INTEGRAL PART 1

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IG: elevateiq_tutoring
Email: elevateiqtutor

## Integration to integrals:

-> One of the two operations that defines calculus with differentiation

-> Primary purposes:

-> Find areas under curves, volumes, central points

-> Two main types:

-> Indefinite integrals: Represent a family of functions and include an arbitrary constant C

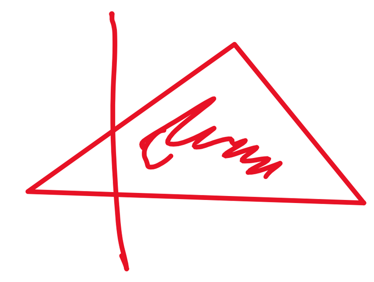
↳ Known as constant of integration

-> Essentially the antiderivative of a function

-> Definite integrals: Have upper and lower limits; used to calculate area under a curve from one point to another

-> Gives specific value

$\int \underbrace{x}_{u} \, dx \to du$



$\underbrace{C}$

## Basic integration rules:

(1) Constant Rule: $\int a \, dx = ax + C$, where a is a constant

(2) Power Rule: $\int x^n \, dx = \frac{x^{n+1}}{n+1} + C$ for all $n \neq -1$

$n + 1 = 0$

$n = -1$

(3) Sum Rule: $\int [f(x) + g(x)] dx = \int f(x) \, dx + \int g(x) \, dx$

## Techniques of integration:

(1) Substitution: Useful when you spot a function and its derivative in an integral

Ex: $\int x\cos(x^2+1) \, dx \to$ let $u = x^2 + 1$

(2) Integration by parts: method derived from product rule of differentiation

Useful formula: $\int u \, dv = uv - \int v \, du$

(3) Partial fractions: used for integrating rational functions, where you express the fraction as a sum of simple fractions

$\frac{A}{x} + \frac{B}{x} + \frac{C}{x}$

## Examples:

(1) $\int 5 \, dx \to 5x + C$    $ax + C$

(2) $\int 3x^2 \, dx \to \frac{x^{n+1}}{n+1} + C$

$\to \frac{3x^{2+1}}{2+1} = \frac{3x^3}{3} + C$

$= x^3 + C$

$x^3 \to 3x^2$

(3) $\int [f(x) + g(x)] dx$

$= \int f(x) dx + \int g(x) \, dx$

$\int (\underbrace{2x^2}_{f(x)} + \underbrace{3x}_{g(x)} + \underbrace{4}_{h(x)}) dx \to \int 2x^2 \, dx + \int 3x \, dx + \int 4 \, dx$

$\int f(x) + \int g(x) + \int h(x)$

$3x^1$

$\to \left[\frac{2x^{2+1}}{2+1} + C_1\right] + \left[\frac{3x^{1+1}}{1+1} + C_2\right] + \left[4x + C\right]$

$n + 1$    $1 = n$

$4x + C$

$= \frac{2x^3}{3} + \frac{3x^2}{2} + 4x + C$

$\hookrightarrow C_1 + C_2 + C_3$

$C =$

$\int 4v$    $4$

$\int a$