We will start integration by first looking at the Indefinite Integral (general integral) and then later the definite integral.

We find the indefinite integral by finding the antiderivative.

Antiderivatives

think of it as you are given the derivative and you must find the original function

** working backwards

$f'(x) \longrightarrow f(x)$

Ex. $f'(x) = 7x^3+9x^2+8x-1$

Find the antiderivative

* Add 1 to the exponent, then divide by the exponent

This is the reverse of the power rule

*** This only works for simple terms !

same as power rule

Ex. $f'(x) = 7x^3+9x^2+8x-1$

* Check answer by finding the derivative

Ex. $f'(x) = 8x^{\frac{1}{2}} + 2x^{-3} + 5x - 6$

antiderivative ⟶ " integral"

$\int$ integral sign

this symbol is often put in front of the function
meaning find the antiderivative

$$\int \left(x^{\frac{5}{6}} - 3x^{\frac{9}{2}} + x^{-6} - 3x^{\frac{-1}{2}} \right) dx$$

finish with dx at the end
means slices go in the x direction
and approach the width of zero

Indefinite Integral

- most "general" antiderivative

$$\int f(x)\,dx = F(x) + c$$

$\int$ ⟶ integral symbol

$f(x)$ ⟶ integrand

x ⟶ integration variable

c ⟶ constant of integration

Ex. $\int \frac{5x^4 - 7x^2 + 8}{x^4} \, dx$

The process of finding the indefinite integral is called integration or integrating f(x)

We are integrating f(x) with respect to x.

$$\int (x^4+3x-9)\,dx$$

Ex. $\int (\sqrt{x} - 5\sqrt[4]{x} + 10)\, dx$

One of the most common mistakes with integrals is to drop the dx at the end of the integral. This is required!

Think of the integral sign and dx as a set of brackets.

$\int$ opens the brackets and dx must close it.

Simple Integrals

$$\int e^x \, dx = e^x + c$$

$$\int \frac{1}{x} \, dx = \ln|x| + c$$

Constants do not change these, however powers do.

Ex. $\int 5e^x \, dx$

Ex. $\int \frac{10}{x} \, dx$

Integrals of Trig. functions

$$\int \sin x \, dx = -\cos x + c$$

$$\int \cos x \, dx = \sin x + c$$

$$\int \sec^2 x \, dx = \tan x + c$$

$$\int \sec x \tan x \, dx = \sec x + c$$

$$\int \csc x \cot x \, dx = -\csc x + c$$

$$\int \csc^2 x \, dx = -\cot x + c$$

* All of these have a linear power of x
  [that is, x is to the power of one]

* If there is a constant in front of the linear x, then divide by that constant
[do not add one to the constant for these simple integrals]

$$\int e^{10x}\,dx = \frac{e^{10x}}{10} + c$$

Ex. $\int (e^{5x} - 4e^{6x} + \sin 12x - \sec^2 8x) \, dx$

Ex. $\int x^3 + 9x^{-5} + \frac{2}{x} + 7e^{-2x} \; dx$

$$\int \sin x^2 \, dx$$

Cannot do yet! (Not a simple integral because x is squared)