

Chapter 5 / Example 16

Finding turning points

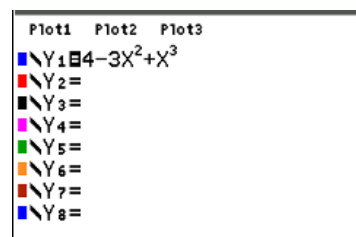
The GDC can be used to locate turning points as an alternative to using differentiation or to check results.

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 f which the function is increasing or decreasing.

Press $[F1]$ $[Y=]$ to display the equation entry screen.

Type $4 - 3x^2 + x^3$ and press $[ENTER]$ to enter the equation as Y_1 .

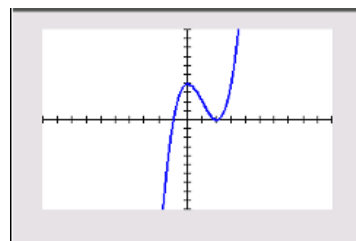


Press $[F5]$ $[GRAPH]$ to display the graph screen

The GDC now displays the quadratic function:

$$Y_1 = 4 - 3x^2 + x^3$$

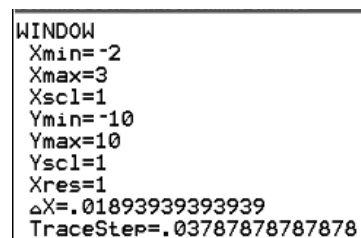
The default axes are $-10 \leq x \leq 10$ and $-10 \leq y \leq 10$.



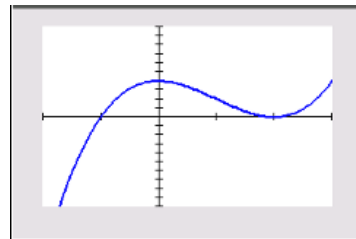
Press $[F2]$ $[WINDOW]$ Set the axes to show $-2 \leq x \leq 3$

You can leave y-values as they are and the scales set to 1.

Press $[F5]$ $[GRAPH]$ when you have finished.



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



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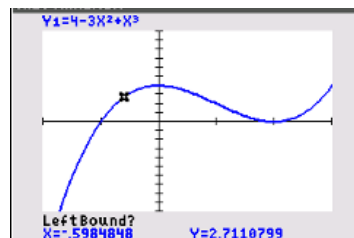
Finding turning points

To find the maximum press **[2nd]** **[f4]** **[calc]** 4:maximum

You will need to give the left and right bounds of the region that includes the maximum.

The GDC shows a point on the curve and asks you to set the left bound. Move the point using **[▶]** **[◀]** and choose a position to the left of the turning point.

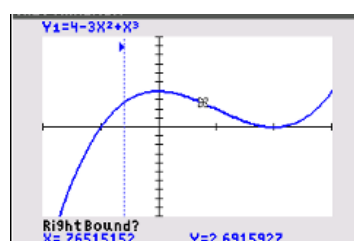
Press **[enter]**.



The GDC shows a line where you have set the left bound and a point on the curve.

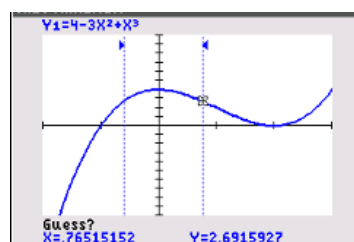
Move the point using **[▶]** **[◀]** and choose a position to the right of the turning point.

When the region contains the turning point, Press **[enter]**.



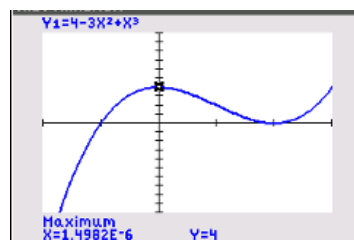
The GDC requires an initial guess for the position of the turning point. Choose the default position.

Press **[enter]**.



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

Take care to interpret what the GDC displays. $X = 1.4982E-6$ means $1.4982 \times 10^{-6} = 0.0000014982$ which is very close to zero. The small difference is due to the numerical way that the GDC calculates the value.

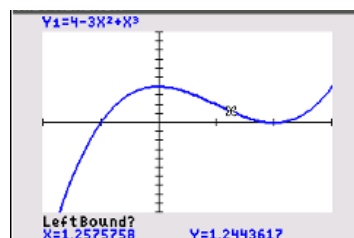


To find the minimum press **[2nd]** **[f4]** **[calc]** 3:minimum

You will need to give the left and right bounds of the region that includes the minimum.

The GDC shows a point on the curve and asks you to set the left bound. Move the point using **[▶]** **[◀]** and choose a position to the left of the turning point.

Press **[enter]**.



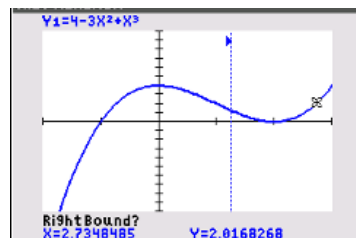
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The GDC shows a line where you have set the left bound and a point on the curve.

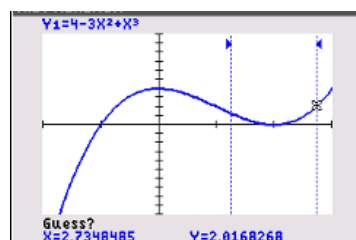
Move the point using \blacktriangleright \blacktriangleleft and choose a position to the right of the turning point.

When the region contains the turning point, Press enter .



The GDC requires an initial guess for the position of the turning point. Choose the default position.

Press enter .



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

Remember to round these very small differences.

From the graph,

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

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

