

Chapter 13 / **Example 13**

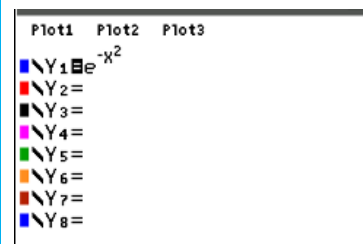
Definite integrals with technology

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 $g(x) = 0.5x$.

Press **MENU** 5 **GRAPH** **Y=** to display the equation entry screen.

Type e^{-x^2} and press **EXE** to enter the equation as Y1.

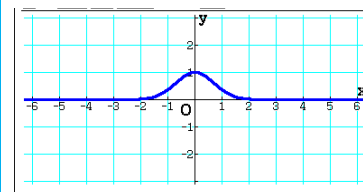


Press **F6** DRAW to display the graph screen

The GDC now displays the function:

$$Y1 = e^{-x^2}$$

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

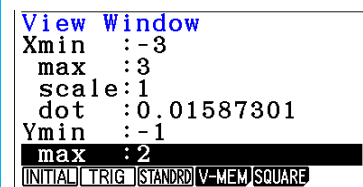


Press **F3** V-WIN.

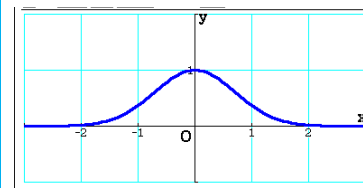
Set the axes to show $-3 \leq x \leq 3$ and $-1 \leq y \leq 2$

You can leave the last three items as they are.

Press **EXIT** **F6** DRAW when you have finished.



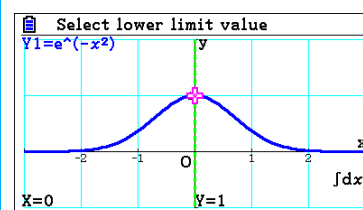
The GDC displays the function $Y1 = e^{-x^2}$ in a suitable window.



To find the integral press **F5** G-SOLVE **F6** \triangleright **F3** $\int dx$ **F1** $\int dx$

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

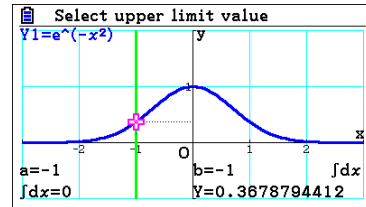
The GDC asks you to set the lower limit.



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Type -1 and press **EXE**.

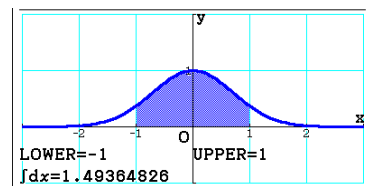
The GDC asks you to set the upper limit.



Type 1 , the upper limit, and press **EXE**.

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

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

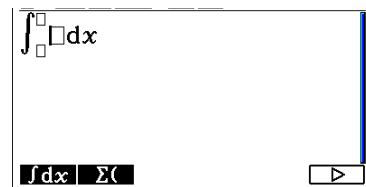


The integral can also be calculated without the need for a graph.

Press **MENU** 1 **RUN-MATH** to display the Run-Matrix screen for arithmetical calculations.

Press **F4** MATH **F6** \int **F1** $\int dx$

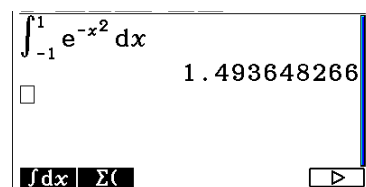
You will see an integral template. There are three fields to complete in the template: one for each of the limits and one for the function you are integrating.



Enter the function e^{-x^2}

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

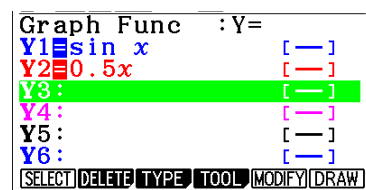
Press **EXE**.



Press **MENU** 5 **GRAPH** to display the equation entry screen.

Type $\sin x$ and press **EXE** to enter the equation as Y1.

Type $0.5x$ and press **EXE** to enter the equation as Y2.

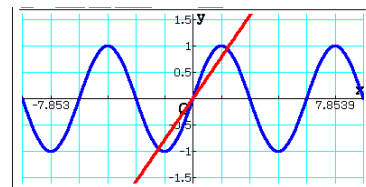


Press **SHIFT** **F3** V-WIN **F2** TRIG.

Press **EXIT** **F6** DRAW to display the graph screen.

The GDC now displays the functions:

$Y1 = \sin x$ and $Y2 = 0.5x$ with the default trigonometric axes.



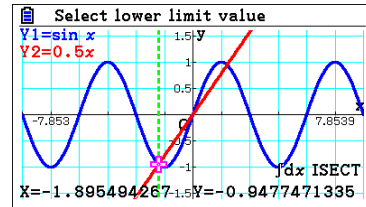
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Definite integrals with technology

To find the area of the region between the curve and the line press **F5** G-SOLVE **F6** \triangleright **F3** $\int dx$ **F3** INTSECT

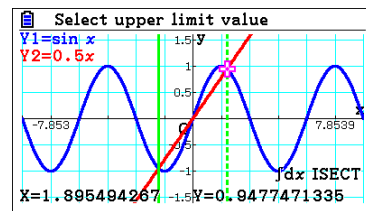
The GDC asks you to select the lower limit value.

Press **EXE**.



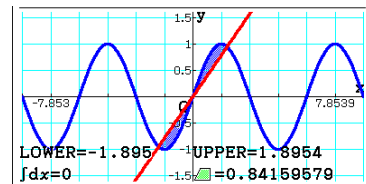
The GDC asks you to select the upper limit value.

Press **►** **►** to select the upper limit and press **EXE**.



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

The area of the region is 0.842.

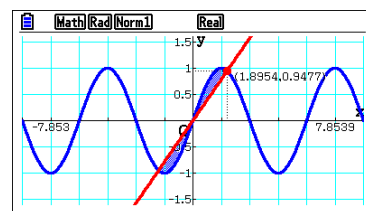


To find the area by integration you need to know the x-coordinate of the intersection.

Press **F5** G-SOLVE **F5** INTSECT.

Press **►** **►** to select the intersection to the right and press **EXE**. Press **EXIT** to leave G-Solv mode and **F6** DRAW to display the graph screen again.

The intersection is at (1.90, 0.948)

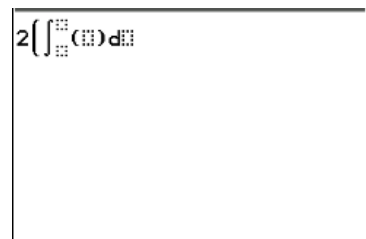


Due to the symmetry of the curve, you can find the area by calculating $2 \left(\int_0^X (Y1 - Y2) dx \right)$, where X is the x-coordinate of the intersection.

Press **MENU** 1 **RUN-MAT** to display the Run-Matrix screen for arithmetical calculations.

Type 2 (and press **F4** MATH **F6** \triangleright **F1** $\int dx$

You will see an integral template. There are three fields to complete in the template: one for each of the limits and one for the function you are integrating.



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Press **VAR** **F4** GRAPH **F1** Y and type 1 **=** **F1** 2

Press **▶** and type the lower limit 0.

Press **▲** and type X in the upper limit. (The result of the x-coordinate of the intersection was stored here).

Press **▶** and close the parentheses.

Press **EXE**.

$$2 \left(\int_0^X Y1 - Y2 dx \right) = 0.8415957901$$