

According to the Standards:

**Instructional programs from preK-grade 12 should enable students to:**

- Recognize and use connections among mathematical ideas
- Use the language of mathematics to express mathematical ideas precisely
- Select, apply and translate among mathematical representations to solve problems

**In grades 9-12 students should**

1. Students should develop an increased capacity to link mathematical ideas and a deeper understanding of how more than one approach to the same problem can lead to equivalent results.

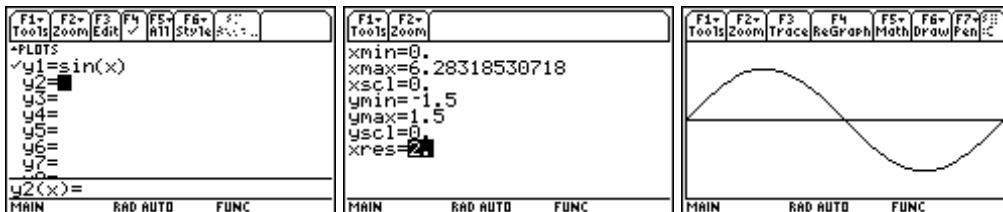
**Calculus Scope and Sequence:** Applications of Definite Integrals

**Keywords:** area, bounded area, area under a curve

**Description:** This activity will illustrate the idea of using the definite integral to represent the area bounded by a function and the  $x$ -axis.

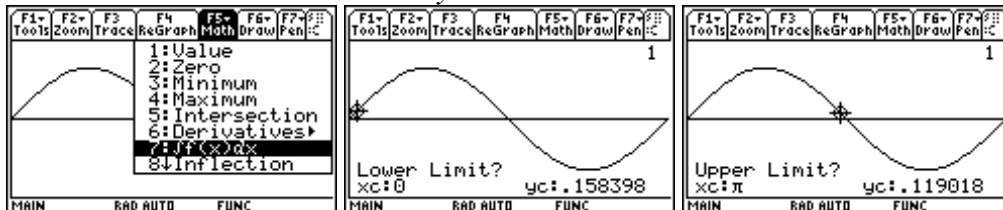
Find the area of the region bounded by one arch of the function  $y = \sin(x)$  in the first quadrant.

1. Go to the Y= screen and input the function  $\sin(x)$  in  $y_1$ :
2. Use a window as follows :  $x: [0, 2\pi]$  and  $y: [-1.5, 1.5]$
3. Produce the graph

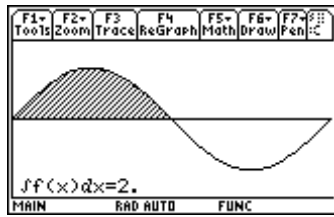


To find the definite integral on the graph screen

- Press F5-Math
- Item #7 is the definite integral key
- Give it a lower bound of 0
- Give it an upper bound of  $\pi$  (both of these can be entered directly)
  - *Note: use the arrows to trace to the approximate position But enter the boundaries directly.*

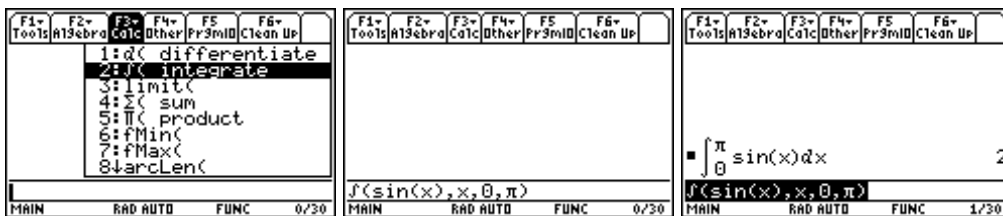


- Press Enter. It will shade the region and produce the result



To confirm the calculation on the Home screen:

- Press HOME
- The integral is found in F3-Calculator, #2
- The syntax is: (function, variable, lower, upper)



What the calculator shows you is the area bounded by the function and the  $x$ -axis.

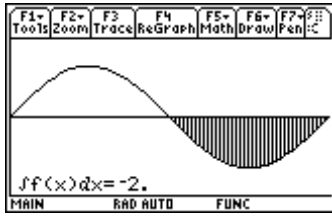
**Consider this:**

What would you expect to see if you did the same calculation from  $x = \pi$  to  $x = 2\pi$  ?

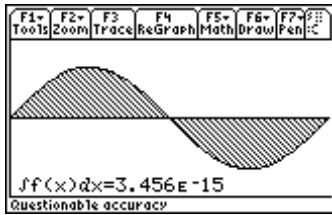
How about from  $x = 0$  to  $x = 2\pi$  ?

Why do you think you got those results? What does that say about the definite integral as a measuring tool?

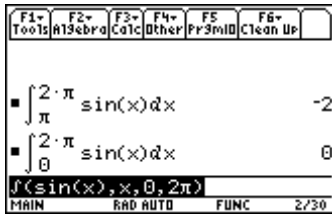
Answers to **Consider this:**



the area from  $x = \pi$  to  $x = 2\pi$



note how the graphical approximation here shows a “variation” on the value zero.



while the homescreen calculates exactly.

The definite integral is showing the signed area, with the boundaries moving from left to right. When some of the area is above the axis and some below what it does is take the net result.