Things to remember:

1. The problem to complete is shown below. Write your name and solution on the next page where instructed.
2. Please make sure your full name is written neatly in the box.
3. Your score will be determined by **Mechanics** (2 points) and by **Content** (3 points).
4. The following rubric will be used for **Mechanics**:

Clear neat work, steps in order and easily followed, proper use of notation	2
Mostly clear work; minor errors in notation or skipped steps	1.5
Steps/handwriting hard to follow/read; major errors in notation	1
No discernible or relevant work, or work impossible to read/follow	0

5. You are not allowed to consult outside sources, including notes, books, the internet, or other people, while taking this assessment. Calculators are allowed only for basic numerical or scientific computations, not for graphing or algebra.
6. If you need more room, you may finish on a plain piece of paper or blank document. If you do all your work on separate sheets, please **copy the problem** and make sure to write **Version A** at the top of the first page.
7. When you are finished, create a legible, well-lit **.pdf file** of your work and upload it to Assessment 9 on Gradescope. Please follow the directions to **assign the page(s)** of your submission that contain your work for the question. More info about submitting to Gradescope:

   `http://bit.ly/gradescope-help`

Use the given numerical methods to estimate the area on the next page. For each method, give both an **exact answer** (no simplification required) and an **approximation** to 2 decimal places.

Your solution should include:

- (0.5 point) Correct computations of Δx;
- (1 point) Correct explanation and use of Trapezoid Rule, with correct exact answer;
- (1 point) Correct explanation and use of Simpson's Rule, with correct exact answer;
- (0.5 point; 0 if no relevant work/explanation) Correct decimal approximations.

You may or may not find the following formulas useful:

- $T(n) = \dfrac{\Delta x}{2}(f(x_0) + 2f(x_1) + 2f(x_2) + \ldots + 2f(x_{n-1}) + f(x_n))$
- $S(n) = \dfrac{\Delta x}{3}(f(x_0) + 4f(x_1) + 2f(x_2) + \ldots + 4f(x_{n-1}) + f(x_n))$

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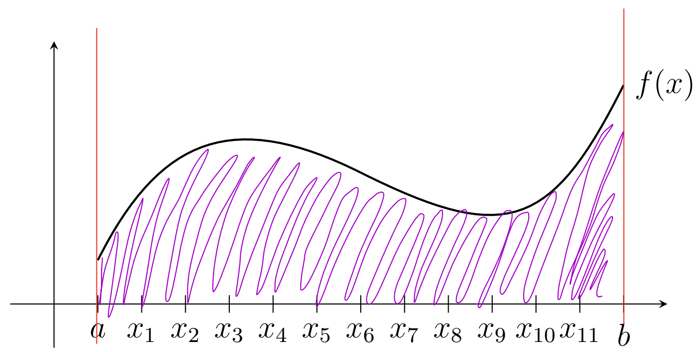
Version A

For the function $f(x)$ graphed below, estimate the area between $f(x)$ and the x-axis from $x = a$ to $x = b$ in each of the following ways:

(a) Using the Trapezoid Rule with $n = 4$;

(b) Using Simpson's Rule with $n = 6$.

(n refers to the number of sub-intervals used in the approximation.)



The graph is not necessarily to scale. Assume $a = 1$ and $b = 23$, that the marks on the x-axis are equally spaced, and that the y-values of $f(x)$ are as follows:

x	a	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	b
$f(x)$	1.3	4	10.7	14.2	13.1	9.8	8.3	7	5.9	3.2	4.8	9.6	14
	0		1	a	2		3 b		4	c	5		6 d

(a) Using the Trapezoid Rule with $n = 4$;

$$\frac{b-a}{n} = \frac{23-1}{4} = \frac{11}{2}$$

$$\left[\underset{x_0}{1.3}, \underset{x_3}{14.2}, \underset{x_6}{8.3}, \underset{x_9}{3.2}, \underset{x_{12}}{14}\right]$$

$$\frac{\Delta x}{2}\left[f(x_0) + 2f(x_1) + 2f(x_2) + \cdots + f(x_n)\right]$$

$$= \frac{\frac{11}{2}}{2}\left[1.3 + 2(14.2) + 2(8.3) + 2(3.2) + 14\right]$$

$$= \frac{11}{4}\left[1.3 + 28.4 + 16.6 + 6.4 + 14\right]$$

$$= \frac{11}{4}\left[66.7\right]$$

$$\boxed{= 183.43 \text{ or } \frac{7337}{40}}$$ ✓

(b) Using Simpson's Rule with $n = 6$.

$$\frac{b-a}{n} = \frac{23-1}{6} = \frac{11}{3}$$

$$\left[\underset{x_0}{1.3}, \underset{x_2}{10.7}, \underset{x_4}{13.1}, \underset{x_6}{8.3}, \underset{x_8}{5.9}, \underset{x_{10}}{4.8}, \underset{x_{12}}{14}\right]$$

$$\frac{\Delta x}{3}\left[f(x_0) + 4(f(x_1)) + 2f(x_3) + \cdots + f(x_n)\right]$$

$$= \frac{\frac{11}{3}}{3}\left[1.3 + 4(10.7) + 2(13.1) + 4(8.3) + 2(5.9) + 4(4.8) + 14\right]$$

$$= \frac{11}{9}\left[1.3 + 42.8 + 26.2 + 33.2 + 11.8 + 19.2 + 14\right]$$

$$= \frac{11}{9}\left[148.5\right]$$

$$\boxed{= 181.50 \text{ or } \frac{363}{2}}$$ ✓