Michael's Awesome Derivative Rules Sheet

This sheet lists and explains many of the rules used (in Calculus 1) to take the derivative of many types of functions.

General Handy Rules

The derivative of any constant number (2, -2.544, 200.8) is zero

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

Example

$$\frac{d}{dx} 4.6 = 0$$

The Product Rule

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

Example

$$\frac{d}{dx} x*e^x = 1*e^x + e^x*x$$

The Power Rule

$$\frac{d}{dx} C * X^n = c * n * X^{n-1}$$

Where x is a variable. Where c **and** n are just numbers.
Example

$$\frac{d}{dx} 3x^2 = 3*2*x^{2-1}$$

The Quotient Rule

$$\frac{d}{dx} \frac{f(x)}{g(x)} = \frac{f'(x)*g(x) - g'(x)*f(x)}{g(x)^2}$$

Example:

$$\frac{d}{dx} \frac{\ln(x)}{x} = \frac{\frac{1}{x} * x - 1*\ln(x)}{x^2}$$

Derivative of e^x or e to the power of any function

$$\frac{d}{dx} e^{f(x)} = f'(x) * e^{f(x)}$$

Example:

$$\frac{d}{dx} e^{2x} = 2*e^{2x}$$

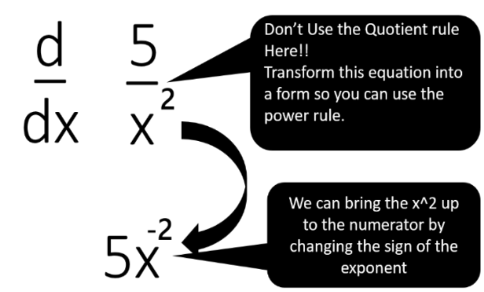
Derivative of ln(x) or any function inside the ln

$$\frac{d}{dx} \ln(\ f(x)\ ) = \frac{1}{f(x)} * f'(x)$$

Example:

$$\frac{d}{dx} \ln(4x) = \frac{1}{4x} * 4$$

Helpful Tips:



1.

2. **Implicit differentiation:** When you have a function that contains two variables (x and y). **Remember that when you take the derivative of y, you end up with a dy/dx.**

$$y^3 \xrightarrow{\text{derivative}} 3y^2 * \frac{dy}{dx}$$

Trig Table

Trig function — Corresponding derivative function	Trig function — Corresponding derivative function	Trig function — Corresponding derivative function
$\frac{d}{dx}\sin(x)=\cos(x)$	$\frac{d}{dx}\cos(x)= -\sin(x)$	$\frac{d}{dx}\sec(x)= \sec(x)*\tan(x)$
$\frac{d}{dx}\tan(x)= \sec^2(x)$	$\frac{d}{dx}\cot(x)= -\csc^2(x)$	$\frac{d}{dx}\csc(x)= -\csc(x)*\cot(x)$

Taking the Derivative of a trig function:

A trig function has an inner function:

$$\sin(\boxed{8x^2-3})$$

Step 1: Locate the derivative function of the trig function. See the above table for reference

Step 2: Put the inner function that is inside the original trig function inside the derivative function.

Last Step: Multiply the derivative function by the derivative of the inner function

For example:

$$\frac{d}{dx}\sin(3x^2)=\cos(3x^2)*3*2*x$$

Following the Steps:

1. cos is the derivative function of sin
2. 3x^2 is the inner function inside the sin function. So we put 3x^2 inside the cos function.
3. 3*2*x or 6x is the derivative of 3x^2 so we multiply it to the cos function.

Chain Rule: (a function within a function)

****We take the derivative of the outer function first then work our way inside**

1. **(with trig or ln functions)**

$$\frac{d}{dx}2*\sin^3(7x) = 6*\sin^2(7x)*\cos(7x)*7$$

a) **We apply the power to the sin function.** the new coefficient (6) is obtained by multiplying the old coefficient (2) and the old exponent (3). the new coefficient is then multiplied by the same function (which is the sin function) raised to the same power (3) minus 1. **-> (sin(7x))^2**

b) We multiply that by the derivative of the sin(7x) (See Taking the Derivative of a trig function).

2. **(without trig or ln functions)**

$$\frac{d}{dx}2*(3x+8)^3= 6(3x+8)^2*3$$

a) **We apply the power rule to the (3x+8) function.** the new coefficient (6) is obtained by multiplying the old coefficient (2) and the old exponent (3). the new coefficient is then multiplied by the same function (which is the **(3x+8)** function) raised to the same power (3) minus 1. **-> (3x+8)^2**

b) We multiply that by the derivative of **(3x+8)**