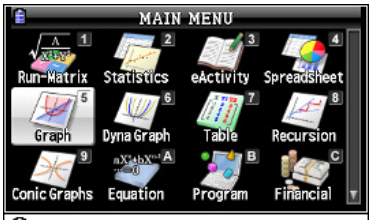
Parametric equations: Graphs and gradients

This resource sheet is designed for use with the Casio fx-CG20. However it can be used with the Casio fx-9860GII or the Casio fx-9750GII although there may be some differences in the key sequences needed and in the screen displays.

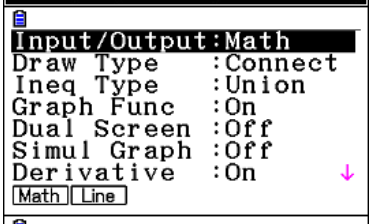
Aim

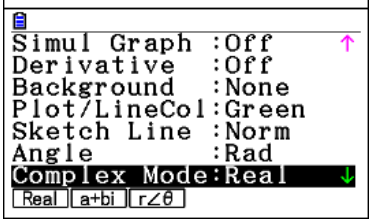
This activity will show you how to graph parametric equations on the calculator. It will also explore how you can display coordinates and derivatives at any point on a graph. There are also some activities for students to explore how these functions can be used to investigate some of the properties of trigonometric functions.

Set your calculator to GRAPH mode. Press [MENU] [5]



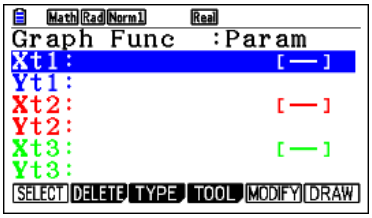
Set the calculator to input/output to 'Math' and 'Angle' to Radians by going to SET UP [SHIFT] [MENU]. Highlight 'input/output and press [F1] to select 'Math. You will need to scroll down to 'Angle' and press [F2] to select Radians. Press [EXIT] to get back to the function table screen





Delete any existing functions using [F2] and following the on-screen instructions

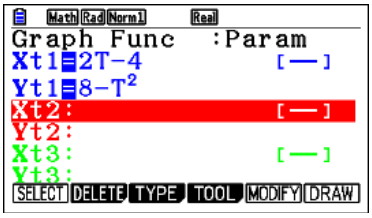
Select TYPE [F3] and select the parametric option, Param [F3]



Enter the function Xt1 = 2T – 4

Yt1 = $8 - T^2$

Use the [X,θ,T] button to get the variable T. Press [EXE] to finish.



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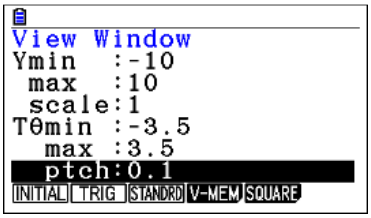
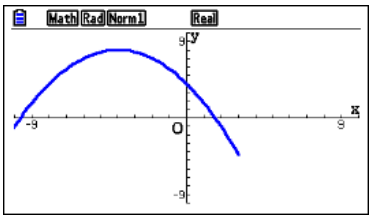
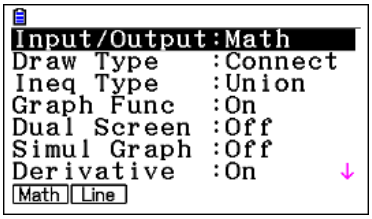
Set the viewing window to standard [SHIFT] [F3] [F3]
but then scroll down until you see the T,θ settings and set them as follows:
T θ min = -3.5
T θ max = 3.5
pitch = 0.1
press [EXE] to finish



Select Draw [F6] to display the graph

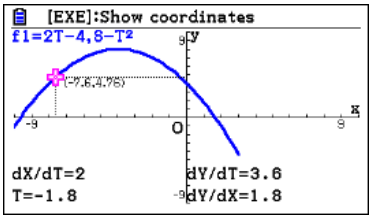


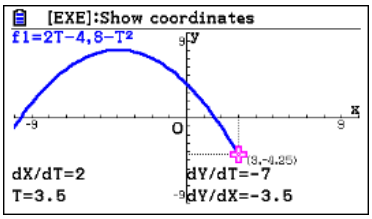
Go to SET UP [SHIFT] [MENU] and set DERIVATIVE to 'On'.
Get back to original screen by pressing [EXIT]
Go back to the graph screen [F6].
Go to Trace [SHIFT] [F1]



You can now see the values of T, dx/dt, dy/dt, and dy/dx.

As you move the cursor, explore the relationship between dy/dt, dt/dx, and dy/dx. What do you notice?





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You should now feel fairly confident graphing parametric equations on the calculator. Here are some investigations that will encourage your students to explore some of the features of parametric functions using the graphics calculator.

Some investigations:

Investigation 1

Investigate the curve with parametric equations:

X = 8cosT
Y = 5sinT

Use the standard viewing window with the following settings changed:

Tmin = 0
Tmax = 360
Pitch = 3.6

You will need to scroll down in the viewing window and you might also need to check that the calculator is set to degrees in SET UP SHIFT MENU

Why does the calculator show an error for dy/dx when T = 0 and when T = 180?

As you move the cursor around the curve notice what happens to dx/dt, dy/dt, and dy/dx.

Investigation 2

Turn off the derivative function by going to SET UP SHIFT MENU and set DERIVATIVE to 'Off'.

Leaving the equations from Investigation 1 in the calculator, enter the following parametric equations in Xt2 and Yt2

X = 7cosT
Y = 7sinT

Plot both graphs on the same screen and using the Trace function, (and the Zoom if needed) find the x and y values for the points where they intersect.

What do you notice about the values of T for each curve at the points of intersection?