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Math 31A Lecture Notes: Integration

Derivative position 🡪 velocity 🡪 acceleration

Antiderivative / Indefinite Integral ⬄ Area / Definite Integral

“formal” Fundamental Theorem of Calculus “geometric”

Definition; Antiderivative:

A function is called an antiderivative of in an open interval (a, b) if

Example 1:

is an antiderivative of

is an antiderivative of

Observation: If is an antiderivative of , is an antiderivative of ; is constant.

, , and are all antiderivatives of .

Theorem; Indefinite Integrals:

Let be an antiderivative of in (a, b), then every other antiderivative of is the form for is constant.

Proof: Let be antiderivatives of then,

Hence, for a constant c

Example 2:

Describe the general antiderivative in the form, then every other derivative of is of the form for is constant.

🡪 is the general antiderivative of

Notation: The notation means that

↗ ↑ ↖

integral integrand differential

We say that is the definite integral of .

Theorem; Power rule for integrals:

for

Proof:

is the antiderivative of

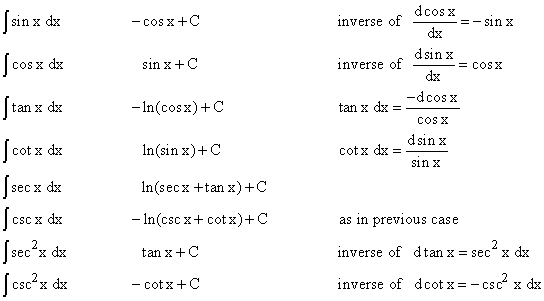
Example 3:

Theorem; Linearity of indefinite integral:

Where are constants

Example 4: Evaluate

Basic Trigonometric Integrals



Initial Condition

Antiderivatives are solutions to differential equations at the form:

This had infinitely many solutions where is an antiderivative. But if we fix an initial condition . There will be a unique solution.

Example 5: Solve subject to

Example 6:

A car has a velocity of 24 m/s at . We brake at a constant deceleration of 6 m/s2. Find:

1. velocity v(t) at t
2. distance traveled between the car stop

Solution: