Class 12 Maths Chapter 8: Application of Integrals - Notes, Important Questions and MCQs (2026-27)

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These Class 12 Maths Chapter 8 notes cover “Application of Integrals” from the NCERT Mathematics Part II textbook (2026-27): finding the area under simple curves – lines, parabolas, circles and ellipses – with respect to the x-axis and y-axis, and the area of regions bounded by a curve and a line, with step-by-step solved examples, Q&A, 10 MCQs and a free PDF.

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Chapter Overview

The definite integral $\int_a^b y\,dx$ gives the area of the region bounded by the curve $y = f(x)$, the x-axis and the lines $x = a$ and $x = b$, when the curve lies above the x-axis. This is built from adding thin vertical strips of area $y\,dx$.

Similarly, $\int$ (from c to d) $x\,dy$ gives the area bounded by $x = g(y)$, the y-axis and lines $y = c$ and $y = d$. If part of the region lies below the axis, we take the absolute value of that integral.

Important Topics and Concepts

Area under a Curve

- Area $= \int_a^b y\,dx = \int_a^b f(x)\,dx$, for $f(x) \geq 0$ on $[a, b]$.

- Vertical strip of width dx and height y.
- Area with respect to y-axis: $\int$ (from c to d) x dy using horizontal strips.
- If curve is below x-axis, area = $|\int_a^b f(x)\,dx|$.
- If curve crosses the axis, split the integral and add absolute values.

Area of Circle and Ellipse

- Circle $x^2 + y^2 = a^2$: area = $4\int_0^a \sqrt{(a^2 - x^2)}\,dx = \pi a^2$.
- Ellipse $x^2/a^2 + y^2/b^2 = 1$: area = $4(b/a)\int_0^a \sqrt{(a^2 - x^2)}\,dx = \pi ab$.
- Use symmetry: find area in first quadrant and multiply by 4.
- Use the standard integral $\int \sqrt{(a^2 - x^2)}\,dx$.

Area Bounded by a Parabola

- Parabola $y^2 = 4ax$ and line x = a: area = $2\int_0^a 2\sqrt{(ax)}\,dx = 8a^2/3$.
- Parabola $x^2 = 4y$ and line y = 4: use $\int x\,dy = 2\int_0^4 2\sqrt{y}\,dy$.
- Always sketch the region before integrating.

Area between a Curve and a Line

- Find points of intersection by solving equations together.
- Area = $\int_a^b$ [upper curve – lower curve] dx.
- Choose vertical or horizontal strips depending on which is simpler.
- Example: area between $y = x^2$ and y = x is $\int_0^1 (x - x^2)\,dx = 1/6$.

Step-by-step Method

- 1. Sketch the curves and shade the required region.
- 2. Find intersection points / limits.
- 3. Decide the strip (vertical or horizontal).
- 4. Set up the integral and use symmetry if possible.
- 5. Evaluate and write units as square units.

Solved Examples

Board-pattern practice.

- Area bounded by $y = x^2$, x = 1, x = 2 and x-axis. $\int_1^2 x^2\,dx = 7/3$ sq units.
- Area of ellipse $x^2/9 + y^2/4 = 1$. $\pi ab = 6\pi$ sq units.
- Area bounded by $y^2 = 9x$, x = 2, x = 4 and x-axis (first quadrant). $\int_2^4 3\sqrt{x}\,dx = 2[x\text{^}(3/2)]_2^4 = 2(8 - 2\sqrt{2}) = 16 - 4\sqrt{2}$ sq units.
- Area between y = x and $y = x^2$. 1/6 sq units.
- Area of circle $x^2 + y^2 = 16$. 16π sq units.

Standard Areas

Region	Area
Circle $x^2 + y^2 = a^2$	πa^2
Ellipse $x^2/a^2 + y^2/b^2 = 1$	πab
$y^2 = 4ax$ and latus rectum x = a	$8a^2/3$
$y = x^2$ and y = x	1/6

Region	Area
Under y = f(x) from a to b	$\int_a^b f(x)\,dx$

Important Definitions and Terms

Term	Meaning
Elementary strip	Thin rectangle used to build area
Vertical strip	Width dx, height y
Horizontal strip	Height dy, length x
Bounded region	Region enclosed by curves and lines
Point of intersection	Common point of two curves
Symmetry	Equal parts across an axis
Ellipse	$x^2/a^2 + y^2/b^2 = 1$
Parabola	$y^2 = 4ax$ type curve
Square units	Unit of area
Latus rectum	Chord through focus perpendicular to axis

Short Answer Questions

Q1. Write the formula for area under y = f(x) from x = a to b.

