points in the region where the shadings overlap are the solutions of the original inequality. Using the calculator's **intersect** feature, you can conclude that the solution set is  $\{x \mid x \geq 2.5\}$ .



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**EXERCISES**

Solve each equation or inequality.

1.  $9^{x-1} = \frac{1}{81}$
2.  $4^{x+3} = 2^{5x}$
3.  $5^{x-1} = 2^x$
4.  $3.5^{x+2} = 1.75^{x+3}$
5.  $-3^{x+4} = -0.5^{2x+3}$
6.  $6^{2-x} - 4 > -0.25^{x-2.5}$
7.  $16^{x-1} > 2^{2x+2}$
8.  $3^x - 4 \leq 5^{\frac{x}{2}}$
9.  $5^{x+3} \leq 2^{x+4}$
10.  $12^x - 5 > 6^{1-x}$
11. Explain why this technique of graphing a system of equations or inequalities works to solve exponential equations and inequalities.