# Antidifferentiation ↔ "Integration"

Antidiff. ✓
Rect. mot.
Substit
* Diff. Eq.
Slope field

Summations $\sum_{i=1}^{n} i^2$
Approx area
Exact area $\lim \sum$
Def Integral

FTC
Areas / Volumes
Accumulator ✓

$f'(x) = 4x + 3$

$f(x) = 2x^2 + 3x + C$

$$\int (4x+3)\,dx = 2x^2 + 3x + C$$

$$\int \left(\sqrt{x} + \sqrt{x^3}\right) dx = \int \left(x^{1/2} + x^{3/2}\right) dx$$

$$= x^{3/2} + x^{5/2} + C$$

$$= \sqrt{x^3} + \sqrt{x^5} + C.$$

$$\int x^{-1}\,dx = \frac{x^0}{0}$$ nope.

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

## Power Rule for Antiderivatives

$$\int u^n\,du = \begin{cases} \dfrac{u^{n+1}}{n+1} & n \neq -1 \\ \ln|u| & n = -1 \end{cases}$$

$$\int \sqrt{x}\,(x+5)\,dx$$

$$= \int x^{1/2}(x+5)\,dx$$

$$= \int \left(x^{3/2} + 5x^{1/2}\right) dx$$

$$= \frac{2}{5}x^{5/2} + 5 \cdot \frac{2}{3}x^{3/2} + C$$

$$= \frac{2}{5}\sqrt{x^5} + \frac{10}{3}\sqrt{x^3} + C$$

$$\int \frac{x^2+5x}{x^2}\,dx = \int x^{-2}\left(x^2+5x\right)dx$$

$$= \int \left(1+5x^{-1}\right)dx$$

$$= x + 5\ln|x| + C$$

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

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

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

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

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

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

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

"+C" → general soln.

Given $f'(x) = 12x^2 - 24x + 1$ and $f(1) = -2$, find $f(x)$

$$f(x) = 4x^3 - 12x^2 + x + C$$

$$-2 = 4 - 12 + 1 + C$$

$$5 = C$$

$$\therefore f(x) = 4x^3 - 12x^2 + x + 5$$

particular soln.

$$f''(x) = 2x + 7$$

$$f'(x) = x^2 + 7x + C$$

$$f(x) = \frac{1}{3}x^3 + \frac{7}{2}x^2 + Cx + D$$

Slope given $4x-5$ and contains $(3,7)$ find eq. of curve.

$f'(x) = 4x - 5$

$f(x) = 2x^2 - 5x + C$

$7 = 18 - 15 + C$

$4 = C$

$\therefore f(x) = 2x^2 - 5x + 4$