Theorem 5.5.1 (FTC)**.** *Assume f is continuous on $[a, b]$.*

If $F(x)$ is an antiderivative of f then

Remark 5.5.1. *We can use any antiderivative of $F(x)$ when integrating definite integrals. Therefore, we will choose the antiderivative with $C = 0$.*

Examples

Example 5.5.1. *Evaluate* $\displaystyle\int_{-3}^{4} (3x^2 - 4x)\, dx$

Example 5.5.2. *Integrate* $\displaystyle\int_0^4 3 + \sqrt{x}\,dx$

Example 5.5.3. *Integrate* $\displaystyle\int_0^{\ln 3} e^{-2x}\,dx$

Example 5.5.4. *Evaluate* $\displaystyle\int_{-3}^{0} \frac{x}{16 - x^2}\, dx$

Example 5.5.5. *Evaluate* $\displaystyle\int_{3}^{0} x\sqrt{x^2 + 16}\, dx$

Example 5.5.6. *An oil well starts out producing oil at a rate of 60,000 barrels per year, and the production rate decreases by 4,000 barrels per year. Thus, if $P(t)$ is the total production (in thousands of barrels) in t years, the rate of change of production is $P'(t) = 60 - 4t$, $0 \le t \le 15$. Find the total production of oil (in thousands of barrels) over the first 7 years of operation.*

(1) 32
(2) 42
(3) 322
(4) 420

Average Function Value

The Average Value of f over the interval $[a, b]$ is defined as

Examples

Example 5.5.7. *Find the average value of $g(t) = -6t^2 + 4t$ over the interval $[-2, 3]$.*

Example 5.5.8. *Suppose the inventory, I, of a certain item, t months after the first of the year, is $I(t) = 3 + 18t - 3t^2$, $0 \leq t \leq 12$. What is the average inventory for the first 6 months of the year?*