

CLASS 11 MATHEMATICS — FORMULA SHEET

Chapter 12 : Limits and Derivatives (NCERT)

12.1 Limits — Basic Concept & Algebra

Concept	Formula
Limit notation	$\lim_{x \rightarrow a} f(x) = L$
Left-hand limit (LHL)	$\lim_{x \rightarrow a^-} f(x)$
Right-hand limit (RHL)	$\lim_{x \rightarrow a^+} f(x)$
Limit exists if	LHL = RHL (both equal & finite)
Sum / difference	$\lim (f \pm g) = \lim f \pm \lim g$
Product	$\lim (f \cdot g) = (\lim f)(\lim g)$
Quotient	$\lim (f/g) = (\lim f) \div (\lim g)$, if $\lim g \neq 0$
Constant multiple	$\lim (k f) = k \lim f$

12.2 Standard Limits

Limit	Value
$\lim_{x \rightarrow a} (x^n - a^n)/(x - a)$	$n a^{(n-1)}$
$\lim_{x \rightarrow 0} (\sin x)/x$	1
$\lim_{x \rightarrow 0} (\tan x)/x$	1
$\lim_{x \rightarrow 0} (1 - \cos x)/x$	0
$\lim_{x \rightarrow 0} (1 - \cos x)/x^2$	1/2
$\lim_{x \rightarrow 0} (e^x - 1)/x$	1
$\lim_{x \rightarrow 0} (a^x - 1)/x$	$\log_e a$
$\lim_{x \rightarrow 0} \log(1+x)/x$	1
$\lim_{x \rightarrow 0} (1 + x)^{(1/x)}$	e

12.3 Methods of Evaluating Limits

Method	When to Use
Direct substitution	Put $x = a$ if result is defined (not $0/0$ or ∞/∞)
Factorisation	For $0/0$ form: factor & cancel the common term
Rationalisation	When square roots cause $0/0$ (multiply by conjugate)
Standard limit formulas	Convert to a known limit ($\sin x/x$ etc.)
Substitution method	Replace to convert into a standard form

12.4 Derivative — Definition (First Principle)

Concept	Formula
Derivative (first principle)	$f'(x) = \lim_{h \rightarrow 0} [f(x+h) - f(x)] \div h$
Derivative at a point	$f'(a) = \lim_{h \rightarrow 0} [f(a+h) - f(a)] \div h$
Meaning	Slope of tangent / instantaneous rate of change
Notation	$f'(x) = dy/dx = d/dx [f(x)]$

12.5 Standard Derivatives

Function	Derivative
x^n	$n x^{(n-1)}$
constant (c)	0
$\sin x$	$\cos x$
$\cos x$	$-\sin x$
$\tan x$	$\sec^2 x$
$\cot x$	$-\operatorname{cosec}^2 x$
$\sec x$	$\sec x \tan x$
$\operatorname{cosec} x$	$-\operatorname{cosec} x \cot x$
e^x	e^x
a^x	$a^{x \log_e a}$
$\log_e x$	$1/x$
$\sqrt{x}$	$1 \div (2\sqrt{x})$

12.6 Rules of Differentiation

Rule	Formula
Sum / difference	$(u \pm v)' = u' \pm v'$
Constant multiple	$(k u)' = k u'$
Product rule	$(uv)' = u'v + uv'$
Quotient rule	$(u/v)' = (u'v - uv') \div v^2$
Power rule	$d/dx (x^n) = n x^{(n-1)}$
Chain rule (idea)	$d/dx f(g(x)) = f'(g(x)) \cdot g'(x)$

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Limit exists	Only when LHL = RHL. Always check both sides for piecewise functions.
$\sin x / x$	$\lim_{x \rightarrow 0} \sin x / x = 1$ — the most-used limit. Also $\tan x / x = 1$.
0/0 form	Factor, rationalise, or use a standard limit — never just substitute.
First principle	$f'(x) = \lim_{h \rightarrow 0} [f(x+h) - f(x)] / h$. The definition of the derivative.
Trig derivatives	$\sin \rightarrow \cos$, $\cos \rightarrow -\sin$, $\tan \rightarrow \sec^2$. The 'co' functions get the minus sign.

Product rule	$(uv)' = u'v + uv'$ — 'first times derivative of second, plus...'
Quotient rule	$(u/v)' = (u'v - uv')/v^2$. Order matters — numerator derivative first.
e^x is special	$d/dx(e^x) = e^x$ — the only function that is its own derivative.