

Chapter 6 / **Example 9**

Sketching cubic functions

Sketch the graphs of $y = f(x)$ for the following functions.

a $f(x) = (x-2)^3$, $0 \leq x \leq 4$ **b** $f(x) = x^3 - 7x^2 + 4x - 12$, $-2 \leq x \leq 8$

On your sketch, label the coordinates of points where the graphs intersect the axes, and any local maximum or minimum points.

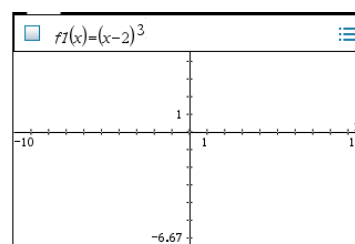
Open a new document and add a Graphs page.

The entry line is displayed at the top of the work area.

The default graph type is function, so ' $f1(x)=$ ' is displayed.

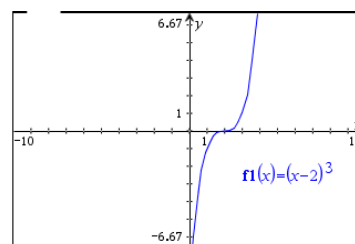
The default axes are $-10 \leq x \leq 10$ and $-6.67 \leq y \leq 6.67$.

Type $(x-2)^3$ and press **enter**.



The GDC displays the graph $f1(x) = (x-2)^3$ with the default axes.

There is no maximum or minimum point.

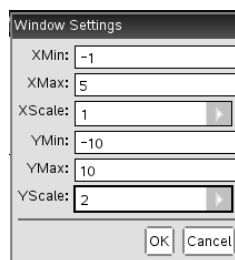


Press **menu** 4:Window/Zoom | 1:Window Settings...

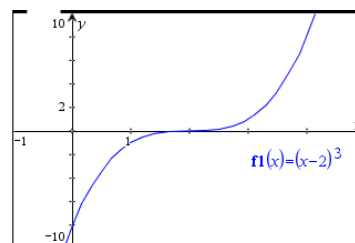
Set the axes to show $-1 \leq x \leq 5$ with a scale of 1 and $-10 \leq y \leq 10$ with a scale of 2.

Use **tab** to navigate through the settings.

Press **enter** when you have finished.



The GDC displays the graph in a suitable window.



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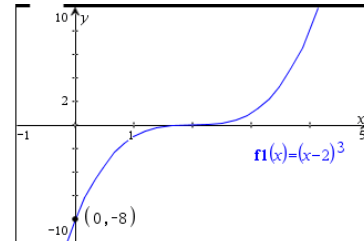
Sketching cubic functions

To find the y -intercept press **menu** 5:Trace | 1:Graph Trace.

Press **0** **enter** to change the x coordinate to 0.

Press **enter** again and then press **esc** to leave the graph trace mode.

The GDC displays the coordinates of the y -intercept, $(0, -8)$.

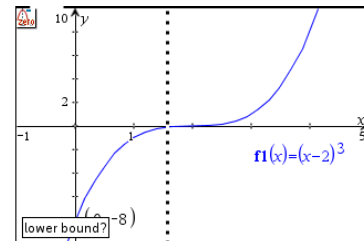


To find the zero press **menu** 6:Analyse Graph | 1:Zero.

You will need to give the lower and upper bounds of the region that includes the zero.

The GDC shows a line and asks you to set the lower bound. Move the line using the touchpad and choose a position to the left of the zero.

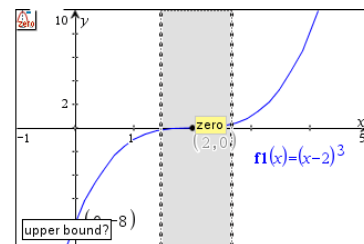
Click the touchpad.



The GDC shows another line and asks you to set the upper bound.

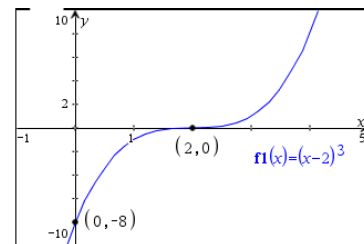
Use the touchpad to move the line so that the region between the lower and upper bounds contains the zero.

