Derivatives Rules Cheat Sheet

All the essential derivative rules and formulas for calculus. From basic rules to chain rule and beyond.

Definition of the Derivative

Limit definition: $f'(x) = \lim(h \to 0) [f(x + h) - f(x)] / h$

Interpretation: Slope of the tangent line to f(x) at a point

Basic Differentiation Rules

Constant: $d/dx[c] = 0$

Power rule: $d/dx[x^n] = nx^{(n-1)}$

Constant multiple: $d/dx[cf(x)] = cf'(x)$

Sum rule: $d/dx[f + g] = f' + g'$

Difference rule: $d/dx[f - g] = f' - g'$

Product & Quotient Rules

Product rule: $(fg)' = f'g + fg'$

Quotient rule: $(f/g)' = (f'g - fg') / g^2$

Chain rule: $d/dx[f(g(x))] = f'(g(x)) \times g'(x)$

Chain rule tip: Differentiate the outer function, keep the inner, then multiply by the derivative of the inner.

Trigonometric Derivatives

d/dx[sin x]: cos x

d/dx[cos x]: -sin x

d/dx[tan x]: $\sec^2 x$

d/dx[cot x]: $-\csc^2 x$

d/dx[sec x]: sec x tan x

d/dx[csc x]: -csc x cot x

Exponential & Logarithmic

d/dx[e^x]: e^x

d/dx[a^x]: $a^x \ln(a)$

d/dx[ln x]: 1/x

d/dx[log_a(x)]: $1 / (x \ln(a))$

Power Rule Examples

Applying the Power Rule

Example 1: $f(x) = x^5$, $f'(x) = 5x^4$
Example 2: $f(x) = x^{(-2)}$, $f'(x) = -2x^{(-3)}$
Example 3: $f(x) = x^{(1/2)} = x$, $f'(x) = (1/2)x^{(-1/2)}$
Example 4: $f(x) = 3x^4 - 2x^2 + 7x$, $f'(x) = 12x^3 - 4x + 7$

Chain Rule Examples

d/dx[sin(3x)]: $3\cos(3x)$
d/dx[$(2x+1)^5$]: $5(2x+1)^4 \times 2 = 10(2x+1)^4$
d/dx[e^{3x}]: $3e^{3x}$
d/dx[ln(5x)]: $1/x$

Common Mistakes to Avoid

Power rule: Don't forget to reduce the exponent by 1
Chain rule: Don't forget to multiply by the inner derivative
Product rule: It is NOT (fg)' = f'g'
Quotient rule: Numerator order matters: f'g - fg'
Constants: The derivative of a number is always 0

When in doubt, rewrite the function first. Convert roots to fractional exponents and move terms from the denominator to negative exponents, then apply the power rule.