

Mr. C. Sdoutz

Unit 4: Integration
4.1 Indefinite Integration

If $f'(x) = 4x^3$, find $f(x)$.

*"undo" the differentiation process

Definition

A function F is an antiderivative of f if $F'(x) = f(x)$.

A function can have an infinite number of antiderivatives because of all the different constants – called a "family" of solutions.

Finding antiderivatives is often referred to as solving a differential equation (DE).

ex. Find the general solution of the differential equation $f'(x) = 2x$.

Notation:

When solving a differential equation

$$\frac{dy}{dx} = f(x)$$

We rewrite

Then

The process is called antidifferentiation or indefinite integration.

* indefinite integral = antiderivative

The variable of integration is important.

ex. $\int 2 dx =$ $\int 2 dt =$

Differentiation and indefinite integration are inverse operations.

Basic Integration Rules

1. $\int 0 \, dx =$

2. $\int k \, dx =$

3. $\int kf(x) \, dx =$

4. $\int [f(x) \pm g(x)] \, dx =$

5. $\int x^n \, dx =$

ex. Find $\int 3x \, dx$

ex. Find $\int \frac{1}{x^3} \, dx$ *rewrite

ex. Find $\int 2\sin x \, dx$

ex. Find $\int (x + 2) \, dx$

ex. Find $\int \frac{x^3+3}{x^2} dx$

*note: there is no product or quotient rule for antiderivatives

$$\neq \frac{\int x^3 + 3 dx}{\int x^2 dx}$$

If given an initial condition (a point) we can find a particular solution to the differential equation (ie. determine the value of c through substitution).

ex. Solve the D.E. $f'(x) = \frac{1}{x^2}$ if $f(1) = 0$

Step 1: find the general solution

Step 2: solve for c using the initial condition

Thus the particular solution is

Practice Questions

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