Class 11 Maths Chapter 12: Limits and Derivatives - Notes, Important Questions and MCQs (2026-27)

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Class 11 Maths Chapter 12, Limits and Derivatives, introduces the core ideas of calculus – how a function behaves near a point and how fast it changes.

These notes cover the intuitive idea of limits, left- and right-hand limits, algebra of limits, limits of polynomial, rational and trigonometric functions, the derivative and its first-principle definition, and the rules for differentiating sums, products and quotients.

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Chapter Overview

Calculus studies change. The limit describes the value a function approaches as x approaches a point, even if the function is not defined there.

The derivative measures the instantaneous rate of change of a function – for example, velocity as the rate of change of distance with time.

Important Topics and Concepts

Intuitive Idea of Limits

- $\lim_{x \to a} f(x) = l$ means $f(x)$ gets arbitrarily close to l as x gets close to a.
- Left-hand limit ($x \to a^-$) and right-hand limit ($x \to a^+$).
- The limit exists if both one-sided limits exist and are equal.

- Example: f(x) = |x|/x has left limit −1 and right limit 1 at 0, so the limit does not exist.

Algebra of Limits

- lim [f(x) ± g(x)] = lim f(x) ± lim g(x).
- lim [f(x)·g(x)] = lim f(x) · lim g(x).
- lim [f(x)/g(x)] = lim f(x)/lim g(x), provided lim g(x) ≠ 0.
- lim [k f(x)] = k lim f(x).

Limits of Polynomial and Rational Functions

- For a polynomial f, $\lim_{x\to a} f(x) = f(a)$.
- For a rational function g(x)/h(x): if h(a) ≠ 0, the limit is g(a)/h(a); if both are 0, factorise and cancel.
- Standard result: $\lim_{x\to a} (x^n - a^n)/(x - a) = na^{n-1}$.
- Example: $\lim_{x\to 1} (x^{15} - 1)/(x^{10} - 1) = 15/10 = 3/2$.

Limits of Trigonometric Functions

- $\lim_{x\to 0} \sin x/x = 1$.
- $\lim_{x\to 0} (1 - \cos x)/x = 0$.
- $\lim_{x\to 0} \tan x/x = 1$.
- Example: $\lim_{x\to 0} \sin 4x/\sin 2x = (4/2) \times 1 = 2$.
- Sandwich theorem: if f ≤ g ≤ h and lim f = lim h = l, then lim g = l.

Derivatives

- The derivative of f at a: $f'(a) = \lim_{h\to 0} [f(a + h) - f(a)]/h$, if the limit exists.
- The derivative function: $f'(x) = d/dx\ f(x) = \lim_{h\to 0} [f(x + h) - f(x)]/h$ – this is the first principle.
- Geometrically, f′(a) is the slope of the tangent to y = f(x) at x = a.
- Example: f(x) = x²: $f'(x) = \lim (2xh + h^2)/h = 2x$.

Algebra of Derivatives

- (u ± v)′ = u′ ± v′.
- Product rule: (uv)′ = u′v + uv′ (Leibnitz rule).
- Quotient rule: (u/v)′ = (u′v − uv′)/v², v ≠ 0.
- (ku)′ = ku′ for constant k.

Derivatives of Polynomials and Trig Functions

- $d/dx\ (x^n) = nx^{n-1}$ for any positive integer n (and other n used in practice).
- d/dx (constant) = 0.
- For a polynomial $a_n x^n + \ldots + a_1 x + a_0$, the derivative is $na_n x^{n-1} + \ldots + a_1$.
- d/dx sin x = cos x; d/dx cos x = −sin x; d/dx tan x = sec²x.

Standard Limits and Derivatives

Standard limit	Value	Function	Derivative
$\lim (x^n - a^n)/(x - a)$, x→a	na^{n-1}	x^n	nx^{n-1}
lim sin x/x, x→0	1	sin x	cos x
lim tan x/x, x→0	1	cos x	−sin x

Standard limit	Value	Function	Derivative
lim (1 − cos x)/x, x→0	0	tan x	sec²x
lim k, x→a	k	k (constant)	0

Important Definitions and Terms

Term	Meaning
Limit	Value a function approaches as x approaches a point.
Left-hand limit	Limit as x approaches a from values less than a.
Right-hand limit	Limit as x approaches a from values greater than a.
Derivative	Instantaneous rate of change: lim [f(x+h) − f(x)]/h.
First principle	Finding derivatives directly from the limit definition.
Tangent	Line touching the curve at a point; its slope is f′(a).
Sandwich theorem	If f ≤ g ≤ h and f, h have the same limit, so does g.

Short Answer Questions

Q1. Evaluate limx→3 (x + 3).

3 + 3 = 6.

Q2. Evaluate limx→2 (x² − 4)/(x − 2).

(x + 2) → 4.

Q3. Evaluate limx→0 sin 3x/x.

3 × 1 = 3.

Q4. Find the derivative of x³ at x = 2.

3x² = 12.

Q5. Differentiate 5x⁴ − 3x² + 7.

20x³ − 6x.

Q6. Differentiate x sin x.

sin x + x cos x (product rule).

