

# The Fundamental Theorem of Calculus

The Fundamental Theorem of Calculus is a theorem that connects the concept of differentiating a function with the concept of integrating a function. This theorem is divided into two parts:

### 1.1 First Part

The first part of the Fundamental Theorem of Calculus states that if  $f$  is a continuous real-valued function defined on a closed interval  $[a, b]$  and  $F$  is the function defined, for all  $x$  in  $[a, b]$ , by:

$$F(x) = \int_a^x f(t) \, dt \tag{1.1}$$

Then,  $F$  is uniformly continuous and differentiable on the open interval  $(a, b)$ , and  $F'(x) = f(x)$  for all  $x$  in  $(a, b)$ .

### 1.2 Second Part

The second part of the Fundamental Theorem of Calculus states that if  $f$  is a real-valued function defined on a closed interval  $[a, b]$  that admits an antiderivative  $F$  on  $[a, b]$ , and  $f$  is integrable on  $[a, b]$  (it need not be continuous), then

$$\int_a^b f(t) \, dt = F(b) - F(a). \tag{1.2}$$

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*This is a draft chapter from the Kontinua Project. Please see our website (<https://kontinua.org/>) for more details.*



# Answers to Exercises





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