When the region contains the zero, the calculator will display the word 'zero' in a box.



Click the touchpad.

The GDC displays a zero at $(2, 0)$.

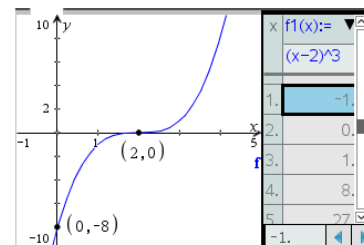


To view the coordinates of some further points use a table of values. Press **ctrl** **T**.

A table of values is displayed alongside the graph.

You can scroll through the table using **▲** and **▼** on the touchpad.

Take some more points from the table and plot the graph.

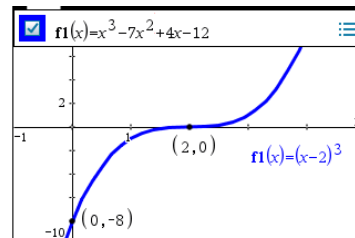


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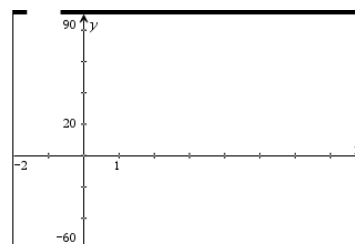
Press **ctrl** **T** to return to graph mode.

Press **tab** **▲** so ' $f1(x)=$ ' is displayed. Delete the function and type $x^3 - 7x^2 + 4x - 12$ and press **enter** to enter the equation as Y_1 .



The GDC now displays the quadratic function:

$f1(x) = x^3 - 7x^2 + 4x - 12$, however there is nothing to see in this window.



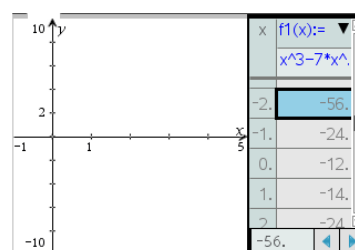
Press **ctrl** **T**.

A table of values is displayed alongside the graph.

You can scroll through the table using **▲** and **▼** on the touchpad.

From the table, suitable axes will be $-2 \leq x \leq 8$ and $-60 \leq y \leq 90$.

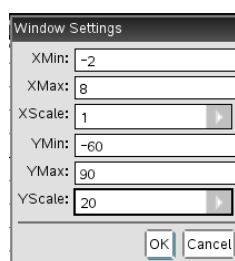
Press **ctrl** **T** to return to the graph screen.



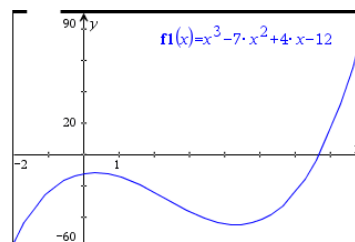
Press **menu** 4:Window/Zoom | 1:Window Settings...

Set the axes as above with an x-scale of 1 and a y-scale of 20.

Press **enter** when you have finished.



The GDC displays the cubic curve in a suitable window.



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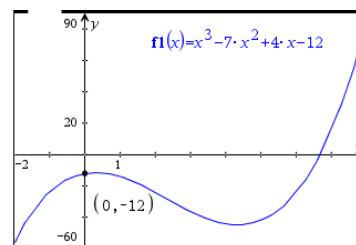
Sketching cubic functions

To find the y -intercept press **menu** 5:Trace | 1:Graph Trace.

Press **0** **enter** to change the x coordinate to 0.

Press **enter** again and then press **esc** to leave the graph trace mode.

The GDC displays the coordinates of the y -intercept, $(0, -12)$.

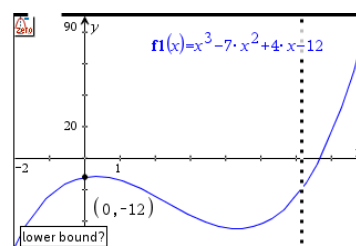


To find the zero press **menu** 6:Analyze Graph | 1:Zero.

