Chapter 9 / **Example 6**

Solving exponential equations

The value of a boat, y, in thousands of UK pounds (£) is modelled by the function $y = 20(0.85)^x$, where x is the number of years since the boat was manufactured.

a Find the value of the boat when it was brand new.

b Estimate the value of the boat when it is 3 years old. Give your answer to the nearest pound.

c Use your GDC to estimate when the value of the boat will be worth half its original value.

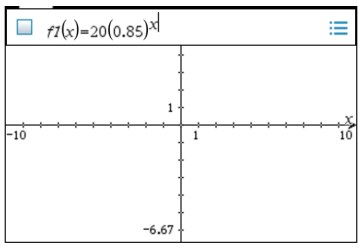
Open a new document and add a Graphs page.

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

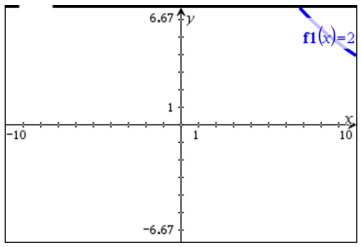
The default graph type is function, so '$f1(x)=$' is displayed.

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

Type [2] [0] [(] [0] [.] [8] [5] [)] [^] [X] and press [enter].



The GDC displays the curve $f1(x) = 20(0.85)^x$ in the default window.

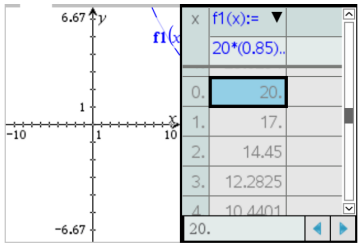


To find the value of the function when $x = 0$ press [ctrl] [T] [del]

A table of values is displayed alongside the graph.

You can scroll through the table using ▲ and ▼ on the touchpad.

From the table, you can see that the graph can see that $f1(0) = 20$ and $f1(3) = 12.3$



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

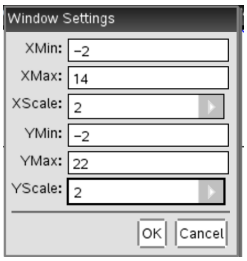
Press [ctrl] [T] again to remove the table.

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

Set the axes to show $-2 \le x \le 14$ and $-2 \le y \le 22$

Set both the scales set to 2.

Press [enter] when you have finished.



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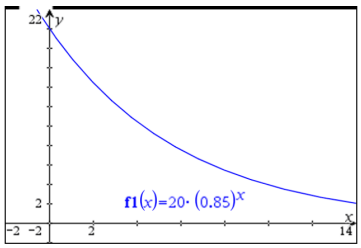
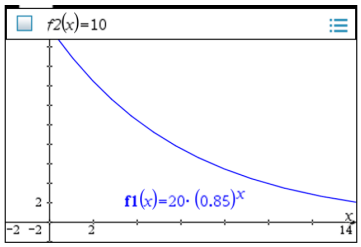
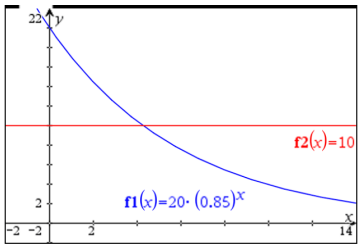
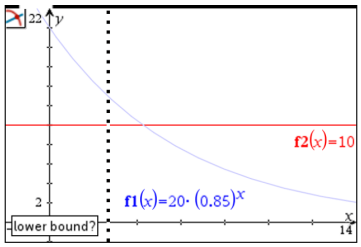
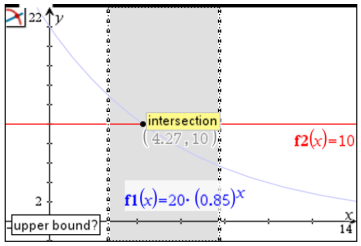
The GDC displays the curve $f1(x) = 20(0.85)^x$ in a suitable window.	
The value of the boat will have halved when it is £10 thousand. Plot the line $y = 10$ on the same graph to find the intersection. Press tab to display the entry line again. This time '$f2(x)=$' is displayed. Type 10 and press enter.	
The GDC now displays the curve and the straight line: $f1(x) = 20(0.85)^x$ $f2(x) = 10$	
Press menu 6:Analyse Graph | 4:Intersection To find the intersection you need to give the lower and upper bounds of the region that includes the intersection. 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 intersection. 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 intersection. When the region contains the intersection, the calculator will display the word 'intersection' in a box. Click the touchpad.	

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The GDC displays the intersection of the two straight lines at the point $(4.27,10)$.

The boat will be worth half its original value in approximately 4.27 years.