

# TI-83 Plus Calculator: Graphing Functions and Inverse Functions

3.5

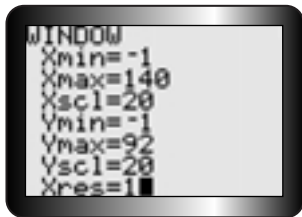


In section 3.4, you examined a rule for converting a temperature in degrees Celsius into degrees Fahrenheit. The rule is, “double the temperature in degrees Celsius, and then add 30.” The following table shows some approximate temperatures.

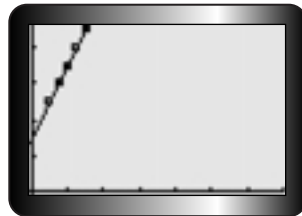
| Temperature (°C) | Temperature (°F) |
|------------------|------------------|
| 10               | 50               |
| 15               | 60               |
| 20               | 70               |
| 25               | 80               |
| 30               | 90               |

## Method 1: Using Lists, Stat Plots, and the Equation Editor

1. (a) Graph the data in the table as a scatter plot.  
On the TI-83 Plus calculator, enter the data into lists and create a scatter plot, **Plot1**. Use the window settings shown in the screen.
- (b) The function includes all possible temperatures, so the graph should be a line. The rule is, “multiply  $x$  by 2, and then add 30 to get  $y$ ,” so the equation for the function is  $y = 2x + 30$ . Enter the function into **Y1** and graph. The line should pass through all of the points in the scatter plot.
- (c) Plot the inverse by switching the lists. Create a second scatter plot. Turn on **Plot2** and use the settings shown in the screen. Display the graph by pressing **[GRAPH]**.



step 1a



step 1b



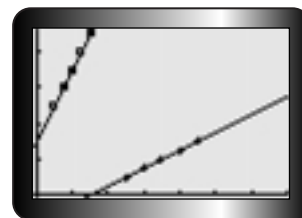
step 1c

- (d) Find the inverse function by interchanging  $x$  and  $y$  and solving for  $y$ .

$$\begin{aligned}x &= 2y + 30 \\x - 30 &= 2y \\ \frac{x - 30}{2} &= y\end{aligned}$$

Enter this function in Y2 and graph. The line should pass through all of the new points plotted.

- (e) Enter  $y = x$  into Y3 and graph. Describe the relationship between the three lines.



step 1d

## Method 2: Using Parametric Equations

Sometimes it is difficult to determine the defining equation of the inverse. Sometimes graphing in function mode will not directly produce the graph of the inverse function. **Parametric equations** allow you to graph any function and its inverse.

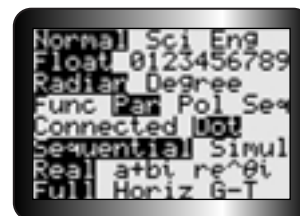
For example, graph the function  $y = 2x + 30$  for  $x \in \{10, 15, 20, 25, 30\}$ .

For a parametric equation, both  $x$  and  $y$  must be expressed in terms of a parameter,  $T$ .

Replace  $x$  with  $T$ . Then  $x = T$  and  $y = 2T + 30$ .

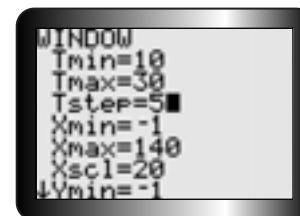
Next, set restrictions on  $T$  so that it will take the values 10, 15, 20, 25, and 30.

1. (a) First clear the calculator. Press **[MODE]**. Change the settings so that your screen matches the one shown.



step 1a

- (b) Press **[WINDOW]**. Enter the values shown for Tmin, Tmax, Tstep, and Xmax. The remaining window settings are the same as in method 1.

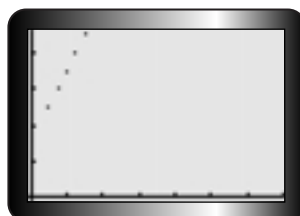


step 1b

- (c) Press **[Y=]**. Enter  $T$  into  $X_{1T}$  by pressing **[X,T,θ,n]**. Enter **[2]** **[X,T,θ,n]** **[+]** **[3]** **[0]** into  $Y_{1T}$ . Press **[GRAPH]**.



step 1c (a)

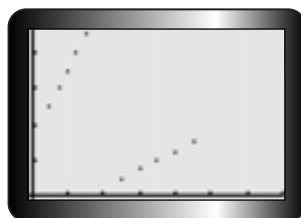


step 1c (b)

- (d) What is the domain of the graphed function? What is its range?
- (e) Use **TRACE** to verify that the points are correct.
- (f) To graph the inverse relation, reverse the expressions in  $X_{1T}$  and  $Y_{1T}$ . Enter " $2T + 30$ " into  $X_{2T}$  and " $T$ " into  $Y_{2T}$ . Press **GRAPH**.

