Class 12 Maths Chapter 6: Application of Derivatives - Notes, Important Questions and MCQs (2026-27)

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These Class 12 Maths Chapter 6 notes cover “Application of Derivatives” from the NCERT Mathematics Part I textbook (2026-27): rate of change of quantities, increasing and decreasing functions, maxima and minima using the first and second derivative tests, and absolute maximum and minimum values on closed intervals – with tables, solved word problems, Q&A, 10 MCQs and a free PDF.

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Chapter Overview

The derivative dy/dx measures the rate of change of y with respect to x. This lets us solve problems about changing areas, volumes and costs, and find where a function rises or falls.

The sign of f′(x) tells whether a function is increasing or decreasing. Points where f′(x) = 0 are critical points, and the first or second derivative test tells whether they give a local maximum or minimum. On a closed interval, the absolute extrema occur at critical points or endpoints.

Important Topics and Concepts

Rate of Change of Quantities

- dy/dx is the rate of change of y with respect to x.

- If x and y depend on t: dy/dt = (dy/dx)(dx/dt).
- Marginal cost = dC/dx; marginal revenue = dR/dx.
- Example: rate of change of area of circle w.r.t. radius = 2πr.

Increasing and Decreasing Functions

- f′(x) > 0 on (a, b) ⇒ f is strictly increasing.
- f′(x) < 0 on (a, b) ⇒ f is strictly decreasing.
- f′(x) = 0 for all x ⇒ f is constant.
- Method: find f′(x), solve f′(x) = 0, split the number line and test the sign in each interval.

Maxima and Minima – First Derivative Test

- Critical point: f′(c) = 0 or f′(c) does not exist.
- If f′ changes from + to – at c: local maximum.
- If f′ changes from – to + at c: local minimum.
- If f′ does not change sign: point of inflection (neither).

Second Derivative Test

- If f′(c) = 0 and f″(c) < 0: local maximum.
- If f′(c) = 0 and f″(c) > 0: local minimum.
- If f″(c) = 0: test fails; use first derivative test.
- Local maximum/minimum values are f(c).

Absolute Extrema and Word Problems

- On [a, b]: find critical points, evaluate f at them and at a and b; largest is absolute maximum, smallest is absolute minimum.
- Word problems: express the quantity in one variable, differentiate, set derivative zero, verify with second derivative.
- Example: of all rectangles with fixed perimeter, the square has maximum area.
- Example: open box from a square sheet by cutting corners – maximise volume.

Solved Examples

Board-pattern practice.

- Radius of a circle increases at 0.7 cm/s. Rate of increase of circumference? dC/dt = 2π(0.7) = 1.4π cm/s.
- Find intervals where f(x) = x² – 4x + 6 is increasing. f′(x) = 2x – 4 > 0 for x > 2: increasing on (2, ∞), decreasing on (–∞, 2).
- Find local extrema of f(x) = x³ – 3x. f′ = 3x² – 3 = 0 ⇒ x = ±1; f″(1) = 6 > 0 → min –2; f″(–1) = –6 < 0 → max 2.
- Absolute max/min of f(x) = 2x³ – 15x² + 36x + 1 on [1, 5]. Critical points 2, 3; f(1) = 24, f(2) = 29, f(3) = 28, f(5) = 56; max 56 at 5, min 24 at 1.

Derivative Tests at a Glance

Condition	Conclusion
f′(x) > 0	Increasing
f′(x) < 0	Decreasing

Condition	Conclusion
f′ changes + to –	Local maximum
f′ changes – to +	Local minimum
f′(c) = 0, f″(c) < 0	Local maximum
f′(c) = 0, f″(c) > 0	Local minimum
f″(c) = 0	Test fails

Important Definitions and Terms

Term	Meaning
Rate of change	Derivative of one quantity w.r.t. another
Increasing function	Value rises as x increases
Decreasing function	Value falls as x increases
Critical point	f′(c) = 0 or undefined
Local maximum	Highest value in a neighbourhood
Local minimum	Lowest value in a neighbourhood
Point of inflection	f′ does not change sign
Absolute maximum	Greatest value on the whole interval
Marginal cost	Rate of change of total cost
Second derivative test	Uses sign of f″ at critical point

Short Answer Questions

Q1. What does dy/dx represent?

The rate of change of y with respect to x.

Q2. When is a function strictly increasing?

When f′(x) > 0 on the interval.

Q3. Define a critical point.

A point where f′(c) = 0 or f′(c) does not exist.

Q4. State the second derivative test for a maximum.

If f′(c) = 0 and f″(c) < 0, f has a local maximum at c.

Q5. What if f″(c) = 0?

The second derivative test fails; use the first derivative test.

Q6. Rate of change of area of a circle with respect to radius?

2πr.

Q7. Where can absolute extrema occur on [a, b]?

At critical points or endpoints.

Q8. What is marginal revenue?

Long Answer Questions

Q1. Show that of all rectangles with a given perimeter, the square has maximum area.

Let sides x and y, $2(x + y) = P$.

Area $A = x(P/2 – x)$.

$dA/dx = P/2 – 2x = 0 \Rightarrow x = P/4$.

$d^2A/dx^2 = –2 < 0$ – maximum.

$y = P/4 = x$; hence square.

Q2. Find intervals in which $f(x) = 2x^3 – 3x^2 – 36x + 7$ is increasing or decreasing.

$f'(x) = 6x^2 – 6x – 36 = 6(x – 3)(x + 2)$.

Critical points $x = –2, 3$.

$f' > 0$ on $(–\infty, –2)$ and $(3, \infty)$.

$f' < 0$ on $(–2, 3)$.

Increasing and decreasing intervals stated.

Q3. Explain the method to find absolute maximum and minimum on a closed interval.

Find $f'(x)$.

Find critical points in the interval.

Evaluate f at critical points and endpoints.

Largest value – absolute maximum.

Smallest value – absolute minimum.

MCQs with Answers

1. $f'(x) > 0$ means f is(a) decreasing (b) increasing (c) constant (d) zeroAnswer: (b) increasing

2. $f'(c) = 0$, $f''(c) > 0$ gives(a) maximum (b) minimum (c) inflection (d) nothingAnswer: (b) minimum

3. Rate of change of volume of sphere w.r.t. r(a) $4\pi r^2$ (b) $4\pi r^3/3$ (c) $2\pi r$ (d) πr^2Answer: (a) $4\pi r^2$

4. $f(x) = x^2$ is decreasing on(a) $(0, \infty)$ (b) $(–\infty, 0)$ (c) R (d) noneAnswer: (b) $(–\infty, 0)$

5. Local maximum of $–x^2$ occurs at(a) $x = 1$ (b) $x = 0$ (c) $x = –1$ (d) noneAnswer: (b) $x = 0$

6. Absolute extrema on [a, b] occur at(a) only endpoints (b) critical points or endpoints (c) only critical points (d) midpointAnswer: (b) critical points or endpoints

7. $f(x) = e^x$ is(a) increasing on R (b) decreasing on R (c) constant (d) neitherAnswer: (a) increasing on R

8. Critical points of $x^3 – 3x$(a) ± 1 (b) 0 (c) ± 3 (d) 1 onlyAnswer: (a) ± 1

9. Rectangle of maximum area with fixed perimeter(a) rhombus (b) square (c) triangle (d) circleAnswer: (b) square

Quick Revision Points

- dy/dx = rate of change; chain for time rates.
- Sign of f′ for increasing/decreasing.
- Critical points.
- First derivative test.
- Second derivative test.
- Absolute extrema and word problems.

Chapter Summary

Derivatives measure rates of change, helping solve problems on changing areas, volumes and costs. The sign of f′(x) shows where a function increases or decreases, and critical points where f′(x) = 0 are candidates for extreme values.

The first derivative test (sign change of f′) and second derivative test (sign of f″) identify local maxima and minima, while absolute extrema on a closed interval are found by comparing values at critical points and endpoints.

Exam Tips and PYQ Pattern

- Draw a sign chart for f′.
- Convert word problems to one variable.
- Always verify max/min with f″.
- Check endpoints for absolute extrema.
- Write units in rate problems.

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.

Can I download these notes as a PDF?

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

How do you find local maxima and minima?

Find critical points where f′(x) = 0, then use the first derivative test (sign change) or second derivative test (sign of f″).

When is a function increasing?

On intervals where its derivative f′(x) is positive.

Conclusion

Application of Derivatives carries big marks through word problems. Practise them here and save the free PDF.

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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 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.