

Chapter 6 / **Example 3****Problems involving quadratics**

A rectangular mirror has perimeter 260 cm.

- If the length of the mirror is x cm, find the height of the mirror in terms of x .
- Find an equation for the area of the mirror, A cm², in terms of x .
- Use your GDC to plot a graph of your equation for the area of the mirror, showing area A on the y -axis and length x on the x -axis. Choose a suitable domain and range.
- Find the coordinates of the points where the graph intersects the x -axis.
- State what these two values of x represent.
- Find the equation of the graph's line of symmetry.
- State what the equation of the line of symmetry tells you in this context.

$$\text{height} = 130 - x, \text{ area} = x(130 - x)$$

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

Type $x(130 - x)$ and press $[ENTER]$ to enter the equation as Y_1 .

Plot1 Plot2 Plot3
 $Y_1 = X(130 - X)$
 $Y_2 =$
 $Y_3 =$
 $Y_4 =$
 $Y_5 =$
 $Y_6 =$
 $Y_7 =$
 $Y_8 =$
 $Y_9 =$

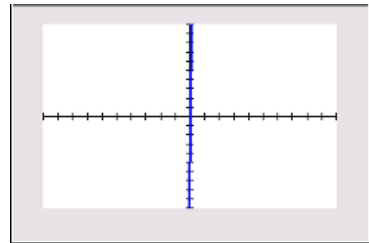
Press $[F5]$ $[GRAPH]$ to display the graph screen

The GDC now displays the quadratic function:

$$Y_1 = x(130 - x)$$

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

There is not much to see with these axes.



To get a better idea of the best window to view the graph in, it is helpful to use a table of values.

Press $[MODE]$. Use the \leftarrow \rightarrow \uparrow \downarrow keys to place the cursor on GRAPH-TABLE in the Mode menu, and then press $[ENTER]$ to highlight it.

MATHPRINT CLASSIC
 NORMAL SCI ENG
 FLOAT 0 1 2 3 4 5 6 7 8 9
 RADIAN DEGREE
 FUNCTION PARAMETRIC POLAR SEQ
 THICK DOT-THICK THIN DOT-THIN
 SEQUENTIAL SIMUL
 REAL a+bi re^(θi)
 FULL HORIZONTAL GRAPH-TABLE
 FRACTIONTYPE: n/d Un/d
 ANSWERS: AUTO DEC FRACTION APPROX
 GO TO 2ND FORMAT GRAPH: NO YES
 STAT DIAGNOSTICS: OFF ON
 STAT WIZARDS: ON OFF
 SET CLOCK 09/04/18 1:04PM

Press $[F5]$ $[GRAPH]$.

A table of values is displayed alongside the graph.

Press $[2nd]$ $[F5]$ $[TABLE]$ to move the cursor into the table.

You can scroll through the table using \uparrow and \downarrow on the touchpad.

From the table, you can see that the maximum value of y is around 4225

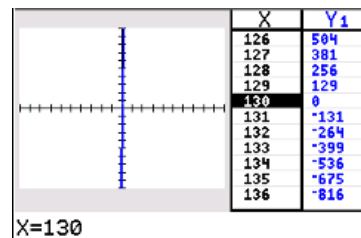
X	Y1
59	4189
60	4200
61	4209
62	4216
63	4221
64	4224
65	4225
66	4224
67	4221
68	4216
69	4209

X=65

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Scrolling further you can see that the value of y remains positive for values of x up to 130.

Press **[MODE]** Use the **[←]** **[↑]** **[→]** **[↓]** keys to place the cursor on FULL in the Mode menu, and then press **[ENTER]** to highlight it.



Use this information to choose suitable window settings to display the graph.

Press **[F2]** **[WINDOW]**

Set the axes to show $-10 \leq x \leq 150$ with a scale of 10 and $-500 \leq y \leq 4500$ with a scale of 500.

