

Derivative Formulas

Match the visible structure of the function to a rule, then check the rule's domain before differentiating.

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Single terms

Differentiate constants and powers before combining longer expressions.

Constant rule

$$\frac{d}{dx}c = 0$$

Text version: The derivative with respect to x of a constant c equals zero.

When to use: Use this rule for a term that does not change as x changes.

Conditions

- c is constant with respect to x .

Power rule

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

Text version: The derivative with respect to x of x to the n equals n times x to the n minus one.

When to use: Use this rule to differentiate a power of the variable.

Conditions

- n is constant with respect to x .
- Work at points where the real-valued power is defined and differentiable.

Sum rule

$$\frac{d}{dx}[f(x) + g(x)] = f'(x) + g'(x)$$

Text version: The derivative of f of x plus g of x equals f prime of x plus g prime of x .

When to use: Use this rule to differentiate a sum term by term.

Conditions

- f and g are differentiable at the point being evaluated.

Products, quotients, and compositions

Choose a structural rule when functions multiply, divide, or sit inside one another.

Product rule

$$\frac{d}{dx}[f(x)g(x)] = f'(x)g(x) + f(x)g'(x)$$

Text version: The derivative of f of x times g of x equals f prime of x times g of x plus f of x times g prime of x.

When to use: Use this rule when two differentiable functions are multiplied.

Conditions

- f and g are differentiable at the point being evaluated.

Quotient rule

$$\frac{d}{dx} \left[\frac{f(x)}{g(x)} \right] = \frac{f'(x)g(x) - f(x)g'(x)}{[g(x)]^2}$$

Text version: The derivative of f of x divided by g of x equals f prime times g minus f times g prime, all divided by g squared.

When to use: Use this rule when one differentiable function is divided by another.

Conditions

- f and g are differentiable at the point being evaluated.
- g of x is not zero at that point.

Chain rule

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

Text version: The derivative of f composed with g equals f prime evaluated at g of x, multiplied by g prime of x.

When to use: Use this rule when one differentiable function is composed inside another.

Conditions

- g is differentiable at x.
- f is differentiable at g of x.

Exponential, logarithmic, and trigonometric functions

Use these base derivatives directly or inside the chain rule.

Natural exponential derivative

$$\frac{d}{dx}e^x = e^x$$

Text version: The derivative with respect to x of e to the x equals e to the x .

When to use: Use this rule for the natural exponential function; combine it with the chain rule when the exponent is not x .

Conditions

- x is real for the real-valued form shown.
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Natural logarithm derivative

$$\frac{d}{dx}\ln x = \frac{1}{x}$$

Text version: The derivative with respect to x of the natural logarithm of x equals one divided by x .

When to use: Use this rule to differentiate the natural logarithm on its real domain.

Conditions

- x is greater than zero.
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Sine derivative

$$\frac{d}{dx}\sin x = \cos x$$

Text version: The derivative with respect to x of sine x equals cosine x .

When to use: Use this rule to differentiate sine; combine it with the chain rule for sine of another function.

Conditions

- Angles are measured in radians.