



Part 1 – Graphical Riemann Sums

On the HOME screen, type **area()** to start the Area Approximation program.

To use the program, select to view the approximation either graphically or numerically. Next, enter the equation that you are examining and press **ENTER**. You will be prompted for the minimum value, maximum value, and the number of steps. Then, select the approximation method and press **ENTER**. The approximation will be displayed on the screen. You can then select to enter another function, do another approximation or to exit the program.

Use the Area Approximation program to graphically examine functions to complete this part of the activity.

1. For $y_1(x) = -0.5x^2 + 40$, how do the left, midpoint, and right Riemann sums compare? Explain why.

2. Describe what happens to the left, midpoint, and right Riemann sums as you increase the number of subintervals, n .

3. Is the midpoint Riemann sum an over or under approximation if the graph is:

- a. increasing and concave down? ___ over ___ under
- b. increasing and concave up? ___ over ___ under
- c. decreasing and concave down? ___ over ___ under
- d. decreasing and concave up? ___ over ___ under

After graphically exploring (especially with a small number of subintervals), explain why.



Part 2 – Summation notation

Examine the function $y_1(x) = -0.5x^2 + 40$.

1. The thickness of each rectangle is $\Delta x = h = \frac{b-a}{n}$. If $a = 1$, $b = 6$, and $n = 5$. What is Δx ?
2. Expand $\sum_{i=1}^5 (1 \cdot y(a + (i-1) \cdot 1))$ by writing the sum of the five terms and substitute $i = 1, 2, 3, 4$, and 5 .
3. Explain why this is the summation notation for LEFT Riemann sums and not the RIGHT.
4. Let $y(x) = -0.5x^2 + 40$, $a = 1$, and $b = 6$. Write the sigma notation and use the HOME screen to evaluate the left Riemann sum for 10, 20, 50, and 100 subintervals.
 - a. $n = 10$
 - b. $n = 20$
 - c. $n = 50$
 - d. $n = 100$

Extension – Area Programs

Use the Area Approximation program to answer the following questions.

1. Let $y(x) = x^2$, $a = 1$, and $b = 6$. Write the results for midpoint and trapezoid area approximations when:
 - a. $n = 10$
 - b. $n = 100$
 - c. $n = 500$
2. Compare the above midpoint and trapezoid values with the actual area.