A Modular Presentation System for the Calculus Sequence

5.4 Indefinite Integrals and the Net Change Theorem

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Indefinite Integral Symbol

Indefinite Integral

$$\int f(x)dx = F(x) \Leftrightarrow F'(x) = f(x)$$

Recall the Leibniz notation:

$$\frac{d}{dx}F(x) = f(x) \Leftrightarrow dF(x) = f(x)dx$$

Common Indefinite Integrals

See Table 1 on page 406.

The Net Change Theorem

The Net Change Theorem

The integral of a rate of change is the net change:

$$\int_a^b F'(x)dx = F(b) - F(a)$$

Example

Example If $V(t)$ is the volume of water in a reservoir at time t, then its derivative $V'(t)$ is the rate at which water flows into the reservoir at time t. So

$$\int_{t_1}^{t_2} V'(t)dt = V(t_2) - V(t_1)$$

is the change in the amount of water in the reservoir between time t_1 and time t_2.

Application: Particle Movement

A particle moves along a line so that its velocity at time t is $v(t) = t^2 - t - 6$ (measured in meter per second).

1. Find the displacement of the particle during the time period $1 \leq t \leq 4$.
2. Find the distance traveling during this time period.