

## Chapter 7 / Example 12

# Exponential modelling

The equation  $M(t) = 85.7 \times 0.966^t$  gives the amount ( $M$ ) in grams of a radioactive material  $t$  years from its production.

- What was the original mass of the radioactive material?
- How much of the radioactive material is left after one decade?
- Calculate the complete number of years it would take for the radioactive material to reduce below 55 grams.
- What is the half-life of the material?

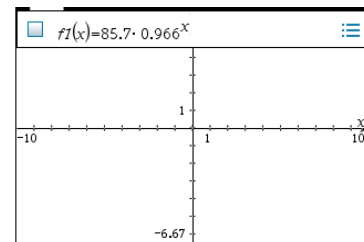
Open a new document and add a Graphs page.

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

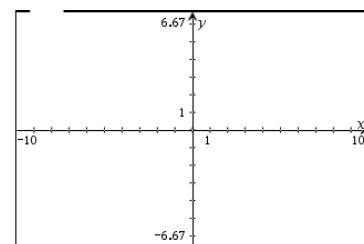
The default graph type is function, so ' $f1(x)=$ ' is displayed.

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

Type  $85.7 \times 0.966^x$  and press **enter**.



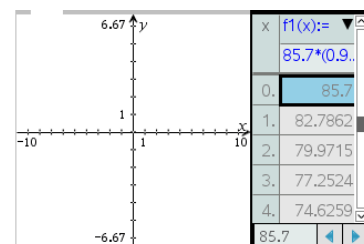
The GDC displays the graph  $f1(x) = 85.7 \times 0.966^x$  with the default axes, but there is nothing to be seen with these scales.



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

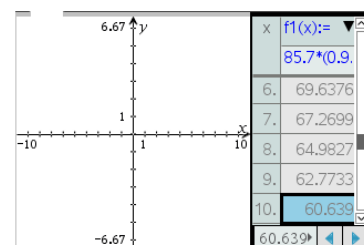
A table of values is displayed alongside the graph.

From the table, you can see that the graph can see that  $M(0) = 85.7$ .



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

$M(10) = 60.6$ .



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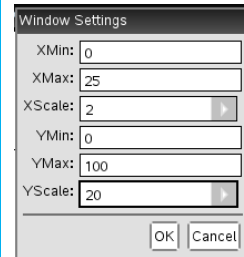
Use this information to choose suitable window settings to display the graph.

Press **ctrl** **T** again to remove the table.

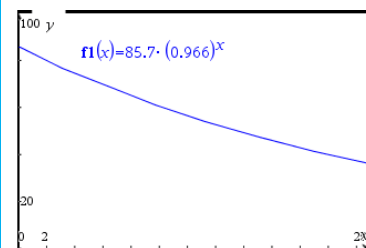
Press **menu** 4:Window/Zoom | 1:Window Settings...

Set the axes to show  $0 \leq x \leq 25$  with a scale of 2 and  $0 \leq y \leq 100$  with a scale of 20, leaving the remaining items the same.

Press **enter** when you have finished.

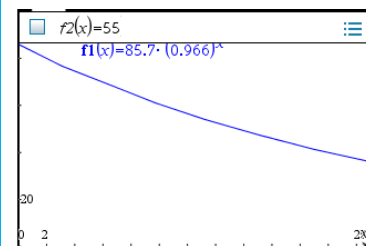


The GDC displays the graph of the mass of radioactive material in a suitable window.

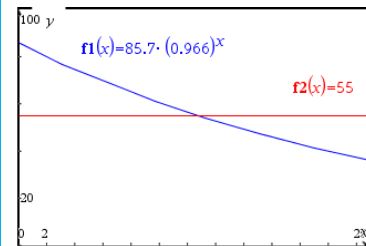


Press **tab** to display the entry line again. This time 'f2(x)= ' is displayed.

Type 55 and press **enter**.



The GDC displays  $f1(x) = 85.7 \times 0.966^x$  and  $f2(x) = 55$ .

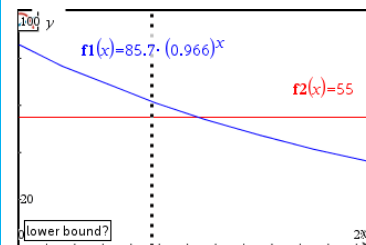


Press **menu** 6:Analyse Graph | 4:Intersection.

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.



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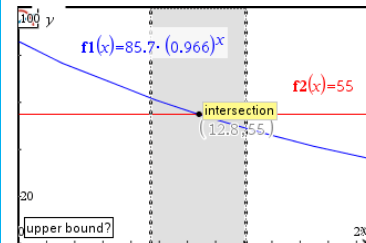
# Exponential modelling

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.

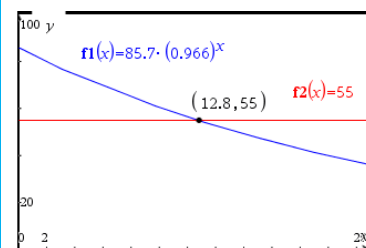
When the region contains the intersection, the calculator will display the word 'intersection' in a box.

Click the touchpad.



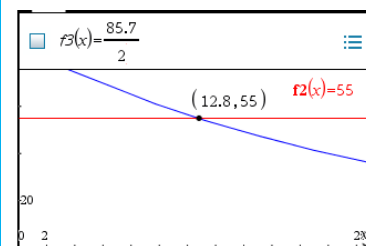
The GDC displays the intersection of the two straight lines at the point  $(12.8, 55)$ .

After 13 years the amount of the radioactive material has reduced below 55 g.

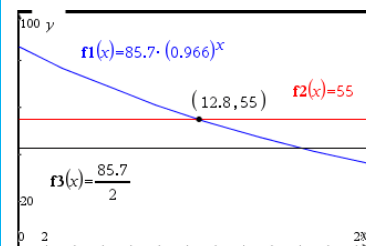


Press **tab** to display the entry line again. This time ' $f3(x)=$ ' is displayed.

Type  $\frac{85.7}{2}$  and press **enter**.

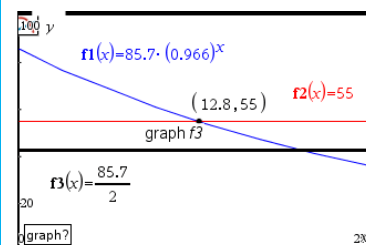


The GDC displays the curve and two straight lines.



Press **menu** 6:Analyse Graph | 4:Intersection.

Use the touchpad to select  $f1$  and  $f3$ .



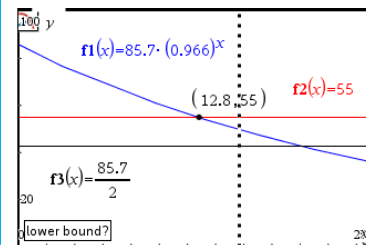
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# Exponential modelling

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.

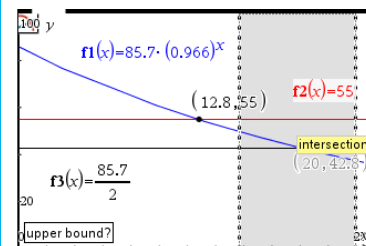


The GDC shows another line and asks you to set the upper bound.

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.



The GDC displays the intersection of the two straight lines at the point  $(20.0, 42.8)$ .

The half-life of the material is 20 years.

