# Antiderivatives and Indefinite Integration I

*Antiderivatives (integrals)* “undo” derivatives. When taking the antiderivative, think of doing the opposite of taking the derivative.

Can we find a function $F(x)$ so that $F'(x) = 5x^2$?

Example 1: Evaluate the following integral.

$$\int \frac{x^2+5}{4}\,dx$$

Example 2: Evaluate the following integral.

$$\int \frac{x^2 - x^5}{\sqrt{x}}\, dx$$

Example 3: Evaluate the following integral.

$$\int \left(4\cot(x)\sin(x) + 3\sec^2(x)\right)\, dx$$

# DIY

1. Evaluate the following integral.

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

| Basic Differentiation Rules | Basic Integration Rules |
|---|---|
| $\frac{d}{dx}C = 0$ | $\int 0\ dx = C$ |
| $\frac{d}{dx}(kx) = k$ | $\int k\ dx = kx + C$ |
| $\frac{d}{dx}[kf(x)] = kf'(x)$ | $\int [kf(x)]\ dx = k\int f(x)\ dx$ |
| $\frac{d}{dx}[f(x) \pm g(x)] = f'(x) \pm g'(x)$ | $\int [f(x) \pm g(x)]\ dx = \int f(x)\ dx \pm \int g(x)\ dx$ |
| $\frac{d}{dx}x^n = nx^{n-1}$ | $\int x^n\ dx = \frac{x^{n+1}}{n+1} + C, n \neq -1$ (Power Rule) |
| $\frac{d}{dx}\sin x = \cos x$ | $\int \cos x\ dx = \sin x + C$ |
| $\frac{d}{dx}\cos x = -\sin x$ | $\int \sin x\ dx = -\cos x + C$ |
| $\frac{d}{dx}\tan x = \sec^2 x$ | $\int \sec^2 x\ dx = \tan x + C$ |
| $\frac{d}{dx}\cot x = -\csc^2 x$ | $\int \csc^2 x\ dx = -\cot x + C$ |
| $\frac{d}{dx}\sec x = \sec x \tan x$ | $\int \sec x \tan x\ dx = \sec x + C$ |
| $\frac{d}{dx}\csc x = -\csc x \cot x$ | $\int \csc x \cot x\ dx = -\csc x + C$ |
| $\frac{d}{dx}e^x = e^x$ | $\int e^x\ dx = e^x + C$ |
| $\frac{d}{dx}\ln x = \frac{1}{x},\ x > 0$ | $\int \frac{1}{x}\ dx = \ln\lvert x\rvert + C$ |