



# USING CHATGPT IN SOLVING DEFINITE INTEGRALS

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## ABSTRACT

Artificial intelligence has an inevitable scientific and societal development nowadays. It is increasingly involved in human everyday life with the simple purpose of making it easier. Therefore, in this work, we will explore the possibilities of ChatGPT as an artificial intelligence tool in the application of definite integrals. The application of definite integrals is reviewed in calculating the length of a curve, the area of a figure, the volume, and the surface area of a rotating body generated by rotation around the X or Y axis. In this paper, the following questions will be answered: How effective is the solution to the task given to ChatGPT? To what extent does this solution correspond to the solution of the same task solved by a human? Are mathematicians satisfied with this tool for solving this type of math problem? What improvements should be made for ChatGPT so that the solution of such types of tasks meets mathematical standards?

### Example 1. Solving the definite integral

#### The integral

$$\int_0^{-3} \frac{dx}{\sqrt{25+3x}}$$

By the substitution  $u = 25 + 3x$ ,  $du = 3dx$ ,

and by changing the limits of integration:

$$\int_{25}^{16} \frac{dx}{\sqrt{25+3x}} = \int_{25}^{16} \frac{1}{\sqrt{u}} \cdot \frac{du}{3}$$

i.e.

$$\int_0^{-3} \frac{dx}{\sqrt{25+3x}} = -\frac{2}{3}$$

Mistake

### Example 2. Finding the length of the curve

The length of the curve  $y = \frac{2}{3}x^{\frac{3}{2}}$  for  $x \in [0, 8]$

By the formula:

$$L = \int_{x_1}^{x_2} \sqrt{1 + \left(\frac{dy}{dx}\right)^2} dx$$

i.e.

$$L = \int_0^8 \sqrt{1+x} dx$$

The length of the curve is  $\frac{52}{3}$ .

### Example 3. Finding the area of the figure bounded functions

The area bounded by the functions

$y = x^2$  and  $y = x^3$ :

$$\int_0^1 (x^3 - x^2) dx = \left[ \frac{x^4}{4} - \frac{x^3}{3} \right]_0^1 = -\frac{1}{12}$$

Ah, there was error. So, the area

bounded by the functions

$y = x^2$  and  $y = x^3$  is  $\frac{1}{12}$  square units.

Mistake

## Main conclusions

Advantages are:

1. ChatGPT solves the problems in detail;
2. ChatGPT writes down all the formulas it uses;
3. Sometimes ChatGPT finds its own mistakes.

Disadvantages are:

1. does not draw diagrams when calculating area and volume;
2. When calculating the area of a region bounded by functions, ChatGPT often gets a negative number, not considering which function is upper and which is lower;
3. ChatGPT makes mistakes when solving more complex definite integrals.

**Therefore, ChatGPT still needs more learning in this mathematical area.**

### Example 4. Finding the volume by rotating around the x-axis

The volume by rotating around the x-axis of the figure limited by  $y = \frac{1}{x}$  from  $x=1$  to  $x=\pi$  is

$$V = \pi \int_a^b [f(x)]^2 dx$$

$$V = \pi \int_1^\pi \left(\frac{1}{x}\right)^2 dx$$

$$= \pi \int_1^\pi \frac{1}{x^2} dx$$

$$= \pi \left[ -\frac{1}{x} \right]_1^\pi$$

$$= \pi \left( -\frac{1}{\pi} + 1 \right)$$

$$= \pi \left( 1 - \frac{1}{\pi} \right)$$

$$= \pi - 1$$

**Therefore, the volume is  $\pi-1$  cubic units.**