

## Chapter 5 / Example 16

# Finding turning points

The GDC can be used to locate turning points as an alternative to using differentiation or to check results.

Consider the function  $f(x) = 4 - 3x^2 + x^3$  for  $-2 \leq x \leq 3$ .

- Find and classify the nature of any turning points.
- State the intervals in which the function is increasing or decreasing.

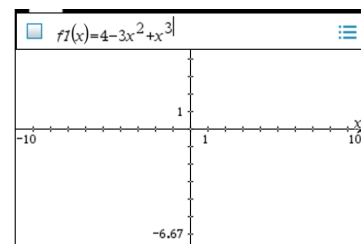
Open a new document and add a Graphs page.

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

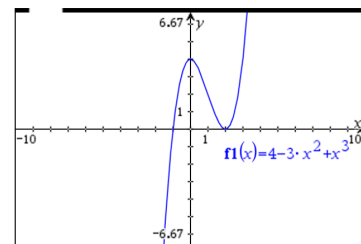
The default graph type is function, so 'f1(x)= ' is displayed.

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

Type  $4 - 3x^2 + x^3$  and press **enter**.



The GDC displays the graph  $f1(x) = 4 - 3x^2 + x^3$  with the default axes.

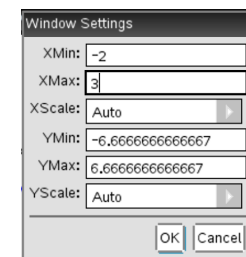


Press **menu** 4:Window/Zoom | 1:Window Settings...

Set the axes to show  $-2 \leq x \leq 3$

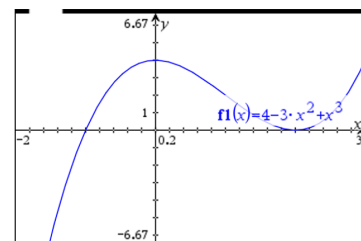
You can leave y-values as they are and the scales set to Auto.

Press **enter** when you have finished.



Hint: use the **tab** key to move between the settings.

The GDC displays the function  $f(x) = 4 - 3x^2 + x^3$  for  $-2 \leq x \leq 3$ .



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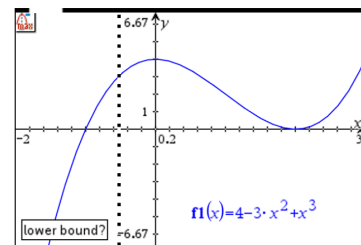
# Finding turning points

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.

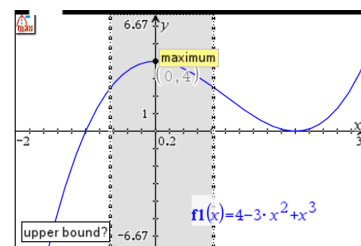


The GDC shows another line and asks you to set the upper bound.

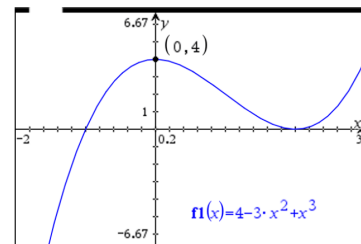
Use the touchpad to move the line so that the region between the lower and upper bounds contains the maximum.

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

Click the touchpad.



The GDC displays the local maximum point at  $(0, 4)$ .

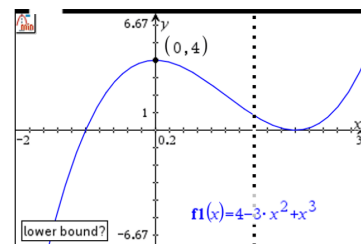


To find the minimum press **menu** 6:Analyse Graph | 3: Minimum

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.

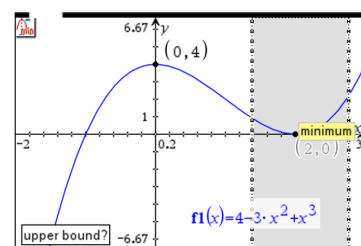


The GDC shows another line and asks you to set the upper bound.

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.



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The GDC displays the minimum at  $(2, 0)$ .

From the graph,

$f$  is increasing for  $x \in [-2, 0[ \cup ]2, 3]$ .

$f$  is decreasing for  $x \in ]0, 2[$ .

