Class 12 Maths Chapter 5: Continuity and Differentiability - Notes, Important Questions and MCQs (2026-27)

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These Class 12 Maths Chapter 5 notes cover “Continuity and Differentiability” from the NCERT Mathematics Part I textbook (2026-27): continuity at a point and on an interval, algebra of continuous functions, differentiability, the chain rule, derivatives of inverse trigonometric, exponential and logarithmic functions, implicit, logarithmic and parametric differentiation, and second-order derivatives – with formula tables, solved examples, Q&A, 10 MCQs and a free PDF.

Use the table of contents below to jump to the part you need, or read top to bottom for a complete revision of the chapter.

Table of Contents

- Chapter Overview
- Important Topics and Concepts
- Solved Examples
- Standard Derivatives
- Important Definitions and Terms
- Short Answer Questions
- Long Answer Questions
- MCQs with Answers
- Quick Revision Points
- Chapter Summary
- Exam Tips and PYQ Pattern
- Frequently Asked Questions
- Conclusion

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Chapter Overview

A function f is continuous at x = c if lim(x→c) f(x) exists and equals f(c); informally, its graph has no break at c. A function is differentiable at c if the left-hand and right-hand derivatives exist and are equal.

Every differentiable function is continuous, but not every continuous function is differentiable – f(x) = |x| is continuous at 0 but not differentiable there. The chapter then builds the tools to differentiate composite, implicit, logarithmic and parametric functions.

Important Topics and Concepts

Continuity

- f is continuous at c if LHL = RHL = f(c).
- LHL = $\lim_{x \to c^-} f(x)$; RHL = $\lim_{x \to c^+} f(x)$.
- f is continuous if it is continuous at every point of its domain.
- Polynomials, sin x, cos x, e^x, |x| are continuous everywhere; log x is continuous for x > 0.
- Algebra: f ± g, fg and f/g (g ≠ 0) are continuous if f, g are; composition of continuous functions is continuous.

Differentiability

- $f'(c) = \lim_{h \to 0} [f(c + h) - f(c)]/h$, if it exists.
- Differentiable at c ⇔ LHD = RHD.
- Differentiable ⇒ continuous; converse not true.
- f(x) = |x| is continuous but not differentiable at x = 0 (LHD = –1, RHD = 1).

Chain Rule and Standard Derivatives

- If y = f(t), t = g(x), then dy/dx = (dy/dt)(dt/dx).
- $d/dx(\sin^{-1}x) = 1/\sqrt{(1 - x^2)}$; $d/dx(\cos^{-1}x) = -1/\sqrt{(1 - x^2)}$.
- $d/dx(\tan^{-1}x) = 1/(1 + x^2)$; $d/dx(\cot^{-1}x) = -1/(1 + x^2)$.
- $d/dx(e^x) = e^x$; $d/dx(\log x) = 1/x$; $d/dx(a^x) = a^x \log a$.

Implicit, Logarithmic and Parametric Differentiation

- Implicit: differentiate both sides w.r.t. x treating y as a function of x, then solve for dy/dx.
- Logarithmic: for y = [u(x)]^(v(x)) or long products, take log on both sides first.
- Example: $y = x^x \Rightarrow \log y = x \log x \Rightarrow dy/dx = x^x(1 + \log x)$.
- Parametric: x = f(t), y = g(t) ⇒ dy/dx = (dy/dt)/(dx/dt), dx/dt ≠ 0.

Second Order Derivative

- $d^2y/dx^2 = d/dx(dy/dx)$, also written y″ or f″(x).
- Example: y = A sin x + B cos x ⇒ y″ + y = 0.
- Used for concavity and maxima/minima in the next chapter.

Solved Examples

Board-pattern practice.

- Find k if f(x) = kx + 1 (x ≤ 5), 3x – 5 (x > 5) is continuous at 5. 5k + 1 = 10 ⇒ k = 9/5.
- Differentiate $\sin(x^2)$. $2x \cos(x^2)$.
- Find dy/dx if $x^2 + y^2 = 25$. 2x + 2y y′ = 0 ⇒ dy/dx = –x/y.
- Find dy/dx if x = a cos θ, y = a sin θ. dy/dx = (a cos θ)/(–a sin θ) = –cot θ.
- Differentiate $x^{\sin x}$. log y = sin x log x ⇒ $dy/dx = x^{\sin x}$ (cos x log x + sin x / x).

Standard Derivatives

Function	Derivative
x^n	nx^{n-1}
sin x / cos x	cos x / –sin x
tan x	$\sec^2 x$
$\sin^{-1}x$	$1/\sqrt{(1 - x^2)}$
$\tan^{-1}x$	$1/(1 + x^2)$
e^x	e^x
log x	1/x
a^x	$a^x \log a$

Important Definitions and Terms

Term	Meaning
Continuity	No break in the graph at a point
LHL / RHL	Left and right hand limits
Differentiability	Existence of derivative at a point
LHD / RHD	Left and right hand derivatives
Chain rule	Derivative of composite function
Implicit function	y not expressed explicitly in x
Logarithmic differentiation	Taking log before differentiating
Parametric form	x and y expressed in a third variable
Second derivative	Derivative of the first derivative
Composite function	Function of a function

Short Answer Questions

Q1. When is f continuous at x = c?