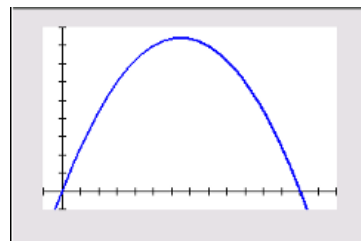
You can leave the last three items as they are.

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

```

WINDOW
Xmin=-10
Xmax=150
Xscl=10
Ymin=-500
Ymax=4500
Yscl=500
Xres=1
ΔX=.60606060606061
TraceStep=1.21212121212
  
```

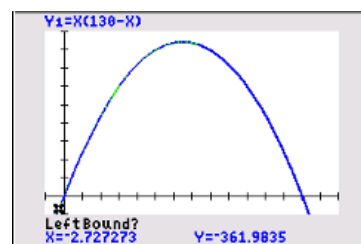
The GDC displays the quadratic curve in a suitable window.



To find the x -intercepts or zeros press **[2nd]** **[F4]** **[CALC]** 2:zero

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

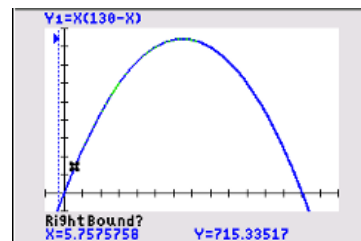
The GDC shows a point on the curve and asks you to set the left bound. Move the point using **[→]** **[←]** and choose a position to the left of the zero. Press **[ENTER]**.



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.

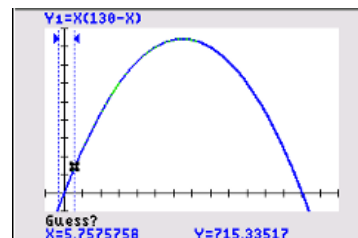
When the region contains the zero, Press **[ENTER]**.



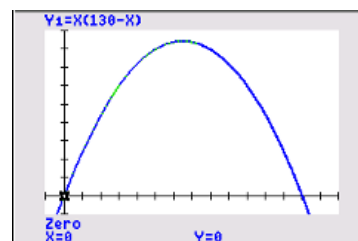
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The GDC requires an initial guess for the position of the zero.
Choose the default position.

Press **ENTER**.



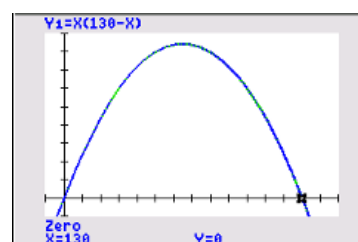
The GDC displays an x-intercept at $(0,0)$.



Repeat for the second zero.

The GDC displays an x-intercept at $(130,0)$.

x must lie between the values 0 and 130.

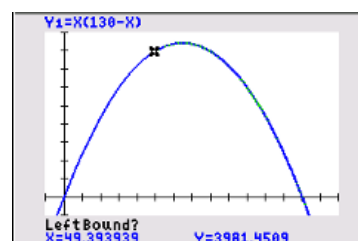


To find the vertex press **2nd** **[F4]** **[CALC]** 4:maximum

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

The GDC shows 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 vertex.

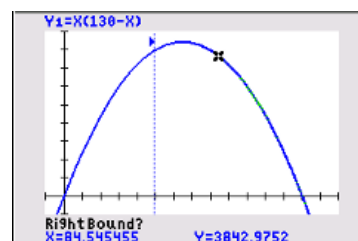
Press **ENTER**.



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

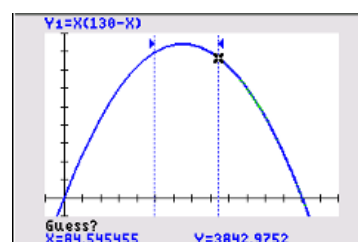
Move the point using **▶** **◀** and choose a position to the right of the vertex.

When the region contains the vertex, 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 the vertex.

The vertex of the quadratic function is at $(65, 4225)$.

Take care to interpret what the GDC displays. $X = 64.999999$ is very close to 65. The small difference is due to the numerical way that the GDC calculates the value.

The axis of symmetry passes through the vertex.

The line of symmetry is $x = 65$.

