

Basic Properties and Formulas for Derivatives

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

1. $(cf)' = cf'(x)$
2. $(f \pm g)' = f'(x) \pm g'(x)$
3. $(fg)' = fg'(x) + f'g(x)$ Product Rule
4. $\left(\frac{f}{g}\right)' = \frac{f'g - fg'}{g^2}$ Quotient Rule
5. $\frac{d}{dx}(c) = 0$
6. $\frac{d}{dx}(x^n) = nx^{n-1}$ Power Rule
7. $\frac{d}{dx}(f(g(x))) = f'(g(x))g'(x)$ Chain Rule

Rules for Indefinite Integrals

■ **Rule 1.** For a constant k , $\int k \, dx = kx + c$

■ **Rule 2.** The integral of 1, written simply as dx , is $\int dx = x + c$

■ **Rule 3.** The integral of a power function x^n , where $n \neq -1$,

$$\int x^n dx = \frac{1}{n+1} x^{n+1} + c$$

■ **Rule 4.** The integral of x^{-1} or $1/x$ (for $x > 0$) is

$$\int x^{-1} dx = \ln x + c$$

■ **Rule 5.** The integral of a natural exponential function is

$$\int e^{kx} dx = \frac{1}{k} e^{kx} + c$$

■ **Rule 6.** The integral of a constant times a function equals the constant times the integral of the function.

$$\int k f(x) dx = k \int f(x) dx$$

■ **Rule 7.** The integral of the sum or difference of two or more functions equals the sum or difference of their integrals.

$$\int [f(x) \pm g(x)] dx = \int f(x) dx \pm \int g(x) dx$$

■ **Rule 8.** The integral of the negative of a function equals the negative of the integral of the function. Is

$$\int -f(x) dx = - \int f(x) dx$$

Properties of Definite Integrals

1. Reversing the order of the limits of integration changes the sign of the definite integral.

$$\int_a^b f(x)dx = - \int_b^a f(x)dx$$

2. If the upper limit of integration equals the lower limit of integration, the value of the definite integral is zero.

$$\int_a^a f(x)dx = F(a) - F(a) = 0$$

3. The definite integral can be expressed as the sum of component subintegrals.

$$\int_a^c f(x)dx = \int_a^b f(x)dx + \int_b^c f(x)dx \quad \text{for } a \leq b \leq c$$

4. The sum or difference of two definite integrals with identical limits of integration is equal to the definite integral of the sum or difference of the two functions.

$$\int_a^b f(x)dx \pm \int_a^b g(x)dx = \int_a^b [f(x) \pm g(x)]dx$$

5. The definite integral of a constant times a function is equal to the constant times the definite integral of the function.

$$\int_a^b kf(x)dx = k \int_a^b f(x)dx$$