Chapter 4 / **Example 26**

Finding extrema graphically

The GDC can be used to confirm the position and nature of turning points.

If $f(x) = 1 - 4x^2 + 2x^4$:

a Find any turning points.

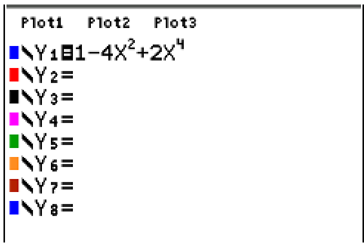
b Determine the nature of the points and justify your answers.

c State the intervals in which the function increases/decreases.

d Confirm your answers graphically, and state whether the points found in **a** are local or global extrema.

Press [f1] [y=] to display the equation entry screen.

Type $1 - 4x^2 + 2x^4$ and press [enter] to enter the equation as Y_1.

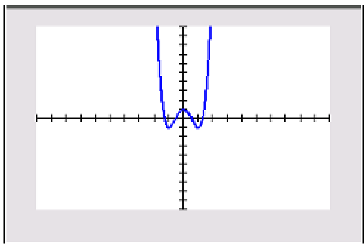


Press [f5] [graph] to display the graph screen

The GDC now displays the function:

$Y_1 = 1 - 4x^2 + 2x^4$

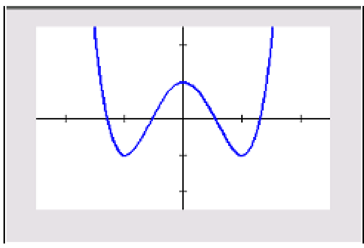
The default axes are $-10 \le x \le 10$ and $-10 \le y \le 10$.



To view the extrema better press [zoom] 2:Zoom In.

The default centre for zooming is the origin so press [enter].

Press [f5] [graph] to exit zoom mode.

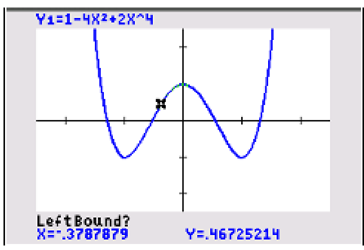


To find the maximum press [2nd] [f4] [calc] 4:maximum

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].



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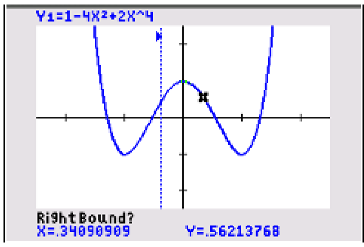
Finding extrema graphically

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

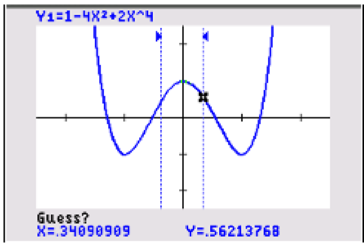
Move the point using ▶ ◀ and choose a position to the right of the turning point.

When the region contains the turning point, Press enter.



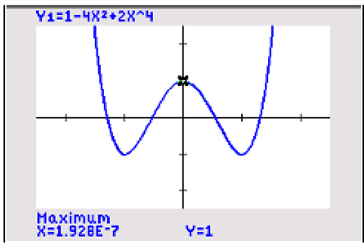
The GDC requires an initial guess for the position of the turning point. Choose the default position.

Press enter.



The GDC displays the local maximum point at $(0,1)$.

Take care to interpret what the GDC displays. $X = 1.928\text{E}-7$ *means* $1.928 \times 10^{-7} = 0.0000001928$ *which is very close to zero. The small difference is due to the numerical way that the GDC calculates the value.*

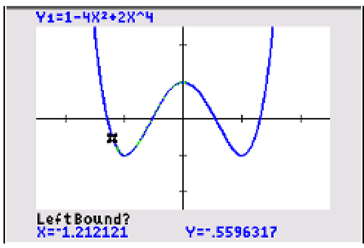


To find the first minimum press 2nd f4 calc 3:minimum.

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.

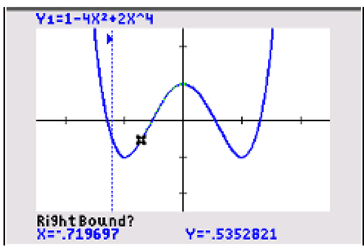
Press enter.



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.



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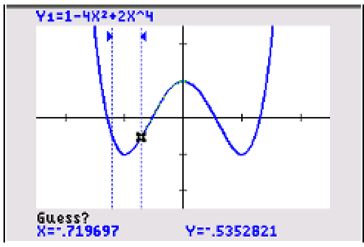
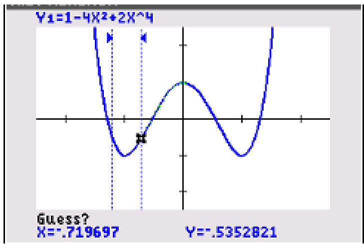
The GDC requires an initial guess for the position of the turning point. Choose the default position.

Press $\boxed{\text{enter}}$.



The GDC displays the minimum at $(-1,-1)$.

Remember to round these very small differences.



Repeat for the second minimum.

The GDC displays the minimum at $(1,-1)$.

From the graph,

f is increasing for $x \in \left]-1,0\right[\cup \left]1,\infty\right[$.

f is decreasing for $x \in \left]-1,0\right[\cup \left]1,\infty\right[$.