Q7. Differentiate (x + 1)/x.

(x − (x + 1))/x² = −1/x².

Q8. Evaluate limx→1 (x⁵ − 1)/(x − 1).

5 × 1⁴ = 5.

Long Answer Questions

Q1. Find the derivative of f(x) = 1/x from first principle.

f′(x) = limh→0 [1/(x + h) − 1/x]/h.

$= -1/x^2$.

Q2. Find the derivative of sin x from first principle.

$f'(x) = \lim_{h\to 0} [\sin(x + h) - \sin x]/h = \lim 2\cos(x + h/2) \sin(h/2)/h$.

$= \lim \cos(x + h/2) \times [\sin(h/2)/(h/2)]$.

$= \cos x \times 1 = \cos x$.

Q3. Evaluate $\lim_{x\to 0} (1 - \cos 2x)/x^2$.

$1 - \cos 2x = 2 \sin^2 x$.

Limit $= \lim 2 \sin^2 x/x^2 = 2 (\lim \sin x/x)^2$.

$= 2 \times 1 = 2$.

MCQs with Answers

1. $\lim_{x\to 0} \sin x/x$ =(a) 0 (b) 1 (c) ∞ (d) Does not existAnswer: (b) 1
2. $d/dx (x^5)$ =(a) $5x^4$ (b) x^4 (c) $5x^5$ (d) $4x^5$Answer: (a) $5x^4$
3. $d/dx (\cos x)$ =(a) sin x (b) −sin x (c) cos x (d) $\sec^2 x$Answer: (b) −sin x
4. $\lim_{x\to a} (x^n - a^n)/(x - a)$ =(a) na^n (b) na^{n-1} (c) a^{n-1} (d) nAnswer: (b) na^{n-1}
5. Derivative of a constant:(a) 1 (b) 0 (c) The constant (d) UndefinedAnswer: (b) 0
6. $(uv)'$ =(a) $u'v'$ (b) $u'v + uv'$ (c) $u'v - uv'$ (d) uv'Answer: (b) $u'v + uv'$
7. $\lim_{x\to 0} (1 - \cos x)/x$ =(a) 1 (b) 0 (c) ½ (d) 2Answer: (b) 0
8. $d/dx (\tan x)$ =(a) sec x (b) $\sec^2 x$ (c) cot x (d) $-\text{cosec}^2 x$Answer: (b) $\sec^2 x$
9. Limit exists if LHL and RHL are:(a) Different (b) Equal (c) Zero (d) InfiniteAnswer: (b) Equal
10. Slope of tangent to $y = x^2$ at x = 3:(a) 3 (b) 6 (c) 9 (d) 2Answer: (b) 6

Quick Revision Points

- Limit exists ⇔ LHL = RHL.
- Algebra of limits: sum, product, quotient, constant multiple.
- Polynomial limits by substitution.
- 0/0 form: factorise and cancel.
- $\lim (x^n - a^n)/(x - a) = na^{n-1}$.
- $\lim \sin x/x = 1$; $\lim (1 - \cos x)/x = 0$.
- $f'(x) = \lim [f(x + h) - f(x)]/h$.
- Product rule and quotient rule.
- $d/dx\ x^n = nx^{n-1}$.
- $d/dx \sin x = \cos x$; $\cos x \to -\sin x$; $\tan x \to \sec^2 x$.

Chapter Summary

A limit describes the value a function approaches near a point; it exists only when the left- and right-hand limits are equal. Limits obey algebraic rules, and standard results like lim sin x/x =

The derivative, defined as a limit, gives the instantaneous rate of change and the slope of the tangent. Using first principles and the sum, product and quotient rules, we can differentiate polynomials and trigonometric functions.

Exam Tips and PYQ Pattern

- Try direct substitution first; if you get 0/0, simplify.
- Adjust trig limits to match sin(kx)/(kx).
- Show all steps when using first principle.
- Use the quotient rule carefully – order matters in the numerator.
- Memorise the standard limits and derivatives table.
- Check units in rate-of-change word problems.

Frequently Asked Questions

Is this chapter in the 2026-27 CBSE syllabus?

Yes. It is part of the NCERT Class 11 Mathematics textbook, prescribed in the CBSE 2026-27 syllabus.

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Yes. Use the free PDF link at the top of this page – no signup needed.

What is the first principle of derivatives?

$f'(x) = \lim_{h \to 0} [f(x + h) - f(x)]/h$.

What is $\lim_{x \to 0} \sin x/x$?

It equals 1 (x in radians).

When does a limit not exist?

When the left-hand and right-hand limits are unequal or infinite.

Conclusion

Limits and Derivatives is your entry into calculus. Learn the standard results, practise first-principle problems and download the free PDF for quick revision.

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Author Bio: Written and reviewed by the Nextoper Editorial Team, a group of CBSE maths educators who build chapter notes directly from the NCERT textbook and past board paper patterns.

Freshness Note: These notes follow the NCERT Class 11 Maths textbook, Mathematics (Class XI) (NCERT reprint 2026-27, rationalised syllabus), and the CBSE syllabus for the 2026-27 session. Last checked on 28 November 2026.