

Chapter 13 / **Example 13**

# Definite integrals with technology

There are techniques of integration beyond the scope of this course, however, use technology to find the values of definite integrals of these functions.

- a** Find the area of the region bounded by the curve  $f(x) = e^{-x^2}$ , the lines  $x = -1$  and  $x = 1$ , and the  $x$ -axis.
- b** Find the area of the region bounded by the curves  $f(x) = \sin x$  and  $g(x) = 0.5x$ .

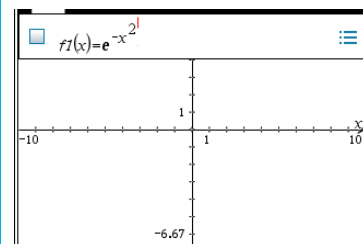
Open a new document and add a Graphs page.

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

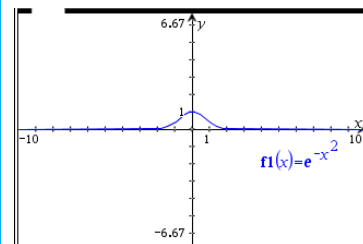
The default graph type is function, so 'f1(x)= ' is displayed.

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

Type  $e^{-x^2}$  and press **enter**.



The GDC displays the graph  $f1(x) = e^{-x^2}$  with the default axes.

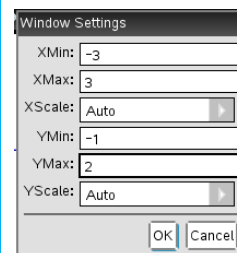


Press **menu** 4:Window/Zoom | 1:Window Settings...

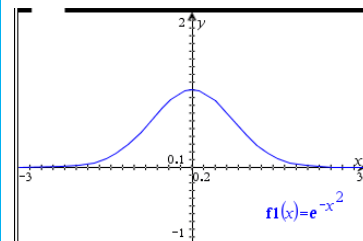
Set the axes to show  $-3 \leq x \leq 3$  and  $-1 \leq y \leq 2$

You can leave the scales set to Auto.

Press **enter** when you have finished.



The GDC displays the function  $Y_1 = e^{-x^2}$  in a suitable window.

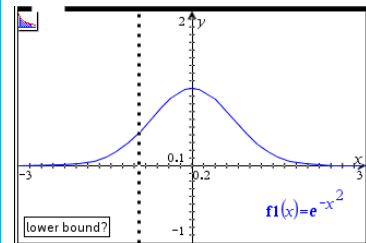


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To find the integral press **menu** 6:Analyze Graph | 6:Integral

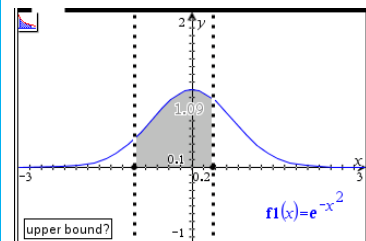
To find the intersection you need to give the lower and upper bounds of the region that includes the intersection.

The GDC shows a line and asks you to set the lower bound.



Do not use the line to set the lower bound as you need to enter an exact value.

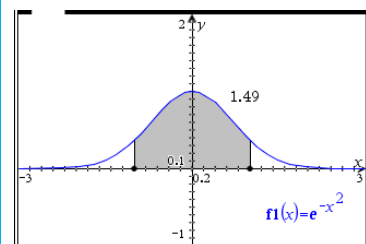
Type  $-1$  and press **enter**.



Type 2, the upper bound, and press **enter**.

The GDC shows the area defined by the integral and its value.

$$\int_{-2}^2 e^{-x^2} dx = 1.49$$

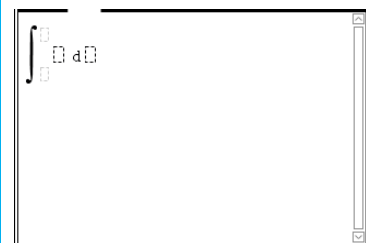


The integral can also be calculated without the need for a graph.

Press **ctrl** **doc** **(+page)** and add a new Calculator page.

Press **int** and select **def** with the trackpad.

