

## 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?

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

Type  $85.7 \times 0.966^x$  and press  $[ENTER]$  to enter the equation as  $Y_1$ .

Plot1	Plot2	Plot3
$Y_1 = 85.7 \times 0.966^x$		
$Y_2 =$		
$Y_3 =$		
$Y_4 =$		
$Y_5 =$		
$Y_6 =$		
$Y_7 =$		
$Y_8 =$		

Press  $[2nd]$   $[F5]$   $[TABLE]$  to display a table of values for

$$Y_1 = 85.7 \times 0.966^x$$

From the table, you can see that the graph can see that  $M(0) = 85.7$  and  $M(10) = 60.6$ .

X	Y <sub>1</sub>			
0	85.7			
1	82.786			
2	79.971			
3	77.252			
4	74.626			
5	72.089			
6	69.638			
7	67.27			
8	64.983			
9	62.773			
10	60.639			

X=10

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

Press  $[F2]$   $[WINDOW]$

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.

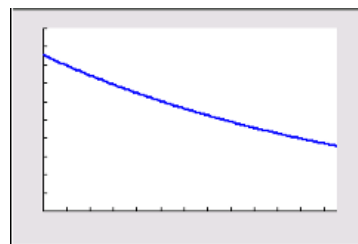
Press  $[F5]$   $[GRAPH]$  when you have finished.

```

WINDOW
Xmin=0
Xmax=25
Xscl=2
Ymin=0
Ymax=100
Yscl=10
Xres=1
ΔX=.09469696969697
TraceStep=.18939393939394

```

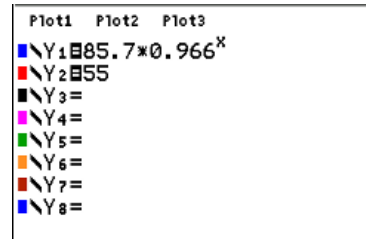
The GDC displays the graph of the mass of radioactive material in a suitable window.



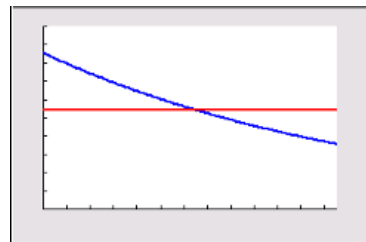
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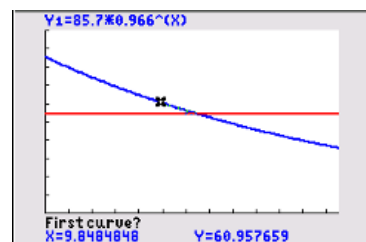
Press **[F1]** **[Y=]** to display the equation entry screen.  
Type 55 and press **[ENTER]** to enter the equation as  $Y_2$ .



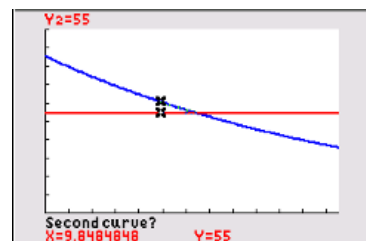
Press **[F5]** **[GRAPH]**.  
The GDC displays  $Y_1 = 85.7 \times 0.966^x$  and  $Y_2 = 55$



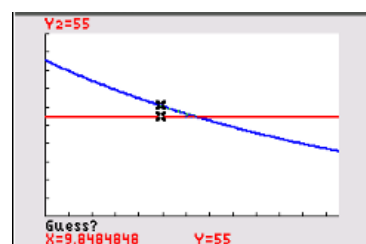
Press **[2nd]** **[F4]** **[CALC]** 5:intersect  
To find the intersection you need to choose the two lines that intersect.  
The GDC shows a cross on one of the lines and 'First curve?'.  
Press **[ENTER]**.



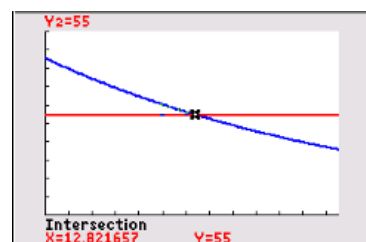
The GDC shows a cross on the other line and 'Second curve?'.  
Press **[ENTER]**.



The GDC requires an initial guess for the position of the intersection. Choose the default position.  
Press **[ENTER]**.



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.

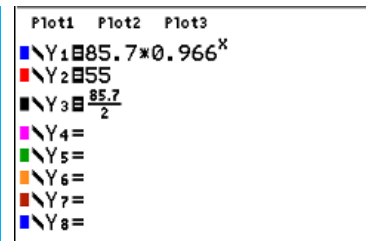


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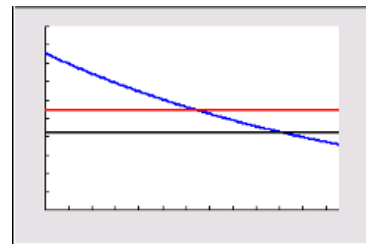
Press **[F1]** **[Y=]** to display the equation entry screen.

Type  $\frac{85.7}{2}$  and press **[ENTER]** to enter the equation as  $Y_3$ .



Press **[F5]** **[GRAPH]**.

The GDC displays the curve and two straight lines.

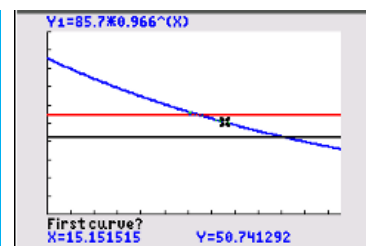


Press **[2nd]** **[F4]** **[CALC]** 5:intersect

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

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

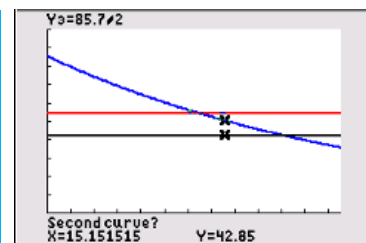
Press **[ENTER]**.



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

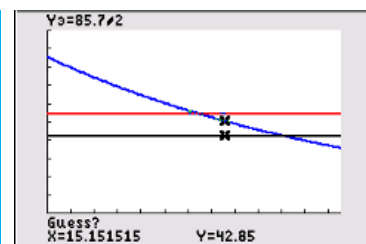
Use **[↓]** to select  $Y_3$ .

Press **[ENTER]**.



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

Press **[ENTER]**.



The GDC displays the intersection of the two straight lines at the point (20.0, 42.85)

The half life of the material is 20 years.

