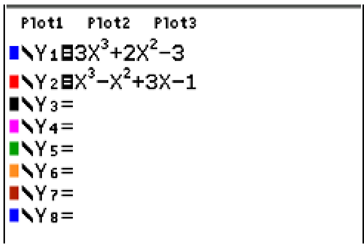
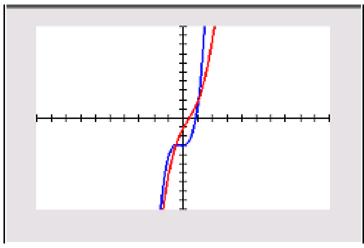
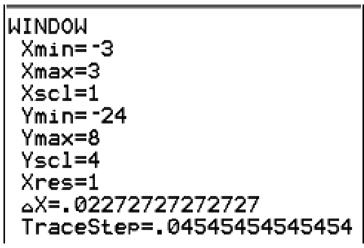
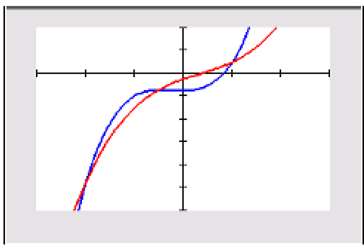
Chapter 3 / **Example 35**

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.

Press [f1] $\boxed{\text{y=}}$ to display the equation entry screen. Type $3x^3+2x^2-3$ and press $\boxed{\text{enter}}$ to enter the first equation as Y_1. Type x^3-x^2+3x-1 and press $\boxed{\text{enter}}$ to enter the second equation as Y_2.	
Press [f5] $\boxed{\text{graph}}$ to display the graph screen The GDC now displays the curves: $Y_1=3x^3+2x^2-3$ $Y_2=x^3-x^2+3x-1$ The default axes are $-10\leq x\leq 10$ and $-10\leq y\leq 10$.	
Choose suitable window settings to display the graphs. Press [f2] $\boxed{\text{window}}$[format] Set the axes to show $-3\leq x\leq 3$ with a scale of 1 and $-24\leq y\leq 8$ with a scale of 4 You can leave the other items as they are. Press [f5] $\boxed{\text{graph}}$ when you have finished.	
The GDC displays the curves in a suitable window.	

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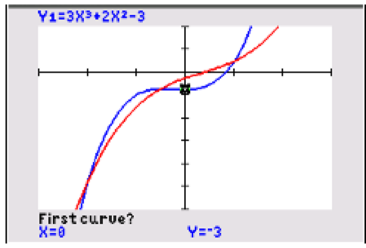
To find the intersections press [2nd] [f4] [calc] 5:intersect

To find the intersection you need to choose the two lines that intersect.

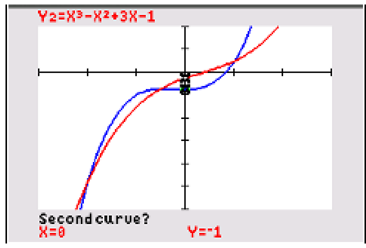
The GDC shows a cross on the curve and 'First curve?'.

Press [enter].



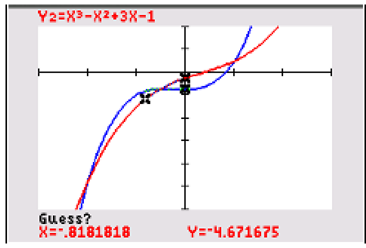
The GDC shows a cross on the line and 'Second curve?'.

Press [enter].

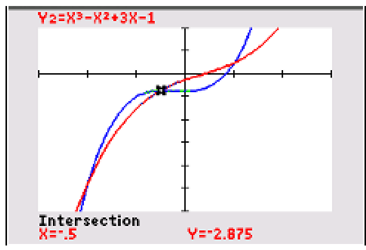


The GDC requires an initial guess for the position of the intersection. Choose a point close to the first intersection by moving the cursor with the [◀] [▶] keys.

Press [enter].

