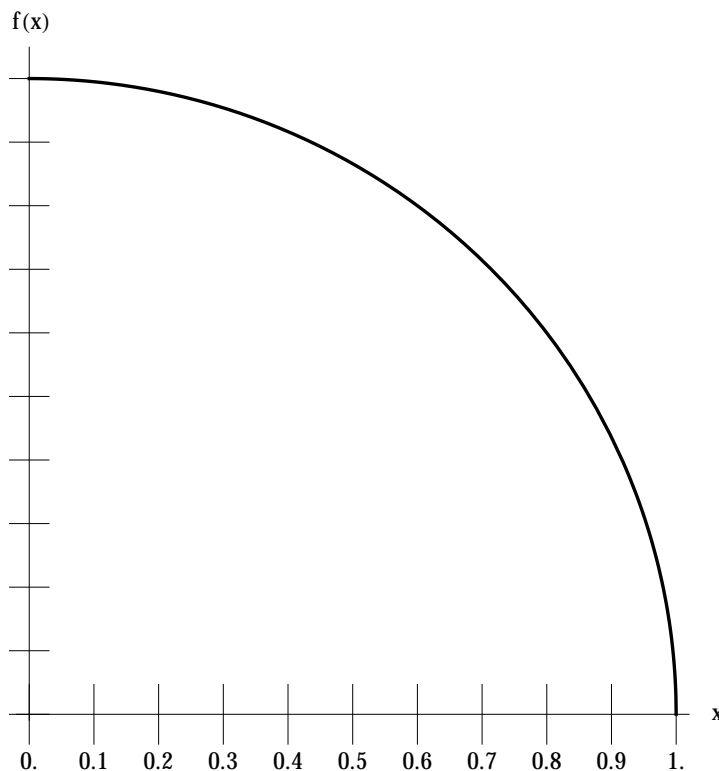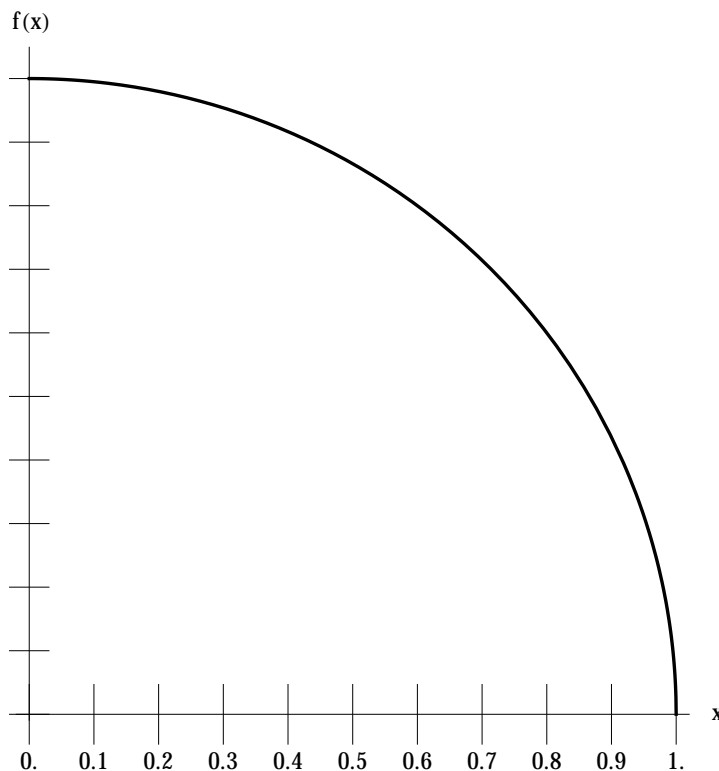1. Below is a sketch of the function $f(x) = \sqrt{1 - x^2}$.

(a) On top of this sketch, draw in the rectangles that would represent a *left endpoint* Riemann sum approximation, with $n = 5$, to the area A under this graph, from $x = 0$ to $x = 1$.

