

Antidifferentiation

The process of undoing differentiation

The reut of antidifferentiating is called an **antiderivative**

Example 1.1

Suppose $3x^2$ is the derivative. What is the antiderivative?

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Theorem 1.2

The **antiderivative** of $f(x)$ is the set of functions $F(x) + C$ such that

$$\frac{d}{dx} [F(x) + C] = f(x)$$

The constant C is called the constant of integration.

Indefinite Integral Notation

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Example 1.3

Determine the indefinite integrals (find the antiderivative) of

1 $\int 3x^2 dx$

2 $\int 4 dx$

3 $\int \frac{1}{x} dx$

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Rules of Antidifferentiation**Theorem 1.4**

1 *Constant Rule:*

2 *Power Rule: ($n \neq -1$)*

3 *Natural Logarithm Rule:*

4 *Exponential Rule (base e)*

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Example 1.5

Find the following indefinite integrals

$$1 \int x^8 dx$$

$$2 \int 3x^8 dx$$

$$3 \int t^{-4} dx$$

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$$4 \int e^{-3x} dx$$

$$5 \int \frac{1}{\sqrt{x}} dx$$

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$$6 \int (2x^4 + 3x^{-3} - 7x^2 + x - 5) dx$$

$$7 \int \frac{x^2 - 7x + 2}{x^2} dx$$

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Find the constant C - Initial Conditions

$$1 \text{ Find } g \text{ such that } g'(x) = \frac{3}{x^2} + 6, f(2) = 1.$$

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2 Find h such that $h'(x) = 6e^{3x} + 2$, $h(0) = 2$.

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Hints for the word problems

1 $C(x) =$

2 $R(x) =$

3 $P(x) =$

4 $h(t) =$

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Example 1.6

A company determines that the marginal cost, C' , of producing the x -th unit of a product is given by

$$C'(x) = x^3 - 2x$$

Find the total cost function, C , where $C(x)$ is in dollars and the fixed costs are \$7,000.

Example 1.7

A rock is thrown directly upward with an initial velocity of 50 ft/sec from an initial height of 10 ft. The velocity of the rock is modeled by

$$v(t) = -32t + 50$$

, where t is in second, v is ft/sec, and $t = 0$ represents the moment the rock is released.

- 1 Determine a distance (height) function h as a function of t .
- 2 Determine the height and velocity of the rock at $t = 0$, after 2 seconds, and after 4 seconds.