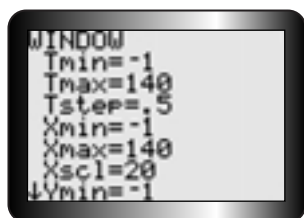


step 1f (a)

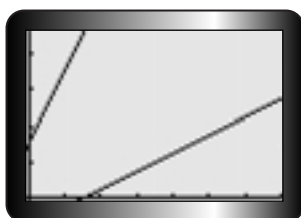


step 1f (b)

- (g) What is the domain of the inverse function? What is its range?
- (h) To graph more values, change the window. Set  $T_{min} = -1$ ,  $T_{max} = 140$ , and  $T_{step} = .5$ . Graph.

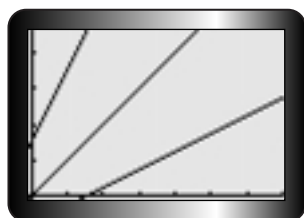


step 1h (a)



step 1h (b)

- (i) Now graph the line  $y = x$ . Since  $x$  and  $y$  are equal, set  $X_{3T} = T$  and  $Y_{3T} = T$ .
- (j) Describe the relation between the three lines on your screen.



step 1j

2. (a) To graph  $f(x) = 3(x - 1)^2 - 2$ , clear the equations from the equation editor and set  $X_{1T} = T$  and  $Y_{1T} = 3(T - 1)^2 - 2$ . Change the window to display both  $T$ -values and  $x$ -values from  $-2.4$  to  $7$ ,  $T_{step}$  to  $0.1$ , and  $y$ -values from  $-2.2$  to  $4$ . Change the plotting mode from **Dot** back to **Connected**.
- (b) Use **TRACE** to determine the domain and range of  $f$ .
- (c) Graph the inverse on the same axes.
- (d) Use **TRACE** to determine the domain and range of the inverse.
- (e) Use **TRACE** to determine the coordinates of the vertex of each parabola.
- (f)  $f$  is a function, but  $f^{-1}$  is not. Explain.

**Practice 3.5**

1. For each function,
  - i. graph the function and its inverse using parametric equations in an appropriate window
  - ii. state the domain and range of the function
  - iii. state the domain and range of the inverse relation
  - iv. state whether the inverse relation is a function. Explain.

|                                  |                                   |
|----------------------------------|-----------------------------------|
| (a) $f(x) = -2(x + 1)^2 + 3$     | (b) $g(x) = \sqrt{x}$             |
| (c) $f(x) = \sqrt{x - 2}$        | (d) $y = x^3$                     |
| (e) $g(x) = \frac{1}{x}$         | (f) $f(x) = \frac{1}{3 - x}$      |
| (g) $y = \frac{1}{\sqrt{x - 2}}$ | (h) $f(x) = \sqrt{9 - (x - 2)^2}$ |
| (i) $g(x) = \sin(3x)$            | (j) $f(x) = 1 + \cos(3x)$         |
2.
  - i. To graph  $f(x) = 3(x - 1)^2 - 2$  for  $-0.3 \leq x \leq 2$ ,
    - enter the parametric equations and settings as in step 2 in method 2
    - use **Tmin**=-0.3 and **Tmax**=2 to draw that section of the graph
  - ii. Graph the inverse.
  - iii. State the domain and range of  $f$  and  $f^{-1}$ .
  - iv. Graph each function and repeat ii and iii.
    - (a)  $f(x) = \frac{1}{3 - x}, -1 \leq x \leq 2$
    - (b)  $g(x) = \sqrt{9 - (x - 2)^2}, -1 \leq x \leq 2$
    - (c)  $y = 2x + 0.5 \sin(10x), 0.4 \leq x \leq 2.3$
    - (d)  $f(x) = -1.2x \sin(x - 0.2), 0 \leq x \leq 5$