The template shows places for the limits, the function and the variable that you are integrating with respect to.



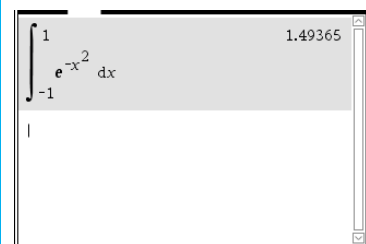
Enter the lower limit  $-1$  and using the upper limit 1.

Enter the function  $e^{-x^2}$

Use **◀▶▲▼** to navigate around the template.

Type X.

Press **enter**.



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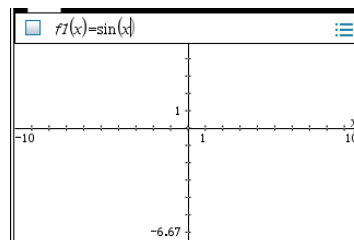
Open a new document and add a Graphs page.

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  $-6.67 \leq y \leq 6.67$ .

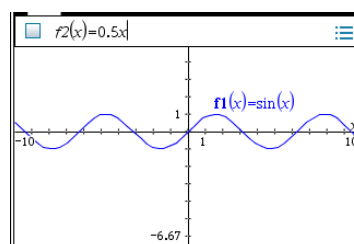
Type  $\sin(x)$ . To enter  $\sin$  press  $\boxed{\text{trig}}$  and select  $\sin$  from the list.



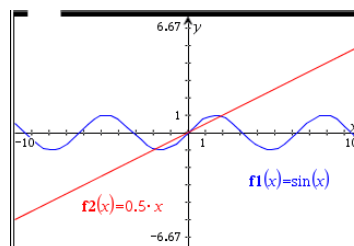
Press  $\boxed{\text{enter}}$ . The GDC displays the curve  $f1(x) = \sin x$  in the default window.

Press  $\boxed{\text{tab}}$  to display the entry line again. This time ' $f2(x)=$ ' is displayed.

Type  $0.5x$  and press  $\boxed{\text{enter}}$ .

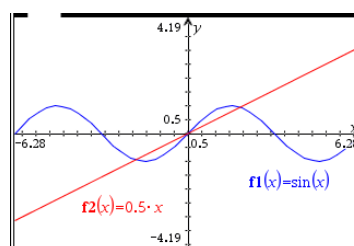


The GDC displays the curve  $f1(x) = \sin x$  and the line  $f2(x) = 0.5x$  in the default window.



Press  $\boxed{\text{menu}}$  4:Window/Zoom | 8:Zoom - Trig

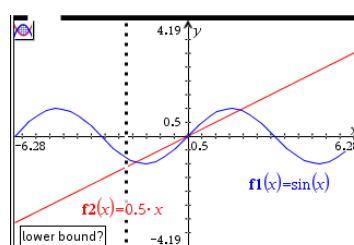
The GDC displays the curve  $f1(x) = \sin x$  and the line  $f2(x) = 0.5x$  in the default trigonometric window.



Calculate the area bounded by the curve and the line using the built-in function of the GDC.

Press  $\boxed{\text{menu}}$  6:Analyze Graph | 7:Bounded Area

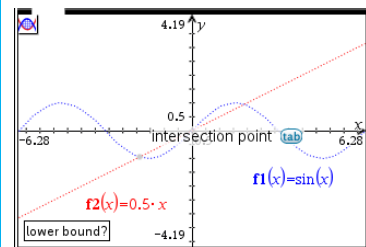
The GDC asks for a lower bound.



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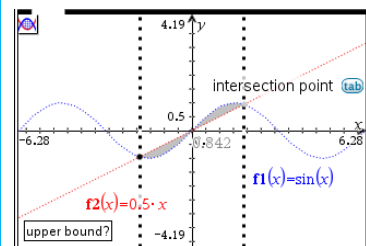
Use the touchpad to position the cursor so that it shows the left-hand intersection point.

Click the touchpad



Position the cursor over the right-hand intersection point.

Click the touchpad.



The GDC has calculated the area between the curve and the line.

The area of the region is 0.842.