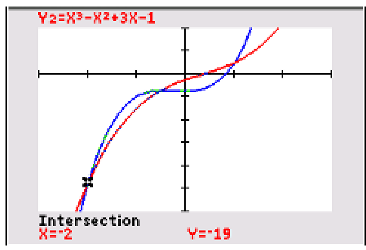


The GDC displays the first intersection at $(-0.5, -2.88)$.



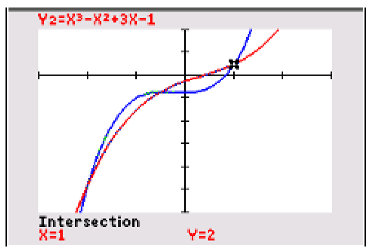
Repeat for the second intersection.

The GDC displays an intersection at $(-2, -19)$.



Repeat for the third intersection.

The GDC displays an intersection at $(1, 2)$.



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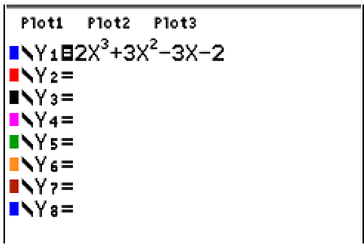
Alternatively, rewrite $3x^3+2x^2-3 \geq x^3-x^2+3x-1$ as $2x^3+3x^2-3x-2 \geq 0$.

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

Press [CLEAR] to delete the functions in Y_1 and Y_2.

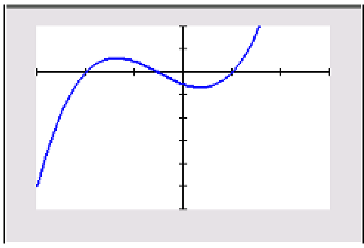
Type $2x^3+3x^2-3x-2$ and press [enter] to enter the equation as Y_1.



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

The GDC now displays the curve $Y_1=2x^3+3x^2-3x-2$

The axes are $-3 \leq x \leq 3$ and $-24 \leq y \leq 8$.

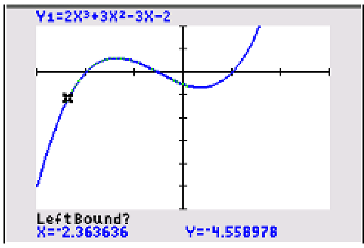


To find the zeros press [2nd] [f4] [calc] 2:zero

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

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 zero.

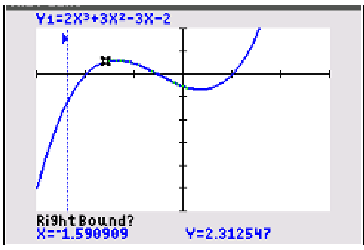
Press [enter].



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

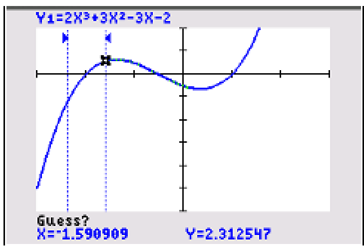
Move the point using [▶] [◀] and choose a position to the right of the zero.

When the region contains the zero, Press [enter].



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

Press [enter].



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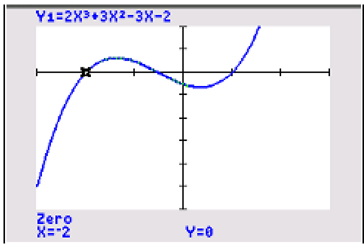
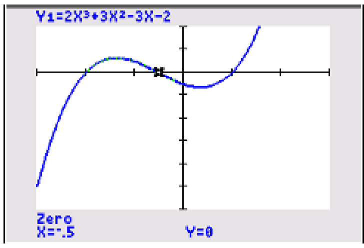
The GDC displays a zero at $(-2,0)$.	
Repeat for the second zero. The GDC displays a zero at $(-0.5,0)$.	
Repeat for the third zero. The GDC displays a zero at $(1,0)$. $x \in \left]-\infty, \frac{1}{3}\right] \cup \left[2, \frac{5}{2}\right]$