BROAD ROOT SCHOLARS ACADEMY

Formulae on Limits & Derivatives

Some Important Results On Limits

• $\lim_{x\to a}\frac{x^n-a^n}{x-a}=na^{n-1}$	• $\lim_{x\to 0}\frac{a^x-1}{x}=log_e a$
• $\lim_{x\to 0}\frac{\sin x}{x}=1$	• $\lim_{x\to \infty}\frac{\sin x}{x}=0$
• $\lim_{x\to 0}\frac{\sin ax}{x}=a$	• $\lim_{x\to 0}\frac{sin^{-1}x}{x}=1$
• $\lim_{x\to 0}\frac{1-\cos x}{x}=0$	• $\lim_{x\to \infty}\frac{1}{x^p}=0$
• $\lim_{x\to 0}\frac{\tan x}{x}=1$	• $\lim_{x\to 0}\frac{\tan^{-1}x}{x}=1$
• $\lim_{x\to 0}\frac{\log(1+x)}{x}=1$	• $\lim_{x\to 0}\frac{e^x-1}{x}=1$
• $\lim_{x\to 0}(1+x)^{\frac{1}{x}}=e$	• $\lim_{x\to \infty}\left(1+\frac{1}{x}\right)^x=e$
• $\lim_{x\to 0}(1-x)^{\frac{1}{x}}=\frac{1}{e}$	• $\lim_{x\to \infty}\left(1-\frac{1}{x}\right)^x=\frac{1}{e}$

Algebra Of Limits & Derivatives

LIMITS

- $\lim_{x\to a}[f(x)\pm g(x)]=\lim_{x\to a}f(x)\pm\lim_{x\to a}g(x)$
- $\lim_{x\to a}[f(x).g(x)]=\lim_{x\to a}f(x).\lim_{x\to a}g(x)$
- $\lim_{x\to a}\left[\frac{f(x)}{g(x)}\right]=\frac{\lim_{x\to a}f(x)}{\lim_{x\to a}g(x)}$
- $\lim_{x\to a}[k.f(x)]=k.\lim_{x\to a}f(x)$

DEVIRATIVES

- $\frac{d}{dx}[f(x)\pm g(x)]=\frac{d}{dx}f(x)\pm\frac{d}{dx}g(x)$
- **Leibnitz Rule:** $\frac{d}{dx}[f(x).g(x)]=g(x).\frac{d}{dx}f(x)+f(x).\frac{d}{dx}g(x)$
- **Quotient Rule:** $\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right]=\frac{g(x).\frac{d}{dx}f(x)-f(x).\frac{d}{dx}g(x)}{g^2(x)}$
- $\frac{d}{dx}[k.f(x)]=k.\frac{d}{dx}f(x)$

Derivatives of some important functions

If $f(x)$ is a real valued function, then its derivative is denoted by $f'(x)$ *or* $\frac{d}{dx}f(x)$ and is given by

$$\frac{d}{dx}f(x) = f'(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$$

• $\frac{d}{dx}(C) = 0, where\ C = constant$	• $\frac{d}{dx}(x) = 1$
• $\frac{d}{dx}(x^n) = nx^{n-1}$	• $\frac{d}{dx}(e^x) = e^x$
• $\frac{d}{dx}(\log_e x) = \frac{1}{x}$	• $\frac{d}{dx}(\log_a x) = \frac{\log_a e}{x}$
• $\frac{d}{dx}(a^x) = a^x \log a$	• $\frac{d}{dx}(\sqrt{x}) = \frac{1}{2\sqrt{x}}$
• $\frac{d}{dx}(\sin x) = \cos x$	• $\frac{d}{dx}(\cos x) = -\sin x$
• $\frac{d}{dx}(\tan x) = sec^2 x$	• $\frac{d}{dx}(\sec x) = \sec x \tan x$
• $\frac{d}{dx}(\cot x) = -cosec^2 x$	• $\frac{d}{dx}(cosec\ x) = -cosec\ x \cot x$
• $\frac{d}{dx}(sin^{-1}x) = \frac{1}{\sqrt{1-x^2}}$	• $\frac{d}{dx}(cos^{-1}x) = -\frac{1}{\sqrt{1-x^2}}$
• $\frac{d}{dx}(tan^{-1}x) = \frac{1}{1+x^2}$	• $\frac{d}{dx}(cot^{-1}x) = -\frac{1}{1+x^2}$
• $\frac{d}{dx}(sec^{-1}x) = \frac{1}{\lvert x\rvert\sqrt{x^2-1}}$	• $\frac{d}{dx}(cosec^{-1}x) = -\frac{1}{\lvert x\rvert\sqrt{x^2-1}}$

Some Standard Substitutions

Expressions	Substitution
• $\sqrt{a^2 - x^2}$	$x = a\sin\theta$ or $x = a\cos\theta$
• $\sqrt{a^2 + x^2}$	$x = a\tan\theta$ or $x = a\cot\theta$
• $\sqrt{x^2 - a^2}$	$x = a\sec\theta$ or $x = a\ cosec\ \theta$
• $\sqrt{\frac{a+x}{a-x}}$ or $\sqrt{\frac{a-x}{a+x}}$	$x = a\cos\theta$ or $x = a\cos 2\theta$
• $\sqrt{(a-x)(x-b)}$	$x = acos^2\theta + bsin^2\theta$
• $\sqrt{\frac{a^2-x^2}{a^2+x^2}}$ or $\sqrt{\frac{a^2+x^2}{a^2-x^2}}$	$x^2 = a^2\cos 2\theta$

BROAD ROOT SCHOLARS ACADEMY

FROM BASICS TO ADVANCE.....

COMPLETE GUIDANCE FOR BOARD + NEET/JEE

[OLYMPIAD | CUET-UG | IPMAT | JIPMAT | IISC | IISER | NISER | NDA]

FOUNDATION PROGRAME
[Class VIII-X]

- GENERAL MATHEMATICS
- ADVANCED MATHEMATICS
- GENERAL SCIENCE
- Extended/Core MATHEMATICS [Cambridge IGCSE]

INTEGRATED PROGRAME
[Class XI-XII]

- PHYSICS
- CHEMISTRY
- MATHEMATICS [Core/Applied]
- BIOLOGY

HOW LEARNING HAPPENS HERE

- CONCEPT CLARITY FIRST
- REGULAR TESTS + FEEDBACK
- DOUBT CLEARING SESSIONS
- PERSONAL ATTENTION TO EVERY STUDENT
- NO ROTE LEARNING METHODS

RESULTS ARE A BY-PRODUCT OF THE PROCESS

IS THIS COACHING CENTRE RIGHT FOR YOUR CHILD?

DOES YOUR CHILD

- STRUGGLE WITH CONCEPT?
- NEED PERSONAL ATTENTION?
- AFRAID OF MATHS & SCIENCE?
- WANT STRONG FUNDAMENTALS?
- HATE ROTE LEARNING?

IF **YES**, THEN YOU'RE IN THE RIGHT PLACE.

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