

Basic Properties and Formulas

If $f(x)$ and $g(x)$ are differentiable functions (the derivative exists), c and n are any real numbers,

$$1. (cf)' = cf'(x)$$

$$5. \frac{d}{dx}(c) = 0$$

$$2. (f \pm g)' = f'(x) \pm g'(x)$$

$$6. \frac{d}{dx}(x^n) = nx^{n-1} - \text{Power Rule}$$

$$3. (fg)' = f'g + fg' - \text{Product Rule}$$

$$7. \frac{d}{dx}(f(g(x))) = f'(g(x))g'(x)$$

$$4. \left(\frac{f}{g}\right)' = \frac{f'g - fg'}{g^2} - \text{Quotient Rule}$$

This is the Chain Rule

	$y = f(x)$	$\frac{dy}{dx}$
1	x^n	nx^{n-1}
2	e^x	e^x
3	e^{kx}	ke^{kx}
4	a^x	$a^x \cdot \ln a$
5	$\ln x$	$\frac{1}{x}$
6	$\log_a x$	$\frac{1}{x \cdot \ln a}$
7	$\sin x$	$\cos x$
8	$\cos x$	$-\sin x$
9	$\tan x$	$\sec^2 x$
10	$\cot x$	$-\operatorname{cosec}^2 x$
11	$\sec x$	$\sec x \cdot \tan x$
12	$\operatorname{cosec} x$	$-\operatorname{cosec} x \cdot \cot x$
13	$\sinh x$	$\cosh x$
14	$\cosh x$	$\sinh x$

$$1 \quad y = (4x - 5)^6 \quad \frac{dy}{dx} = 6(4x - 5)^5 \cdot 4 = 24(4x - 5)^5$$

$$2 \quad y = e^{3-x} \quad \frac{dy}{dx} = e^{3-x}(-1) = -e^{3-x}$$

$$3 \quad y = \sin 2x \quad \frac{dy}{dx} = \cos 2x \cdot 2 = 2 \cos 2x$$

$$4 \quad y = \cos(x^2) \quad \frac{dy}{dx} = -\sin(x^2) \cdot 2x = -2x \sin(x^2)$$

$$5 \quad y = \ln(3 - 4 \cos x) \quad \frac{dy}{dx} = \frac{1}{3 - 4 \cos x} \cdot (4 \sin x) = \frac{4 \sin x}{3 - 4 \cos x}$$

The Integration :

Integration is considered as the anti derivative operation.

The formula $\frac{d}{dx} F(x) = f(x)$

is the same as $\int f(x) dx = F(x) + c$

ex: $\frac{d}{dx} \sin x = \cos x$ $\int \cos x = \sin x + c$

Rules:

1. $\int dx = x + c$ 2. $\int k dx = kx + c$, k is constant

3. $\int x^n dx = \frac{x^{n+1}}{n+1} + c$ $n \neq -1$

4. $\int (f(x) + g(x)) dx = \int f(x) dx + \int g(x) dx$

5. $\int kf(x) = k \int f(x) dx$, k is constant

6. $\int f(x)^n f'(x) dx = \frac{f(x)^{n+1}}{n+1} + c$

Here is a list of basic derivatives and the basic integrals that go with them:

$$1 \quad \frac{d}{dx}(x^n) = nx^{n-1}$$

$$\therefore \int x^n dx = \frac{x^{n+1}}{n+1} + C \quad \left\{ \begin{array}{l} \text{provided} \\ n \neq -1 \end{array} \right\}$$

$$2 \quad \frac{d}{dx}(\ln x) = \frac{1}{x}$$

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

$$3 \quad \frac{d}{dx}(e^x) = e^x$$

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

$$4 \quad \frac{d}{dx}(e^{kx}) = ke^{kx}$$

$$\therefore \int e^{kx} dx = \frac{e^{kx}}{k} + C$$

$$5 \quad \frac{d}{dx}(a^x) = a^x \ln a$$

$$\therefore \int a^x dx = \frac{a^x}{\ln a} + C$$

$$6 \quad \frac{d}{dx}(\cos x) = -\sin x$$

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

$$7 \quad \frac{d}{dx}(\sin x) = \cos x$$

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

$$8 \quad \frac{d}{dx}(\tan x) = \sec^2 x$$

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

$$9 \quad \frac{d}{dx}(\cosh x) = \sinh x$$

$$\therefore \int \sinh x dx = \cosh x + C$$

$$10 \quad \frac{d}{dx}(\sinh x) = \cosh x$$

$$\therefore \int \cosh x dx = \sinh x + C$$

$$1 \quad \int (2x-7)^3 dx = \frac{(2x-7)^4}{2 \cdot 4} + C = \frac{(2x-7)^4}{8} + C$$

$$2 \quad \int \cos(7x+2) dx = \frac{\sin(7x+2)}{7} + C$$

$$3 \quad \int e^{5x+4} dx = \frac{e^{5x+4}}{5} + C$$

$$4 \quad \int \sinh 7x dx = \frac{\cosh 7x}{7} + C$$

$$5 \quad \int \frac{1}{4x+3} dx = \frac{\ln(4x+3)}{4} + C$$

$$7 \quad \int \sec^2(3x+1) dx = \frac{\tan(3x+1)}{3} + C$$

$$8 \quad \int \sin(2x-5) dx = -\frac{\cos(2x-5)}{2} + C$$

$$9 \quad \int \cosh(1+4x) dx = \frac{\sinh(1+4x)}{4} + C$$

$$10 \quad \int 3^{5x} dx = \frac{3^{5x}}{5 \ln 3} + C$$