

Limits and Derivatives

CBSE Class 11 Maths · Knowledge organiser

KEY DEFINITIONS

Limit

The value $f(x)$ approaches as x approaches a .

Derivative

The rate of change of f at a point: the limit of $(f(x+h) - f(x))/h$ as $h \rightarrow 0$.

First principles

Finding a derivative directly from the limit definition.

KEY FORMULAS

Standard limits $\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a} = na^{n-1}$, $\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$

Definition $f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$

Rules $(uv)' = u'v + uv'$, $\left(\frac{u}{v}\right)' = \frac{u'v - uv'}{v^2}$

Derivatives $(x^n)' = nx^{n-1}$, $(\sin x)' = \cos x$, $(\cos x)' = -\sin x$, $(\tan x)' = \sec^2 x$

WORKED EXAMPLE

Find $\lim_{x \rightarrow 3} \frac{x^2 - 9}{x - 3}$.

$$\frac{(x-3)(x+3)}{x-3} = x+3 \rightarrow 6.$$

YOU SHOULD BE ABLE TO...

- Evaluate standard limits by substitution or factorising and differentiate polynomials and $\sin$, $\cos$.
- Use $\sin x/x \rightarrow 1$, differentiate from first principles and apply the product and quotient rules.
- Handle limits needing surds or trigonometric rewriting and use derivatives as rates of change.
- Find constants that make a limit exist and prove standard derivatives from the definition.

COMMON MISTAKES

- ✗ Writing $\frac{0}{0} = 0$ or 1 : it means "simplify first".
- ✗ $\frac{\sin 3x}{x} \rightarrow 1$: it tends to 3 .
- ✗ Product rule applied as $(uv)' = u'v'$; quotient rule with the numerator the wrong way round.
- ✗ $\frac{d}{dx} \cos x = \sin x$: the sign is negative.