You will need to give the lower and upper bounds of the region that includes the zero.

The GDC shows a line and asks you to set the lower bound. Move the line using the touchpad and choose a position to the left of the zero.

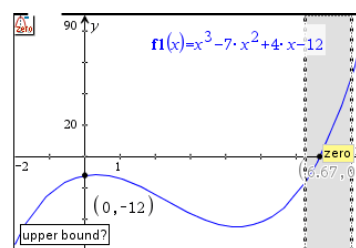
Click the touchpad.



The GDC shows another line and asks you to set the upper bound.

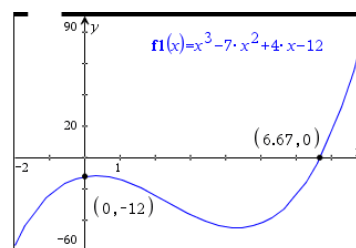
Use the touchpad to move the line so that the region between the lower and upper bounds contains the zero.

When the region contains the zero, the calculator will display the word 'zero' in a box.



Click the touchpad.

The GDC displays a zero at $(6.67, 0)$.

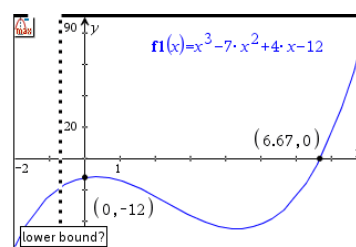


To find the maximum press **menu** 6:Analyse Graph | 3:Maximum.

You will need to give the lower and upper bounds of the region that includes the maximum.

The GDC shows a line and asks you to set the lower bound. Move the line using the touchpad and choose a position to the left of the maximum.

Click the touchpad.



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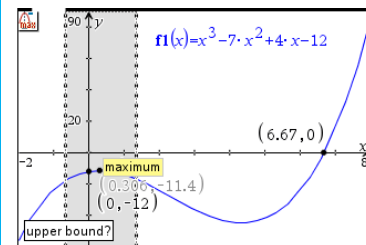
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The GDC shows another line and asks you to set the upper bound.

Use the touchpad to move the line so that the region between the lower and upper bounds contains the maximum.

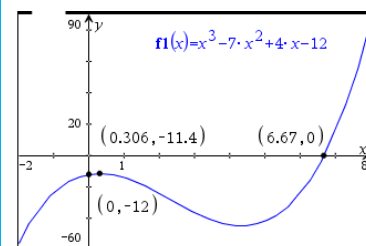
When the region contains the maximum, the calculator will display the word 'maximum' in a box.

Click the touchpad.



The GDC displays the maximum.

The maximum of the cubic function is at $(0.306, -11.4)$.

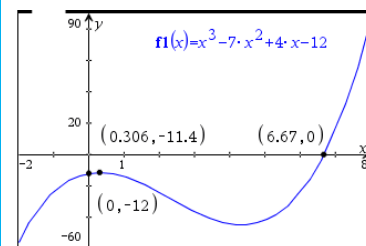


To find the minimum press **menu** 6:Analyse Graph | 2: Minimum.

You will need to give the lower and upper bounds of the region that includes the minimum.

The GDC shows a line and asks you to set the lower bound. Move the line using the touchpad and choose a position to the left of the minimum.

Click the touchpad.

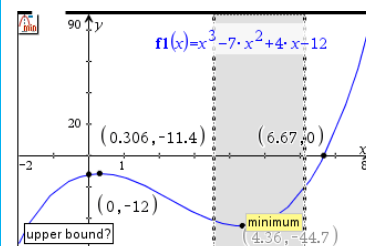


The GDC shows another line and asks you to set the upper bound.

Use the touchpad to move the line so that the region between the lower and upper bounds contains the minimum.

When the region contains the minimum, the calculator will display the word 'minimum' in a box.

Click the touchpad.



The GDC displays the minimum.

The minimum of the cubic function is at $(4.36, -44.7)$.

The four points found should be sufficient to sketch the curve.

