Chapter 12 / **Example 9**

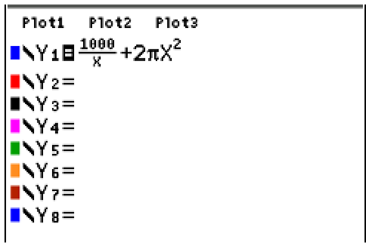
Optimization problems

A can of dog food contains 500 cm^3 of food. The manufacturer wants to make sure that the company received maximum profits by making sure that the surface area of the can has optimal dimensions. Let the radius of the can be *r* cm and the height, *h* cm.
Find the dimensions of the can that will have the minimum surface area.

$S = \frac{1000}{r} + 2\pi r^2$. Find the minimum point where $\frac{\mathrm{d}s}{\mathrm{d}r} = 0$.

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

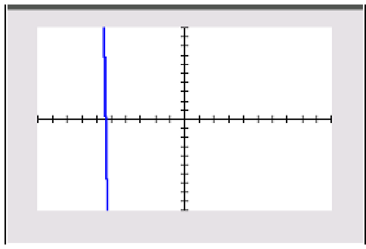
Type $\frac{1000}{x} + 2\pi x^2$ and press [enter] to enter the equation as Y_1.



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

The GDC now displays the curve $Y_1 = \frac{1000}{x} + 2\pi x^2$.

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

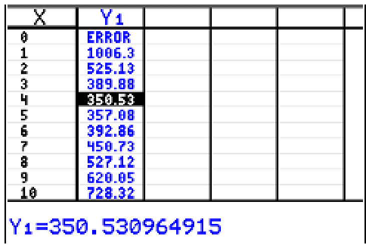


To get a better idea of the best window to view the graph in, it is helpful to use a table of values.

Press [2nd] [f5] [table].

You can scroll through the table using [▲] [▼] to get an idea of the ranges of values you will need to use for *x* and *y* to display the curve.

From the table, you can see that the lowest value is around 350.

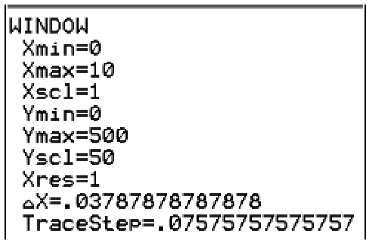


Use this information to choose suitable window settings to display the graph.

Press [f2] [window][format]

Set the axes to show $0 \le x \le 10$ and $0 \le y \le 500$ with a scale of 50.

You can leave the last three items as they are.



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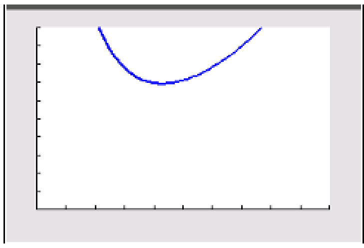
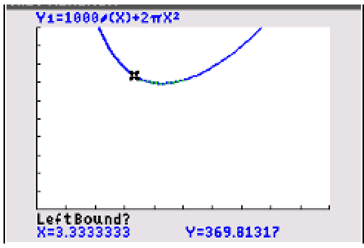
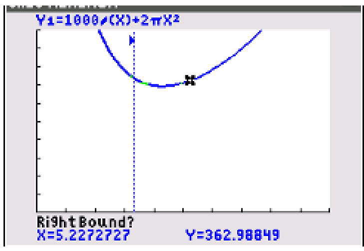
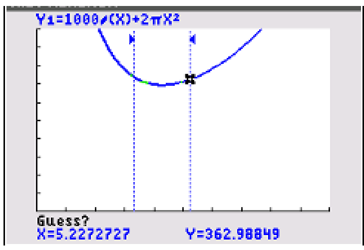
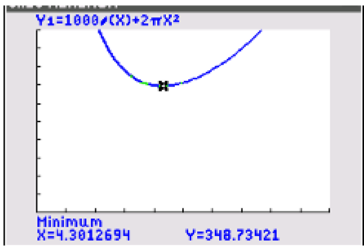
Optimization problems.

Press [f5] [graph] when you have finished to display the graph screen The GDC now displays the quadratic function $\text{Y1} = \frac{1000}{x} + 2\pi x^2$ in a suitable window.	
To find the local maximum 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].	
The GDC requires an initial guess for the position of the turning point. Choose the default position. Press [enter].	
The GDC displays the local minimum point at $(4.30, 349)$.	

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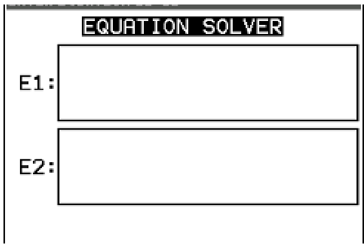
Optimization problems.

An alternative method is to solve $\frac{ds}{dr} = 0$.

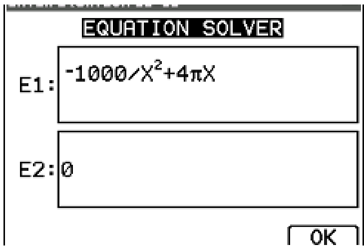
$S = \frac{1000}{r} + 2\pi r^2$ so $\frac{ds}{dr} = -\frac{1000}{r^2} + 4\pi r$

Press [math] B:Solver...



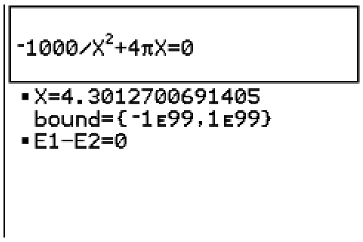
Type −1000 ÷ X^2 + 4 π X in E1 and press [enter].

Type 0 in E2 and press [enter].



Press [illegible] [enter] [solve].

$\frac{ds}{dr} = 0$ when r = 4.30.



Find $\frac{ds}{dr}$ when r = 4 and r = 5.

Press [2nd] [quit] to display the calculator screen and calculate the two values.

Since the gradient changes from negative to positive, the point is a minimum.