NEW DAWN LEARNING STUDIO
A NEW LEARNING EXPERIENCE

Laws of Differentiation

Rules of Differentiation

Scalar Product of function

$$\frac{d}{dx}[af(x)] = af'(x)$$

Linear Combination of functions
[For Sum and Difference of Functions]

$$\frac{d}{dx}[af(x) \pm bg(x)] = af'(x) \pm bg'(x)$$

Product Rule: [For Product of Functions]

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

Quotient Rule: [For Rational Functions]

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

Chain Rule: [For Composite Functions]

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

$$\frac{dx}{dy} = \frac{1}{\frac{dy}{dx}}$$

No	Type	General Functions	Gradient Functions
		y	$\frac{dy}{dx}$
1	**Algebraic**	a (constant term)	0
		$[f(x)]^n$	$n[f(x)]^{n-1}f'(x)$
2	**Exponential**	$e^{f(x)}$	$[f'(x)]e^{f(x)}$
		$a^{f(x)}$	$[f'(x)]a^{f(x)}[lna]$
3	**Logarithmic**	$\ln[f(x)]$	$\frac{f'(x)}{f(x)}$
		$\log_a[f(x)]$	$\frac{f'(x)}{[f(x)][lna]}$
4	**Trigonometric**	$\sin[f(x)]$	$f'(x)\cos[f(x)]$
	Inverse Trigonometric	$\cos[f(x)]$	$-f'(x)\sin[f(x)]$
		$\tan[f(x)]$	$f'(x)sec^2[f(x)]$
MF26	$\frac{d}{dx}secx = secxtanx$	$\sec[f(x)]$	$f'(x)\sec[f(x)]\tan[f(x)]$
	$\frac{d}{dx}cosecx = -cosecxcotx$	$cosec[f(x)]$	$-f'(x)cosec[f(x)]\cot[f(x)]$
	$\frac{d}{dx}cotx = -cosec^2x$	$\cot[f(x)]$	$-f'(x)cosec^2[f(x)]$
	$\frac{d}{dx}sin^{-1}x = \frac{1}{\sqrt{1-[x]^2}}, \lvert x\rvert < 1$	$sin^{-1}[f(x)]$	$\frac{f'(x)}{\sqrt{1-[f(x)]^2}}, \lvert f(x)\rvert < 1$
	$\frac{d}{dx}cos^{-1}x = -\frac{1}{\sqrt{1-[x]^2}}, \lvert x\rvert < 1$	$cos^{-1}[f(x)]$	$-\frac{f'(x)}{\sqrt{1-[f(x)]^2}}, \lvert f(x)\rvert < 1$
	$\frac{d}{dx}tan^{-1}x = \frac{1}{1+[x]^2}$	$tan^{-1}[f(x)]$	$\frac{f'(x)}{1+[f(x)]^2}$

Implicit Differentiation

Function that cannot express y in terms of x

$$\frac{d}{dx}f(y) = \frac{d}{dx}\left(\frac{dy}{dy}\right)f(y) = \frac{dy}{dx}\left(\frac{d}{dy}\right)f(y) = \frac{dy}{dx}f'(y)$$

Logarithmic Differentiation

Function that where base and power is variable

$$y = [f(x)]^{f(x)}$$

$$\log_a y = f(x)\log_a[f(x)]$$

Implicit differentiation

Parametric Differentiation

A function express in terms of 3rd variables

$$\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx} = \frac{\left(\frac{dy}{dt}\right)}{\left(\frac{dx}{dt}\right)}$$

Trigonometry Formula

Complementary Angles

$\sin(90^0 - \theta) = \cos\theta$

$\cos(90^0 - \theta) = \sin\theta$

$\tan(90^0 - \theta) = \frac{1}{\tan\theta}$

Pythagorean Identities

$\sin^2\theta + \cos^2\theta = 1$

$1 + \tan^2\theta = \sec^2\theta$

$1 + \cot^2\theta = cosec^2\theta$

Negative Angles

$\sin(-\theta) = -\sin\theta$

$\cos(-\theta) = \cos\theta$

$\tan(-\theta) = -\tan\theta$

Reciprocal Functions

$\tan\theta = \frac{\sin\theta}{\cos\theta}; \cot\theta = \frac{1}{\tan\theta}$

$\sec\theta = \frac{1}{\cos\theta}; cosec\theta = \frac{1}{sin\ \theta}$

Compound Angle Identities

$\sin(A \pm B) = \sin A\cos B \pm \cos A\sin B$

$\cos(A \mp B) = cosAcosB \pm sinAsinB$

$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A\tan B}$

Multiple Angle Identities

$\sin 2A = 2\sin A\cos A$

$\cos 2A = cos^2A - sin^2A = 2cos^2A - 1 = 1 - 2sin^2A$

$\tan 2A = \frac{2\tan A}{1 - tan^2A}$

Factor Formula

$\sin A + \sin B = 2\sin\frac{A+B}{2}\cos\frac{A-B}{2}$

$\sin A - \sin B = 2\cos\frac{A+B}{2}\sin\frac{A-B}{2}$

$\cos A + \cos B = 2\cos\frac{A+B}{2}\cos\frac{A-B}{2}$

$\cos A - \cos B = -2\sin\frac{A+B}{2}\sin\frac{A-B}{2}$

Laws of Logarithmic Functions

Given a complicated Logarithmic functions, simplify using

Power Law : $k\log_a x = \log_a x^k$

Product Law : $\log_a xy = \log_a x + \log_a y$

Quotient Law : $\log_a\left(\frac{x}{y}\right) = \log_a x - \log_a y$

Change of Base Law: $\log_a b = \frac{\log_c b}{\log_c a}$

Radian Measure:

Differentiation holds for x **measured in radians**.

If x never depicts as x^0, assume radian. If x is in degree, convert x degrees to radian.

$\pi\ radians = 180^0$

$\frac{\pi}{180}radians = 1^0$

$\frac{\pi x}{180} = x^0$

Inverse Presentation:

Usually $\mathbf{sin^n x = (sinx)^n}$ for all integers n **except** $\mathbf{n = -1}$.

By convention, $(\sin x)^{-1}$ is written as cosec x while $\sin^{-1}x$ is the **inverse function** of $\sin x$.

Similarly, $(\cos x)^{-1} = \sec x$ and $(\tan x)^{-1} = \cot x$

Further Derivatives of Parametric Function

$$\frac{d^ny}{dx^n} = \frac{\frac{d}{dt}\left[\frac{d^{n-1}y}{dx^{n-1}}\right]}{\left(\frac{dx}{dt}\right)}$$

Differentiation Techniques

Blk 712, Ang Mo Kio Ave 6 #03-4056
S (560712)

newdawnlearning@gmail.com
facebook/newdawnlearning

6909 7225
9880 1259