$\int_a^b f(x)\,dx$, when $f(x) \geq 0$.

Q2. What is the area of the circle $x^2 + y^2 = a^2$?

πa^2.

Q3. What is the area of an ellipse?

πab.

Q4. How do you find area below the x-axis?

Take the absolute value of the integral.

Q5. Area between y = x and $y = x^2$?

1/6 sq units.

Q6. Why do we sketch the region first?

To identify limits and the upper and lower curves correctly.

Q7. Area under y = x from 0 to 2?

2 sq units.

Q8. Which integral is used for area of circle?

$\int \sqrt{(a^2 - x^2)}\,dx$.

Long Answer Questions

Q1. Find the area of the ellipse $x^2/a^2 + y^2/b^2 = 1$.

By symmetry, area = 4 × first quadrant area.

$y = (b/a)\sqrt{(a^2 – x^2)}$.

Area = $4(b/a)\int_0^a \sqrt{(a^2 – x^2)}\, dx$.

$\int_0^a \sqrt{(a^2 – x^2)}\, dx = \pi a^2/4$.

Area = πab.

Q2. Find the area of region bounded by $y^2 = 4x$ and x = 1.

Region symmetric about x-axis.

Area = $2\int_0^1 2\sqrt{x}\, dx$.

= 4 × (2/3)[x^(3/2)]$_0^1$.

= 8/3 sq units.

Sketch the parabola and line.

Q3. Find the area bounded by $y = x^2$ and y = 4.

Intersection x = ±2.

Area = $\int_{-2}^{2} (4 – x^2)\, dx$.

= $2\int_0^2 (4 – x^2)\, dx$.

= $2[4x – x^3/3]_0^2 = 2(8 – 8/3)$.

= 32/3 sq units.

MCQs with Answers

1. Area of circle $x^2 + y^2 = 9$(a) 3π (b) 9π (c) 6π (d) 81πAnswer: (b) 9π
2. Area of ellipse $x^2/4 + y^2/1 = 1$(a) 2π (b) 4π (c) π (d) 8πAnswer: (a) 2π
3. Area under y = x from 0 to 1(a) 1 (b) 1/2 (c) 2 (d) 1/3Answer: (b) 1/2
4. Area between y = x and $y = x^2$(a) 1/2 (b) 1/3 (c) 1/6 (d) 1Answer: (c) 1/6
5. Area under $y = x^2$ from 0 to 3(a) 9 (b) 27 (c) 3 (d) 6Answer: (a) 9
6. Horizontal strip area element(a) y dx (b) x dy (c) xy (d) dx dy onlyAnswer: (b) x dy
7. Area is always(a) negative (b) non-negative (c) zero (d) imaginaryAnswer: (b) non-negative
8. Area bounded by $y^2 = 4x$ and x = 1(a) 4/3 (b) 8/3 (c) 2 (d) 16/3Answer: (b) 8/3
9. Area under y = cos x from 0 to π/2(a) 0 (b) 1 (c) 2 (d) πAnswer: (b) 1
10. Area bounded by $y = x^2$, y = 4(a) 16/3 (b) 32/3 (c) 8 (d) 4Answer: (b) 32/3

Quick Revision Points

- Area = ∫ y dx or ∫ x dy.
- Absolute value for regions below axis.

- Circle πa^2; ellipse πab.
- Parabola areas.
- Area between curves = ∫(upper – lower).
- Sketch first; use symmetry.

Chapter Summary

The definite integral finds areas of regions bounded by curves. $\int_a^b y\,dx$ gives area between a curve and the x-axis, ∫ (from c to d) x dy area with the y-axis, and absolute values are taken for parts below the axis.

Using symmetry and standard integrals, the area of a circle is πa^2 and an ellipse πab. The area between a curve and a line is the integral of the upper function minus the lower one between their intersection points.

Exam Tips and PYQ Pattern

- Always sketch and shade the region.
- Find intersection points carefully.
- Use symmetry to reduce work.
- Write the answer in square units.
- Practise parabola–line regions.

Frequently Asked Questions

Is this chapter in the 2026-27 CBSE syllabus?

Yes. It is part of the NCERT Class 12 Mathematics Part II 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 the area between two curves?

Find their intersection points and integrate (upper curve – lower curve) between them.

What is the area of an ellipse $x^2/a^2 + y^2/b^2 = 1$?

πab square units.

Conclusion

Application of Integrals is a guaranteed long-answer area. Practise the sketches here and save the free PDF.

More Notes: Class 12 Maths Chapter 7: Integrals notes | Class 12 Maths Chapter 9: Differential Equations 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 II