(b) Will your above left endpoint Riemann sum approximation, call it LEFT(5), be an overestimate or an underestimate of the above area? Explain, without doing any computations (yet).

(c) Use the Riemann sum represented in your above picture to approximate A. Give a numerical answer with at least four digits to the right of the decimal point.

$A \approx \text{LEFT}(5) =$

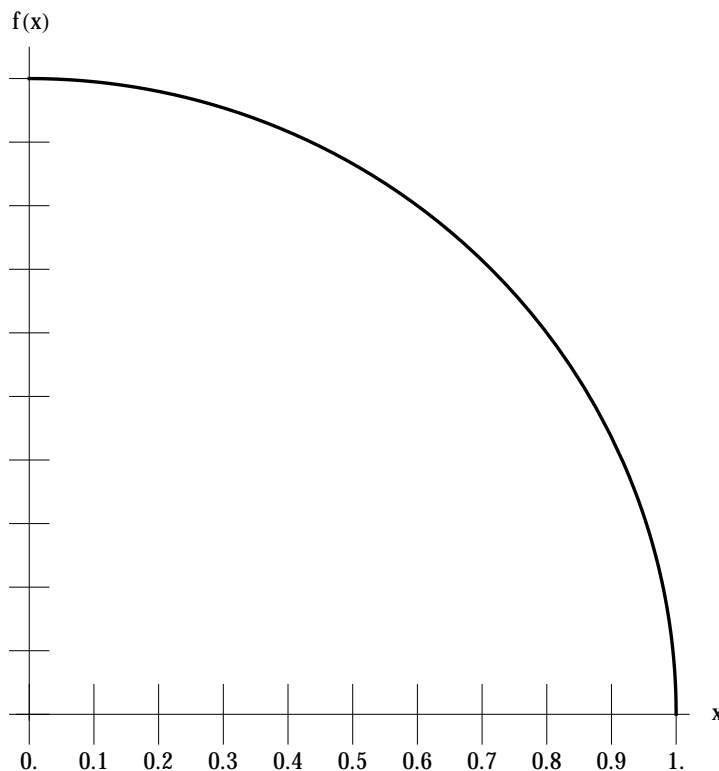2. Below, again, is a sketch of the function $f(x) = \sqrt{1 - x^2}$.

(a) On top of this sketch, draw in the rectangles that would represent a *right endpoint* Riemann sum approximation, with $n = 5$, to the area A under this graph, from $x = 0$ to $x = 1$.

(b) Will your above left endpoint Riemann sum approximation, call it RIGHT(5), be an overestimate or an underestimate of the above area? Explain, without doing any computations (yet).

(c) Use the Riemann sum represented in your above picture to approximate A. Give a numerical answer with at least four digits to the right of the decimal point.

$A \approx \text{RIGHT}(5) =$

3. Below, yet *again*, is a sketch of the function $f(x) = \sqrt{1 - x^2}$.

(a) On top of this sketch, draw in the rectangles that would represent a *midpoint* Riemann sum approximation, with $n = 5$, to the area A under this graph, from $x = 0$ to $x = 1$.

(b) Will your above left endpoint Riemann sum approximation, call it MID(5), be an overestimate or an underestimate of the above area? Explain, without doing any computations (yet).

(c) Use the Riemann sum represented in your above picture to approximate A. Give a numerical answer with at least four digits to the right of the decimal point.

$A \approx \mathrm{MID}(5) =$

4. *Without actually computing* the quantities LEFT(2000), RIGHT(2000), and MID(2000), list the following in increasing order:

   LEFT(2000), RIGHT(2000), MID(2000), MID(5), A, RIGHT(5), LEFT(5)

   Please explain how you got your answer.

5. What is A *exactly* (to four decimal places)? Hint: as you can see, the graph of $f(x)$ on $[0, 1]$ describes a quarter circle.