When lim(x→c) f(x) exists and equals f(c).

Q2. Is every continuous function differentiable?

No; |x| is continuous but not differentiable at 0.

Q3. State the chain rule.

dy/dx = (dy/dt)(dt/dx).

Q4. Find d/dx($\tan^{-1}x$).

$1/(1 + x^2)$.

Q5. Differentiate e^(3x).

3e^(3x).

Q6. When is logarithmic differentiation used?

For functions like u^v or long products/quotients.

(dy/dt)/(dx/dt).

Q8. If y = sin x, find y″.

–sin x.

Long Answer Questions

Q1. Show that f(x) = |x| is continuous but not differentiable at x = 0.

LHL = RHL = 0 = f(0) – continuous.

LHD = lim(h→0⁻) |h|/h = –1.

RHD = lim(h→0⁺) |h|/h = 1.

LHD ≠ RHD.

Not differentiable at 0.

Q2. Differentiate y = x^x + $(\sin x)^x$.

Let u = x^x, v = $(\sin x)^x$.

du/dx = $x^x(1 + \log x)$.

log v = x log sin x ⇒ dv/dx = $(\sin x)^x(\log \sin x + x \cot x)$.

dy/dx = du/dx + dv/dx.

Write the final sum.

Q3. If y = A e^(mx) + B e^(nx), show y″ – (m + n)y′ + mny = 0.

y′ = Am e^(mx) + Bn e^(nx).

y″ = Am^2 e^(mx) + Bn^2 e^(nx).

Substitute in LHS.

Coefficient of A e^(mx): m^2 – (m + n)m + mn = 0.

Similarly for B; LHS = 0.

MCQs with Answers

1. d/dx($\sin^{-1}x$) =(a) $1/\sqrt{(1 - x^2)}$ (b) $-1/\sqrt{(1 - x^2)}$ (c) $1/(1 + x^2)$ (d) $\sqrt{(1 - x^2)}$Answer: (a) $1/\sqrt{(1 - x^2)}$

2. |x| at x = 0 is(a) not continuous (b) continuous, not differentiable (c) differentiable (d) undefinedAnswer: (b) continuous, not differentiable

3. d/dx(log x) =(a) x (b) 1/x (c) log x (d) e^xAnswer: (b) 1/x

4. d/dx(a^x) =(a) a^x (b) a^x log a (c) x a^{x-1} (d) a^x/log aAnswer: (b) a^x log a

5. Differentiable implies(a) continuous (b) discontinuous (c) constant (d) linearAnswer: (a) continuous

6. d/dx(sin 2x) =(a) cos 2x (b) 2 cos 2x (c) –2 cos 2x (d) 2 sin 2xAnswer: (b) 2 cos 2x

7. If $x^2 + y^2 = 1$, dy/dx =(a) x/y (b) –x/y (c) y/x (d) –y/xAnswer: (b) –x/y

8. d/dx(x^x) =(a) $x \cdot x^{x-1}$ (b) $x^x(1 + \log x)$ (c) x^x log x (d) 1 + log xAnswer: (b) $x^x(1 + \log x)$

10. d/dx(tan x) =(a) sec x (b) sec²x (c) –cosec²x (d) cot xAnswer: (b) sec²x

Quick Revision Points

- Continuity: LHL = RHL = f(c).
- Differentiable ⇒ continuous; |x| example.
- Chain rule.
- Inverse trig, exponential and log derivatives.
- Implicit, logarithmic, parametric methods.
- Second-order derivatives.

Chapter Summary

A function is continuous at a point when its limit equals its value there, and differentiable when left and right derivatives are equal. Differentiability implies continuity, but |x| shows the converse fails.

The chain rule, standard derivatives of inverse trigonometric, exponential and logarithmic functions, and implicit, logarithmic and parametric differentiation allow differentiation of complex functions, while second-order derivatives measure how the rate of change itself changes.

Exam Tips and PYQ Pattern

- Write LHL, RHL and f(c) separately in continuity questions.
- Memorise the derivative table.
- Use logarithmic differentiation for variable powers.
- Simplify inverse trig expressions by substitution.
- Verify second-order identities step by step.

Frequently Asked Questions

Is this chapter in the 2026-27 CBSE syllabus?

Yes. It is part of the NCERT Class 12 Mathematics Part I textbook, prescribed in the CBSE 2026-27 syllabus.

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Is every continuous function differentiable?

No. f(x) = |x| is continuous at x = 0 but not differentiable there.

What is logarithmic differentiation?

Taking logarithm on both sides before differentiating, useful for functions like x^x or long products.

Conclusion

Continuity and Differentiability is the core calculus chapter. Practise every method here and save the free PDF.

More Notes: Class 12 Maths Chapter 4: Determinants notes | Class 12 Maths Chapter 6: Application of Derivatives notes | All Class 12 Maths notes

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 12 Maths textbook, Mathematics Part I (NCERT reprint 2026-27, rationalised syllabus), and the CBSE syllabus for the 2026-27 session. Last checked on 26 November 2026.