Chapter 3 / **Example 35**

Solving polynomial inequalities

Given the polynomials $f(x)=3x^3+2x^2-3$ and $g(x)=x^3-x^2+3x-1$, find all the values of x such that $f(x)\geq g(x)$ by using a graphical method on a calculator.

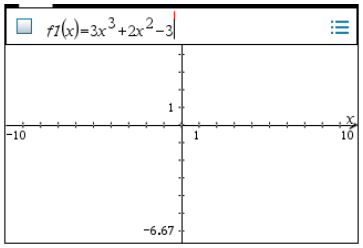
Open a new document and add a Graphs page.

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

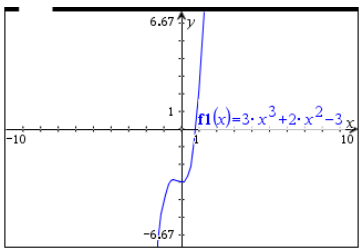
The default graph type is function, so '$f1(x)=$' is displayed.

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

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

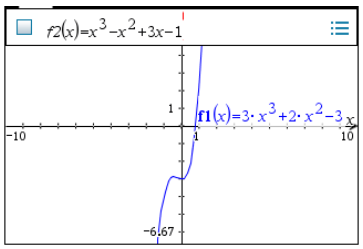


The GDC displays the graph $f1(x)=3x^3+2x^2-3$ with the default axes.



Press tab to display the entry line again. This time '$f2(x)=$' is displayed.

Type x^3-x^2+3x-1 and press enter.

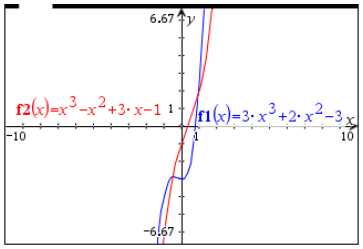


The GDC now displays both graphs:

$f1(x)=3x^3+2x^2-3$

$f2(x)=x^3-x^2+3x-1$

with the default axes.

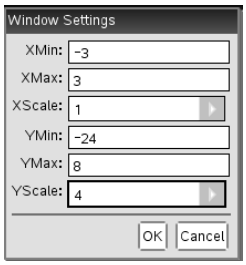


Choose suitable window settings to display the graphs.

Press menu 4:Window/Zoom | 1:Window Settings…

Set $-3\leq x\leq 3$ with a scale of 1 and $-24\leq y\leq 8$ with a scale of 4

Press enter when you have finished.



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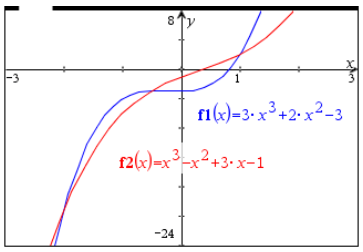
The GDC displays the graphs in a suitable window.

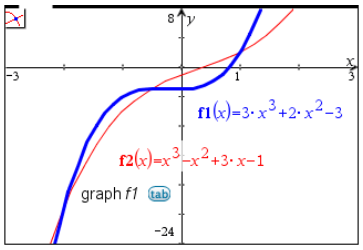


There are two ways to find intersection points. The first is to use menu 6:Analyse Graph | 4:Intersection. When there is more than one point, however, the following method is quicker.

Press menu 8:Geometry | 1:Points & Lines | 3: Intersection Point(s)

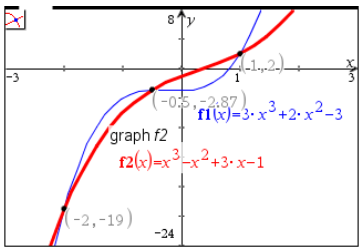
To find the points use the touchpad to highlight the quadratic curve. You will see '*graph f1*' displayed.

Click the touchpad.



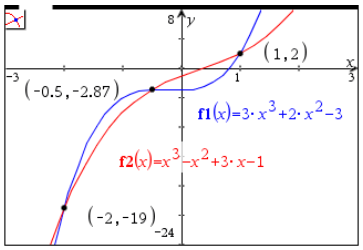
Use the touchpad to highlight the straight line. You will see '*graph f2*' displayed.

Click the touchpad.



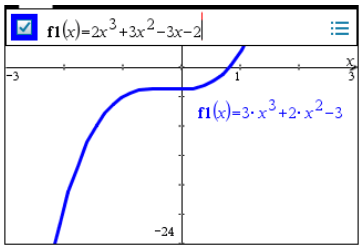
The GDC now displays the coordinates of both points of intersection.

The points of intersection are $(2.09, 8.26)$ and $(-0.838, -0.514)$



Alternatively, rewrite $3x^3 + 2x^2 - 3 \geq x^3 - x^2 + 3x - 1$ as $2x^3 + 3x^2 - 3x - 2 \geq 0$

Press tab to display the entry line again. This time '*f3*(*x*)=' is displayed. Press ▲ to display *f*2(*x*) and press ctrl clear and enter. Press tab again and press ▲ to display *f*1(*x*). press ctrl clear and type $2x^3 + 3x^2 - 3x - 2$. Press EXE to enter the equation as *f*1(*x*).



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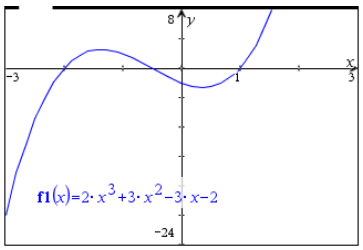
The GDC now displays the graphs $f1(x) = 2x^3 + 3x^2 - 3x - 2$ with the axes $-3 \leq x \leq 3$ and $-24 \leq y \leq 8$.

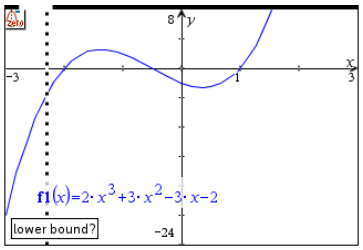


To find the zeros press menu 6:Analyse Graph | 1:Zero

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.

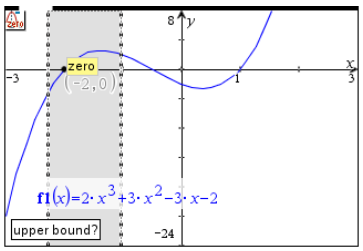


The GDC shows another line and asks you to set the upper bound.

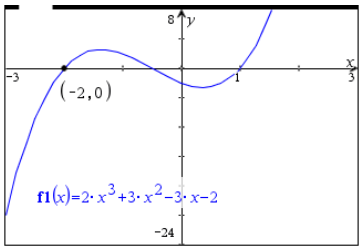
Use the touchpad to move the line so that the region between the lower and upper bounds contains the zero.

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 $(-2, 0)$.



Repeat for the second and third zeros.

The GDC displays the zeros at $(-2, 0)$, $(-0.5, 0)$ and $(1, 0)$.

$x \in \left]-\infty, \frac{1}{3}\right] \cup \left[2, \frac{5}{2}\right]$