

The Fundamental Theorem of Calculus, Part 2

Warm-up

Find the area under the curve $f(x) = 2x - 1$ over $[-1, 1]$.

The Fundamental Theorem of Calculus Part 2

Example 1: Find $\frac{d}{dx} \left[\int_1^x t^3 dt \right]$

Example 2: Find $\frac{d}{dx} \left[\int_3^x (t^2 + 2) dt \right]$

Practice Problem 1: Find $\frac{d}{dx} \left[\int_{-2}^x (3t - 1) dt \right]$

The Fundamental Theorem of Calculus, Part 2

$$\frac{d}{dx} \left[\int_a^x f(t) dt \right] = f(x)$$

Example 3: Find $\frac{d}{dx} \left[\int_1^x \frac{\sin t}{t} dt \right]$

The Fundamental Theorem of Calculus, Part 2

Practice Problem 2: $\frac{d}{dx} \int_1^x \sin(t^2) dt$

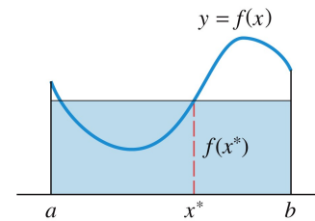
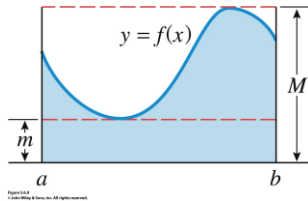
Example 4: Let $F(x) = \int_4^x \sqrt{t^2 + 9} dt$. Find

a) $F(4)$

b) $F'(4)$

c) $F''(4)$

The Mean-Value Theorem for Integrals



The area of the shaded rectangle is equal to the area of the shaded region in Figure 5.6.9.

Figure 5.6.9
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The Mean-Value Theorem for Integrals

$$\int_a^b f(x) dx = f(c)(b-a)$$

Example 5: Find the mean value guaranteed by the Mean-Value Theorem for Integrals for the function $f(x) = x^2$ over $[1, 4]$.

Practice Problem 3: Find the mean value guaranteed by the Mean-Value Theorem for Integrals for the function $f(x) = \sqrt{x}$ over $[0, 3]$.